This document was too large to scan as a single document. It has been divided into smaller sections.

Section 2

| Document Information | | | |
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| Document # | FOIA-2009-0054 | Revision | |
| Title | FREEDOM OF INFORMATION ACT REQUEST (FOI 2009-0054) | | |
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| Recipient | JARVIS R | Recipient Co. | HEART OF AMERICA NW |
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| 172. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The "actual amount of recharge" needs to be revised based upon the new data that is now available.<br><br>DOE-RL/WHC Response: The text will be revised based upon the more recent studies of Gee and others, to indicate that the actual net recharge is not known, but is thought to vary locally from near zero to about 4 inches per year, depending upon the local soil and vegetative characteristics. | |
| 173. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The paragraph beginning on line 23 is unclear. Please clarify how the difference between high and low transmissivities effect the monitoring network.<br><br>DOE-RL/WHC Response: A higher and larger mound developed in the 200-West Area because a greater hydraulic gradient and aquifer thickness were required to move the same volume of water through a less transmissive medium. The effects of varying hydraulic properties on the monitoring network are discussed in Section 5.5.2 rather than in this section. The transmissivity may be a factor in determining an appropriate buffer zone width, and will affect the modeling results if the hypothetical plume moves so slowly that it does not reach a monitoring well. At the Hanford Site, the plumes would be expected to move with sufficient velocity that the network design developed with the help of the Monitoring Efficiency Model is not affected by the transmissivity. The discussions of this and other characteristics and assumptions of the model will be expanded and clarified in Section 5.5.2. | |
| 174. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The quoted ranges of hydraulic conductivity and the information provided in Tables 5-3 and 5-4 are not relevant because they are provided as estimated ranges. Additional discussion should be presented to indicate the impact of this variability on the design of the monitoring system.<br><br>DOE-RL/WHC Response: The general ranges of hydraulic conductivity are relevant to the discussion on page 5-39 in Section 5.3.4 because that section addresses regional hydrogeology. The general water quality data presented in Tables 5-3 and 5-4 are also | |

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| | relevant to the discussion of regional hydrogeology in Section 5.3.4. More detailed discussions of hydraulic properties at the LLBG begin in Section 5.3.5 where the results of aquifer tests performed in the LLBG monitoring wells and other nearby wells are presented. An expanded discussion of the effects of the variability in hydraulic conductivity on the design of the monitoring system will be provided in Section 5.5.2. | |
| 175. | Comment: Section 5.3.5, Uppermost Aquifer, Page 5-42<br><br>The thickness of the sediments must be specified. This information can be found in Last (1989).<br><br>DOE-RL/WHC Response: The total thicknesses of the sediments beneath each of the LLBG will be added to the text in Sections 5.3.5.1.1 (for those in the 200-East Area) and 5.3.5.2.1 (for those in the 200-West Area). | |
| 176. | Deficiency: Section 5.3.5.1.4, Vadose Zone, Page 5-46<br><br>There is no data provided from recent drilling.<br><br>Requirement: The information from the most recent drilling program must be provided.<br><br>DOE-RL/WHC Response: The text will be revised to provide additional data on the vadose zone obtained from recent drilling. | |
| 177. | Deficiency: Section 5.3.5.1.5, Aquifer Properties, Page 5-48<br><br>The porosity was not tested, but estimated. This is not acceptable because these values should have been obtained after analyzing samples from recent drilling.<br><br>Requirement: The analysis of soil samples should include determining porosity from undisturbed samples obtained during recent drilling.<br><br>DOE-RL/WHC Response: The text will be revised to provide available information on porosity determined from samples taken in the aquifer during recent drilling. | |

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178. Comment: Section 5.3.5.1.5, Aquifer Properties, Page 5-49

The text states that "The impact of the mound reduction on the local hydraulic gradient and velocity may be significant." Please elaborate on this comment.

**DOE-RL/WHC Response: The text in Section 5.3.5.1.5 will be revised to further explain the potential effects of mound reduction on local hydraulic gradients and flow velocities. In general, hydraulic gradients would be expected to decrease in the vicinity of the mounds, groundwater flow directions may change, and groundwater flow velocities may decrease.**

179. Comment: Section 5.3.5.2.4, Vadose Zone, Page 5-57

The text indicates the presence of an 8-15 foot thick section of unconsolidated loess. Was this section analyzed for its effect on pollutant migration? The applicable data supporting this effect, or the absence of an effect, must be provided.

**DOE-RL/WHC Response: The various stratigraphic horizons within the vadose zone in the 200 West Area, including the loess, sandy gravels, sands, and cemented calcium carbonate units, were considered in estimating the size of the source in the Monitoring Efficiency Model. Because the model assumes constant, steady state releases, retardation within the vadose zone was not considered. The horizons with smaller pore sizes such as the loess would tend to spread a release over a wider area because of lower hydraulic conductivities and stronger lateral capillary effects. However, with wider lateral spreading the contaminant flux per unit surface area of the aquifer decreases, reducing the contaminant concentration in the aquifer. Sensitivity studies that will be presented in the revised text have shown that the two effects of lateral spreading and reduced concentration offset each other, resulting in a low net sensitivity to lateral spreading for the final network design. The network design was not found to be sensitive to the presence of the loess, and a detailed evaluation of its properties was not considered necessary.**

180. Deficiency: Section 5.3.5.2.4, Vadose Zone, Page 5-58

The text indicates that the sediment thickness varies from 80-150 feet and the moisture content varies from 2-18.7%. This is not an adequate description of the unsaturated zone.

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| | Requirement: The results of soil sampling and analysis from new wells should be used for the description of the unsaturated zone. The changes of moisture content should be then mapped more precisely.<br><br>**DOE-RL/WHC Response: The text will be revised to provide an expanded discussion of the properties of the vadose zone. This will include additional details on changes of moisture content and new data that have become available from recent drilling.** | |
| 181. | Comment: Section 5.3.6, Underlying Aquifer, Page 5-60<br><br>The aquifer description should include how the new wells respond to monitoring. In addition, new data obtained during drilling and monitoring should be included.<br><br>**DOE-RL/WHC Response: Several new wells not associated with this permit application have been drilled into the underlying Rattlesnake Ridge aquifer since the 1989 text was prepared. Although none of the wells in the Rattlesnake Ridge aquifer are part of the monitoring network for the LLBG, the text will be revised to incorporate more recent data that may be relevant.** | |
| 182. | Deficiency: Section 5.4, Contaminant Plume Description, Page 5-62<br><br>The text states "Presently, water quality information is available for only the first quarter sampling event (October 1988)." New data is now available.<br><br>Requirement: The new data should be presented.<br><br>**DOE-RL/WHC Response: Additional water quality data are now available and statistical analysis of the interim status indicator parameters has been completed. The text will be revised in Section 5.2.3 to present the new water quality data that has become available from the LLBG monitoring wells, and will be revised in Section 5.4 to present any new information regarding any contamination that may have entered the groundwater from one of the regulated units.** | |

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| 183. | Deficiency: Section 5.4.1.3, Vadose Zone, Page 5-63<br><br>The vadose zone description does not include any site specific information, nor soil testing results from the 36 new LLBG boreholes.<br><br>Requirement: The new information should be provided.<br><br>DOE-RL/WHC Response: The text will be revised to incorporate available site-specific information relating to plume travel times in the vadose zone, including results from the new LLBG boreholes. | |
| 184. | Deficiency: Section 5.4.1.3.2, Measured Contaminant Plumes, Page 5-65<br><br>There is no supporting evidence for the example given in the text. Therefore, the conclusions are premature.<br><br>Requirement: The data which supports this example must be provided.<br><br>DOE-RL/WHC Response: The text will be revised to provide additional supporting information (plan and cross-section views of the extent of contamination) and to cite a recent modeling study of the 241-T-106 tank leak prepared by Pacific Northwest Laboratory that provides an analysis of the leak. | |
| 185. | Deficiency: Section 5.4.2, Travel Time, Page 5-70<br><br>The estimated travel times given here are not substantiated because aquifer parameters and flow paths are not presently known.<br><br>Requirement: New travel times should be specified based on more accurate calculations.<br><br>DOE-RL/WHC Response: Travel times based upon actual plume migration rates at the Hanford Site on the scale of interest are more accurate than the results of calculations based upon averaged aquifer parameters and flow paths inferred from those plumes. Further, travel times based upon theoretical considerations can only be substantiated if actual plume data are available at a burial ground site on the same scale of interest. Thus it is preferable, where possible, to base travel time estimates upon actual plume migration rates rather than | |

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| | upon aquifer parameter and flow path data. The regional travel times given in the text are based upon actual large-scale plume migration rates for the Hanford Site in the uppermost aquifer. Their accuracy should be equal to or greater than that for travel times computed for similar flowpath lengths at other (not at Hanford) landfill sites, and is considered acceptable. Because these estimates are based upon actual plume migration rates, any new aquifer parameter or flowpath data that estimate significantly different rates would be of questionable validity. | |
| 186. | Comment: Section 5.4.4, Summary of travel, Page 5-70<br><br>See above comment.<br><br>DOE-RL/WHC Response: See response to Comment 185. | |
| 187. | Deficiency: Figures 5-28, 5-29 and 5-30, Pages 5-71 through 5-76<br><br>These figures provide no interpretation of plume behavior in different lithological formations.<br><br>Requirement: The modeling should include the behavior of the plume in different lithologies using field obtained parameters.<br><br>DOE-RL/WHC Response: The text will be revised to provide an interpretation of plume behavior in different lithological formations. The discussion and application of the model in Section 5.5.2 will be revised to incorporate dispersivity values obtained from Hanford Site plumes, and to evaluate the effects of changing lithologies and hydrologic parameters on the model results. | |
| 188. | Comment: Section 5.4.6, Conclusions, Page 5-77<br><br>The conclusions are unclear and need to be substantiated with new data.<br><br>DOE-RL/WHC Response: The text will be revised to clarify and update the conclusions, based upon the new data that have become available. | |

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| 189. | Comment: Section 5.5.1, Indicator Parameters, Page 5-80<br><br>Were any volatile organic compounds or supplemental parameters present in the soil or water during the more recent drilling? Provide the justification for choosing these "indicator" parameters.<br><br>DOE-RL/WHC Response: The text will be revised to present groundwater monitoring data obtained since the 1989 draft was prepared. The indicator parameters will be reevaluated based on these new data and on a reanalysis of the quantity and chemical form of each parameter in the waste. The justification for developing the indicator parameter list will be presented. | |
| 190. | Deficiency: Section 5.5.2, Groundwater Monitoring Program, Page 5-82<br><br>This section does not address the interim status monitoring program.<br><br>Requirement: The groundwater monitoring program should be based on the results of interim monitoring and incorporate all improvements necessary for the final detection system.<br><br>DOE-RL/WHC Response: The text will be revised to explain how the results of the interim status monitoring program are used to design the final detection system. Emphasis will be placed upon the use of the expanded groundwater level data to refine the directions of groundwater flow, and the use of the aquifer test data to assess the influence of permeability variations on monitoring network design. | |
| 191. | Deficiency: Section 5.5.2.1.1, Background, Page 5-84<br><br>There is a need for monitoring the middle portion of the aquifer. The lithology between some "deep" and "shallow" portions might be such that it will retain pollutants.<br><br>Requirement: A portion of the monitoring wells must be screened to monitor the middle section of the aquifer if the aquifer thickness exceeds 40 feet.<br><br>DOE-RL/WHC Response: Retention of pollutants in the middle section of the aquifer would require (1) the presence of lithologic layers that could retain and laterally divert contaminants that would otherwise reach the bottom of the aquifer, and (2) the presence of | |

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| | contaminants in the middle section of the aquifer. The stratigraphy of the saturated zone is discussed in Sections 5.3.5.1.3 (for the 200-East Area) and 5.3.5.2.3 (for the 200-West Area), and illustrated in Figures 5-16 and 5-19. In both cases the sediments in the middle of the aquifer are sands, gravelly sands, and sandy gravels with no laterally extensive fine-grained silts or clays. There is therefore no evidence that a lithologic layer that could retain and laterally divert contaminants is present. The presence of contaminants in the middle section of the aquifer beneath the LLBG is also unlikely, for the reasons stated in the accepted DOE-RL/WHC response to Comments 68 and 78. In view of the lack of identified lithologic layers that could cause retention and lateral diversion of contaminants, and the small likelihood that contaminants could reach the middle section of the aquifer, monitoring wells completed in the middle section of the aquifer are not considered to be needed. | |
| 192. | Comment: Section 5.5.2.1.1, Background, Page 5-84<br><br>The ranges of hydraulic conductivity should be based on the soils sampling from new wells. The aquifer properties should be described in greater detail after obtaining the new samples and lab analysis results. This will allow the calculation of transmissivity for each change of lithology within the Hanford or Ringold formation.<br><br>DOE-RL/WHC Response: Identification of hydraulic conductivity on the basis of sedimentary facies rather than geologic formations is being studied at the Hanford Site (see, for example, Poeter and Gaylord, Groundwater, Vol. 28 No. 6, 1990). These studies will be reviewed and the correlations adapted, where pertinent, to the LLBG. Both new and old soil sampling data at the LLBG will be used in this correlation. | |
| 193. | Deficiency: Section 5.5.2.1.2, Monitoring Design Approach, Page 5-84<br><br>The assumptions about hydraulic conductivities can be misleading. As a consequence, some constituents can be missed in the monitoring wells.<br><br>Requirement: The text here must provide support for the assumptions.<br><br>DOE-RL/WHC Response: The text will be revised to more fully explain the monitoring design approach, which is based upon more factors than the hydraulic conductivity and depth considerations discussed here. | |

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| 194. | Comment: Section 5.5.2.1.3, Monitoring Efficiency, Page 5-87<br><br>The monitoring efficiency model is being reevaluated since a presentation to Ecology by the model's author.<br><br>**DOE-RL/WHC Response: No additional comments on the Monitoring Efficiency Model have been received.** | |
| 195. | Comment: Section 5.5.2.1.9, Monitoring Design, Page 5-112<br><br>It is not appropriate to assume the shallow wells will be the most indicative of contamination. Deep wells need to be used in the monitoring system as extensively as shallow monitoring wells. This will depend upon what constituents will be detected in the first deep well that is drilled.<br><br>**DOE-RL/WHC Response: The basis for the proposed relative density of shallow and deep wells was addressed in accepted Comments 68 and 78, and the text will be revised as stated in the responses to those comments to more fully support the design basis. The text will also be revised to present the monitoring results from the deep wells, and to evaluate the implications of those results on the adequacy of the deep well network.** | |
| 196. | Comment: Section 5.5.2.1.9.1, Deep Well Locations, Page 5-113<br><br>Lines 40-48 are unclear and not defensible. Please clarify.<br><br>**DOE-RL/WHC Response: The text will be clarified by rewording, providing additional supporting information on groundwater flow directions, and referring to Figure 5-20 as well as Figure 5-21. The direction of groundwater movement will be indicated on Figure 5-20. Both of these figures illustrate the extent of the lower Ringold sediments beneath LLWMA-3 and LLWMA-4.** | |

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| 197. | Deficiency: Section 5.5.2.1.9.2, Deep Well Locations, Page 5-114<br><br>Two deep wells were constructed for the interim monitoring network, but no results from these wells are presented to support these conclusions. Deep wells might be extremely important in total network efficiency. If there are differences in the predicted distribution of aquifers, the results from sampling deep wells will also confirm or negate changes in transmissivities.<br><br>Requirement: The results from the deep wells must be presented.<br><br>DOE-RL/WHC Response: There are actually four deep LLBG monitoring wells, two at upgradient and two at downgradient locations. The text will be revised to present the monitoring results from the deep wells, and to evaluate the implications of those results on the adequacy of the total monitoring well network. | |
| 198. | Comment: Section 5.5.2.1.11, Well Installation Staging, Page 5-125<br><br>The text indicates that the monitoring system will consist of 69 shallow wells and 6 deep wells. Of these, 42 new shallow wells and 2 new deep wells will be installed. This means that 27 shallow wells and 4 deep wells were installed for the interim monitoring system. However, page 5-1 indicates that thirty-five wells were in the interim monitoring system. Please correct this discrepancy. | |

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DOE-RL/WHC Response: The monitoring system is explained in the following tabulation.

| | Shallow | Deep | Total |
|---|---|---|---|
| Number of Interim Status Wells Installed in 1987 | 31 | 4 | 35 |
| Number of Additional Wells to be Installed | 42 | 2 | 44 |
| Number of Wells within Final Line of Compliance to be Removed from System at Closure | (4) | (0) | (4) |
| Final Number of Wells in Monitoring System | 69 | 6 | 75 |

The text will be revised to more clearly explain the number of wells in the final system. Please note that the number of wells may change as a result of network reevaluations in response to the comments received.

199. Comment: Table 5-12, Well Installation Priority, Page 5-127

The preliminary results from drilling the priority 1 wells should serve as a base for drilling wells in the priority 2 list. Staging of wells should depend upon the results obtained during previous drilling.

DOE-RL/WHC Response: The priority of installation of monitoring wells that have not yet been drilled will be reviewed based upon the results obtained from the previous wells to determine if any changes should be made in the schedule.

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| 200. | Comment: Section 5.5.2.3, Representative Samples, Page 5-129<br><br>Sampling may be subject to revision depending upon results from the past two years of monitoring, 1991 monitoring, and one additional year for monitoring all the wells in the network.<br><br>DOE-RL/WHC Response: The sampling procedure will be reviewed for adequacy based upon the results obtained from previous monitoring. The text will be modified to provide for continuing review and evaluation of the representativeness of the samples based upon past monitoring results. | |
| 201. | Comment: Section 6.2.2.6.2, Leak Detection System, Page 6-4<br><br>The text here indicates that the leak detection system design was scheduled for completion in February 1990. If complete, it must be included in the revised text. If not complete, provide the new date for completion. This also applies to the LCRS referred to in Section 6.2.2.6.4.<br><br>DOE-RL/WHC Response: The information requested was provided to Ecology in September 1990 as the Supplement to the Permit Application for the LLBG, "Low Level Burial Waste Dangerous Waste Permit Application Design Documents, DOE/RL 88-20, Supplement 2." | |
| 202. | Comment: Section 6.3.1.3, Emergency Equipment, Page 6-5<br><br>List any emergency equipment located at each trench or burial ground, i.e., spill control material, fire suppressants, first aid. If there is none, this should be justified.<br><br>DOE-RL/WHC Response: The following text will be added to Section 6.3.1.3: "Emergency equipment is not located at burial ground trenches. Portable fire extinguishers are carried on all LLBG operations vehicles. The 200 area fire station with trained fire fighting and emergency medical personnel and equipment is located within five minutes of any location within the LLBG. Spill cleanup materials are readily available from the 272WA building and the Central Waste Complex staging area (overpack drums, protective clothing, handling and cleanup equipment). The Building Emergency Plan (Contingency Plan) lists the emergency equipment." | |

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| 203. | Comment: Section 7.2, Emergency Coordinators, Page 7-2<br><br>The identification of emergency coordinators is under development through the facility wide permit negotiations. The need to identify these individuals along with their addresses and phone numbers will be addressed upon resolution of this issue. WAC 173-303-350(3)(d)<br><br>**DOE-RL/WHC Response: The names of Building Emergency Directors and Building Wardens are maintained by the Hanford Patrol Operations Center and the Hanford Occurrence Notification Center (ONC) on a twenty four hour basis. These names may accessed by calling the ONC.** | |
| 204. | Deficiency: Section 7.4.1.3, Notification of Authorities, Page 7-19<br><br>The discussion in the first paragraph on this page does not address Ecology's Nuclear and Mixed Waste Program Policy for spill reporting. Also, WAC 173-303-082 is an incorrect citation for spill reporting.<br><br>Requirement: The above referenced policy, to be outlined in a forthcoming letter from Ecology, must be incorporated into the text. The correct regulatory citation is WAC 173-303-145.<br><br>**DOE-RL/WHC Response: The citation will be corrected as requested. The text will be revised as required to respond to the forthcoming letter that defines Ecology's Nuclear and Mixed Waste Program Policy.** | |

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205. Comment: Section 7.4.1.3, Notification of Authorities, Page 7-19

Spill reports should be submitted to Ecology's Kennewick office:

Washington State Department of Ecology
7601 West Clearwater
Suite 102
Kennewick, WA 99336
Phone: (509) 546-2990

Please note that the proper zip code for Ecology's Olympia Office is 98504-8711, not 98501-8711.

**DOE-RL/WHC Response: The address will be changed to identify the Kennewick office for reporting.**

206. Comment: Section 7.4.6, Treatment, Storage, or Disposal, Page 7-32

The text should indicate that releases of dangerous wastes or materials which, upon release, would be considered a dangerous waste, must be handled in accordance with WAC 173-303.

**DOE-RL/WHC Response: The text will be revised to comply with the revised regulations in WAC 173-303-340.**

207. Deficiency: Section 9.2.1.2.2, Migration Through the Vadose, Page 9-8

Based upon discussions in Section 2.1.2.1 regarding past practices, the statement that "no liquid waste is disposed of in the LLBG" is incorrect.

Requirement: Delete or edit the sentence containing this phrase on line 34 and 35.

**DOE-RL/WHC Response: The sentence will be edited as follows: "A leak of this magnitude is unlikely because free liquid currently in containers within the LLBG is to be retrieved. Since November 23, 1987, no free liquid has been accepted in the LLBG."**

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| 208. | Deficiency: Section 11.1.4.3, Gas Sampling, Page 11-27<br><br>Hydrogen gas generation recently created concerns in the tank farms and grout vaults. Therefore, it may not have been prudent to discontinue gas sampling.<br><br>Requirement: In light of the recent hydrogen gas concerns, justification should be provided for not taking gas samples until immediately before retrieval.<br><br>**DOE-RL/WHC Response: Unlike the tank farms, it is expected that radiogenic hydrogen will escape into the atmosphere through the relatively permeable soils and that dangerously high concentrations are unlikely. However, this issue will be addressed in the health and safety plan for waste retrieval, described in Section 11.1.4.6. The word "immediately" will be deleted from Section 11.1.4.3.** | |
| 209. | Comment: Section 11.1.5.2, Cover Design, Page 11-29<br><br>There is a reference on line 33 and throughout this application citing a 1982 EPA guidance document on landfill design. The EPA has published numerous technical guidance documents on this subject since that document was issued. In addition, a substantial amount of regulatory changes concerning dangerous waste landfills have occurred since that time. The LLBG permit application will be evaluated against the more recent documents. It is therefore recommended that past and future work be assessed against the most current guidance.<br><br>**DOE-RL/WHC Response: The cover design in the permit application is conceptual and was prepared in accordance with regulatory guidance existing at the time of writing (1988). Actual (detailed) cover design has yet to be done and will be performed in accordance with the most current regulations and guidance. The text in Section 11.1.5.2 will be modified to include this discussion.** | |
| 210. | Comment: Section 11.1.5.2.1, General Description, Page 11-30<br><br>Comment 146 also applies here.<br><br>**DOE-RL/WHC Response: 3H:1V slopes have been included around the margins of the covers because of limited horizontal distance between the waste trenches and the boundaries of the burial grounds. As shown on Figure 11-9, this slope is only about 5 feet high, so toe** | |

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| | support is substantial and stability will not be a problem. In addition, this slope will be covered with a 2-foot-thick riprap layer to prevent gullying and animal intrusion. Hence, these slopes are considered adequate as designed. | |
| 211. | Comment: Figures 11-15 and 11-16, Pages 11-43/44 and 11/45/46<br><br>Typos. The burial ground in Figure 11-15 should be "218-W-5", not "218-E-5". The burial ground in Figure 11-16 should be "218-W-6", not "218-E-6".<br><br>DOE-RL/WHC Response: Corrections will be made as requested. | |
| 212. | Comment: Section 11.1.5.2.2.1, Native Soil Grade Layer, Page 11-48<br><br>A statement should be made that Ecology will be notified and provided a copy of the construction test pad plan for review and approval prior to initiating construction of this pad.<br><br>DOE-RL/WHC Response: Ecology will be provided with a copy of the test pad plan for review prior to construction. This also applies to a number of other plans and designs, many of which have not been completed or even identified at this time. On this basis, it is not appropriate to attempt to identify such submittals in the permit application. EPA guidance suggests preparation of a CQA Plan for landfill and closure cover construction, and such a plan will therefore be prepared for the LLBGs. As an example, Ecology is referred to the CQA Plan for the non-dragoff landfill, which was recently submitted for review and includes detailed plans for a test fill. | |
| 213. | Deficiency: Section 11.1.5.2.2.3, Soil/Bentonite Layer, Page 11-49<br><br>The disking method described for the soil/bentonite layer has been used with mixed results. The method of spreading bentonite on the ground and tilling it into the soil is fraught with inexactness. Soil/bentonite mixing can only be provided for with any certainty by processing in a pugmill. This method is being used for the LERF project and will also be used at the grout facility. | |

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| | Requirement: The soil/bentonite material must be mixed in a pugmill in accordance with current practice.<br><br>DOE-RL/WHC Response: At this time, material sources for the LLBG covers have not been identified and therefore the applicability of the LERF experience cannot be assessed. The disking method has been successfully used at commercial hazardous waste facilities in the western U.S. and should not be excluded at this time. The text will be revised to state "...(e.g., by disking or mixing in a pugmill)...".<br><br>The design, Specifications, and CQA Plan for the LLBGs will provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications will require a submittal to the WHC Project Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the LLBG covers are constructed. | |
| 214. | Deficiency: Section 11.1.5.2.2.4, FML, Page 11-51<br><br>The EPA currently recommends a 45-mil flexible membrane liner in situations where the liner will be exposed to weathering. Furthermore, standard practice dictates that a 60-mil liner be used even if not exposed (see Grout and LERF designs).<br><br>Requirement: This geomembrane must be 60-mil thick.<br><br>DOE-RL/WHC Response: EPA's recommendation for 45 mils is for bottom liners, not cover geomembranes. In addition, the cover geomembrane will not be exposed to weathering, as a landfill liner with no soil cover or a pond liner would be. The most recent (1989) EPA guidance for covers recommends a 20-mil FML for covers, which has been doubled for the LLBG. Use of a 40-mil FML is standard practice at RCRA hazardous waste landfills in arid regions of the western U.S. | |

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| 215. | Comment: Section 11.1.5.2.2.6, Drainage Layer, Page 11-52<br><br>Comment 157 also applies here.<br><br>DOE-RL/WHC Response: The cover design in the permit application is conceptual and was prepared in accordance with regulatory guidance existing at the time of writing (1988). Actual (detailed) cover design has yet to be done and will be performed in accordance with the most current regulations and guidance. The text in Section 11.1.5.2 will be modified to include this discussion. | |
| 216. | Comment: Section 11.1.5.2.2.9, Vegetative Cover, Page 11-54<br><br>The justification for vegetative specie selection should be provided or a document referenced which, at a minimum, discusses other vegetative varieties which were considered and the reasons for there dismissal.<br><br>DOE-RL/WHC Response: The selection of wheat grasses was based on successful past practice at the Hanford Site. Formal documentation of these practices has not been identified, but a comprehensive search will be conducted. In addition to the existing discussion in the permit application, the text will be modified to note that Russian wheat grasses develop a much higher root density than native wheat grasses and thus more rapidly extract water from the soil profile (Cadwell et al., 1983). The text will also be modified to note that other grasses, if proven more suitable, may be substituted if reseeding is required during the postclosure period.<br><br>Cadwell, M.M, Dean, T.J., Nowak, R.S., Dzurec, R.S., and Richards, J.H., 1983, "Bunchgrass Architecture, Light Interception, and Water Use Efficiency: Assessment by Fiber Optic Point Quadrants and Gas Exchange", Oecologia, Vol 59, pp. 178-184. | |

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| 217. | Comment: Section 11.1.5.2.2.10, Riprap Bedding Layer, Page 11-55<br><br>The bedding layers should also be designed as a filter. Otherwise the storm water runoff and wind will remove fines from beneath the riprap and eventually cause undermining of the riprap and failure.<br><br>**DOE-RL/WHC Response: A geotextile layer will be placed between the bedding layer and the riprap to serve as a filter. Figure 11-9 and the text in Section 11.1.5.2.2.10 will be modified accordingly.** | |
| 218. | Comment: Section 11.1.5.3, Minimization of Liquid, Page 11-56<br><br>The term "leakance factor" should be edited to read "leakage fraction".<br><br>**DOE-RL/WHC Response: The correction will be made as requested.** | |
| 219. | Comment: Section 11.1.5.3, Minimization of Liquid, Page 11-57<br><br>Although the regulations require the use of 24-hour, 25-year design storms, the text here specifies a 30-year storm event to match the design life of the covers. Although this makes sense, how does the 30-year design life compare to DOE's requirements for constructing mixed waste disposal facilities? (see comment 128). In addition, would it not be more conservative to design for a shorter duration storm (e.g. 6-hour duration as specified in DOE Order 6430.1A) as it is probably more indicative of the most intense storms received by the Reservation?<br><br>**DOE-RL/WHC Response: With respect to DOE's long-term performance objectives for mixed waste facilities, the permit application does not attempt to address compliance with these requirements. Section 11.1.1.1 states that "compliance with these objectives will be demonstrated through a radiological performance assessment as specified by the Department of Energy" and discusses this issue in more detail.**<br><br>**For the purposes of HELP modelling discussed in Section 11.1.5.3, the 24-hour storm is more conservative than the 6-hour storm because it applies a greater total volume of precipitation to the cover (see Table 11.D.1). The intensity of the 24-hour storm is less than that of the 6-hour storm, but this consideration is not relevant to the proposed analysis.** | |

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| 220. | Comment: Section 11.1.5.4.3, Deep-Rooted Plants, Page 11-58<br><br>Roots will not penetrate a coarse, clean, dry, uniformly graded gravel layer. Such a layer, one foot thick and placed above the drainage layer, should be considered. This layer could be keyed into the riprap bedding layer to provide a biotic barrier across the entire cover.<br><br>**DOE-RL/WHC Response: This type of barrier will be evaluated during detailed cover design. The text in Section 11.1.5.4.3 will be modified accordingly.** | |
| 221. | Requirement: Section 11.1.5.4.4, Burrowing Animals, Page 11-59<br><br>The biotic barrier discussed in comment 220 would also address the burrowing animal concern. In addition, the HPDE liner should be designed with the following criteria to reduce the potential for attack by burrowing animals: 1) underground installation of free edges should be avoided, 2) angles of 90 degrees and less should be avoided, and 3) any radius of curvature should be greater than 60mm.<br><br>**DOE-RL/WHC Response: See response to Comment 220. With respect to the suggestions about HDPE liner design, the conceptual design incorporates all of these features, and it is expected that the detailed design will as well.** | |
| 222. | Deficiency: Section 11.1.5.5.1, Cover Drainage, Page 11-60<br><br>The text does not identify where the cover drainage goes. In addition, a means must be provided to monitor the amount of liquid collected from the cover.<br><br>Requirement: Define where the cover drainage will go and how the amount of cover drainage will be measured.<br><br>**DOE-RL/WHC Response: Cover drainage is shown on Figures 11-10 through 11-16. Drainage patterns were designed to conform to the extent possible with existing topography and to discharge into natural channels presently draining the cover areas. More comprehensive surface water management plans will be prepared as part of detailed cover design.** | |

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| | Measurement of drainage from the covers could be performed using standard methods (weirs, flowmeters, gaging, and similar techniques) in the discharge pipes. However, the usefulness of doing this needs to be established. | |
| 223. | Comment: Section 11.1.5.4.3, Page 11-61<br><br>In regards to the choice of storm duration, comment 219 also applies here.<br><br>DOE-RL/WHC Response: The type of storm depends on the type of analysis and the model being used. In Appendix 11, appropriately conservative storms were always selected, for example, the 50-year, 20 minute rainfall for sheet erosion (Appendix 11.D) where intensity is critical. Also see response to Comment 219. | |
| 224. | Comment: Section 11.1.5.6, Settlement and Subsidence, Page 11-67<br><br>Comment 107 also applies here.<br><br>DOE-RL/WHC Response: Lift thickness for the grade layer will be selected so that the compaction specification can be satisfied. The compaction specification of 95% of modified Proctor density was selected as the maximum potentially achievable with conventional methods, and has been found to effectively minimize settlements under structures far less tolerant than the closure cover. Increasing the cover slope from 1.5% to 3%, as discussed above, will also lessen the impact of any areal settlements. | |
| 225. | Deficiency: Section 11.1.6, Schedule for Closure, Page 11-68<br><br>It is unacceptable to defer closure of trenches containing mixed waste for extended periods of time in order to fill low-level waste trenches near the mixed waste trench. Overall, the current closure schedule does not provide for the timely isolation of the mixed waste trenches.<br><br>Requirement: The configuration of proposed trenches must be reevaluated to reduce the amount of time the trenches will remain open. In addition, acceleration of the retrieval schedule must be assessed to shorten the time mixed waste trenches are uncovered. | |

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| | **DOE-RL/WHC Response: The schedule for LLBG closure is in review. A revised schedule may be forthcoming after the impact of acceleration has been completely evaluated.** | |
| 226. | Deficiency: Section 11.2.1.2, Erosion Damage, Page 11-77<br><br>There is insufficient detail provided on the surveying to be conducted.<br><br>Requirement: A drawing of the final cover should be provided indicating where each monument will be located. A drawing or additional text should also be added detailing the design and installation of the monuments. In addition, surveying should be conducted quarterly for at least the first two years and then reduced to annually if no significant changes are noted.<br><br>**DOE-RL/WHC Response: As noted in Section 11.2.1.2, surveying monuments will generally be installed on a 100-foot grid. More exact locations cannot be specified until the final cover designs are completed. The design and installation of survey monuments will also be addressed during final cover design. Quarterly surveying is not considered necessary given the long periods of time during the year when there is little or no precipitation at the Hanford Site.** | |
| 227. | Comment: Section 11.2.1.4, Vegetative Cover Condition, Page 11-77<br><br>The means to determine adequate vegetative cover must be discussed. Two possible methods are identified in the 183-H Basins Closure Plan.<br><br>**DOE-RL/WHC Response: Methods for assessing the vegetative cover as described in the 183-H Basins closure plan will be incorporated as appropriate in the LLBG Permit Application.** | |
| 228. | Deficiency: Section 11.2.1.9, Benchmark Integrity, Page 11-78<br><br>It is insufficient to rely solely on visual inspections when determining benchmark integrity.<br><br>Requirement: Each benchmark should be surveyed to ascertain its integrity.<br><br>**DOE-RL/WHC Response: Benchmark integrity refers to the absence of physical deterioration, for example spalling from frost action. Visual inspections are necessary to determine if changes in survey data are actually ground displacements or the result of other physical** | |

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| | processes affecting the monument itself. The survey monuments will be designed to be robust and weather resistant to the extent practical. | |
| 229. | Comment: Section 11.3, Notice in Deed, Page 11-83<br><br>This section should be rewritten in accordance with the language found in the 183-H Basins Closure Plan (Rev. 3).<br><br>DOE-RL/WHC Response: The notice in deed section from the 183-H Basins closure plan will be incorporated in the LLBG Permit Application. | |
| 230. | Deficiency: Section 11.5, Closure Cost Estimates, Page 11-84<br><br>Closure cost estimates must be provided as agreed to for the facility wide permit.<br><br>Requirement: A statement to this effect must be provided in the text.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text on page 11-84, Section 11.5 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |

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| 231. | Comment: Section 11.7, Post-Closure Cost Estimate, Page 11-84<br><br>Comment 230 also applies to post-closure cost estimates.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text in Section 11.7 on page 11-84 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |
| 232. | Comment: Section 12.3, Transporter Requirements, Page 12-6<br><br>Although transporter requirements are not required per WAC 173-303-260 and -270 at the Hanford Reservation, these requirements must still be fulfilled as requirements under WAC 173-303-395. This statement must be incorporated into the text.<br><br>DOE-RL/WHC Response: The requirements to comply with other environmental protection laws and regulations as stated in WAC 173-303-395(2) pertain to receiving, storing, handling, treating, processing, and disposing of waste at a TSD facility; requirements for transport of waste are not specified. Additional clarification is requested. | |
| 233. | Comment: Section 12.4.1.5.1, Immediate Notification, Page 12-11<br><br>Comment 204 is also applicable to this section and section 12.4.1.6.1.<br><br>DOE-RL/WHC Response: The text will be revised as required to respond to the forthcoming letter that defines Ecology's Nuclear and Mixed Waste Program Policy and WAC 173-303-145. | |

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| 234. | Comment: Section 12.4.2.3.3., Closure and Post-Closure, Page 12-18<br><br>Comment 230 also applies.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text in Section 12.4.2.3.3 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |
| 235. | Comment: Appendix 4A, List of Mixed Waste, Page 4A-ii<br><br>It is unclear what the term "UNSEG" means. Does this term identify trenches which could have any type of waste including TRU, mixed, etc.? Please clarify.<br><br>DOE-RL/WHC Response: The following definition will be added to Appendix 4B: "Unseg is an abbreviation of unsegregated. The term arises from the description of waste buried prior to 1970 which did not have the transuranic waste component segregated from the low level component of the waste matrix." | |
| 236. | Comment: Appendix 4A, List of Mixed Waste, Page 4A-18, 38, 44<br><br>Trenches CU1 and TV7 are not identifiable on Figure 2-9. These trenches should be identified on the figure or the proper identification numbers provided in this appendix. In addition, trenches T05 and T10 are listed in this appendix but only trenches T05E and T10E exist on Figure 2-8. The text or the figure should be clarified.<br><br>DOE-RL/WHC Response: "Trench CU1" is not a standard trench, but is a caisson that contains low level waste. This number 1 caisson is located in the area where trench 14 of burial ground 218-W-4B would be located as shown in Figure 2-9. Appendix 4B, page APP 4B-9 provides additional information. "Trench TV7" is a concrete portion of trench 7 in burial ground 218-W-4B as shown in Figure 2-9. The "E" will be removed from Figure 2-8. | |

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| 237. | Comment: Appendix 4B, Trench Classifications, Page 4B-3<br><br>Trenches 1D and 16 in burial ground 218-E-12B should be classified as LL-MW (low-level mixed waste) based upon information provided on page 4A-1. In addition, if trench 28 is closed, why is part of its classification "*" (trench will be dug)? Please clarify or correct.<br><br>**DOE-RL/WHC Response: Trench 1D and 16 will be revised and classified as UG-MW which means unsegregated mixed waste. Trench 28 classification will be revised to be LL-MW and appropriate dates added.** | |
| 238. | Comment: Appendix 4B, Trench Classifications, Page 4B-9<br><br>Based upon information provided in Appendix 4A, trenches 3, 4, 8, 9, 10, 12, and 13 should also be classified as LL-MW (low-level mixed waste). Please correct or clarify.<br><br>**DOE-RL/WHC Response: Trenches 3, 4, 6, 8, 9, 10, 12, and 13 will be redesignated UG-MW in the table.** | |
| 239. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-1<br><br>The specific gravity of the liner must be no less than 0.94 and the maximum melt flow index must be no more than 0.3 grams per 10 minutes.<br><br>**DOE-RL/WHC Response: A detailed set of Specifications has been prepared for the Project W-025 Landfill. These specifications require that the specific gravity of the FML resin be greater than 0.94. Melt index is required to be within the range of 0.1 to 1.1 g/10min, based on typical values reported by geomembrane manufacturers.** | |

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| 240. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-2<br><br>The geosynthetic quality assurance consultant must not only verify the specifications identified, or to be identified, in Table 4F-1, but also every fingerprinting parameter (see comment 161).<br><br>DOE-RL/WHC Response: Melt index and specific gravity are considered "fingerprinting" tests and will be required submittals from the FML manufacturer as discussed in the Specifications (Section 02275) and the CQA Plan (Section 4.4.1.1). Other 'fingerprinting' tests such as thermogravimetric analysis and differential scanning calorimetry will be performed as part of the 9090 testing program for evaluating chemical changes in the FML. These tests are also required for each lot of geomembrane as noted in Appendix A of the CQA Plan. | |
| 241. | Comment: Appendix 4F, Liner Material Specifications, Table 4F-1<br><br>Why are four identical values given for some parameters? The fingerprinting parameters must also be listed, with limits, on this table.<br><br>DOE-RL/WHC Response: The Specifications prepared for the Project W-025 Landfill now contain only information pertinent to the geosynthetics actually used in the design. With respect to "fingerprinting" parameters, see responses to comments 239 and 240. | |
| 242. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-8<br><br>One factor of the geomembrane layout which could be "detrimental to the project" is excessive seam footage. To reduce this problem, a minimum liner roll width should be specified. A list of other possible detrimental aspects should be listed.<br><br>DOE-RL/WHC Response: This discussion has been eliminated in the revised Specifications. As described in Section 02275, the Geosynthetics Installer will be required to submit a panel layout plan for approval prior to construction, and general requirements for panel layout are explicitly stated. The specified geomembrane is supplied in 34-ft-wide rolls, among the widest in the industry. | |

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| 243. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-9<br><br>The preferred method of seaming is double hot wedge welding. Any other method of welding will have to be justified over this method.<br><br>DOE-RL/WHC Response: The 'best' seaming method for geomembranes is still an open issue, particularly for textured FMLs. It also depends on factors other than equipment, such as crew experience. Any seaming method used at the Project W-025 Landfill will be demonstrated and proved satisfactory by test seams, as well as ongoing destructive and non-destructive tests of actual seams. These requirements are in Section 02275 of the Specifications and Section 4.4 of the CQA Plan. | |
| 244. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-10<br><br>The specifications must include extreme temperatures (absolute maximum and minimum ambient temperatures) beyond which no seaming will occur. In addition, the methods must be specified which will be used during temperatures between the optimal range and the extreme range.<br><br>DOE-RL/WHC Response: Construction Specification WHC-S-045, Section 02275, page 20, specifies the absolute maximum and minimum ambient temperatures for seaming and specifies methods that the installer must satisfactorily demonstrate for use during weather conditions between the optimal range and this extreme range. | |
| 245. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-20<br><br>Comment 213 also applies here. In addition, moisture adjustments cannot be made at the borrow site, but must be made at the pugmill.<br><br>DOE-RL/WHC Response: The Design Report, Specifications, and CQA Plan provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications require a submittal to the WHC Project Engineer and the CQA Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the Project W-025 Landfill is constructed (see response to comment 19 in regards to an individual test fill). | |

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| 246. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-21<br><br>In-situ permeability testing must be done with a sealed double ring infiltrometer.<br><br>DOE-RL/WHC Response: A Sealed Double Ring Infiltrometer (SDRI) test will be performed on the test fill (see response to comment number 19). | |
| 247. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-22<br><br>Comment 157 also applies here and to Table 4F-7.<br><br>DOE-RL/WHC Response: EPA guidance allows use of either granular or synthetic drainage layer materials. The Project W-025 Landfill design includes both. As noted in response to comment 31, the transmissivity of the geocomposite exceeds the EPA proposed requirement, and thus would be adequate by itself. However, the drainage gravel has been added for redundancy. Hence, the design provides high flow capacity and substantially exceeds the proposed EPA requirements. | |
| 248. | Comment: Appendix 4F, Liner Material Specification, Page 4F-23<br><br>Transmissivity should be measured with the geonet sandwiched between the actual boundary materials, not steel plates. Explain why the condition in footnote "a" must be met. Comments 239 and 240 also apply here.<br><br>DOE-RL/WHC Response: This is a manufacturer's test method and is intended as a conformance test, not a simulation test. In other words, if the geonet has this transmissivity under these conditions, it is an acceptable product. With respect to Note (a), it has been found that a higher specific gravity produces a harder HDPE. To avoid the geonet embedding into the FML under load and thereby restricting flow, the geonet specific gravity is specified to be less than that of the FML. Responses to comments 239 and 240 apply here as well. | |

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| 249. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-25<br><br>The drainage net must be stored above ground in a dust-proof wrapper.<br><br>**DOE-RL/WHC Response: This requirement has been included in the Specifications (Section 02275).** | |
| 250. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-27<br><br>Frozen material will be removed from the fill and reprocessed through the pugmill or discarded.<br><br>**DOE-RL/WHC Response: The CQA Plan discusses restrictions on construction activity during freezing weather and establishes the requirement to protect the completed admix layer from freezing. See also response to comment 151.** | |
| 251. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-29<br><br>The list of actual specifications to avoid desiccation cracking should be provided.<br><br>**DOE-RL/WHC Response: Measures to minimize desiccation as well as repair criteria are described in the CQA Plan (Section 4.3.2) and Specifications (Section 02224).** | |
| 252. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-44<br><br>Ecology shall be notified of the date, time, and place of resolution meetings. If Ecology plans to attend, the meeting must be delayed a reasonable length of time to allow their attendance. This is also applicable to the preconstruction meeting and problem/work deficiency meetings. This requirement must be reflected in the application.<br><br>**DOE-RL/WHC Response: The application will include that Ecology will be notified within a reasonable amount of time of the date, time, and place of resolution meetings, so that their non-attendance will not result in a delay of the meeting.** | |

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253. Comment: Appendix 4F, Liner Material Specifications, Page 4F-49

The facility design and specifications will be part of the dangerous waste permit. Therefore, any changes to or deviations from the design or specifications must be approved by Ecology. Ecology will treat these changes as Class I permit modifications requiring pre-approval. Ecology assumes that these changes and deviations will be handled through the Engineer Change Notice (ECN) process and Nonconformance Report (NCR) process such as used for the Grout project. If this is true, Ecology must be provided a copy of the draft ECN/NCR to allow response, if necessary, prior to implementing the change or dispositioning the nonconformant condition. This requirement may be fulfilled by either 1) hand delivering the draft ECN/NCR to Ecology's on-site construction inspector, if one is present, or 2) sending a facsimile copy (fax) to Ecology's LLBG unit manager. Ecology will notify DOE-RL if the modification should be upgraded to a Class II or III modification. This method of handling modifications is limited to design and specification changes which occur during construction. All other changes must be handled in accordance with WAC 173-303-830. A statement reflecting this discussion must be made in the application.

**DOE-RL/WHC Response: ECN/NCRs will be provided to the on-site inspector prior to implementation by the construction contractor. If the on-site inspector is unavailable, the ECN/NCR will be faxed to the Ecology office in Lacy, Washington for their immediate review. The turnaround time for this review is expected to be within 8 hrs.**

254. Comment: Appendix 4F, Liner Material Specifications, Page 4F-51

Comment 246 also applies here.

**DOE-RL/WHC Response: A Sealed Double Ring Infiltrometer (SDRI) test will be performed on the test fill (see response to comment number 19).**

255. Comment: Appendix 4G, Construction Procedures, Page 4G-1

These procedures must be approved by Ecology before construction begins.

**DOE-RL/WHC Response: Construction procedures are described in both the CQA Plan and the Specifications. Ecology will be provided with an opportunity to examine these procedures before construction begins.**

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The following comments refer to Supplement 1 of the LLBG permit application, Request for Exemption from Lined Trench Requirements.

256. Deficiency: Section 2.3.2, Long-Term Migration, Page 2-8

This section discusses the reasons for requiring liner systems at dangerous waste land-based units. In addition to the reasons provided, the bottom liner system provides the function of detecting leachate. This liner system is, in fact called the leachate detection, collection and removal system (LDCRS). Although Ecology agrees that the SRC's are designed such that we can be reasonably sure liquids will not leach from/through the SRC's, the most prudent practice in this case is to provide a means to verify that the SRC system performs as asserted in this document.

Requirement: A means to monitor the amount of liquids, if any, that could pass from/through an SRC needs to be included in the disposal design. Ecology recommends that a catch basin similar to those beneath the grout vaults be installed beneath one of the SRC's as a demonstration project. The basin would need to be capable of collecting liquids as well as provide a means to measure the quantity and assess the composition of any liquids which could reach the basin.

**DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation.**

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257. Comment: Section 3.1, General Description, Page 3-1

Typo. "U.S. Ecology" should be edited to read "US Ecology".

**DOE-RL/WHC Response: The text will be corrected to read US Ecology.**

258. Comment: Section 4.1, Waste Characteristics, Page 4-1

Are the bulkheads which are added at Bremerton Navy Yard welded with the same specifications and performance standards utilized in welding the original hull? Describe any differences between the specifications and standards used for the original hull and those used on the bulkheads welded for disposal purposes.

**DOE-RL/WHC Response: The new welding to install shipyard fabricated disposal bulkheads is also accomplished using Navy shipbuilding and repair welding processes and electrodes to produce the same high-integrity welding as found on original ship construction.**

**Since the initial construction of nuclear powered submarines, the Navy has established the highest standards for critical welds, including submarine hull welds and reactor plant welds. In general, these Navy welding standards are more rigorous than private sector critical welding standards.**

**The strength of the Navy standards lies not only in the proper selection and qualification of materials and welding parameters, but also in the rigorous personnel training and qualification process, nondestructive testing (NDT) and audit and surveillance programs. Most importantly, official records for each of these areas are maintained as objective quality evidence that welding and NDT were completed satisfactorily.**

**All weld materials are tested and maintained to ensure the materials meet specified standards. Welding procedures are formally developed and qualified in accordance with Navy requirements. The personnel performing the welds must be qualified, and periodically requalified, to demonstrate the ability to perform the welding in accordance with the weld procedure. Finally, nondestructive testing is performed by personnel who are qualified, and periodically requalified on the use of nondestructive test equipment. In addition, in-process surveillances are conducted by independent quality assurance personnel to evaluate work performance and to verify welding is being performed in accordance with specifications.**

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| | **The original welding of the SRC hull was accomplished to Navy standards designed to ensure the integrity of deep diving hull structures, which must resist submergence pressures and potential battle shock while protecting human life and the operating reactor plant. The only significant difference between original hull welding and new welding is that since the new welds will not be subjected to the cyclic stresses experienced by deep diving hulls, they do not require the radiographic inspection used on original hull welds. It should be noted that all containment boundary welds (both original and new) are subjected to a package air test to verify their integrity.** | |
| 259. | Comment: Section 5.1.1, Integrity of the SRC, Page 5-2<br><br>This section should include a discussion regarding: 1) the effects of radiation on corrosion rates; and, 2) the corrosion potential of original hull and new bulkhead welds.<br><br>**DOE-RL/WHC Response: The text will include:**<br><br>**a. "The corrosion rate of the hull, containment bulkheads, and containment bulkhead welds is not affected since these materials are basically non-irradiated."**<br><br>**b. "There is no difference in corrosion potential between the ship's original welds and new welds accomplished in preparing the SRC package for disposal."** | |
| 260. | Comment: Section 5.1.2.1, Lead, Page 5-5<br><br>Typo. The word "At" in line 6 should be edited to read "As".<br><br>**DOE-RL/WHC Response: The text will be changed to "As".** | |
| 261. | Comment: Appendix 5A, Conceptual Design of Cathodic Protection, Page 5A-1<br><br>The specifications for the epoxy-polyamide paint should be provided to include a discussion of the durability of this paint under the handling, transportation and disposal scenarios expected.<br><br>**DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation.** | |

Attachment #1

**Low Level Burial Grounds**
**Unit Managers Meeting**
**1100 Jadwin Ave., Room 508**
**Richland, Washington**
**August 9, 1991**

**Summary of Discussion and Commitments**

An agenda was provided for the meeting (See Attachment 3).

I. Cliff Clark (RL) asked the attendees to introduce themselves.

II. The first topic discussed was the responses to the Notice of Deficiency Table which were submitted July 26, 1991 (Attachment 5). Ecology (Joe Witczak) provided some preliminary questions and remarks to the NOD responses, and a formal Ecology response will follow later.
NOD 14: Ecology (Joe Witczak) inquired about real-time response regarding using radiography for detecting the presence of free liquids which does not work when there is lead shielding. Mr. Witczak wondered whether very many shipments have lead shielding and what percentage can't be verified for liquids. WHC (D. Armstrong) stated that not very many shipments are lead shielded and that the percentage of shipments for which liquid verification cannot be done is "very small."

NOD 15: Ecology (Joe Witczak) stated that this NOD shows approval, but Ecology has not yet concurred with the response, and Ecology will have to verify that information contained in Appendix 4A will satisfy this NOD.

Ecology (Joe Witczak) made reference to a letter to Tim Nord of Ecology (June 19, 1991 from E.A. Bracken of RL) requesting that a meeting be set up to discuss transferring waste from Single-Shell Tanks to Low-Level Burial Grounds and referencing equipment such as blowers. WHC (Rick Pierce) stated that this letter to Mr. Nord stated that WHC/RL would like to remove de minimis quantities of mixed waste from tank farms and that another letter had been written to Mr. Nord stating that, in effect, WHC/RL will proceed as planned if Ecology does not respond. Mr. Pierce of WHC also stated that WHC/RL is very hesitant to proceed without Ecology approval, but there is also pressure to go ahead with the above-stated mixed waste transfer because of ALARA concerns. RL (Cliff Clark) stated that safety concerns are an issue in this matter and that there is a possibility that a contest could arise between following the Atomic Energy Act or the WAC regulations regarding protection of human health and the environment if no resolution is made. Mr. Witczak asked that he be called after his return to Olympia in order to set up this meeting. Mr. Witczak stated that his initial reaction to the letter was to deny this disposal for the reasons stated in the following discussion of NOD 16.

NOD 16: Ecology (Joe Witczak) stated that Ecology's statement in NOD 16 was based on a reading of the Federal Register which had come out in either May or June of 1985 regarding minimum technology requirements.

Final

Meeting Minutes Transmittal/Approval
Unit Managers Meeting: Low Level Burial Grounds

Meeting Held August 9, 1991
1100 Jadwin Ave., Room 508
Richland, Washington

Appvl. _____ Date: 9/11/91
Clifford E. Clark, Environmental Policy and Permitting, RL

Appvl. _____ Date: _____
Daniel L. Duncan, EPA Region 10, RCRA Program Manager

Appvl. _____ Date: 9/11/91
Joe Witczak, Unit Manager, Washington State Department of Ecology

Appvl. _____ Date: 9/11/91
Richard Pierce, Unit Manager, Contractor Representative, WHC

PURPOSE:
Meeting Minutes are attached. These minutes are from the August 1991 Unit Managers Meeting held 8-9-91. Minutes are comprised of the following:

Attachment 1 - Summary of Discussion and Commitments
Attachment 2 - Attendance List
Attachment 3 - Agenda
Attachment 4 - Action Items List with Status
Attachment 5 - Notice of Deficiency Response Table

# CORRESPONDENCE DISTRIBUTION COVERSHEET 

| Author | Addressee | Correspondence No. |
|---|---|---|
| G. C. Evans, 6-8939 | P. T. Day, EPA<br>T. L. Nord, Ecology | Incoming: 9103481<br>Ref #9154912D |

Subject: LOW-LEVEL BURIAL GROUNDS PART B PERMIT APPLICATION (TSD: D-2-9)

## INTERNAL DISTRIBUTION

| Approval | Date | Name | Location | w/att |
|---|---|---|---|---|
| | | Correspondence Control | A3-01 | X |
| | | SOLID/LIQUID WASTE REMEDIATION | | |
| | | D. L. Armstrong | T3-02 | X |
| | | W. H. Hamilton, Jr. | N3-10 | |
| | | D. G. Hay | T3-21 | X |
| | | J. M. Nielsen | T3-29 | X |
| | | R. D. Pierce | N3-13 | X |
| | | R. J. Roberts | N3-13 | X |
| | | PROJECTS | | |
| | | T. L. Yount | G6-47 | X |
| | | ENVIRONMENTAL DIVISION | | |
| | | G. C. Evans | H4-57 | X |
| | | C. J. Geier | B2-19 | |
| | | R. J. Landon | B2-19 | |
| | | R. E. Lerch (Assignee) | B2-35 | X |
| | | S. M. Price | H4-57 | X |

AUG 08 1991
CORRESPONDENCE CONTROL

# CORRESPONDENCE DISTRIBUTION COVERSHEET 

| Author | Addressee | Correspondence No. |
|---|---|---|
| G. C. Evans, 6-8939 | P. T. Day, EPA<br>T. L. Nord, Ecology | Incoming: 9103481<br>Ref # 9154912D |

Subject: LOW-LEVEL BURIAL GROUNDS PART B PERMIT APPLICATION (TSD: D-2-9)

## INTERNAL DISTRIBUTION

| Approval | Date | Name | Location | w/att |
|---|---|---|---|---|
| | | SAFETY, QUALITY ASSURANCE, AND SECURITY | | |
| | | J. R. Bell | R3-09 | |
| | | G. D. Carpenter | B2-16 | |
| | | D. G. Farwick | H4-16 | |
| | | D. E. Good | S0-97 | |
| | | J. W. Hagan | B3-55 | |
| | | P. A. Praetorius | R2-56 | |
| | | GENERAL COUNSEL | | |
| | | P. J. Mackey | B3-15 | |
| | | CONTROLLER | | |
| | | E. P. Vodney | B3-50 | |
| | | ENVIRONMENTAL AND WASTE MANAGEMENT PROGRAM INTEGRATION | | |
| | | L. L. Powers | B2-35 | |
| | | J. L. Waite | B2-35 | |
| | cc: | R. J. Bliss | B3-04 | |
| | | EDMC/AR | H4-22 | X |
| | | GCE LB | H4-57 | X |

Attachments same as letter #9154912D

RECEIVED
AUG 08 1991
CORRESPONDENCE CONTROL

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 262. | Comment: Appendix 5A, Conceptual Design of Cathodic Protection<br><br>The report states that if the passive cathodic protection fails, an impressed current can be substituted. If the conductors fail, how will an impressed current work? If the sacrificial anodes fail, why not replace them?<br><br>DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation. | |

Mr. Witczak stated that, according to the Federal Register, even though a portion of a trench which contains no waste is considered an existing trench and therefore is not required to have a double liner, the Federal Register would still compel that the requirements be met which were in place prior to HSWA. Mr. Witczak said that the Federal Register states that what was in place at that time was a single-liner system. RL (Cliff Clark) noted that a single-liner system would not alleviate the immediate problems existing at the Low-Level Burial Grounds. Also, the engineering work involved in producing the single liner as well as going through the budgeting process with Congress would extend the date of installing the liner a few years. Witczak stated that Ecology will follow the Federal Register and suggested that perhaps RL could try to make a case for a waiver.

NOD 19: Ecology (Joe Witczak) inquired whether the NOD response referred to destructive soil samples from the actual liner or samples from the test pad. WHC (Tom Yount) stated that destructive tests on the synthetic liner will be conducted on the procurement material before installation and there will not necessarily be destructive tests of the installed landfill material except, for the welds and joints. Mr. Yount will check the CQA Plan to determine if destructive tests will be performed on the soil liner.

NOD 102: Ecology (Joe Witczak) questioned why this response was limited to extremely hazardous waste. WHC (Rick Pierce) did not have the information during the meeting, but noted that the intent was probably to show extremely hazardous waste as a higher concern on NOD 102.

NOD 103: Some general discussion took place regarding corrosion of metal exposed to certain liquids in a relatively arid climate. No resolution was reached.

NOD 106: Ecology (Joe Witczak) noted that the NOD response refers to a 3% slope but does not mention Ecology's specification of 1/10th of a foot. RL (Cliff Clark) stated that WHC/RL will look at what Golder & Associates designs and this will be the basis for the Permit Application, and if Ecology has an idea that something in the design needs to be changed, then WHC/RL would need to know the technical basis for the change. Ecology (Joe Witczak) noted that these comments had been compiled before review of the definitive design, and there is not yet a definitive design of the final cover.

NOD 107: Discussion took place regarding a layer of coarse material up to 12 inches in diameter. Ecology (Joe Witczak) asked whether there is a design specification for the soil distribution in this layer. WHC (Rick Pierce) replied that there is not a design specification for soil distribution in this layer, and the 12-inch diameter of coarse material is a design limitation for the lifts.

NOD 117: Ecology (Joe Witczak) inquired as to the meaning of "heads of field elements," which RL (Cliff Clark) stated is a term from an RL manual and refers to John Wagoner (DOE-RL Manager).

NOD 139: Ecology (Joe Witczak) pointed out that WAC 173-303-161 defines lab packs as small containers with liquids in them, and also noted that this NOD response mentions containers with up to 15 gallons of liquid being considered lab packs. Mr. Witczak suggested a change in the text to take care of this. WHC (B. Broomfield) agreed that "lab packs" was not the correct terminology.

NOD 144: Ecology (Joe Witczak) does not want it to appear that the postclosure period will definitely be 30 years; it could be less or more depending on the individual situation. Mr. Witczak suggested that 30 years may be used as a design basis, and that the Parties can say that they are assuming a 30-year postclosure period without locking it "in stone." RL (Cliff Clark) stated that, at least for purposes of the initial Permit, the anticipated postclosure time period should be estimated.

Ecology will include comments from review of the Construction Quality Assurance Plan and the Definitive Design in its next response to the NOD comments. RL (Cliff Clark) requested that Ecology's letter of transmittal include 120 days for RL to respond. Ecology (Joe Witczak) agreed.

NOD 230: Ecology (Joe Witczak) would like to see a statement in the text stating when closure cost estimates must be provided which is in accordance with the facility-wide permit.

NOD 252: Ecology (Joe Witczak) noted that there had been agreement that Ecology would be notified of resolution meetings. Mr. Witczak noted that nothing had been said about pre-construction meetings or problems/work efficiency meetings and wondered whether this was inadvertant or if Ecology RL planned to exclude Ecology from these meetings. RL (Cliff Clark) responded that RL is assuming that at some time soon Moses Jaraysi (Ecology) will be able to get on site and be able to schedule his own participation; also, there are some meetings which RL holds with its contractors which RL would not consider it appropriate for Ecology to attend. WHC (Rick Pierce) stated that the definition of a "resolution meeting" is important because there will not be actual resolution without Ecology present. Ecology (Joe Witczak) expressed interest in being notified of work deficiency meetings and problem meetings. RL (Cliff Clark) did not agree to notify Ecology of all such meetings.

III. Ecology (Joe Witczak) noted that a number of comments had been deferred on the submarine compartments and asked when those responses might come in. RL (Cliff Clark) said that at the next UMM there will be a schedule. WHC (Sue Price) asked whether Ecology would be able to respond to the comments on the submarine compartments in 60 days. Ecology (Joe Witczak) stated that Ecology would be able to do so. The end of 60 days would be September 26, 1991.

WHC (Rick Pierce) requested that when Ecology transmits comments on definitive design that WHC/RL receive an informational copy from Ecology's consultant (Parametrix). The request was for the purpose of expediting the up-coming year's construction schedule. Ecology (Joe

Witczak) stated that an effort would be made to get a quick turnaround on the comments, and WHC/RL will just see a smooth copy. RL (Cliff Clark) noted that RL will be handing over documents from contractors to Ecology which RL hasn't previously reviewed and suggested that Ecology could consider doing likewise for the purpose of expediting the project.

IV. WHC (Tim Greager) said that the construction specifications referring to the geomembrane liner stated that SLT will be the contractor and no substitutions will be made. RL has informed WHC, however, that sole sourcing will not be done. Ecology (Joe Witczak) stated that this is one case in which it is highly recommended that whatever brand and model number is tested be used. This way, the 9090 testing can be part of "what goes out on the street." Mr. Greager stated that if fingerprinting specifications are used, there is a potential that only one contractor will be able to match the specifications; however, it is possible that another manufacturer could at least have an opportunity to meet the specifications. RL (Cliff Clark) stated that federal procurement rules are specific that specifications can't be overly precise, but it can be worded to use a certain specification or equivalent.

WHC (Tim Greager) stated the the 9090 Test Report Phase I has been completed, and all of the material looks "pretty good." There are, however, questionable results on the geotextile, and WHC is continuing to look at the impacts of this. WHC would like to have Golder & Associates make a special presentation to Ecology in particular to discuss the 9090 test results. This presentation with Golder & Associates and Ecology is planned to take place immediately following the next Unit Managers Meeting on September 10, 1991. Ecology (Joe Witczak) stated that agreement will need to be reached on the degree of tolerance which will be allowed on the fingerprinting data when formulating the procurement specifications.

- RL (Cliff Clark) noted that a meeting has been scheduled between WHC/RL and EPA (Cathy Massimino) on August 28 at 2:15 p.m. to discuss the PCB TSCA Permit. Mr Clark also noted that in a notice of proposed rule making, EPA has indicated that EPA is considering removing PCBs from submarines from the regulative realm.

- Roger Bowman (WHC) is now acting for the Westinghouse RCRA Permits Section Manager.

- The next meeting is scheduled for September 10, 1991 at 10 a.m. at the EPA Region 10 office, 712 Swift Blvd., Richland, Washington.

Attachment 2

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**August 9, 1991**

Attendence List

| NAME | ORGANIZATION | PHONE # |
|---|---|---|
| D. Armstrong | WHC | (509) 373-9240 |
| R. Bowman | WHC | (509) 376-4876 |
| B. Broomfield | WHC | (509) 376-4966 |
| C. Clark | RL | (509) 376-9333 |
| K. Davis | CNES | (509) 376-0412 |
| D. Duncan | EPA | (206) 553-6693 |
| M. French | DOE-NR | (206) 476-3655 |
| R. Gilbert | RL | (509) 376-9210 |
| T. Greager | WHC | (509) 376-0312 |
| J. King | SWEC | (509) 376-4726 |
| B. Koch | PSNS | (206) 476-1932 |
| R. Pierce | WHC | (509) 376-5681 |
| S. Price | WHC | (509) 376-1653 |
| J. Witczak | Ecology | (206) 438-7557 |
| T. Yount | WHC | (509) 376-0034 |

Attachment 3

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**August 9, 1991**

**Agenda**

LOW-LEVEL BURIAL GROUNDS

I Opening Remarks (C. Clark)

II Discuss Responses to the Draft Notice of Deficiencies (J. Witczak)

III Status of Ecology Comments on Design Package (J. Witczak)

IV Is a Specific Brand of Liner Material required or May an Equivalent be Used Even Though a Brand Name Was Named in the Specifications (T. Greager

Attachment 4

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**August 9, 1991**

**Commitments/Agreements Status (Status date: (8/9//91)**

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

# Attachment 5

## Notice of Deficiency Response Table with Responses

Attendance
Unit Managers Meeting
**Low-Level Burial Grounds**
September 10, 1991

| Name | Org. | Role | Phone |
|---|---|---|---|
| | | | ( ) |
| Frank Shuri | Golder | | (206) 883-0777 |
| | | | ( ) |
| Eric B. Effenberk | WHC | | (509) 376-8032 |
| [illegible] | WHC | [illegible] | (509) 376 [illegible] |
| DL Armstrong | WHC | Solid Waste | (509) 373-9240 |
| RC Bowman | WHC | Permitting | (509) 376-4876 |
| | | | ( ) |
| TM GREAGER | WHC | PROJECTS | (509) 376-0312 |
| Kathy Lim | SAIC | SSC | (509) 376-5011 |
| JE WITCZAK | Ecology | Unit Manager | (206) 438-7557 |
| Clifford E Clark | DOE-RL | Unit Manager | (509) 376 [illegible] |
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Attachment 4

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**August 9, 1991**

Commitments/Agreements Status (Status date: (8/9//91)

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

# LOW-LEVEL BURIAL GROUNDS
# NOTICE-OF-DEFICIENCY RESPONSE TABLE



| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 1. | Chapter 2.0 (2-1). In several sections of Chapter 2.0 (page 2-14, Table 2-1, and page 2-21) it is documented that mixed waste is currently being disposed of in unlined trenches at the (Low-Level Burial Grounds (LLBG). On page 2-21, it is stated that this disposal is allowed under the existing portion exemption. There is no reference, within the document, that the Applicant has applied for or received from Washington State Department of Ecology (Ecology) an existing portion exemption in accordance with Washington Administrative Code (WAC) 173-303-665(2)(b).<br><br>Ecology Recommendation. The Applicant should submit with this permit application all information in support of it's request for an exemption for mixed wastes currently being disposed of in unlined trenches.<br><br>DOE-RL/WHC Response: It is our understanding from the reading of the Environmental Protection Agency (EPA) regulations [40 CFR 264.301(a)] and Ecology regulations [WAC 173-303-806(4)(h)(ii)(A)] that the existing portion is exempt from liner leachate requirements by regulation; therefore, no application for exemption in accordance with WAC 173-303-665(2)(b) is required. Mixed waste is disposed in the existing portion of the trenches based on criteria described in Section 4.6.2.1 and after notifying Ecology. | 4-26-91 |
| 2. | Page 2-14 (2-2). It is noted in the first paragraph that the permit application will not be revised to include all changes to the volume forecasts.<br><br>Ecology Recommendation. In accordance with WAC 173-303-830(3)(a)(i), any modifications in the projected volume of waste should be noted in a revised permit application and submitted to Ecology.<br><br>DOE-RL/WHC Response: As stated in the text, the annual waste forecast was used for the preparation of Table 2-1. The forecast is for a period of 30 years and is necessarily only a rough estimate in the later years. Any waste receipts greater than the amounts forecasted in the Part A of the permit application would of course result in a revision to the permit. The paragraph will be rewritten to clarify why Table 2-1 will not be revised. | 4-26-91 |

Attachment 5

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 3. | Page 2-14, Section 2.1.2.2.1 (2-3). In the third paragraph, mention is made of drag-off boxes being transported to a trench by a flatbed railroad and remotely skidded off into the trench.<br><br>Ecology Recommendation. It is not clear if the boxes are arranged after they are remotely skidded into the trench. Detailed procedures should be provided.<br><br>DOE-RL/WHC Response: Text will be added discussing that the waste is covered with soil as soon as it is placed and a description of procedures will be provided. | 4-26-91 |
| 4. | Page 2-23, lines 10 and 11 (2-4). Section 2.5.1 states "The LLBG are located in a semiarid climate with an average annual rainfall of about 6.3 inches." There is no cite given for this conclusion.<br><br>Ecology Recommendation. Include the reference cite for this conclusion.<br><br>DOE-RL/WHC Response: Reference to Pacific Northwest Laboratory (PNL) PNL-4622, Climatological Summary for the Hanford Area, Washington State, Stone et. al., June 1983 will be added to the text. | 4-26-91 |
| 5. | Page 2-57 (2-5). Section 2.7.2.3 states that due to the remote location of the LLBG that discharges occurring on property not owned by the U.S. Government are unlikely and, therefore, a description of the actions to restore the impacted area is not required. There is no cite given for this conclusion.<br><br>Ecology Recommendation. Include the reference cite for this conclusion.<br><br>DOE-RL/WHC Response No. 1: Reference to the site map, which shows the LLBG location well within the site boundaries, will be added.<br><br>Ecology Response No. 1 Comment: Section 2.7, Spills and Discharges, Page 2-57<br><br>Edit Section 2.7.2.3 to read "actions taken to restore an off-site impacted area and to replenish off-site resources is not required". | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| | **DOE-RL/WHC Response No. 2: The last sentence of 2.7.3.3 will be revised to read "Therefore a description of the actions taken to restore an offsite impacted area and to replenish offsite resources is not required."** | |
| 6. | Page 3-1, lines 11 through 13 (3-1). This section states, inter alia, that, "The generators are responsible for identifying and providing waste designations in accordance with WAC 173-303 (Ecology 1989)." A complete cite is required when referencing any statutes or regulations.<br><br>Ecology Recommendation. Include the complete cite (i.e., WAC 173-303-070).<br><br>**DOE-RL/WHC Response: A complete cite to WAC 173-303-070(1)(b) will be included in the text.** | 4-26-91 |
| 7. | Page 3-2, lines 10 through 12 (3-2). Section 3-1 discusses mixed wastes and states that "such waste also is categorized as toxic ... under WAC 173-303 (Ecology 1989)." A complete cite is required.<br><br>Ecology Recommendation. Include the complete cite (i.e., WAC 173-303-070).<br><br>**DOE-RL/WHC Response No. 1: A complete cite to WAC 173-303-070 will be included in the text.**<br><br>Deficiency: Section 3.1, Chem, Bio and Physical Analysis, Page 3-2<br><br>Although the correct reference has been provided in the response, the Extraction Procedure Toxicity test is no longer accepted.<br><br>Requirement: All references to future toxicity testing must reference the Toxicity Characteristic Leaching Procedure (TCLP). WAC 173-303-090(8) (October 16, 1990)<br><br>**DOE-RL/WHC Response No. 2: The text will be revised to remove Extraction Procedure requirements and insert Toxicity Characteristic Leaching Procedure in its place.** | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 8. | Page 3-3, line 20 (3-3). Section 3.1.1.3 states that "small quantities" of mercury are disposed at the Hanford Site.<br><br>Ecology Recommendation. The term "small quantities" should be refined (e.g., less than 5 pounds per year).<br><br>DOE-RL/WHC Response: The term "small quantities" will be refined to read 'less than 10 pounds per year.' | 4-26-91 |
| 9. | Page 3-4, lines 35 through 37 (3-4). Section 3.1.3 states that operation of the LLBG does not involve storage of waste in tank systems and, therefore, the requirements of "this section" are not applicable to the LLBG. It is unclear what "section" is referenced.<br><br>Ecology Recommendation. Explain which "section" and its requirements that are not applicable to the LLBG.<br><br>DOE-RL/WHC Response: The text will be changed to "... the requirements of WAC-173-303-640 are not applicable to...". | 4-26-91 |
| 10. | Page 3-4, lines 42 and 43 (3-5). Section 3.1.4 states that operation of the LLBG does not involve the placement of waste in piles and, therefore, the requirements of "this section" are not applicable to the LLBG. It is unclear what "section" is referenced.<br><br>Ecology Recommendation. Explain which "section" and its requirements that are not applicable to the LLBG.<br><br>DOE-RL/WHC Response: The text will be changed to "... the requirements of WAC 173-303-660 are not applicable to...". | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 11. | Page 3-5, lines 8 through 10 (3-6). Section 3.1.6 states that operation of the LLBG does not involve the incineration of waste and waste used in performance tests and, therefore, the requirements of "this section" are not applicable to the LLBG."<br><br>Ecology Recommendation. Explain which "section" and its requirements that are not applicable to the LLBG.<br><br>DOE-RL/WHC Response: The text will be changed to "...the requirements of WAC 173-303-807 are not applicable to...". | 4-26-91 |
| 12. | Page 3-5, lines 15-16 (3-7). Section 3.1.7 states that operation of the LLBG does not involve the land treatment of waste and, therefore, the requirements of "this section" are not applicable to the LLBG. It is unclear what "section" is referenced.<br><br>Ecology Recommendation. Explain which "section" and its requirements that are not applicable to the LLBG.<br><br>DOE-RL/WHC Response: The text will be changed to read "... the requirements of WAC 173-303-655 are not applicable to...". | 4-26-91 |
| 13. | Page 3-5, lines 39 through 41 (3-8). Section 3.2 states that "...the waste must be completely and accurately characterized in accordance with Ecology regulations before approval for storage or disposal is granted." No cite for the referenced regulations is given.<br><br>Ecology Recommendation. Include the complete cite for the referenced regulations.<br><br>DOE-RL/WHC Response: "...Ecology regulations..." will be changed to "...WAC 173-303-070...". | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 14. | Page 4-3, Section 4.1.2.1 (4-1). It is noted that testing for free liquids is not performed because testing would increase the potential for radiation exposure of personnel.<br><br>Ecology Recommendation. The reason for not testing for liquids seems reasonable. However, there is no means of verifying whether or not free liquids actually exist in a particular waste. Alternative methods to test for free liquids should be explored and discussed here.<br><br>DOE-RL/WHC Response No. 1: Text will be revised.<br><br>Comment: Section 4.1.2.1, Test for Free Liquids, Page 4-3<br><br>The alternate methods of testing for free liquids should be presented in the next NOD Response Table. This discussion must also justify the equivalency of any alternate method to the Paint Filter Method.<br><br>DOE-RL/WHC Response No. 2: The proposed alternative method for determining the presence of free liquids is real time radiography. This is the approved method for determining the presence of free liquids in transuranic waste to be shipped to the WIPP site, and has been proven very effective in locating small quantities of free liquids where lead shielding isn't used. This will be done in accordance with a sampling plan to be developed in support of the Hanford Facility Dangerous Waste Permit Application. | |
| 15. | Page 4-4, Section 4.6.1 (4-2). Appendix 4B indicates the waste type, age, and status of the trenches in the 200 West and 200 East Areas burial grounds. Based on information presented in Appendix 4B tables, some trenches are presently accepting mixed waste.<br><br>Ecology Recommendation. The Applicant should identify the specific areas of the existing unlined trenches in the LLBG that have received these mixed wastes, identify the mixed waste characteristics, and present a plan for dealing with these mixed wastes.<br><br>DOE-RL/WHC Response No. 1: Trenches receiving mixed waste are existing portion trenches which are exempt from liner and leachate collection requirements [WAC 173-303-806(4)(h)(ii)(A)]. A listing of the mixed waste placed since November 23, 1987, will be added to the text. The plan for dealing with these wastes is the same as for other remote-handled waste. The waste will be covered with 8 feet of soil and will receive a RCRA compliant cover upon closure as described in Chapter 11.0. | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| | Comment: Section 4.6.1, List of Wastes, Page 4-4<br><br>Concurrence with this response will be based upon the additional information to be submitted. This information should be provided as soon as possible to facilitate our evaluation. In addition, the trench locations where liquids have disposed must also be identified.<br><br>DOE-RL/WHC Response No. 2: Trenches receiving mixed waste and trenches containing liquid waste will be identified to Ecology, and in the list of waste. This information already is listed in Appendix 4A. | |
| 16. | Page 4-5, Section 4.6.2.1 (4-3). A request for an exemption for mixed wastes (specifically categorized as remote-handled waste) placed in unlined trenches subsequent to November 23, 1987, is reported here. The Applicant states that this element of the radioactive mixed waste management strategy was summarized in Applicant's January 26, 1988, letter to Ecology.<br><br>Ecology Recommendation. The Applicant should identify the specific areas of the existing unlined trenches in the LLBG that have received these mixed wastes, identify the mixed waste characteristics, and present a plan for dealing with these mixed wastes.<br><br>DOE-RL/WHC Response No. 1: Trenches receiving mixed waste are existing portion trenches which are exempt from liner and leachate collection requirements [WAC 173-303-806(4)(h)(ii)(A)]. A listing of the mixed waste placed since November 23, 1987, will be added to the text. The plan for dealing with these wastes is the same as for other remote-handled waste. The waste will be covered with 8 feet of soil and will receive a RCRA compliant cover upon closure as described in Chapter 11.0.<br><br>Deficiency: Section 4.6.2.1, Exemption Based on Existing, Pg 4-5<br><br>Although trenches which were operational and received mixed waste prior to November 23, 1987 are exempt from the double-liner requirements of HSWA, the portion of these trenches which did not receive wastes must still meet the single liner with leachate collection system required prior to HSWA. | |

| No. | Comment/Response | Ecology Concurrence |
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| | Requirement: The additional information to be provided should also specify what portions of each trench did not contain wastes on November 23, 1987. In addition, the term "notification of" on line 21 must be replaced with "approval from."<br><br>DOE-RL/WHC Response No. 2: There is no question that the mixed waste is subject to the Hazardous and Solid Waste Amendments (HSWA); however, HSWA did not change the definition of the existing portion of a landfill. Mixed waste has been accepted, with prior notification of Ecology by DOE, in the open trenches beyond that which was there on November 23, 1987; therefore, the definition of the existing portion of the landfill has had implicit concurrence by Ecology. | |
| 17. | Page 4-5, lines 26 through 33 (4-4). The Applicant states that a liner system exemption request for trench 94 in burial ground 218-W-12B will be submitted in a separate submittal.<br><br>Ecology Recommendation. It is recommended that the Applicant submit the application for exemption in accordance with WAC 173-303-665(2)(b) with sufficient information demonstrating equivalent protection for the hazardous wastes to be included in the reactor compartments.<br><br>DOE-RL/WHC Response: An application for exemption in accordance with WAC 173-303-665(2)(b) was prepared and submitted to Ecology on July 25, 1990. | 4-26-91 |
| 18. | Page 4-12, Section 4.6.3.3.1 (4-5). Placing the asphalt in nondrag-off landfills using heavy machinery will be difficult and if not done with proper care, could damage the underlying liner.<br><br>Ecology Recommendation. It is recommended that the use of light vehicles be investigated for use over the liner to lay asphalt as a way to avoid heavy loading on the liner during construction. Detailed procedures for ensuring liner and leachate collection system integrity must be developed during final design but should be provided at the conceptual level in the permit application.<br><br>DOE-RL/WHC Response No. 1: The construction of an asphalt pad is not included in the definitive design that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design. | |

| No. | Comment/Response | Ecology Concurrence |
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| | Comment: Section 4.6.3.3.1, Liner System Description, Page 4-12<br><br>Until the definitive design is complete, Ecology will not issue a dangerous waste permit for the dragoff mixed waste trench. If this trench is not scheduled for design and construction in the near future (within the next 12 months), all references to this trench should be eliminated from the Part A and the Part B applications. A permit modification can be used if and when the dragoff trench becomes a reality.<br><br>**DOE-RL/WHC Response No. 2: Design and Construction of the dragoff mixed waste trench will not be completed in the next 12 months. The project was replaced with the non-dragoff mixed waste trench. The reference to the dragoff trench will be removed from the Part A and Part B permit application.** | |
| 19. | Page 4-13, lines 5 and 6 (4-6). There is high potential for significant shear when boxes loaded with wastes are pulled into place in the drag-off trenches. The Applicant has proposed to evaluate the effects on the liner by use of a test pad.<br><br>Ecology Recommendation. As noted by the Applicant, there is a high degree of uncertainty associated with quantifying the shear stresses associated with movement of the drag-off trenches on the liner. Applicant should provide a detailed review of the alternative procedures proposed for testing of the liner damage.<br><br>**DOE-RL/WHC Response No. 1: The mixed waste trench to be constructed in burial ground 218-W-5 is designed for nondrag-off packages. This section will be revised to address only burial ground 218-W-5.**<br><br>Deficiency: Section 4.6.3.3.2. Stresses from Equipment, Page 4-13<br><br>The response is unclear. If burial ground 218-W-5 is a nondrag-off burial ground, why would it be the only burial ground addressed in a permit section discussing the effects of dragging boxes? Furthermore, the text appears to indicate that the sole purpose of the test pad is to evaluate operational stresses on the liner. The test pad must also be constructed to determine the acceptability of the soil liner construction and design specifications. Section 4.6.5.5.1 discusses some field tests for the liner, but does not indicate whether these tests are for both the dragoff and non-dragoff trenches, nor if these will be performed on a test pad or the installed liner. | |

| No. | Comment/Response | Ecology Concurrence |
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| | Requirement: Please clarify the response and provide more detail for the dragoff test pad if the dragoff trench is to be included in the application (see comment 18). . . | |
| | DOE-RL/WHC Response No. 2: Burial Ground 218-W-5 is a non-dragoff mixed waste trench. The portion of section 4.6.3.3.2 that pertains to the dragoff trench will be removed from the permit. The field test mentioned in section 4.6.5.5.1 applies to the non-dragoff landfill. A test fill (also known as a test pad) will be performed for the admix liner material to document the adequacy of the materials, design, equipment, and construction procedures proposed for the admix liner [see the recently submitted Construction Quality Assurance Plan (WHC-SD-W025-PLN-001), Sections 4.3.2 and 4.4.1]. Furthermore, samples of the liner material will be collected and tested upon delivery and preparation to document that the material properties are within the range stated in the specifications (WHC-S-045, Section 02275). As noted in WHC-SD-W025-FDR-001, section 5.3.3., Page 19 of 197, a two-foot operations layer will be placed over the entire landfill, including the slopes, during construction to protect the liners from equipment damage during operations and to act as an insulating layer. | |
| 20. | Page 4-14, lines 26 through 29 (4-7). The anchor trenches are intended to hold the liners in place while the liner is extended up the side slopes to the ground surface. | |
| | Ecology Recommendation. Details of the anchor trench construction and overlying weight specifications should be provided in the detailed design. The Applicant should provide conceptual information in the permit application sufficient to demonstrate that the anchor trenches will be of adequate design to hold the liners in place during construction and operation periods. | |
| | DOE-RL/WHC Response No. 1: The information requested will be provided in the definitive design that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design. | |
| | Comment: Section 4.6.3.4, Liner System Coverage, Page 4-14 | |
| | This comment will be addressed in a subsequent NOD to be issued for the definitive design document. | |

| No. | Comment/Response | Ecology Concurrence |
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| | DOE-RL/WHC Response No. 2: The anchor trench design is shown on Drawing H-2-131579. Pullout resistance for this system is analyzed in Appendix C.11 of the Design Report and demonstrated to be substantially greater than required. | |
| 21. | Page 4-14, lines 31 through 33 (4-8). The Applicant states that the portion of the liner system on the upper side slopes will be exposed to the weather for several years.<br><br>Ecology Recommendation. The Applicant has not demonstrated with test data that the integrity of the liner will remain after an extended period of exposure to the elements. Although some liner materials are less effected by exposure than others, Ecology knows of no liner materials which would be unaffected by prolonged exposure over several years. Alternative approaches to limit the period of exposure of a particular liner section, such as covering the liner and phased cell construction, should be evaluated.<br><br>DOE-RL/WHC Response No. 1: The liner will be covered with soils to protect it from the environment as described in the definitive design that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design.<br><br>Deficiency: Section 4.6.3.5, Liner Exposure Prevention, Page 4-14<br><br>Comment 20 also applies here.<br><br>DOE-RL/WHC Response No. 2: The stresses caused by thermal contraction can be seen in the Definitive Design Report WHC-SD-W025-FDR-001, Appendix C.10, Pages 275-279 of 397 and on Page 19 of 397, Sections 5.3.3, 5.4.1. A two foot operations layer will be placed over the entire landfill, including the slopes, during construction to act as an insulating layer and to prevent exposure of the geosynthetics to ultraviolet (UV) radiation, the most serious cause of deterioration. Carbon black will be added to the FML and will prevent deterioration during reasonably expected storage times even if the geomembrane is exposed to UV light. Any deterioration would be identified by conformance testing as described in Section 4.4.1.2 of the CQA Plan. | |

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| 22. | Page 4-26, lines 3 through 5 (4-9). Indicates an absence of hydraulic conductivity test data.<br><br>Ecology Recommendation. Hydraulic conductivity test data would be useful as part of the permit review process. The Applicant should provide the test results.<br><br>**DOE-RL/WHC Response No. 1: Hydraulic conductivity test data are not required for the definitive design. There are no plans to conduct additional testing as part of this project.**<br><br>Deficiency: Section 4.6.4.3.4, Hydraulic Conductivity, Page 4-26<br><br>Line 4 and 5 indicate that some hydraulic conductivity test results from the unsaturated zone were not available at the time of preparing the permit application. These results should be available now.<br><br>Requirement: A summary of these test results should be provided in the application.<br><br>**DOE-RL/WHC Response No. 2: The requested hydraulic conductivity test results have been incorporated into the revised Chapter 4.0.** | |
| 23. | Page 4-31, Section 4.6.4.4.5 (4-10). As part of the preliminary design, there are no provisions for monitoring the potential landfill gas.<br><br>Ecology Recommendation. Although significant amounts of landfill gas are not expected to be generated in the LLBG, it is possible that radioactive gases, such as tritium, could be produced in the LLBG cells. The Applicant should provide an assessment of the potential for gas production and an evaluation of alternative gas monitoring alternatives.<br><br>**DOE-RL/WHC Response: Section 4.6.4.4.5 is discussing the potential for gas pressure in the subgrade beneath the liner of the landfill and not generation of gas by the waste placed in the lined trench and above the liner. The discussion as written is correct for the subject of this section as defined by the Ecology permit application outline. Generation of gas by the waste is discussed in Section 11.1.4.3.** | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
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| 24. | Pages 4-34 and 4-35, Section 4.6.5.2 (4-11). According to the testing protocol, separate samples will be subjected to primary leachate, secondary leachate, and radiation levels to provide the total expected design-life dose in a period of about 30 days.<br><br>Ecology Recommendation. The test protocol as proposed may not be adequate. In order to simulate the cumulative effect of all three forms of contaminants, some of the liner samples should be exposed concurrently to combinations of the strongest leachate form and radiation. Extended period testing should also be considered in parallel with permitting and design activities to increase information available on the basis for liner selection.<br><br>DOE-RL/WHC Response: A "Liner/Leachate Compatibility Test Plan" has been submitted to Ecology for review. The proposed leachate and radiation testing protocols are described in more detail in the test plan. The permit application will be revised to agree with the test plan. | 4-26-91 |
| 25. | Page 4-36, lines 14 and 15 (4-12). The Applicant refers to "substantial modification" of the conceptual design.<br><br>Ecology Recommendation. Some additional clarification with regard to the term "substantial modification" is needed. A change in the conceptual design requires a modification of the permit application, per WAC 173-303-610(3)(b).<br><br>DOE-RL/WHC Response: The definitive design will be submitted for review and will be the basis for modifying the permit application. | 4-26-91 |
| 26. | Page 4-37, Section 4.6.5.3.4 (4-13). The thermal expansion of the liner due to temperature variations will be accommodated by installing the flexible membrane liner with a small amount of slack in the side slopes of the trenches.<br><br>Ecology Recommendation. Given the extreme temperature variations at the Hanford Site, providing slack might not be sufficient to prevent damage due to thermal stresses and other effects of prolonged exposure. The exposed portion of the liner on the side slope portions of the trenches should be covered with ultra-violet protection material until the side slopes are covered with waste. See comment number 22. | |

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| | **DOE-RL/WHC Response No. 1: Thermal expansion is described in more detail in the definitive design that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design.** | |
| | Deficiency: Section 4.6.5.3.4, Thermal Stresses, Page 4-37 | |
| | Comment 20 also applies here. | |
| | **DOE-RL/WHC Response No. 2: The stresses caused by thermal contraction are described in the Definitive Design Report WHC-SD-W025-FDR-001, Page 19 of 397, Section 5.4.1. and in Appendix C.10, Pages 275-279 of 397. This analysis shows that thermal stresses and strains in the FML were well within acceptable limits even when extreme temperature conditions and no slack were assumed. Also, once the operations layer is in place, thermal fluctuations will be relatively minor compared to the extreme conditions assumed for the analysis.** | |
| 27. | Page 4-41, Section 4.6.5.5.2 (4-14). Soil liner compatibility test procedures. | 4-26-91 |
| | Ecology Recommendation. Similar to the synthetic liner testing protocol, some means of testing the cumulative effects of the contaminant types should be included. | |
| | **DOE-RL/WHC Response: This information will be provided in the Liner/Leachate Compatibility Test Plan. The permit application will be revised to agree with the test plan.** | |
| 28. | Page 4-44, Section 4.6.6.1.1 (4-15). The locations of the sumps in the primary system are not specified. | |
| | Ecology Recommendation. Specify the location of sumps in the primary system. | |
| | **DOE-RL/WHC Response No. 1: The locations of the sumps will be provided in the definitive design documents that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design.** | |
| | Comment: Section 4.6.6.1.1, Primary System Page 4-44 | |
| | Comment 20 also applies here. | |

| No. | Comment/Response | Ecology Concurrence |
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| | **DOE-RL/WHC Response No. 2: See the Definitive Design Report WHC-SD-W025-FDR-001, Page 29 of 397, Section 6.4.1.1, "Primary System." The sump locations are shown on the design drawings and on Figure 4-7 of the revised Chapter 4.** | |
| 29. | Page 4-46, Section 4.6.6.1.2 (4-16). The locations of the sumps in the secondary system are not shown.<br><br>Ecology Recommendation. Specify the locations of the sumps in the secondary system.<br><br>**DOE-RL/WHC Response No. 1: The locations of the sumps will be provided in the definitive design documents that will be submitted to Ecology for review. The permit application will be revised to agree with the definitive design.**<br><br>Comment: Section 4.6.6.1.2, secondary System, Page 4-46<br><br>Comment 20 also applies here.<br><br>**DOE-RL/WHC Responses No. 2: See the Definitive Design Report WHC-SD-W025-FDR-001, Page 30 of 397, Section 6.4.1.2, "Secondary System Pumps." The sump locations are shown on the design drawings and on Figure 4-7 of the revised Chapter 4.** | |
| 30. | Page 4-47, Section 4.6.6.5 (4-17). The Applicant cites references to other sources for information on components within the waste stream.<br><br>Ecology Recommendation. Test results for compatibility of components within the waste stream handling system (pumps, holding tanks, and drain pipes) with radioactive and dangerous wastes should be provided here or appended by reference.<br><br>**DOE-RL/WHC Response No. 1: Items that are replaceable, such as pumps and tanks, will not be subjected to Method 9090 testing. The high-density polyethylene pipe used for drainage and transfer of leachate from the sump area into the aboveground holding tank will be tested. The design attempts to minimize the components that would not be accessible for maintenance.** | |

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Comment: Section 4.6.6.5, System Compatibility, Page 4-47

Comment 20 also applies here.

**DOE-RL/WHC Responses No. 2: When the 9090 test report is completed, it will be submitted to Ecology and will provide the information applicable to this comment.**

31. Pages 4-36 through 4-48, Sections 4.6.5.3.2 and 4.6.6.6.1 (4-18). Both sections discuss the stresses on the liner and geonet from the overlying load.

Ecology Recommendation. The weight of the overlying material on the geonet after the landfill is closed has a tendency to impinge the geonet and impair the function of the geonet resulting in clogging of the drainage layer. Laboratory tests should be performed on a geonet layer sandwiched between flexible membrane liners and geotextile and supplying the weight of the waste and final cover to demonstrate that the geonet will perform in the field. Such tests should include bearing weights of asphalt or other base courses provided as storage flooring overlying the liner system. These test results should be provided for Ecology review. Factors of safety for compression and clogging (particles, mineral deposits, and biological growth) also should be provided for Ecology review.

**DOE-RL/WHC Response No. 1: This concern is addressed in the definitive design specifications which will be submitted to Ecology for review. In the specifications, the transmissivity value is specified under normal load of about one-half the ultimate waste cover. Manufacture's test data and results of planned conformance tests will be submitted to Ecology if requested.**

Comment: Sections 4.6.5.3.2 and 4.6.6.6.1, Weight of Overlying Material and Stability of Drainage Layers, Pages 4-36 and 4-47

Transmissivity tests should indicate adequate performance (i.e., transmissivity greater than $5 \times 10^{-4}$ $m^2$/sec) at 1.5 times the maximum expected load which the geonet will experience. Furthermore, the manufacturer's test data and results must be submitted to Ecology. Comment 20 also applies here.

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| | DOE-RL/WHC Response No. 2: Manufacturer's transmissivity data for the proposed geonet is shown on the attached Figure PN-3000. With respect to performance, we believe that the section tested by Fluid Systems, Inc. is similar to the critical section in the Project W-025 Landfill (operations layer over geocomposite). It can be seen that at loads up to 10,000 psf, the transmissivity of this system exceeds $5 \times 10^{-4}$ $m^2$/sec in all cases. Conservatively assuming a unit weight of 110 pcf for materials above the liner, a load of 10,000 psf corresponds to 90 feet of waste and soil cover. This is 2 to 3 times the expected thickness, so the geocomposite has an acceptable margin of capacity.<br><br>With respect to test data, formal manufacturer's submittals and conformance testing results are required, not only for the geocomposite but for most other materials, as established in the CQA Plan and the Specifications. This information will be made available to Ecology as requested. | |

LOW-LEVEL BURIAL GROUNDS
NOTICE-OF-DEFICIENCY RESPONSE TABLE



| No. | Comment/Response | Ecology Concurrence |
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| No. | Comment/Response | Ecology Concurrence |
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| 32. | Page 5-1, lines 18-21 (5-1). This section states that because a waiver from the groundwater monitoring requirements under WAC 173-303-645 is not requested by this plan,. "therefore, the requirements of this section of the Washington Administrative Code are not applicable to the LLBG." This is not correct. This section of the Code (173-303-645) states, inter alia, "(a) Except as provided in (b) of this subsection, the regulations in this section apply to owners and operators of facilities that treat, store, or dispose of dangerous waste in surface impoundments, waste piles. land treatment units, or landfills. The owner or operator must satisfy the requirements of this section for all wastes (or constituents thereof) contained in any such waste management unit at the facility that is a "regulated unit" [as defined in WAC 173-303-040(75)]." Thus, subsection -645 applies although application of specific provisions of this subsection (i.e., those relating to exemption from groundwater monitoring) are not requested.<br><br>Ecology Recommendation. Rewrite this section to state that WAC 173-303-645 applies and that exemption from this subsection of the code is not requested.<br><br>DOE-RL/WHC Response: The sentence "Therefore, the requirements of this section ... are not applicable to the LLBG." will be deleted. | 4-26-91 |
| 33. | Page 5-2, lines 25 through 35 (5-2). Section 5.2.1 discusses what the Interim Status Groundwater Monitoring Approach was supposed to do to meet the 1986 compliance order. To what degree these requirements were carried out is not detailed.<br><br>Ecology Recommendation. Outline to what degree requirements, goals, and objectives were met.<br><br>DOE-RL/WHC Response: The text will be expanded to indicate that the initial network of 35 monitoring wells was installed as planned, and that the goals of the network in providing hydrogeologic property information and background water quality data were met. | 4-26-91 |
| 34. | Page 5-3, lines 4 and 5 (5-3). The basis for establishing the compliance boundaries is not explained. Is the compliance boundary the same as the low-level waste management area (LLWMA) boundary shown in Figures 5-1 and 5-2?<br><br>Ecology Recommendation. Describe the basis for establishing compliance boundaries and delineate the compliance boundary in figures. | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
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| | DOE-RL/WHC Response: The compliance boundary is defined by a line that connects the monitoring wells spaced around the perimeter of the waste management area. If no well is located at a corner of a waste management area the compliance line is continued along both sides of the waste management area until they meet. The lines on Figures 5-1 and 5-2 that delineate the 'low-level waste management area' are the compliance boundaries. Both text and figures will be altered to specifically define these boundaries. | |
| 35. | Page 5-6, line 51 (5-4). Bierschenk initials turned around in reference section. | 4-26-91 |
| | DOE-RL/WHC Response: The order of Bierschenk's initials will be corrected in the references. | |
| 36. | Page 5-7, line 8 (5-5). Deju (1975) citation omitted in reference section. | 2-26-91 |
| | DOE-RL/WHC Response: The Deju (1975) citation is not correct. The citation in the text will be corrected to Ledgerwood and Deju (1975). | |
| 37. | Page 5-7, lines 30-42 (5-6). Section 5.2.2.2 discusses the interim status monitoring well network and states that four of the 35 wells, completed in 1987, are screened over the lowermost 20 feet of the uppermost aquifer. The remaining 31 wells are completed in the upper 20 feet of the uppermost aquifer. No explanation is given why four wells were completed in the deep section of the aquifer. | 4-26-91 |
| | Ecology Recommendation. Provide an explanation on the number of wells chosen for monitoring the deeper section of the aquifer. This discussion should focus on explaining why a small number of wells were completed in the deeper section of the aquifer relative to the larger number of wells for the upper part of the aquifer. | |
| | DOE-RL/WHC Response: There is considered to be virtually no likelihood of dense non-aqueous phase liquids reaching the groundwater from the wastes in the LLBG. However, four wells were selected as deep wells for verification. This concept is supported by the types and quantities of waste described in Chapter 3.0, the methods of disposal, and the mechanisms available for mobilization and transport to the groundwater. Furthermore, the results of the first year of monitoring have been found to be consistent with this concept. The text will be revised to explain the number of wells chosen to monitor the deeper section of the aquifer. | |

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| 38. | Page 5-9, lines 25 and 26 (5-7). A detailed explanation on casing and screen inspection was not provided. Was decontamination performed prior to placement? If so, what solutions/solvents were used?<br><br>Ecology Recommendation. Provide a detailed explanation on casing and screen inspection.<br><br>**DOE-RL/WHC Response: The casing and screen were factory-cleaned and delivered to the well site in clean plastic bags where they were visually inspected prior to installation. No additional cleaning was found to be required at the well site. A detailed description of the cleaning, inspection, and handling process will be added to the text.** | 4-26-91 |
| 39. | Page 5-9, line 30 (5-8). What size and type of silica sand?<br><br>**DOE-RL/WHC Response: The size and type of silica sand will be specified in the text.** | 4-26-91 |
| 40. | Page 5-9, line 38 (5-9). What proportion of grout is Volclay vs. concrete?<br><br>**DOE-RL/WHC Response: Volclay does not contain concrete. A detailed description of Volclay will be added to the text.** | 4-26-91 |
| 41. | Pages 5-10 and 5-13 (5-10). Well 299-W7-2 has been left out of well listing.<br><br>Ecology Response. Include Well 299-W7-2 to the well listing.<br><br>**DOE-RL/WHC Response: Well 299-W7-2 will be added to the well listing.** | 4-26-91 |
| 42. | Page 5-13, lines 12-17 (5-11). Text says that the data do not "clearly indicate" whether upgradient contamination is a problem. Is there 'some' indication that upgradient contamination is a problem?<br><br>Ecology Recommendation. Elaborate on the potential for upgradient contamination and how it should be addressed in the monitoring program.<br><br>**DOE-RL/WHC Response: Upgradient contamination is a potential problem at the site. A description of this upgradient contamination is provided in Section 5.4. An approach for treating the statistical complications resulting from the presence of upgradient** | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
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| | contamination is outlined in Section 5.5.4.7. References to these sections will be added to Section 5.2.2.4. | |
| 43. | Page 5-13, lines 26 through 35 (5-12). Section 5.2.2.5 lists analysis performed on sediments. Were the grab samples used for analysis? If so, were they hard drive slurry or drive barrel samples?<br><br>Ecology Recommendation. Elaborate and clarify the sampling methods employed and the type of samples tests were performed on. Subsequent sections' discussion on heterogeneity of material types, hydraulic conductivity, etc., could raise question on quality of lithologic evaluation.<br><br>DOE-RL/WHC Response: A more detailed description of the sediment sampling techniques and the testing performed on each type of soil sample will be added to the text. Sediment was collected as split barrel continuous core, hard tool slurry, and drive barrel samples. | 4-26-91 |
| 44. | Page 5-13, line 47 (5-13). How was contaminated purge water disposed of?<br><br>DOE-RL/WHC Response: A more detailed discussion of purge water disposal will be presented in the new Section 5.2.3.1.8, and a reference to that section will be added to the text. | 4-26-91 |
| 45. | Page 5-14, lines 37 through 44 (5-14). What decontamination techniques were used to decontaminate water-level measuring equipment between wells?<br><br>DOE-RL/WHC Response: The water-level measuring equipment is decontaminated between wells by rinsing with distilled water. A description of the decontamination techniques will be added to the text. | 4-26-91 |
| 46. | Page 5-15, lines 2 through 4 (5-15). For low-yielding wells, at least two volumes should be evacuated to purge annular space water in contact with casing volume water.<br><br>DOE-RL/WHC Response: The LLBG monitoring networks contain no low-yielding wells at present, and at least three well volumes have been removed from all interim status wells before each sampling event. The discussion of reduced purging of low-yielding wells will be removed from the text. | 4-26-91 |

| No. | Comment/Response | Ecology Concurrence |
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| 47. | Page 5-15, lines 7 and 8, Section 5.2.3.1.3 (5-16). Specify pump flow rate during VOA collection.<br><br>**DOE-RL/WHC Response: The flow rate during collection of VOA samples is generally 1 gallon per minute. A discussion of this flow rate will be added to the text.** | 4-26-91 |
| 48. | Page 5-15, line 34 (5-17). Semivolatiles were not specified in above sampling order (Section 5.2.3.1.3, lines 16 and 17). When was this fraction sampled?<br><br>Ecology Recommendation. Specify semivolatiles in the sampling order. Identify when this fraction was sampled.<br><br>**DOE-RL/WHC Response: The sampling order, including semivolatiles, will be more clearly described in the text.** | 4-26-91 |
| 49. | Page 5-15, lines 43 through 45 (5-18). Semivolatiles require a volume of only 75 percent container.<br><br>**DOE-RL/WHC Response: All sample bottles, other than those for VOA's, are filled to the top, although a small amount of air space (less than 5 percent) may remain in the bottle. The VOA vials are filled slightly more than full so that no air space remains in the bottle. The text will be modified to clarify the extent of filling and specify sample bottle types.** | 4-26-91 |
| 50. | Page 5-15, lines 40 through 43 (5-19). Specify sample bottle types - size, clear glass, amber glass, polyethylene, etc.<br><br>**DOE-RL/WHC Response: The text will be revised to specify sample bottle types.** | 4-26-91 |
| 51. | Page 5-15, line 48 (5-20). What methods were used to monitor the 4°C temperature?<br><br>Ecology Recommendation. Specify methods used to monitor the 4°C temperature.<br><br>**DOE-RL/WHC Response: A description of the methods will be included in the permit application.** | 4-26-91 |

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| 52. | Page 5-16, lines 29 through 37 (5-21). What preparation procedures were used for field and trip blanks? What kind of water is used - distilled, deionized, or carbon-free? Where are trip blanks prepared?<br><br>DOE-RL/WHC Response: A more complete description of the preparation procedures for blank samples will be added to the text. | 4-26-91 |
| 53. | Page 5-16 (5-22). Section 5.2.3.1.7 does not indicate whether samples were collected as a check on matrix homogeneity (duplicates, replicates).<br><br>Ecology Recommendation. Applicant should elaborate on this and specify frequency. In addition, state whether or not any unsates on ancillary equipment (water-level measurement tapes, probes) were taken to evaluate the effectiveness of the decontamination process.<br><br>DOE-RL/WHC Response: Duplicate sampling frequency and a discussion of equipment blanks will be added to the text. | 4-26-91 |
| 54. | Page 5-25, lines 10 and 11 (5-23). What was done with the water from Well 299-E28-26?<br><br>DOE-RL/WHC Response: Well 299-E28-26 was not pump tested. Purge water from this well was treated the same as other purge water, as described in Section 5.2.3.1.8. The text will be modified to clarify water handling from this well. | 4-26-91 |
| 55. | Pages 5-25 through 5-27, Section 5.2.3.2.3 (5-24). What was done with unacceptable purge water during quarterly monitoring?<br><br>DOE-RL/WHC Response: A description of disposal procedures for all purge water will be outlined in the new Section 5.2.3.1.8. A reference to this section will be added to the text. | 4-26-91 |
| 56. | Page 5-39, line 34 (5-25). Refer to Section 5.3.3 which does not discuss transmissivity.<br><br>Ecology recommendation. Delete reference or clarify.<br><br>DOE-RL/WHC Response: The reference to Section 5.3.3 will be changed to Section 5.3.5.1.5. | 4-26-91 |

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| 57. | Page 5-41, Table 5-3 (5-26). This table identifies the major ion chemistry of the unconfined aquifer on the Hanford Site. No source for this data is noted.<br><br>Ecology Recommendation. Include the citation for this data at the bottom of Table 5-3.<br><br>DOE-RL/WHC Response: The source of the data will be added to Table 5-3. | 4-26-91 |
| 58. | Pages 5-42 through 5-59, Section 5.3.5 (5-27). There is a considerable amount of ambiguity with respect to hydraulic conductivities. It is understood that a considerable degree of heterogeneity in site materials results in great variations in hydraulic conductivity. However, evaluation and analysis should focus more attention on this critical parameter because it does play such a critical role in the efficiency modeling, potential plume dispersion, and ultimately the location of monitoring wells.<br><br>DOE-RL/WHC Response: Although discussion of hydraulic conductivities will be clarified in the text, this parameter does not affect dispersion, the efficiency modeling, or the location of monitoring wells. Efficiency modeling depends upon the plume shape when plumes reach the boundary of the buffer zone. As described in Section 5.5.2.1.4, dispersion in porous media is the sum of molecular diffusion and mechanical dispersion. Mechanical dispersion, which equals velocity times a dispersivity coefficient, dominates molecular diffusion except at very low flow rates. Assuming a diffusion coefficient of $1 \times 10^{-6}$ square feet per day, and a low transverse dispersivity of 1 foot, molecular diffusion may be neglected at flow rates greater than $1 \times 10^{-6}$ feet per day, which is several orders of magnitude smaller than the estimated flow rates beneath the LLBG. For nonreactive transport dominated by mechanical dispersion, the shape of a plume of a given size is independent of groundwater velocity and, therefore, also independent of hydraulic conductivity. This velocity independence is evident upon careful inspection of the equation in Section 5.5.2.1.4. This will be described in greater detail in the text. | 4-26-91 |

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| 59. | Page 5-48, lines 33 through 38 (5-28). Section 5.3.5.1.5 suggests a comparison of hydraulic conductivity in feet per day for basalt to transmissivity in square feet per day of Hanford and Ringold Formations.<br><br>Ecology Recommendation. Convert transmissivity to average hydraulic conductivity so units will allow direct comparison.<br><br>DOE-RL/WHC Response: Transmissivity values will be converted to hydraulic conductivity values. | 4-26-91 |
| 60. | Page 5-59, lines 12 through 16 (5-29). Section 5.3.5.2.5 discusses groundwater flow velocities beneath the low-level waste management areas and indicates that Darcian flow is assumed to be valid. No explanation is given why this assumption should not be considered valid.<br><br>Ecology Recommendation. Provide an explanation why Darcian flow should be considered valid for groundwater flow beneath these management areas.<br><br>DOE-RL/WHC Response: Darcy's law is considered valid for all flow through granular media except in fine-grained materials of very low permeability (Freeze and Cherry, 1979, pp. 72-73). Sediments in the Hanford and Ringold Formations are relatively coarse grained with moderate to high permeability. The text will be modified to eliminate the suggestion that Darcy's law may not be valid. | 4-26-91 |
| 61. | Page 5-60, line 44, Section 5.3.6 (5-30). What is (I)?<br><br>DOE-RL/WHC Response: 'I' refers to the upper member of the Elephant Mountain Basalt. The text will be changed to be consistent with the usage of 'upper' throughout. | 4-26-91 |

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| 62. | Page 5-62, lines 3 through 5 (5-31). Section 5.4 states that, "Ecology regulations require a description and delineation of any groundwater contaminant plume that, based on interim status monitoring data, is suspected of originating from one of the LLBG-regulated units." The specific Ecology regulations must be cited.<br><br>Ecology Recommendation. Cite the specific Ecology regulations referenced.<br><br>**DOE-RL/WHC Response: The specific Ecology regulation will be added to the text.** | 4-26-91 |
| 63. | Page 5-62, line 5 (5-32). The, "on" should be "of".<br><br>**DOE-RL/WHC Response: This sentence will be replaced as part of revising Chapter 5.** | 4-26-91 |
| 64. | Pages 5-77, lines 22 and 23 (5-33). Text implies drinking water standard for nitrate is 45 parts per million as $NO_3$, but should specifically state.<br><br>**DOE-RL/WHC Response: The text will be changed to specifically state that the water standard for nitrate is expressed in terms of nitrate.** | 4-26-91 |
| 65. | Pages 5-77 through 5-148, Section 5.5 (5-34). General monitoring program design should consider contingency for monitoring aquifer below uppermost aquifer if uppermost aquifer becomes contaminated.<br><br>**DOE-RL/WHC Response: The text will be changed to indicate that monitoring the aquifer below the uppermost aquifer may be necessary should the bottom of the uppermost aquifer become contaminated from waste in the LLBG.** | 4-26-91 |

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| 66. | Page 5-85, Section 5.5.2.1.3 (5-35). The monitoring efficiency model appears to be an ideal approach to the design of monitoring systems. However, even if the model is valid, it should be in addition to conventional hydrogeologic analysis, particularly, the preparation of detailed planer and cross-sectional flow nets for each of the sites.<br><br>There may not be sufficient data for the preparation of detailed flow nets. specifically for LLWMA-2, -4, and -5. If this is the case, and representative flow net construction is not possible, this may indicate that data are insufficient for a valid interpretation of the hydrogeology and the proper design of a monitoring system, including application of the efficiency model.<br><br>Ecology Recommendation. Provide detailed planer and cross-sectional flow nets for each site or provide a detailed explanation why construction of these nets is not possible.<br><br>DOE-RL/WHC Response: Equipotential maps of the groundwater surface have been prepared for three consecutive years for all low-level waste management areas to supplement the efficiency model results and will be added to the text. These maps have contour intervals of 1 foot or less and are based upon data from the immediate vicinity of the low-level waste management areas and from the surrounding area. The consistency of the equipotentials with time and the level of detail provided by the small contour intervals are considered to provide sufficient information on the hydrogeology to support monitoring network design. Planer flow nets have been prepared at 1 foot contour intervals or less for all low-level waste management areas for the most recent data set. Companion cross-sectional flow nets have also been prepared at 1-foot contour intervals or less for the low-level waste management areas in the 200 West Area, where the thickness of the uppermost aquifer is about 200 feet and deep monitoring wells have been installed. All flow nets will be added to the text and will be used with the MEMO Model results in monitoring network design. | 4-26-91 |

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| 67. | Page 5-90, lines 1 through 52 (5-36). The original Domenico and Robbins (1985) article on the two-dimensional analytical transport model could not be obtained for review within the time available. Until the original article and other documentation can be reviewed, specific comments on the applicability of this particular model must be deferred.<br><br>DOE-RL/WHC Response: Additional comments on the applicability of the Domenico and Robbins plume generation model have not been received from Ecology, and it is assumed that this model was found to be acceptable. | 4-26-91 |
| 68. | Page 5-91, lines 1 through 9 (5-37). The report states the model is valid for lower density contaminants which would not exhibit vertical mixing. A potential problem could exist with heavier contaminants that would show vertical mixing and that would then invalidate the two-dimensional assumption of the Domenico and Robbins model. Deeper monitoring wells and some type of three-dimensional model may be warranted.<br><br>DOE-RL/WHC Response: The text will be modified to include a discussion of potential sources of dense non-aqueous phase liquids and metal salts at the low-level waste management areas that, if present, could invalidate the application of the two-dimensional formulation of the Domenico and Robbins model. In brief, based on the quantities and disposal methods of metal salts and dense non-aqueous phase liquids, no significant potential for density driven transport is considered to exist at the low-level waste management areas. | 4-26-91 |
| 69. | Page 5-92, lines 29 through 32 (5-38). The assumption of a 20-foot long source length through a 200-foot deep vadose zone is not adequately substantiated. This factor could greatly effect the model results as it would effect the generation of the plume family curves used.<br><br>Ecology Recommendation. Backup data for the assumption of 20-foot long source length through a 200-foot deep vadose zone would be helpful. Golder Associates (i.e., Charles Wilson) stated that the figure came from the literature. A source reference was not cited, but should be.<br><br>DOE-RL/WHC Response: The text will be modified to include an expanded discussion (Section 5.5.2.1.5.3) of line source width. The magnitude of this width was determined based upon site specific conditions and was not taken from the literature. A review of Hanford Site data on tank and crib leaks and the associated spreading of the plume through the vadose | 4-26-91 |

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| | zone will be presented. Modeling results of the T-106 point source leak and of an aerially distributed leak scenario will be summarized. In addition, a detailed analysis of model sensitivity to source width will be included. Because monitoring efficiencies decrease at a decreasing rate as source width declines, and changes little below about 40 feet, the selection of source width is not critical to model results. | |
| 70. | Page 5-93, lines 1 through 36 (5-39). Discussion states:<br>a) Smaller dispersitivities are more conservative.<br>b) Longitudinal dispersivity (Dx) for Ringold like material is 49 feet over distance of 260 feet (scale of interest).<br>c) Scale of interest at 200 Areas is 300 to 1,000 feet.<br>d) Selected 'conservative' longitudinal dispersivity is 70 feet.<br>Dx=70 feet may be conservative for a scale of interest of 1,000 feet. However, it is not very conservative for a scale of interest of 300 feet which is closer to what the Ringold like material was evaluated at.<br>For monitoring well placement, proper selection of a representative transverse dispersivity is even more critical. Hydraulic conductivity influences the dispersivity ratio and the data indicate low and high extremes in hydraulic conductivity for the low-level waste management areas. A single transverse dispersivity for all cases does not seem appropriate, particularly in the case of the Hanford formation where hydraulic conductivities are on the order of 10 feet per minute. In such a case, a transverse dispersivity of 3 to 5 feet might be more appropriate.<br>Ecology Recommendation. Re-evaluate dispersivities. If necessary use more than one dispersivity value for modeling runs to reflect variations in site conditions. Due to the extreme sensitivity the model results would have on the selection of both lateral and transverse dispersivity, some type of tracer test should be run to further validate the model assumptions for typical sites around the project. | 4-26-91 |

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| | DOE-RL/WHC Response: Dispersivity values presented in the literature and estimated from existing plumes at the Hanford Site were re-evaluated, and detailed sensitivity studies were performed on both longitudinal and transverse dispersivities using the MEMO Model. The results of these studies will be added to the text. The monitoring efficiency was found to be sensitive to transverse dispersivity but relatively insensitive to longitudinal dispersivity. The data were evaluated at a scale of about 1,000 feet, which is considered appropriate because of the need to model plumes extending across the 500 feet wide buffer zone and well back into the low-level waste management area. The dispersivity data show wide ranges, from which conservative values were selected for use in the model. Emphasis was given to transverse dispersivities because of the demonstrated sensitivity to that parameter.<br><br>While the process of dispersion is velocity dependent, the dispersivity coefficients are material properties that depend only upon the heterogeneity of the material, and not upon the absolute magnitude of the hydraulic conductivity; see, for example, "Three-Dimensional Stochastic Analysis of Macrodispersion in Aquifers" by L. W. Gelhar and C. L. Axness (Water Resources Research, Vol. 19 No. 1, 1983), and "A Natural Gradient Experiment on Solute Transport in a Sand Aquifer, Spatial Variability of Hydraulic Conductivity and Its Role in *the Dispersion Process*" by E. A. Sudicky (Water Resources Research, Vol. 22 No. 13, 1986). While the geology of the 200 East and West Areas are somewhat different, there is no reason to believe that the heterogeneity of the areas differs significantly. As a result, because the scale of interest is the same for all of the low-level waste management areas, the same values for dispersivity coefficients were used for all sites.<br><br>Several existing plumes on the Hanford Site have been analyzed to estimate dispersivities, and the results will be summarized in the text. Performing a field tracer test to further validate the model assumptions is suggested in the comments but is not believed to be warranted for the purpose of supporting network design. A single test could not be demonstrated to be representative of all sites; several tests would need to be run to overcome this difficulty. Further, tracer testing is not a routine practice in the same sense as permeability testing, but is of a somewhat experimental nature. It is proposed instead to base the monitoring network design upon conservatively selected dispersivities from the literature and from analysis of existing plumes at the Hanford Site. | |

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| 71. | Page 5-94, lines 1 through 8 (5-40). The need for a buffer zone in the model is well explained but selection of a 500 foot width appears somewhat arbitrary. . .<br><br>Discussions with Golder Associates (Charles Wilson) indicate that there were no guidelines for buffer zone width designation. Guidelines they did see pertained mostly to urbanized areas. The remote location of the sites appears to have strongly influenced the selection of 500 feet as the zone width. Are there any objective criteria which can be used? What would a small buffer zone be? What would a large buffer zone be?<br><br>Ecology Recommendation. Elaborate on selection of a specific buffer zone width. Some backup references concerning this are in order, even if they pertain mostly to urban areas. This would at least give some feel for the numbers used at other sites. If objective criteria cannot be established, describe the benefit of using 500 foot width over larger or smaller widths (i.e., sensitivity analysis presented on page 5-98, lines 16 through 24, cost differences, etc.).<br><br>DOE-RL/WHC Response: The discussion of buffer zone width will be expanded in the text. Regulatory guidelines relating to the buffer zone concept have been discussed, and references to those guidelines have been included. In addition, several objective criteria are suggested for determining buffer zone widths, although not all may apply to any one site. A sensitivity analysis of monitoring efficiency to buffer zone width was conducted, and the results will be described in the text. The results indicate that the efficiency is not highly sensitive to buffer zone width. | 4-26-91 |
| 72. | Page 5-97, lines 21 through 25 (5-41). Northern wells are spaced farther apart because of angle of incidence. Because hydraulic conductivity is also highest in the north, transverse dispersivity will consequently be less, yielding a narrower plume.<br><br>Ecology Recommendation. Reconsider wider spacing of monitoring wells on the northern margin of LLWMA-1.<br><br>DOE-RL/WHC Response: Transverse dispersivity is a material property that is independent of the magnitude of hydraulic conductivity and groundwater flow velocity (see response to comment number 69). However, the process of dispersion, which governs lateral spreading in the Domenico and Robbins model (ignoring molecular diffusion) is dependent upon the magnitude of hydraulic conductivity and groundwater flow velocity. This process is adequately | 4-26-91 |

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| | represented in the MEMO Model. The width of the plume and the spacing of the northern wells of LLWMA-1 are, therefore, entirely appropriate. | |
| 73. | Page 5-98, lines 26 through 36 (5-42). Larger transverse dispersivity is less conservative given fixed well locations as in design presented. Sensitivity to changes in transverse dispersivity is reported low for high-efficiency levels and high for low-efficiency levels. How low is low?<br><br>Ecology Recommendation. Perform sensitivity analysis using a transverse dispersivity of 3 to 5 feet which would be representative of high hydraulic conductivities and result in lower efficiencies, indicating a given well spacing is less conservative.<br><br>DOE-RL/WHC Response: A sensitivity analysis of monitoring efficiency to transverse dispersivity will be conducted over the range of 1.75 to 17.5 feet, and a discussion of the results will be added to the text. | 4-26-91 |
| 74. | Page 5-100, lines 18 through 20 (5-43). The text states that the lower hydraulic gradient in the west-central part of the area suggests that the groundwater is crossing a band of lower conductivity material. Typically (everything else being equal), a lower hydraulic gradient is indicative of a higher hydraulic conductivity. Therefore, the text is confusing or erroneous. Which data supports the use of the efficiency model, the hydraulic gradient or the hydraulic conductivities?<br><br>Ecology Recommendation. Clarify or correct and relate to model application.<br><br>DOE-RL/WHC Response: This section of the text will be clarified. The original text erroneously referred to a lower, rather than a higher, hydraulic gradient in the central part of the low-level waste management area.<br><br>The MEMO Model depends only on the direction, and not the magnitude, of the hydraulic gradient, and does not depend upon the magnitude of hydraulic conductivity (see response to comment number 69). | 4-26-91 |

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| 75. | Page 5-104, lines 20 through 24 (5-44). A hydraulic conductivity of 0.6 feet per day (4 x 10-4 feet per minute) is not consistent with the sandy gravel depicted in Figure 5-19. This order of magnitude for hydraulic conductivity is characteristic of a very fine sand or silt.<br><br>Ecology Recommendation. Re-evaluate hydraulic conductivity for LLWMA-3, basic data or interpretation of aquifer tests may be in error or original lithologic descriptions may be in error.<br><br>DOE-RL/WHC Response: The values of hydraulic conductivity reported in the text were obtained from Last et al. (1989), in which hydraulic conductivity was estimated by dividing the transmissivity by the total saturated thickness of the aquifer. This was incorrect, since in most cases the wells were not screened over the total saturated thickness of the aquifer. Hydraulic conductivities have been recalculated by dividing the transmissivity obtained from the well tests by the total screen length of 10 feet. These new values will be reported in Sections 5.3.5.1.5 and 5.3.5.2.5. In some cases, the new values of hydraulic conductivity are more than two orders of magnitude larger than originally reported. | 4-26-91 |
| 76. | Pages 5-107 and 5-108, Figure 5-39 (5-45). Figure labeled incorrectly. Should be Area-3.<br><br>DOE-RL/WHC Response: The figure heading will be corrected. | 4-26-91 |
| 77. | Page 5-112, Section 5.5.2.1.9 (5-46). With the data and discussion presented, it is not possible to evaluate the adequacy of the base of aquifer monitoring program (deep wells).<br><br>Ecology Recommendation. Provide cross-sectional flow nets parallel to groundwater flow for each site and relationship of deep wells.<br><br>DOE-RL/WHC Response: Cross-sectional flow nets have been prepared at 1 foot contour intervals or less for the low-level waste management areas in the 200 West Area, where the thickness of the uppermost aquifer is about 200 feet and deep monitoring wells have been installed. These flow nets will be added to the text and are used with the MEMO Model results in monitoring network design. The thickness of the uppermost aquifer in the 200 East Area is sufficiently small that many monitoring wells penetrate the entire aquifer, and vertical flow nets for that area have not been prepared. | 4-26-91 |

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| 78. | Page 5-112, lines 40-43 (5-47). Section 5.5.2.1.9 discusses the need to monitor the deeper portion of the uppermost aquifer due to possible migration of dense contaminants to the bottom of the aquifer. It is stated that, "in view of these considerations, deep wells will be installed at each low-level waste management area to provide samples for upgradient and downgradient water quality analysis, but will not be configured to establish networks equivalent to those described for the shallow wells." This explanation regarding the network density for wells monitoring the deeper portion of the aquifer relative to wells monitoring the shallow portion of the aquifer is inadequate.<br><br>Ecology Recommendation. Provide a detailed explanation regarding the rationale for the network of wells monitoring the shallow portion of the aquifer and wells monitoring the deeper portion of the aquifer.<br><br>DOE-RL/WHC Response: Based on the quantities and disposal methods of metal salts and dense non-aqueous phase liquids, no significant potential for density driven transport exists at the low-level waste management areas. As a result, the number of deep wells is smaller than the number of shallow wells (see response to comment number 68). The text will be revised to explain the number of wells chosen to monitor the shallow and deeper sections of the aquifer. | 4-26-91 |
| 79. | Page 5-115, line 47 (5-48). Well Construction Standard citation not included in references.<br><br>DOE-RL/WHC Response: The WAC 173-160 Well Construction Standard will be added to the reference list. | 4-26-91 |
| 80. | Page 5-129, line 26 (5-49). Implements should be steamed cleaned after 6 and before 7.<br><br>DOE-RL/WHC Response: The type of groundwater sampling equipment addressed in this paragraph is usually not steam cleaned. The text will be changed to clarify that this discussion applies only to laboratory decontamination of groundwater sampling equipment. | 4-26-91 |
| 81. | Page 5-130, lines 44 through 51 (5-50). Section 5.5.3.2.1 states that, "For low-level waste management areas in which regulated units presently contain buried waste, background water quality conditions will be determined from monitoring wells located immediately hydraulically upgradient and within 100 feet of the boundary of the respective low-level waste management area." No explanation is given why 100 feet was chosen as the maximum distance an upgradient well will be situated at the monitored burial ground. | 4-26-91 |

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| | Ecology Recommendation. Provide a detailed explanation regarding the spacing of upgradient monitoring wells from the burial grounds.<br><br>DOE-RL/WHC Response: The text will be modified to clarify the rationale for locating upgradient wells. Generally, it will be necessary to locate upgradient wells relatively near the low-level waste management areas because of the close proximity of other potential sources of contamination. Such locations are also desirable in areas where groundwater flow directions are projected to change because of mound decay, and some upgradient wells may become downgradient wells. However, the text was not intended to imply that 100 feet is a limit that will be applied to all future upgradient wells. The text will be revised accordingly. | |
| 82. | Page 5-134, line 35 (5-51). Section 5.5.3.2.3 should include a discussion of quality control sample types and frequency.<br><br>DOE-RL/WHC Response: A discussion of quality control sample types and frequency will be added to the text. | 4-26-91 |
| 83. | Page 5-135 (5-52). Section 5.5.4.1.1 should discuss procedures used for decontamination of measurement devices between wells.<br><br>DOE-RL/WHC Response: A discussion of decontamination of water-level measurement devices between wells will be added to the text. | 4-26-91 |
| 84. | Page 5-136, lines 14 through 45 (5-53). Pump type selection is critical and should be detailed.<br><br>Ecology Recommendation. Describe pump type, manufacturer, and reason for selection.<br><br>DOE-RL/WHC Response: A discussion of the reasons for selecting the Hydrostar pump will be added to the text. The pump type and manufacturer have also been added to the text. | 4-26-91 |

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| 85. | Page 5-136, lines 21 through 24 (5-54). What is sampling procedure if stabilization of parameters does not occur after evacuation of two well volumes?<br><br>DOE-RL/WHC Response: A description of the procedure to follow, should parameters not stabilize after evacuation of two well volumes, will be added to the text. | 4-26-91 |
| 86. | Page 5-136, lines 33 through 34 (5-55). At least two volumes should be removed to evacuate annular space water in contact with casing volume.<br><br>DOE-RL/WHC Response: A description of the methods will be included in the Hanford Dangerous Waste Permit. The LLBG will cross reference the site-wide permit. | 4-26-91 |
| 87. | Page 5-138, lines 1 through 18 (5-56). Pump type selection is critical and should be detailed.<br><br>Ecology Recommendation. Describe pump type, manufacturer, and reason for selection.<br><br>DOE-RL/WHC Response: The criteria for selection of the pump type will be explained in Section 5.5.4.1.3. The pump type and manufacturer will also be added to the text. A reference to that section will be added to the text. | 4-26-91 |
| 88. | Page 5-138, line 46 (5-57). What methods will be used to monitor the 4°C temperature?<br><br>DOE-RL/WHC Response: A description of the methods will be included in the permit application. | 4-26-91 |
| 89. | Page 5-140, lines 32 and 33 (5-58). How will trip blanks be prepared? What media will be used for field and trip blanks - distilled, deionized, or carbon-free?<br><br>DOE-RL/WHC Response: A description of procedures for field-related quality control blank and duplicate samples will be provided in Section 5.5.3.2.3. This description will be modified to indicate the type of media to be used. A reference to that section will be added to the text. | 4-26-91 |

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| 90. | Page 5-140, line 31 (5-59). Analysis of another sample from the original sample volume is a replicate, not a duplicate.<br><br>**DOE-RL/WHC Response: A description of the methods will be included in the Hanford Dangerous Waste Permit. The LLBG will cross reference the site-wide permit.** | 4-26-91 |
| 91. | Page 5-148, lines 8 through 15 (5-60). This section outlines the DOE-RL actions in the event of determining a statistically significant increase in one or more parameters. However, the discussion omits immediate resampling as required under WAC 173-303-645(9)(h)(ii).<br><br>Ecology Recommendation. Include immediate resampling as the DOE-RL action or explain why resampling will not be performed.<br><br>**DOE-RL/WHC Response: Immediate resampling will be added to the text as a required action if a statistically significant increase is detected.** | 4-26-91 |
| 92. | Page 5-148, line 36 (5-61). Typo, "started" should be "stated".<br><br>**DOE-RL/WHC Response: Typo will be corrected.** | 4-26-91 |
| 93. | Page 5-151, lines 38 and 39 (5-62). Section 5.7 states that, "Characterization will provide concentrations of each constituent listed in WAC 173-303-9905 (Ecology 1989)..." Characterization should be conducted in compliance with 40 CFR 264, Appendix IX (EPA 1988).<br><br>Ecology Recommendation. Replace WAC 173-303-9905 with 40 CFR 264, Appendix IX (EPA 1988) in the above quoted sentence.<br><br>**DOE-RL/WHC Response: The citation will be changed in the text as suggested.** | 4-26-91 |
| 94. | Page APP 7A-1 through 7A-4 (7-1). Appendix 7A is a sample procedure for "clean up/recover radioactive material spills emergency procedures--low-level burial grounds. Submission of a sample procedure is inappropriate for this application.<br><br>Ecology Recommendation. The Applicant is required to submit an actual sampling procedure for clean up/recover radioactive spills emergency procedure for the low-level burial grounds permit application. | |

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| | **DOE-RL/WHC Response No. 1: A description of operations will be provided as required by WAC 173-303-806(4)(a)(viii). All 'sample' procedures and references to such will be removed from the permit application. This approach is consistent with that being used to finalize the 616 NRDWSF permit application.** | |
| | Comment: Appendix 7A, Sample Procedure, Page 7A-1 | |
| | In addition to the description of operations which will be provided, a statement must be made indicating the locations of the actual procedures. | |
| | **DOE-RL/WHC Response No. 2: Controlled copies of the procedures are kept in Building 272WA and in vehicles so that they are available at the work location. A statement will be included noting that these procedures will be available for on-site inspection by the regulators.** | |
| 95. | Page 8-9, Table 8-1, line 15 (8-1). This table indicates that Basic Crane and Rigging Training is not a required course for crane operators. Is this correct? If so, please provide an explanation why crane operators are not required to complete the course. | 4-26-91 |
| | **DOE-RL/WHC Response: The Basic Crane and Rigging Training is required for crane operators. Table 8-1 will be corrected to show that the training is required.** | |
| 96. | Page 9-12, lines 39 through 41 (9-1). Section 9.2.2.2 states, inter alia, that because of low precipitation, flat topography, and the lack of nearby surface water bodies, the risk of human exposure to LLBG waste through the surface water pathway is very low. Emphasis added. Characterizing any risk to human health as low without further quantification is not appropriate for a document of this type. | 4-26-91 |
| | Ecology Recommendation. Quantify the risk to human health of exposure to LLBG waste through the surface water pathway. | |
| | **DOE-RL/WHC Response: The EPA guidelines for preparing the Exposure Information Report state that the "EPA does not expect applicants to develop major, extensive new pieces of information..." Quantification of the risk to human health of exposure to LLBG waste would require developing new information that is beyond the scope of the EPA guidelines; therefore, the text will remain unmodified.** | |

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| 97. | Page 9-14, lines 37 and 38 (9-2). The same comment applies to the characterization of the risk to human health via the air pathway as for the surface water pathway.. .<br><br>Ecology Recommendation. Quantify the risk to human health of exposure to LLBG waste through the air pathway.<br><br>DOE-RL/WHC Response: The EPA guidelines for preparing the Exposure Information Report state that the "EPA does not expect applicants to develop major, extensive new pieces of information..." Quantification of the risk to human health of exposure to LLBG waste would require developing new information that is beyond the scope of the EPA guidelines; therefore, the text will remain unmodified. | 4-26-91 |
| 98. | Page 9-14, lines 1 and 2 (9-3). The same comment applies to the characterization of the risk to human health via soils as for the air and surface water pathways.<br><br>Ecology Recommendation. Quantify the risk to human health of exposure to LLBG waste through soils.<br><br>DOE-RL/WHC Response: The EPA guidelines for preparing the Exposure Information Report state that the "EPA does not expect applicants to develop major, extensive new pieces of information..." Quantification of the risk to human health of exposure to LLBG waste would require developing new information that is beyond the scope of the EPA guidelines; therefore, the text will remain unmodified. | 4-26-91 |
| 99. | Page 9-17, lines 26 through 28 (9-4). The same comment applies to the characterization of the risk to human health via transportation-related releases as for air, surface water, and soil pathways.<br><br>Ecology Recommendation. Quantify the risk to human health of exposure to LLBG waste via transportation-related releases.<br><br>DOE-RL/WHC Response: The EPA guidelines for preparing the Exposure Information Report state that the "EPA does not expect applicants to develop major, extensive new pieces of information..." Quantification of the risk to human health of exposure to LLBG waste would require developing new information that is beyond the scope of the EPA guidelines; therefore, the text will remain unmodified. | 4-26-91 |

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| 100. | Page 11-2, Section 11.1 (11-1). The fourth paragraph indicates burial ground 218-E-12B is to be a RCRA compliant facility.<br><br>Ecology Recommendation. Until an exemption is approved with regard to lining of particular trenches within the LLBG, the LLBG is not considered a RCRA compliant facility.<br><br>DOE-RL/WHC Response: The purpose of the application is to receive a Part B permit for the Low-Level Burial Grounds as a RCRA disposal facility. When this permit and any necessary exemptions are granted, the Low-Level Burial Grounds will indeed be a RCRA compliant facility. The statement is made in this context.<br><br>In light of this, the text in lines 27 and 28 of page 11-2 will be modified with the following or similar text:<br><br>"Landfills for future disposal of low-level mixed waste are required to comply with RCRA standards and are proposed in burial grounds 218-W-5 (lined landfill) and 218-E-12B (trench 94 extension)". | 4-26-91 |
| 101. | Pages 11-15 and 11-16, Figure 11-7 (11-2). The identification of trench numbers 20, 24, and 29 is not shown on the legend.<br><br>Ecology Recommendation. The figure should be revised as appropriate.<br><br>DOE-RL/WHC Response: These trenches are identified in the legend, but the identification appears to be misleading because only the outline of the trench bottom is black instead of the entire bottom. This will be changed to make the identification of this type trench in the figure clearer. | 4-26-91 |
| 102. | Page 11-22, Section 11.1.2 (11-3). This paragraph states that following retrieval of the transuranic and radioactive organic liquid waste, native soils lying beneath the existing unlined trenches that may have been contaminated by waste or waste residues will be left in place. It is proposed that the trenches will be closed in compliance with the closure requirements of WAC 173-303. After retrieval of the transuranic and radioactive organic liquid waste and closure under WAC 173-303, it is possible that the trenches will be reused for the burial of stabilized low-level waste. | |

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| | Ecology Recommendation. Following retrieval of wastes that are regulated by Ecology, the trenches may have to be certified closed before reuse for the disposal of low-level waste or any other waste. The closure performance standards required that all contaminated soils be cleaned to background levels [WAC 173-303-610(2)(b)(i)]. The conditions under which the trenches may be reused should be more clearly defined.<br><br>DOE-RL/WHC Response No. 1: It seems that Ecology's interpretation of the closure of a trench and the closure of a landfill is two separate issues. Individual trenches remain part of the LLBG regardless of whether the waste in those trenches has been moved, retrieved, or replaced. Closure requirements for the LLBG are defined in WAC 173-303-665(6)(b), "a landfill must comply with all postclosure requirements contained in WAC 173-303-610(7), (8), (9), and (10)". There are no requirements in these sections which discuss cleanup levels for soils. Therefore, there are no closure performance standards for a landfill which require that contaminated soils be cleaned to background levels or to designated limits. The WAC 173-303-610(2)(b)(i) and (ii), do not apply to the closure of a landfill.<br><br>To assist in clarifying the WAC requirements which must be met for closure of the LLBG, the text will be modified to cite closure under WAC 173-303-665.<br><br>Deficiency: Section 11.1.1.2, Removal or Decontamination, Page 11-22<br><br>After the waste is retrieved from a trench, any further use of that trench would be considered replacement and would therefore be subject to double liner requirements. Furthermore, it would not be prudent to leave uncontainerized, contaminated soil in place when it can easily be identified and removed. The identification of soil contamination, if any, would also provide valuable insight into the potential extent of contamination beneath other trenches as well as other disposal sites at the Hanford Reservation.<br><br>Requirement: After waste retrieval, soil sampling must be conducted. The results of this sampling will determine any further actions to be taken and future use of the trench. The permit application must contain a generalized sampling plan for this situation. A detailed sampling plan need not be developed until the soil beneath the retrievable waste is visually inspected.<br><br>DOE-RL/WHC Response No. 2: The text will be modified to present a general soil sampling plan for extremely hazardous waste (EHW) in trenches where such waste has been retrieved. Details | |

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of the sampling program, such as depth, locations, and methods, will depend on a number of factors, including trench geometry, age of the waste, and type of waste. Detailed sampling plans for a particular trench or portion thereof will be prepared after the waste has been retrieved and the constituents verified. On the basis of sampling and testing results, further requirements (if any) for reusing the trench will be identified.

103. Page 11-25, Section 11.1.4.1 (11-4). It is noted that in the third and fourth storage configurations (containing retrievable transuranic waste) have not been covered since 1987 and will continue to be that way for the next 10 years. It appears that the containers are left exposed to ambient atmospheric conditions for long periods making them more susceptible to degradation and eventual leakage.

Ecology Recommendation. The Applicant should provide some discussion of measures that have been taken to protect the containers from the weather. If measures have not been taken to date, the possibility of a temporary cover that will serve to protect the waste containers for the next 10 years should be explored and discussed.

DOE-RL/WHC Response No. 1: In a desert climate, such as is present on the Hanford Site, the relative humidity is low and metal surfaces do not corrode rapidly in the open atmosphere. The text will be revised to include a discussion of this 'as is' option as well as soil covering or temporary cover options. The text will provide supporting rationale for the preferred option.

Deficiency: Section 11.1.4.1, Retrievably Stored TRU Waste, Page 11-25

The response is erroneous. The Central Waste Complex has experienced the corrosion of drums stored on exposed pads for periods far less than 10 years. Furthermore, it is not acceptable to only state that the text will be revised.

Requirement: Either retract the first sentence of the response or expand the response to discuss the reality of storing containerized dangerous waste in a semiarid climate. In addition, provide the revised test as part of this response.

DOE-RL/WHC Response No. 2: The reviewer's understanding of the 183H Basin waste problem is incorrect. The drums corroded from the inside out due to improper packaging methods. Many of the presently uncovered waste containers will be retrieved, repackaged, and transferred to

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| | a permitted storage facility in the Central Waste Complex within a year's time period. The concept of providing weather protection for the remaining uncovered mixed-waste containers in the trenches is being discussed. Alternatives under consideration include some type of roof cover and a plastic tarp covered with soil as was used previously. Because this waste is to be retrieved in the future, the method of protection should not unduly hinder the retrieval operation. Current plans call for transferring the uncovered containers of transuranic waste from the trenches to a permitted storage building when space becomes available. It is anticipated that this transfer will be initiated within two years. In addition, an engineering evaluation will be performed during FY 1992 to determine if a cover should be placed over the uncovered waste in the interim. The last sentence of the fourth paragraph will be deleted and replaced with the following statements: "Uncovered waste will be transferred to a permitted storage building at the Central Waste Complex or the 224T Transuranic Waste Storage and Assay Facility when space becomes available. The feasibility of providing a cover over this waste in the interim will be determined in 1992." | |
| 104. | Page 11-27, lines 39 through 43 (11-4). Section 11.1.4.5 states that decontaminated equipment and structures will be disposed of in accordance with requirements of the U.S. Department of Energy and WAC 173-303 (Ecology 1989). The cite to the Washington Administrative Code is incomplete.<br><br>Ecology Recommendation. Include the complete cite to WAC 173-303 for disposal of decontaminated structures and equipment.<br><br>DOE-RL/WHC Response: The text will be modified to cite WAC 173-303-665. | 4-26-91 |
| 105. | Page 11-28, Section 11.1.4.5 (11-5). The last paragraph indicates that contaminated native soils, if any, lying beneath the retrievable trenches will not be removed as part of closure operations.<br><br>Ecology Recommendation. The Applicant should provide some discussion of measures that have been taken to protect the containers from the weather. If measures have not been taken to date, the possibility of a temporary cover that will serve to protect the waste containers for the next 10 years should be explored and discussed.<br><br>DOE-RL/WHC Response No. 1: It seems that Ecology's interpretation of the closure of a trench and the closure of a landfill is two separate issues. Individual trenches remain part of the | |

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| | LLBG regardless of whether the waste in those trenches has been moved, retrieved, or replaced. Closure requirements for the LLBG are defined in WAC 173-303-665(6)(b), "a landfill must comply with all postclosure requirements contained in WAC 173-303-610(7), (8), (9), and (10)". There are no requirements in these sections which discuss cleanup levels for soils. Therefore, there are no closure performance standards for a landfill which require that contaminated soils be cleaned to background levels or to designated limits. The WAC 173-303-610(2)(b)(i) and (ii), do not apply to the closure of a landfill.<br><br>To assist in clarifying the WAC requirements which must be met for closure of the LLBG, the text will be modified to cite closure under WAC 173-303-665.<br><br>Comment: Section 11.1.4.5, Decon and Disposal Procedures, Page 11-28<br><br>Ecology's concern in this comment is not so much whether soil sampling should occur as discussed in comment 102, but a reiteration of the concern raised in comment 103. In other words, what steps have and will be taken to prevent the soil contamination in the first place? The response to this comment need only note that this section will reflect any text changes resulting from the resolution of comments 102 and 103.<br><br>DOE-RL/WHC Response No-2: As noted in the response to comment 103, the uncovered transuranic waste is to be transferred to a permitted storage building when space becomes available. In addition, an engineering evaluation will be performed in 1992 to determine the feasibility of putting a temporary cover over the waste during the interim. | |
| 106. | Page 11-29, Section 11.1.5.2.1 (11-6). The cover will be sloped at a grade of 1.5 percent. This proposed slope is below the 3 percent slope recommended in the EPA technical guidance document entitled, "Final Covers on Hazardous Waste Landfills" (EPA/530-SW-89-047).<br><br>Ecology Recommendation. The Applicant should demonstrate that the proposed slope is sufficient to drain the surface water flows and accommodate projected subsidence. | |

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| | DOE-RL/WHC Response No. 1: The necessary calculations have already been performed to evaluate the covers ability to adequately handle precipitation and other surface water flows. Ecology is directed to Appendices 11-A, B, C, and D. Further demonstration of design adequacy is presented in the response to comment 109.<br><br>Subsidence is not considered to be an issue of concern at the LLBG. Ecology is directed to Section 11.2.1.3 for a discussion on subsidence.<br><br>Deficiency: Section 11.1.5.2.1, General Description, Page 11-29<br><br>Although the calculations support the use of a 1.5% slope, a 3.0% slope would provide for unanticipated settlement/subsidence as well as meet the recommended guidance.<br><br>Requirement: All final cover slopes must be no shallower than 3.0%. This grade must not vary more than 1/10 of a foot in 16 feet.<br><br>DOE-RL/WHC Response No. 2: Final covers will be sloped at a minimum grade of 3%. | |
| 107. | Page 11-48, Section 11.1.5.2.2 (11-7). The third paragraph of this section indicates that the grade layer will be placed in 18- to 24-inch-thick lifts in most areas of the LLBG to a compaction of 95 percent or as high as is reasonably achievable.<br><br>Ecology Recommendation. The proposed lift of 18- to 24-inch-thick lifts appear to be too thick to achieve the compaction limits of 95 percent density. Loose lifts of up to 12 inches should be used in order to achieve a more uniform compaction throughout the depth of the grade layer.<br><br>DOE-RL/WHC Response No. 1: Observations indicate that some of the potential grade layer material is quite coarse, containing a large fraction of cobbles. Experience indicates that this type of material can be placed in relatively thick lifts and compacted satisfactorily. However, it may be premature to specify a lift thickness at this time, even if only as an example. The text will be modified to delete reference to specific lift thickness and will note that the optimum lift thickness will be determined by constructing a test pad. | |

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| | Deficiency: Section 11.1.5.2.2.1, Native Soil Grade Layer, Page 11-48<br><br>It is typical construction practice to place soil in 6 - 8 inch lifts when compaction or permeability are critical factors. Evaluating lift depths of up to 2 feet would only encumber the test pad evaluation.<br><br>Requirement: All soil and soil mixtures must be placed per the accepted practice of 6 - 8 inch lifts.<br><br>**DOE-RL/WHC Response No. 2: The soil available for the grade layer may have coarse material up to 12 inches in dimension. Placing such material in thin lifts would be counterproductive, as the roller would ride on the larger material and not effectively compact the finer grained matrix. Were this a normal fine-grained fill, lift thicknesses of 6 to 8 inches would be appropriate. While permeability is not a design consideration for the grade layer, we agree that compaction is important. Evaluation of compaction as part of the test pad construction may be slightly cumbersome, but is required and will be performed.** | |
| 108. | Page 11-48, Section 11.1.5.2.2 (11-8). It is proposed that the compaction of the grade layer will be accomplished with a 20-ton dead weight or drum vibratory roller.<br><br>Ecology Recommendation. The bearing capacities of the underlying cover material and waste containers should be determined to ensure that they can withstand the loads imposed by the 20-ton or greater weight drums vibratory roller and prevent any damage to the waste containers or the liner and leachate collection systems. The use of lifts of lesser thickness may allow adequate completion to be accomplished with lower weight roller sand limit the potential for such damage.<br><br>**DOE-RL/WHC Response: This is a valid concern for structures with geosynthetics and should be addressed prior to closure when the waste characteristics and geometry are known. Text on page 11-48 will be modified to address this concern.** | 4-26-91 |
| 109. | Page 11-52, Section 11.1.5.2.2.6 (11-9). No mention is made of the slope of the drainage layer.<br><br>Ecology Recommendation. The EPA RCRA cover technical guidance document recommends a drainage layer with a minimum slope of 3 percent after settlement and subsidence. | |

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| | DOE-RL/WHC Response No. 1: The drainage layer will be sloped at 1.5 percent, the same as the other layers. However, the issue primarily relates to the performance of the drainage layer with the use of a 1.5 percent slope. The EPA technical guidance at the time of the LLBG cover design (EPA, 1982) recommended final slopes of 3 to 5 percent. However, slopes outside of this range have been approved for other hazardous waste facilities if adequate performance could be demonstrated. It appears that the EPA implicitly recognizes this in their latest guidance document for closure covers (EPA, 1989), which states:<br><br>"In arid regions...it may be possible to construct a top layer that will absorb most, if not all, of the precipitation that infiltrates into that layer, eliminating the need for a drainage layer."<br><br>Consequently, if the drainage layer is not required, then its slope is no longer a significant issue.<br><br>To investigate this design approach, a series of supplemental HELP (Hydrological Evaluation of Landfill Performance) analyses were performed. The same parameters as in Appendix 11A of the application were used, except that the slope angle and drainage path length were varied.<br><br>HELP version 2.04 was used instead of version 2.02, which was used for the original analysis. Daily precipitation data from 1979 through 1988 from the Hanford Meteorological Station were used in all cases. The results are summarized in the attached Table 1.<br><br>Case 1 is the analysis presently contained in Appendix 11A, which was performed using version 2.02. Case 2 uses the same parameters with version 2.04. It may be seen that version 2.04 predicts slightly less evapotranspiration and slightly more flow through the drainage layer than does version 2.02. The difference is not considered significant. Cases 3 through 5 show the effect of increasing the cover slope from 0 to 5 percent. Case 6 shows the effect of a reduced drainage path length.<br><br>It may be seen that the amount of lateral drainage increases with steeper cover slopes and reduced path length, as might be intuitively expected. However, the amount of percolation through the cover into the waste remains the same in all cases. This supports the EPA approach in that the contribution of the drainage layer to cover performance appears to be negligible at an arid site. This analysis indicates that a flat cover and a 5 percent sloped cover would perform equally well at the Hanford Site. | |

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The advantages of a flatter cover relate primarily to (1) less water erosion, which is a major consideration on such large covers, and (2) less material required for the grade layer, which will reduce the cost.

This type of study should of course be repeated during final cover design, and should incorporate both the current EPA guidance and specific parameters for the cover soils and other components.

Table 1. Supplemental HELP Model Results.

| Parameter | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|---|---|---|---|---|---|---|
| HELP Version | 2.02 | 2.04 | 2.04 | 2.04 | 2.04 | 2.04 |
| Drainage layer slope % | 1.5 | 1.5 | 0 | 3 | 5 | 1.5 |
| Length of layer, ft | 725 | 725 | 725 | 725 | 725 | 200 |
| Average Annual: (inches) | | | | | | |
| Precipitation | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 |
| Run-off | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| Evapotranspiration | 6.782 | 6.684 | 6.684 | 6.684 | 6.684 | 6.684 |
| Lateral drainage | 0.3785 | 0.4174 | 0.1041 | 0.4291 | 0.4309 | 0.4311 |
| Percolation | 0.0011 | 0.0011 | 0.0011 | 0.0011 | 0.0011 | 0.0011 |
| Change in storage | -0.079 | -0.020 | 0.293 | -0.032 | -0.034 | -0.034 |

The text will be changed to identify the slope of the drainage layer.

References:

EPA, 1982, *RCRA (Resource Conservation and Recovery Act) Guidance Document: Landfill Design, Liner Systems and Final Cover*, PB87-157657, National Technical Information Service, Springfield, Virginia.

EPA, 1989, *Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments*, EPA/530-SW-89-047, Office of Solid Waste and Emergency Response, Washington, D.C., July

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| | Comment: Section 11.1.5.2.2.6, Drainage Layer, Page 11-52<br><br>Comment 106 also applies here.<br><br>DOE-RL/WHC Response No. 2: The drainage layer will be sloped at 3%, the same as the other layers. See response to Comment 106. | |
| 110. | Page 11-64, Section 11.1.5.5.5 (11-10). The results of wind erosion analysis indicates a net loss of 3.5 tons of cover soil per year. This amount of soil is greater than the EPA recommended value of 2 tons per year.<br><br>Ecology Recommendation. Discussion of alternative measures to reduce the total erosion due to wind and surface water should be provided here and specifically addressed in the detailed design.<br><br>DOE-RL/WHC Response: The need to revise the cover wind erosion section (Appendix 11F), due to subsequent work done in this area on cover designs for the Hanford Site, is recognized. The revised text will address such information as specific McGee Ranch soil physical property analysis that was not available at the time of submitting the permit application and information on the crusting properties of soil. If this additional information does not indicate a reduction of the erosion levels to EPA guidance levels, then a more in depth discussion will be added to the text that will explain why the erosion levels are not a point of concern and/or discussion of alternative measures proposed to achieve this level. | 4-26-91 |
| 111. | Page 11-64, Section 11.1.5.5.5 (11-11). The total erosion (sum of net cover water and wind erosion) is 4.3 tons of cover soil per acre per year. This exceeds the EPA recommended limit of 2 tons per acre per year.<br><br>Ecology Recommendation. Discussion of alternative measures to reduce the total erosion due to wind and surface water should be provided here and specifically addressed in the detailed design.<br><br>DOE-RL/WHC Response: The main contribution to total erosion is wind erosion. As stated in response 110, this section will be revised. The concern that Ecology raises here will be dealt with in the revised text described in the response to Comment 110. | 4-26-91 |

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| 112. | Page 11-66, Section 11.1.5.6 (11-12). Two of the techniques proposed for correction of existing subsidence problems in inactive trenches prior to placement of final cover are mass impact (pounding of the ground using a weight of up to 30 tons dropped from a height of 65 feet) and dynamic consolidation (hammering or vibrating a beam or pile into the ground).<br><br>Ecology Recommendation. Both methods have the potential for producing or increasing damage to previously disposed of wastes or waste containers and thereby increasing the potential for leakage or leaching. The bearing capacities of underlying waste containers, cover, and other materials should be determined to ensure that they can withstand the stresses due to mass impact and dynamic consolidation and prevent any supplemental damage that might increase the potential for emissions. Alternative approaches for providing the necessary ground improvement to support the final cover loads and minimize cover settlement should be considered, or more adequate assessment of the potential for increased leakage or leaching provided.<br><br>DOE-RL/WHC Response: This NOD suggests that dynamic consolidation will damage waste or waste containers, and thereby increase the potential for leakage or leaching. Furthermore, the NOD suggests that the purpose of dynamic consolidation is for support of static loads imparted by the surface (at grade) cover and for minimization of cover settlement.<br><br>The initial premise of unintentional damaging of waste and waste containers, relative to solid waste burial grounds may not be correct. Solid waste typically consists of contaminated miscellaneous metallic, cellulose based, or mineralogic materials transported and discharged to burial trenches in bulk transport packaging, Little, if any, intent was given to disposal of waste materials in high integrity containers or equivalent packages. Additionally, most waste transport packages used have a nominal expected integrity when buried. Hence, one may assume that most packages and containers, will have presently degraded, or will degrade within a few decades.<br><br>Structural collapse of waste materials and containers has occurred at most burial grounds as manifested by moderate to large subsidence features. This provides evidence as to the present failure of waste and waste containers under ambient conditions. It is indeed the intent of dynamic consolidation to cause "damage" to waste and waste containers. Dynamic consolidation causes compaction of waste under controlled conditions. Past field demonstration activities have shown that greater than 90 percent of potential waste volume reduction can be imparted by dynamic consolidating in situ with negligible health and safety | 4-26-91 |

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| | concerns. Without dynamic consolidation, or equivalent in situ treatment, structural failure of surface engineered barriers overlying buried solid waste trenches is probable and could prove to be compromising to the life of the cover system.<br><br>The text will be modified to clarify the purpose of the waste consolidation efforts. | |
| 113. | Page 12-14, lines 44 through 46 (12-1). Section 12.4.1.8.2 states, "(c) The future use of the above described land is restricted under terms of 40 CFR 264.117(c) and WAC 173-303-61-(7)(d). The reference to the Washington Administrative Code is a misprint. The correct cite is WAC 173-303-610(7)(d).<br><br>DOE-RL/WHC Response: The citation will be corrected. | 4-26-91 |
| 114. | Pages APP 4A-17 through 4A-44 (Volume 5). Under the "Toxic Name" column on each of these pages are listed the various constituents placed in the trenches. In the T50 trench lead, oil, beryllium, zirconium, and "carcinogens" are listed. In the T10 trench, as noted on page APP 4A-44, lead, lead shielding, lead pipes, oil, "carcinogens", mercury, and charcoal are listed. The use of the term "carcinogens" is too vague.<br><br>Ecology Recommendation. Replace "carcinogens" with the specific form of carcinogen (e.g., asbestos insulation).<br><br>DOE-RL/WHC Response No. 1: A better description of "carcinogens" is not available because it was not recorded on the old records. The best information available has been provided in the permit application and in the "LLBG Database" (WHC-MR-0008).<br><br>Comment: Appendix 4A, List of Mixed Waste<br><br>The fact that "carcinogens" cannot be more specifically defined should be stated in the Chapter 4 text where this appendix is referenced.<br><br>DOE-RL/WHC Response No. 2: The following statement will be added to 4.6.1: "Some older type waste was not well characterized at the time it was emplaced (e.g., waste listed as 'carcinogens'). This waste is identified to the extent possible with the available information." | |

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| 115. | Deficiency: Part A Permit Application, Page Part A-iii<br><br>It is inappropriate to dismiss a dangerous waste designation simply because certain tests have not been conducted. Unless toxicity testing proves otherwise, all elemental lead (whether used as shielding or not) must be designated as D008 as well as WT01. Designation of elemental lead as D008 is recognized in the liner exemption request (page 2-3).<br><br>Requirement: Any lead disposed of at the LLBG or elsewhere on the reservation must be designated as WT01 and D008. This correction needs to be made throughout the text. Furthermore, TCLP testing should be cited instead of EP Toxicity testing.<br><br>**DOE-RL/WHC Response: Revision 5 of the LLBG Part A permit application, which was included with the Part B permit application (Revision 0), did not include the D008 designation for all waste lead. Revision 6 of the LLBG Part A permit application now designates all waste lead as D008. The text in the Part A will be revised to designate waste containing radioactive elemental lead waste solids as 'WT01 and D008'. The text will also be revised to indicate that the Toxicity Characteristic Leaching Procedure (TCLP) has replaced the Extraction Procedure (EP) toxicity test for determining the characteristics of toxicity.** | |
| 116. | Deficiency: Part A Permit Application<br><br>The drawings provided in the Part A application, duplicated from Figures 2-7 through 2-14 of the Part B application, are illegible and therefore unacceptable. Furthermore, these drawings do not identify which trenches contain mixed waste.<br><br>Requirement: Legible drawings must be provided and must identify which trenches contain mixed waste.<br><br>**DOE-RL/WHC Response: Legible drawings that identify the mixed waste trenches will be provided.** | |
| 117. | Deficiency: Section 2.1.1, Hanford Site, Page 2-3<br><br>It is not clear what is meant by "Heads of field documents" as used on lines 47 and 48. | |

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| | Requirement: Please clarify the text. | |
| | **DOE-RL/WHC Response: The text will be replaced with "Heads of Field Elements" to agree with DOE Order 5820.2A.** | |
| 118. | Deficiency: Section 2.1.1, Hanford Site, Page 2-4 | |
| | The definition of mixed wastes on lines 6-8 is inadequate because it does not include radioactive waste containing dangerous constituents not regulated by RCRA. | |
| | Requirement: Although DOE Order 5820.2A may not take into account state laws and regulations, the text must be edited to indicate that mixed waste at the Hanford Reservation includes waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Hazardous Waste Management Act. RCW 70.105.109 | |
| | **DOE-RL/WHC Response: The text will be changed to define mixed waste as: "Waste containing both radioactive components as defined by the *Atomic Energy Act*, and hazardous components as defined by RCRA, including state implementation of RCRA."** | |
| 119. | Comment: Section 2.1.1, Hanford Site, Page 2-4 | |
| | The regulation of radionuclides will be addressed in the facility wide permit. Delete the sentence beginning on line 12. | |
| | **DOE-RL/WHC Response: Radionuclides are not regulated under RCW 70.105.109 because the Federal Government has not delegated this authority to the State; therefore this statement is correct.** | |
| 120. | Deficiency: Section 2.1.2.1, Past Practices, Page 2-6 | |
| | It is not clear in the last paragraph of this page and the first paragraph of page 2-11 if liquid waste (whether mixed waste or not) with a dose rate greater than 200 millirem per hour is still being placed in the trenches. Liquid dangerous/mixed waste can no longer be land disposed per WAC 173-303-140. | |

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| | Requirement: The discussion must indicate what type of liquid wastes, if any, have been or continue to be disposed of or stored in the trenches since November 23, 1987.. | |
| | **DOE-RL/WHC Response: The following sentence will be added on page 2-6, line 51: "Liquid mixed waste is no longer accepted for storage."** | |
| 121. | Deficiency: Section 2.1.2.1, Past Practices, Page 2-11 | |
| | The fire retardant that was used on the plywood may contain dangerous constituents which could eventually leach out of the burial ground. The text does not indicate if this possibility has been considerec. | |
| | Requirement: The text should specify what type of fire retardant was and currently is used on the plywood within the burial grounds. A discussion should also be presented on the leaching potential of this material. | |
| | **DOE-RL/WHC Response: The fire retardant type is being investigated and will be fully explained in the text.** | |
| 122. | Deficiency: Section 2.1.2.1, Past Practices, Page 2-11 | |
| | Although trenches which received mixed waste and discontinued operation prior to November 23, 1987 are not subject to permitting under WAC 173-303, they are subject to the Hazardous and Solid Waste Amendments (HSWA) to RCRA. | |
| | Requirement: The application must incorporate the above text. In addition, the term "were backfilled" on line 31 should be replaced with "discontinued operation." | |
| | **DOE-RL/WHC Response: There is no question the mixed waste is subject to the Hazardous and Solid Waste Amendments (HSWA); however, HSWA did not change the definition of the existing portion of a landfill. Mixed waste has been accepted, with Ecology's notification, in the open trenches beyond that which was there on November 23, 1987; therefore, the definition of the existing portion of the landfill has had implicit concurrence by Ecology. The text in section 2.1.2.1 on page 2-11, beginning on line 31, will be changed as follows: "Trenches that received mixed waste and were backfilled before the effective date of regulation of mixed waste are not subject to regulation as permitted treatment, storage, and/or disposal** | |

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| | units under WAC 173-303 (Ecology 1991), although the requirements of the (HSWA) to RCRA will apply." | |
| 123. | Deficiency: Section 2.1.2.1, Past Practices, Page 2-11<br><br>Trenches which were constructed prior to November 23, 1987 but did not receive mixed waste until after November 23, 1987 are not considered existing units and therefore are not exempt from the liner requirements. Therefore, some "unfilled" trenches may be subject to the liner requirements.<br><br>Requirement: Edit the last sentence of this section to read "The existing units include trenches which received mixed waste and were constructed prior to November 23, 1987."<br><br>DOE-RL/WHC Response: The last sentence in section 2.1.2.1 will be changed as follows: "The existing units include trenches which received mixed waste and were constructed before November 23, 1987." | |
| 124. | Deficiency: Section 2.1.2.3, Closure, Page 2-22<br><br>The distinctions drawn between the types of trenches are important to determine the applicable regulations. Although Appendix 4B aids in the identification of how each trench is classified, there is no visual aid to illustrate the locational relationship of each type of trench.<br><br>Requirement: New figures should be provided or Figures 2-7 through 2-14 should be elaborated to distinguish the types of trenches within each burial ground (see comment 116).<br><br>DOE-RL/WHC Response: New figures will be provided that indicate which trenches contain mixed waste. | |
| 125. | Comment: Figure 2-7, Burial Ground, Page 2-25/2-26<br><br>Typo. The proper identification number for this burial ground is "218-W-3A", not "218-2-3A". Please correct.<br><br>DOE-RL/WHC Response: The number will be corrected. | |

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| 126. | Deficiency: Section 2.5.1, Measures to Prevent Degradation, Page 2-53<br><br>It is not clear if the discussion in this section on liquids in the trenches refers only to mixed waste placed prior to November 23, 1987. See comment 120.<br><br>Requirement: The text should be clarified to indicate what, if any, liquid waste has been disposed in the trenches after November 23, 1987.<br><br>DOE-RL/WHC Response: The following statement will be added to second paragraph: "No liquid waste has been placed in the trenches since November 23, 1987." | |
| 127. | Comment: Section 3.1, Chem, Biol and Phys Analysis, Page 3-2<br><br>Waste analysis procedures for the Hanford Site are under development through the facility wide permit negotiations. The specific requirements for waste verification prior to disposal at the LLBG will be addressed upon resolution of this issue.<br><br>DOE-RL/WHC Response: The following paragraph will be added to section 3.0, beginning on line 20: "Unit particular waste analysis plans are being developed through the Hanford Facility Permit negotiations. As part of this effort, specific sampling and analysis strategies will be prepared for any waste received for disposal or storage." | |
| 128. | Deficiency: Section 3.1.2, Containerized Waste, Page 3-4<br><br>The text states that the mixed waste disposed at the LLBG is packaged "to ensure isolation from the environment for 20 years". It is unacceptable to only design for 20 year isolation.<br><br>Requirement: It is Ecology's understanding that USDOE policy requires mixed waste disposal practices to isolate mixed waste for much greater periods of time, in some cases up to 10,000 years. Provide additional discussion in the application defending the 20 year time period in relation to both USDOE policy and dangerous waste closure performance standards.<br><br>DOE-RL/WHC Response: Most waste drums have a design life of 10 years; the drums used on site have a higher design standard of 20 years. This requirement is consistent with the intent to retrieve waste from the LLBG within this time period (Section 3.1, page 3-2, line 19). The DOE requirements for long term isolation will not depend upon waste container | |

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| | design life. Other barriers are to be employed to prevent intrusion and exposure, such as the construction of thick, impervious covers over the trenches. The precise specifications for these barriers have not yet been finalized; however, the requirements of DOE Order 5820.2A, and the soon to be completed performance assessment, will be used to establish these criteria. The date for completion of the Performance assessment is not yet determined.<br><br>To clarify these issues the text in section 3.1.2 will be revised as follows:<br><br>"Under current operating conditions, mixed wastes stored at the LLBG is packaged to maintain containment and retrieval capability of the waste for up to 20 years. The mixed waste stored in open trenches will be moved into permitted storage buildings at the Central Waste Complex when space becomes available. Buried mixed waste in retrievable storage will be retrieved for subsequent processing at the proposed Waste Receiving and Processing Facility. Chapter 4.0, Section 4.1.1 provides details of the waste container system. | |
| 129. | Deficiency: Section 3.1.5, Landfilled Wastes, Page 3-5<br><br>The definition of free liquid given on lines 1 and 2 is not consistent with the dangerous waste regulations.<br><br>Requirement: The definition of free liquids should reference the Paint Filter Liquids Test as described in SW-846. WAC 173-303-140(4)(b)<br><br>DOE-RL/WHC Response: Consistent with 40 CFR 260.10 and WAC 173-303-140, the definition of free liquid will be revised as follows: "liquids which readily separate from the solid portion of a waste under ambient temperature and pressure. For containerized or bulk waste, the absence or presence of free liquids is demonstrated by the Paint Filter Liquids Test." | |
| 130. | Comment: Section 3.2, Waste Analysis Plan, Page 3-6<br><br>Comment 127 also applies here.<br><br>DOE-RL/WHC Response: The issues will be addressed by adding to Section 3.0 the new paragraph shown in the response to comment 127. | |

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| 131. | Comment: Section 3.2.3, Waste Shipment, Inspection, Page 3-7<br><br>Comment 127 also applies here.<br><br>DOE-RL/WHC Response: The issues will be addressed by adding to Section 3.0 the new paragraph shown in the response to comment 127. | |
| 132. | Comment: Section 3.2.4, Generator Oversight, Page 3-8<br><br>How long has the generator assessment program been used? How many noncompliant waste packages have been identified through this program? The application should describe who the "waste certification review committee" is, how often they meet, what criteria they use, etc.<br><br>DOE-RL/WHC Response: The assessment program has been replaced by a full audit and surveillance program for non-naval reactor (NR) generators. The audit program has been in effect for three years. The exact number of noncompliant waste packages identified through the program is estimated to be less than 800.<br><br>As a result of these changes to the audit program, the waste certification review committee has been replaced by the audit team. The audit team will consist of at least two engineers from Solid Waste and one engineer from Quality Assurance. A description of the revised program will be incorporated into Chapter 3.<br><br>Public Law 98-525 Section 1634 gives NR special considerations regarding disposal of their components. NR has exercised their authority in regard to this law and DOE-RL has been directed to use an information exchange program in lieu of an audit. The information exchanges will be performed by the same personnel as audits and will complete the same audit checklist. Generators who are not satisfactory, as measured by the checklist, will not be authorized to ship to Hanford. A description of the program will be incorporated into Chapter 3. The end result is that all generators will be treated the same in fact, if not in format. | |
| 133. | Comment: Section 3.2.4, Generator Oversight, Page 3-8 | |

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| | The overall planning efforts of the assessment team should not be directed toward "minimizing impacts to generator operations", but to ensuring environmentally safe packaging and adequate waste analysis.<br><br>DOE-RL/WHC Response: The sentence in question refers to the assessment procedure itself; the intent of the planning effort is to assure minimal impact to operations during the actual assessment. The objective of the assessment is to provide assurance that waste generators are in compliance with the Hanford Site solid waste acceptance criteria. This statement is made in the first sentence of Section 3.2.4. | |

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| 134. | Deficiency: Figure 3-1, Sample Assessment Checklist, Page 3-9<br><br>It is unclear what is meant in item 4 of this checklist which asks "Are radioactive waste analyzed for dangerous constituents and their constituents?"<br><br>Requirement: Correct or clarify item 4 on this checklist.<br><br>**DOE-RL/WHC Response: The checklist will be replaced with an updated version.** | |
| 135. | Comment: Table 3-1, Mandatory Waste Characterization, Page 3-14<br><br>Item 7 must be corrected to indicate the TCLP test.<br><br>**DOE-RL/WHC Response: Item 7 on page 3-14, lines 45 and 46 will be changed to "Toxicity Characteristic" which is consistent with the terminology used in WAC 173-303-090.** | |
| 136. | Deficiency: Section 3.2.7, Sampling Methods, Page 3-16<br><br>Composite sampling should only be conducted when it is reasonable to assume the constituent concentrations are evenly distributed. Otherwise, samples should always be taken from the location where the highest chemical concentrations are expected. Furthermore, if a phase separation exists, each portion must be sampled and analyzed.<br><br>Requirement: The text in the last paragraph of this section must be modified per the above discussion.<br><br>**DOE-RL/WHC Response: The text in the last paragraph in section 3.2.7 on page 3-16 will be changed as follows: "Composite sampling is conducted when it is reasonably assumed the constituent concentrations are evenly distributed and is performed by obtaining random samples in random locations. Otherwise, samples will be taken from the location where the highest chemical concentrations are expected. Furthermore, if multiple phases or media exist, each different phase or media will be individually sampled and analyzed.** | |

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137. Comment: Table 3-2, Analytical Methodology, Page 3-17

The reference to EP Toxicity testing should be changed to TCLP testing. In addition, the procedure for determining the Ph of a solid outlined in Ecology's Chemical Testing Methods, WDOE 83-13, should be referenced for corrosivity testing. WAC 173-303-090(8) (October 16, 1990)

**DOE-RL/WHC Response: The text on line 11, page 3-17 will be changed from "extraction procedure toxicity, reference 1310," to "toxicity characteristic leaching procedure, reference 1311." The following reference will be put after 9041, line 10, page 3-17: "9045," which is the ASTM testing method used for determining the Ph of soils and semi-solid materials.**

138. Comment: Section 3.2.9, Additional Requirements, Page 3-20

Are offsite generators subject to the generator assessment program discussed in Section 3.2.4? If not, how is offsite waste verified? Offsite waste should be more vigorously assessed than onsite waste. Common practice dictates 10% of offsite generated waste should be verified prior to acceptance.

**DOE-RL/WHC Response: Except for special cases (naval reactor (NR) generators subject to Public Law 98-525, Section 1634), off-site generators are subject to the same auditing and surveillance program as the on-site generators. The schedule for conducting audits is a minimum of one per year. Surveillances are conducted on a more frequent basis. The same information is gathered from NR generators, but a different format is used. (See comment 132)**

139. Deficiency: Section 4.1.1, Containers with Free Liquids, Page 4-1

The text on line 28 indicates that the containers with free liquids are lab packs. Lab packs are specifically defined in WAC 173-303-161. Section 4.1.1.1 describes containers containing liquids which may not meet the regulatory definition of lab packs.

Requirement: Wac 173-303-161 and the federal regulations referenced therein should be reviewed to determine if all containers with liquids are indeed lab packs. If some

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containers are not lab packs, the text should be edited to identify the other type of free liquid containers which are located in the trenches.

DOE-RL/WHC Response: The containers with free liquid consist of an inner container of no more than 15 gallons of liquid surrounded with an amount of absorbent which can absorb at least twice the amount of liquid present; this is packaged in 55-gallon steel drums. As discussed in section 4.1.1, these containers do meet the WAC-303-161 definition of a lab pack. To avoid further confusion, the above description of the containers will be added to the text in section 4.1.1 and will follow the first sentence which starts on line 28. Also the term lab pack will be deleted from the text. The revised text will be as follows: "Containers with free liquid are discussed in the following sections. The containers with free liquid consist of an inner container of no more than 15 gallons of liquid surrounded with an amount of absorbent which can absorb at least twice the amount of liquid present; this is packaged in 55-gallon steel drums.

These sections describe past practices in the LLBG that were discontinued before November 23, 1987. Currently, mixed waste is received and stored at the new Central Waste Complex, which will be covered under a separate Part B permit application."

140. Deficiency: Section 4.1.1.2, Container Management Practices, Page 4-2

It is not appropriate to treat buried containers of waste as storage units because none of the container storage regulations can be applied.

Requirement: The retrievable storage units must be considered landfills.

DOE-RL/WHC Response: It is agreed the reference to storage units is inaccurate. However, it is necessary to differentiate the management of waste considered to be retrievable from that considered to be disposed. Therefore, retrievable waste in trenches will be referenced as such in the text. The phrase "retrievable storage units" will be replaced with "retrievable waste in the LLBG trenches." The buried containers were placed in storage prior to coming under Ecology regulation and the storage unit being classified as a landfill. The waste is to be retrieved when the Central Waste Complex is capable of receiving it.

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141. Deficiency: Section 4.1.2.4, Container Storage Area Drainage, Page 4-3

Precipitation that comes into contact with exposed waste containers could leach chemical and/or radiological contamination. There is no description of how the drainage liquid (run-off) is chemically or radiologically assessed and managed.

Requirement: The application should discuss the potential for precipitation to leach contaminants from exposed waste containers and how the run-off is assessed to verify the absence of such contamination.

DOE-RL/WHC Response: The following text will be added to Section 4.1.2.4: "The Waste is packaged in polyethylene (either double bagged, or bagged and placed in 90 mil polyethylene liners inside 55 gallon DOT 17C or 17H drums containing absorbent material that would absorb any potential leachable waste). The packaging combined with the dry desert climate preclude the leaching of hazardous constituents from the waste. Weekly inspections are performed on waste stored in open trenches to check for evidence of any leakage from drums. Routine radiation surveys are conducted in the burial grounds to check for soil contamination. These checks are more sensitive than hazardous waste tests for verifying that waste drums are not leaking."

142. Comment: Section 4.6.2.2, Exemption Based on Design, Page 4-5

Comment 115 also applies here.

DOE-RL/WHC Response: The sentence on Page 4-5 line 31 will be revised to say, "Each compartment weighs approximately 1,000 tons and contains waste lead designated as WT01 and D008." The paragraph beginning on Page 4-6 line 7 will be replaced with the following: "Of the hazardous constituents listed previously, only waste lead is present in quantities requiring regulation under WAC 173-303. This lead is designated as WT01 and D008."

143. Deficiency: Section 4.6.2.2, Exemption Based on Design, Page 4-5

Based upon discussions with U.S. Navy personnel, it is our understanding that the reactor compartments will be encased in steel hulls with a minimum thickness of 3/4 inch, not 3/8 inch. Furthermore, it is now expected that as much as 230 gallons of liquid may remain in the compartments. Therefore, all free liquids have not been drained.

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| | Requirement: Please verify the text. Also, provide a reference for stating "the compartments should probably last longer than 500 years". | |
| | **DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation.** | |
| 144. | Deficiency: Section 4.6.3, Liner System, General Items, Page 4-6 | |
| | The duration of postclosure has not been defined. Therefore, the term "30-year postclosure period" may not be accurate. | |
| | Requirement: Delete the term "30-year". | |
| | **DOE-RL/WHC Response: The "30-year postclosure period" is defined in WAC 173-303-610(7)(a). No text change is required.** | |
| 145. | Deficiency: Figure 4-1, RCRA Compliant Liner System, Page 4-7/8 | |
| | This figure and several other references indicate a layer of "asphalt". Taken literally, this means that a layer of viscous petroleum residues will be applied over the sand layer. It is unclear if this or asphaltic concrete will be used. | |
| | Requirement: Please verify the composition of this layer. Edit the text to specify the composition and purpose of this layer. | |
| | **DOE-RL/WHC Responses: The only asphalt that will be used on the non-dragoff trench will be asphaltic concrete similar to that used elsewhere in the 200 Areas. The asphaltic concrete will provide pavement for the truck unloading area. Please see the Construction Quality Assurance Plan (CQAP), WHC-SD-W025-PLN-001, Page 23, Section 4.3.6, and the design drawings in WHC-SD-W025-FDR-001 on Page 105 of 397.** | |

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146. Deficiency: Section 4.6.3.1.2, Primary Liner System, Page 4-11

All landfill slopes must be no steeper than 4 horizontal: 1 vertical. This applies to both the lined trench slope and the final cover slope.

Requirement: Edit line 47 to read "4H:1V".

DOE-RL/WHC Response: The basis for Ecology's requirement of 4H:1V slopes is not clear. Slope stability is discussed in Section 5.1 of FDR-001. Details of these analyses are presented in Appendices C.8, C.9, and C.12 of the Design Report, and indicate acceptably high factors of safety under all design conditions. With respect to constructability, 3H:1V side slopes are routinely constructed without difficulties at several major hazardous waste disposal facilities (one facility even has side slopes as steep as 2H:1V). Operations layer material is also typically spread on these 3H:1V slopes.
The Design Report includes a filling plan (Section 6.6) which suggests that the landfill be filled in horizontal lifts. This approach will avoid any unbalanced forces acting downward along the slopes and will thus serve to maximize stability (also see response to comment 150).

The final cover has not yet been designed, so slope of the cover has not been determined.

147. Comment: Section 4.6.4.4.4, Stability of Slopes, Page 4-30

It is not just conjectural that sand will not stay on this slope, it is a certainty. There have been a number of reported slope failures at grades of 3H:1V. As far as mitigating this problem, option 1 is undesirable since it maximizes exposure of the geosynthetics, the solution in option 2 is obscure and needs expansion, and option 3 may not work due to crushing under the load of the backfill. Comments 20 and 146 also apply here.

DOE-RL/WHC Responses: See the Definitive Design Report WHC-SD-W025-FDR-001, Page 14 of 397, Section 5.1.1. and Appendix C.9, Page 264 of 397. The response to Number 146 also applies here.

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| 148. | Comment: Section 4.6.5.1.1, Geotextiles, Page 4-32<br><br>Typo. Line 52 should reference Section 4.6.5.2., not Section 4.6.5.1.1. This correction also needs to be made on line 45 of page 4-33 and line 10 of page 4-34.<br><br>DOE-RL/WHC Responses: The references will be revised as suggested. | |
| 149. | Deficiency: Section 4.6.5.1.2, Geonet, Page 4-33<br><br>The "important consideration" when selecting a geonet is transmissivity, not permeability.<br><br>Requirement: The term "permeability" on line 32 should be replaced with "transmissivity". In addition, the appropriate ASTM test to determine transmissivity should be specified in the text.<br><br>DOE-RL/WHC Responses: The transmissivity is the most important consideration when selecting a geonet. See the Definitive Design Report WHC-SD-W025-FDR-001, Page 21 of 397, Section 5.5.2. and Appendix C.3, Page 209 of 397. It specifically states that the "primary selection criteria for the geonet was the transmissivity." Also note that the specifications require conformance testing for transmissivity (see WHC-S-045, Section 02275 and the CQAP Appendix A). | |
| 150. | Deficiency: Section 4.6.5.3.3, Operational stresses, Page 4-37<br><br>It is not clear how the waste will be backfilled.<br><br>Requirement: Provide a discussion on backfilling waste, i.e., immediately after placement, after the trench is filled, in lifts, etc.<br><br>DOE-RL/WHC Responses: The landfill filling plan is in the Definitive Design Report WHC-SD-W025-FDR-001, Page 35 of 397, and Section 6.6., Waste Stability 5.1.4, Page 15 of 397. Also see Page 112 of 397, Drawing H-2-131588. Golder Associates is currently evaluating alternative materials to be used as backfill and will prepare a report with these findings. Therefore, the approach described in FDR-001 may be modified. | |

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| 151. | Comment: Section 4.6.5.5, Soil Liners, Page 4-39<br><br>Installation of soil/bentonite liners is underway at the LERF site. A number of refinements are being made to the process. Activities involving the development and installation of the admixed liner should be coordinated with the LERF project to ensure consistency in technical and regulatory matters (See Ecology letter to Wisness from Nord dated January 30, 1991 titled: Standardized Soil-Bentonite Project).<br><br>DOE-RL/WHC Response: The LERF team has provided lessons learned on problems encountered during their project. Soil/Bentonite plans can be seen in the Definitive Design Report WHC-SD-W025-FDR-001, Section 4.2.1, 4.3.1, and 5.3. The Design Report, Specifications, and CQA Plan provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications require a submittal to the Westinghouse Hanford Company Project Engineer and the CQA Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the Project W-025 Landfill is constructed (see response to comment 19 in regards to an individual test fill). | |
| 152. | Comment: Section 4.6.5.5.1, Material Testing Data, Page 4-40<br><br>Fines content testing (ASTM D 1140) should also be specified.<br><br>DOE-RL/WHC Response: The CQA Plan requires sieve and hydrometer testing on Eolian sand and admix at the rate of 1 test per 1,000 cubic yards of material. The specified method is ASTM D422, which is much more comprehensive than ASTM D1140 (see WHC-S-045, Section 02224, Paragraph 2-3). | |
| 153. | Deficiency: Section 4.6.5.5.1, Material Testing Data, Page 4-41<br><br>It is not sufficient to only use a nuclear densimeter when measuring density. A minimum number of sand cone tests, ASTM D1556-82, should be performed to provide calibration and backup for the nuclear densimeter. | |

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151. Comment: Section 4.6.5.5, Soil Liners, Page 4-39

Installation of soil/bentonite liners is underway at the LERF site. A number of refinements are being made to the process. Activities involving the development and installation of the admixed liner should be coordinated with the LERF project to ensure consistency in technical and regulatory matters (See Ecology letter to Wisness from Nord dated January 30, 1991 titled: Standardized Soil-Bentonite Project).

DOE-RL/WHC Response: The LERF team has provided lessons learned on problems encountered during their project. Soil/Bentonite plans can be seen in the Definitive Design Report WHC-SD-W025-FDR-001, Section 4.2.1, 4.3.1, and 5.3. The Design Report, Specifications, and CQA Plan provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications require a submittal to the Westinghouse Hanford Company Project Engineer and the CQA Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the Project W-025 Landfill is constructed (see response to comment 19 in regards to an individual test fill).

152. Comment: Section 4.6.5.5.1, Material Testing Data, Page 4-40

Fines content testing (ASTM D 1140) should also be specified.

DOE-RL/WHC Response: The CQA Plan requires sieve and hydrometer testing on Eolian sand and admix at the rate of 1 test per 1,000 cubic yards of material. The specified method is ASTM D422, which is much more comprehensive than ASTM D1140 (see WHC-S-045, Section 02224, Paragraph 2-3).

153. Deficiency: Section 4.6.5.5.1, Material Testing Data, Page 4-41

It is not sufficient to only use a nuclear densimeter when measuring density. A minimum number of sand cone tests, ASTM D1556-82, should be performed to provide calibration and backup for the nuclear densimeter.

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Requirement: The frequency of performing sand cone tests must be specified.

**DOE-RL/WHC Response: The CQA Plan (Section 4.3.2) requires that nuclear gage density measurements be verified with either sand cone (ASTM D1556) or rubber balloon (D2167) tests. At least 1 of these tests is required for each 2 lifts of admix placed, or 1 per day, whichever is greater.**

154. Deficiency: Section 4.6.5.5.2. Soil Liner Compatibility, Page 4-41

A permeability of $1 \times 10^{-7}$ centimeters per second is a maximum value, not a minimum value as indicated on line 42.

Requirement: Edit the word "minimum" to read "maximum".

**DOE-RL/WHC Response: The Design Report WHC-SD-W025-FDR-001, Page 18 of 397, Section 5.3.2 has the correct terminology. The word has been changed to a "maximum value" in the revised Chapter 4.0 permit application.**

155. Comment: Section 4.6.5.5.5, Engineering Report, Page 4-43.

If this report is complete, it must be more specifically referenced and provided to Ecology. If it is not, provide an estimate for when it will be completed and modify the text to note that a copy will be provided to Ecology for review and approval.

**DOE-RL/WHC Response: The Engineering Report has been provided to Ecology for review (see the Design Report WHC-SD-W025-FDR-001, DOE-RL-88-20, Supplement 2, Volume 1 of 2., Chapter 4).**

156. Deficiency: Section 4.6.6.1.1, Primary System, Page 4-44

The text here states that the primary drainage layer will be composed of gravel. This contradicts Figure 4-1 which specifies sand.

Requirement: Clarify this contradiction and edit the application as necessary.

**DOE-RL/WHC Response: The Primary Drainage Layers will be gravel (see the Design Report WHC-SD-W025-FDR-001, DOE-RL-88-20, Supplement 2, Volume 1 of 2, Chapter 4, Page 20 of 397,**

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| | Section 5.5.1 and the design drawings). Figure 4.2 in the revised Chapter 4 has this revision. | |
| 157. | Deficiency: Section 4.6.6.1.1, Primary System, Page 4-44<br><br>EPA guidance has changed since the publishing of the document referenced on line 8. The EPA currently recommends a granular drainage layer hydraulic conductivity of 1 cm/sec and a synthetic drainage layer transmissivity of 5 X $10^{-4}$ $m^2$/sec.<br><br>Requirement: The above specifications must be used for the LLBG's.<br><br>DOE-RL/WHC Response: EPA guidance allows use of either granular or synthetic drainage layer materials. The Project W-025 Landfill design includes both. As noted in the response to comment 31, the transmissivity of the geocomposite exceeds the EPA proposed requirement, and thus would be adequate by itself. However, the drainage gravel has been added for redundancy. Hence, the design provides high flow capacity and substantially exceeds the proposed EPA requirements. | |
| 158. | Deficiency: Section 4.6.6.1.1. Primary System, Page 4-45<br><br>The text describes the possibility of an asphaltic operations layer. However, no evaluation is provided describing the potential impacts of this layer on the bottom liners and associated components.<br><br>Requirement: An evaluation should be provided which addresses the possibility of both waste leachate and precipitation leaching materials from the asphaltic layer into the LDCRS. Effects such as accelerated degradation and clogging should be considered.<br><br>DOE-RL/WHC Response: The words "asphalt operation layer" will be replaced with the following words "two foot operations layer of general fill." See the Design Report WHC-SD-W025-FDR-001, Page 8 of 397, Section 2.2 and design drawings. | |

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| 159. | Deficiency: Section 4.6.6.1.1, Primary System, Page 4-45<br><br>It is insufficient to say the primary sumps will be monitored "regularly".<br><br>Requirement: The monitoring frequency should be specified as weekly.<br><br>**DOE-RL/WHC Responses: See the Design Report WHC-SD-W025-FDR-001, Page 37 of 397, Section 7.2. Periodic (daily) readings of the leachate levels in the primary and secondary sumps will be obtained and recorded.** | |
| 160. | Deficiency: Section 4.6.6.1.2. Secondary System, Page 4-46<br><br>There is no reference to a Response Action Plan (RAP) which is required by EPA's minimum technology requirements for landfills. The RAP addresses the handling of liquids which enter the leachate detection, collection and removal system (LCDRS) and the actions to be taken in response to liquids in the LDCRS.<br><br>Requirement: A RAP must be written and included in this application. Refer to the Grout Processing Facility RAP for guidance.<br><br>**DOE-RL/WHC Response: A Response Action Plan will be included in the permit application prior to operation of the landfill.** | |
| 161. | Deficiency: Section 4.6.6.5. System Compatibility, Page 4-47<br><br>There is no mention here or throughout the text on fingerprinting FML's.<br><br>Requirement: Fingerprinting must be conducted for all synthetic liners. A discussion of the fingerprinting program must be presented in the text. Furthermore, the reference to "Farnsworth et al. 1988" should be corrected to read "Farnsworth et al. 1989".<br><br>**DOE-RL/WHC Response: Fingerprinting will be conducted (see the Design Report WHC-SD-W025-FDR-001, Page 27 of 397, Section 6.3.1. and the 9090 Test Report to be submitted to Ecology). The reference to Farnsworth et al. is no longer cited in the revised Chapter 4.0.** | |

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| 162. | Deficiency: Section 4.6.7.3, Construction Quality Control, Page 4-49<br><br>Although Appendix 4F provides some construction quality control information for the liner system, the EPA requires a comprehensive construction quality assurance (CQA) plan for the entire facility in the Hazardous and Solid Waste Amendments to RCRA.<br><br>Requirement: A CQA plan must be provided as part of the application for the LLBG which addresses the EPA's, as well as Ecology's, concerns.<br><br>**DOE-RL/WHC Response: The CQA Plan has been submitted to Ecology.** | |
| 163. | Comment: Section 4.6.8.1.1. Design and Performance, Page 4-50<br><br>What factor of safety does a 0.3 foot freeboard provide?<br><br>**DOE-RL/WHC Response: See the Design Report WHC-SD-W025-FDR-001, Page 122 of 397, for surface water hydrology calculations. Drainage ditch design is presented in Appendix C.1 of the Design Report. Because the total cross sectional area of the ditch is 3 times the area of flow for the peak 25-year storm, the factor of safety is 3.** | |
| 164. | Deficiency: Section 4.6.8.5, Maintenance, Page 4-52<br><br>Given the sandy and windy conditions of the Hanford site, as well as the problems associated with tumbleweeds, it would seem maintenance may be a greater problem than projected.<br><br>Requirement: Discuss the effect of wind, sand and tumbleweeds on drainage ditch maintenance.<br><br>**DOE-RL/WHC Response: See the Design Report WHC-SD-W025-FDR-001, Page 37 of 397, Section 7.2. Surface drainage ditches surrounding the landfill should be cleaned out and graded in the fall of each year prior to start of the rainy season (see Section 4.6.8.5. of the revised Chapter 4.0).** | |

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| 165. | Comment: Chapter 5, Groundwater<br><br>Although Ecology concurs with the previous NOD responses made on this chapter, a number of new comments on this chapter are presented and may address similar concerns. It is our understanding that this chapter has been extensively revised since this application's submittal. Therefore, although the specific Chapter 5 comments which follow may no longer be applicable, the following general requirements should be addressed in the revised text. Chapter 5 should address the following: 1) all stages of monitoring well installation and well sampling should be coordinated with Ecology; 2) all lab result reports must be provided to Ecology; 3) all well completion reports must be provided to Ecology; 4) the revised chapter should utilize post 1987 data as well as prior data; and 5) provide supporting descriptions for the well location model.<br><br>DOE-RL/WHC Response: 1) DOE/RL will continue to inform Ecology in advance of monitoring well installation and sampling plans. Advance information on each year's drilling program for installing new monitoring wells is provided in quarterly groundwater monitoring reports or in letter reports to Ecology. Advance information on well sampling is provided in the Part B permit application for both Interim Status and the proposed Final Status programs. This procedure provides Ecology with the opportunity to comment upon and discuss well installation and sampling plans at any time.<br><br>2) Ecology will continue to be provided with validated laboratory data from the LLBG monitoring wells in quarterly groundwater monitoring reports. Because of their volume, raw and unvalidated data are not automatically distributed; however, laboratory result reports will be provided to Ecology along with the validated laboratory data upon request.<br><br>3) Well Completion Reports for the LLBG monitoring wells will be provided to Ecology.<br><br>4) Post-1987 data will be incorporated into the revised Chapter 5.<br><br>5) The description of the Monitoring Efficiency Model used to locate monitoring wells will be expanded and clarified in response to Ecology comments. Further, references will be provided to technical reports describing the model that have been prepared since the first draft of Chapter 5 was submitted to Ecology. | |

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166. Deficiency: Section 5.2.1, Interim Status Groundwater, Page 5-2

According to the text, the monitoring system should accomplish the following: 1) define the specific waste management areas for the LLBG, 2) establish an initial ground water monitoring well network, and 3) characterize the hydrogeologic properties of the upper most aquifer beneath the LLBG. Item 3 was not fully accomplished nor completely presented in the application.

Requirement: Based upon the most current data, item 3 must be completed according to the premise in the application.

DOE-RL/WHC Response: The third objective of the interim status program was clarified in response to Ecology Comment 33, to indicate that the first 35 wells were intended to provide preliminary hydrogeologic properties of the uppermost aquifer system beneath the LLBG using data collected from the monitoring well network and from previously collected or published data. These data are being supplemented by additional data collected while installing new monitoring wells, and by monitoring data collected from the entire existing network. Chapter 5 will be revised to discuss these new data and will either present them or describe how they may be obtained. Characterization of the hydrogeologic properties of the uppermost aquifer is sufficient to support this Part B permit application.

167. Deficiency: Section 5.2.3.2.1, Groundwater Elevations, Page 5-18

Although the text states "Hydrographs for the interim status wells are given in Last et al. (1989)", no comments related to the hydrographs or any interpretations of the conclusion are given.

Requirement: The information from the cited reference should be provided along with the conclusions drawn from this information.

DOE-RL/WHC Response: The water level changes shown in the hydrographs are summarized in the paragraph containing the Last et al. citation, and the preceding paragraph of the text. The hydrographs are too short (covering a period of only about 8 months) to draw meaningful conclusions regarding long-term trends. The revised Chapter 5 will address the longer period of record now available, and present interpretations of that record.

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| 168. | Deficiency: Figure 5-6, Water Table Beneath LLWMA 1 and 2, Page 5-19<br><br>A single contour line does not illustrate the flow direction of ground water.<br><br>Requirement: The report cited on page 5-18, Last el al. (1989), indicates that the details of ground water movement in the vicinity of Waste Management Area 1 and 2 are difficult to discern. An explanation of why only one contour line is shown should be provided on the figure or in the text. If other data is available to better characterize the flow, it should be provided and the figure updated. In addition, the interpretation of reasons for ground water movement in the waste management area should be given.<br><br>DOE-RL/WHC Response: In a homogeneous, isotropic system the direction of groundwater movement is perpendicular to the equipotential contour lines, and in heterogeneous, anisotropic systems the equipotential contour lines still provide an indication of the direction of flow (see Freeze and Cherry, 1979, Chapter 5). Thus a single contour line does provide information on the flow direction of groundwater. There are two equipotential contour lines shown on Figure 5-6, which provide an indication of hydraulic gradient as well as the direction of groundwater flow. The difficulties referred to by Last et al. resulted from low hydraulic gradients and a lack of data points to support additional contours. Additional data have since been obtained and Chapter 5 will be revised to present three sets of water table contours beneath LLWMA 1 and 2 covering a period of three consecutive years. Groundwater movement at this location is believed to be strongly influenced by the B-Pond groundwater mound, as stated in the text on page 5-18. | |
| 169. | Deficiency: Section 5.2.3.2.3, Results of Water Quality, Page 5-26<br><br>The text states "The concentration of dissolved chromium exceeded drinking water standards...." However, the origin of the contamination and possible remedial actions are not discussed.<br><br>Requirement: The text must discuss the origin of this contamination as well as remedial actions which could be immediately undertaken to address this contamination. This comment also applies to any other constituents which were above drinking water standards.<br><br>DOE-RL/WHC Response: The origin of the high concentrations of chromium found in several of the wells is thought to be the well construction practices. This is so stated in the | |

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paragraphs immediately preceding the cited paragraph, and the text will be revised to clarify that this same potential source applies to all of the newly installed wells. Such contamination is thought to be highly localized around the well, is expected to dissipate with time, and does not result from a chemical release from a burial ground. A discussion of remedial actions for chromium contamination will be added to the text. The text will also be revised to address the origins of any other constituents found to exceed the drinking water standards listed in WAC 173-303-645(5) Table 1. Should any such constituents be indicated to have originated from the low-level burial grounds, the text will be revised to discuss remedial actions.

170. Comment: Section 5.3.3.2.1, Seismicity, Page 5-37

The Department of Natural Resources may have some pertinent information to these discussions from their state geological mapping efforts. Ecology recommends that the DNR be contacted for more information.

DOE-RL/WHC Response: The Department of Natural Resources will be contacted regarding seismicity, and the text will be revised to incorporate any pertinent new information.

171. Deficiency: Section 5.3.4, Regional Hydrogeology, Page 5-38

The text notes that "The base of the aquifer is the basalt surface, but semiconfining silts and clays are present above the basalt in some areas." However, the locations of these semiconfining layers is not presented.

Requirement: The locations of the semiconfining layers should be specified as well as a description of how these layers influence ground water flow and the entrapment of pollutants.

DOE-RL/WHC Response: The text will be clarified to indicate that the semi-confining silts and clays are found in the lower fine-grained basal Ringold. This unit is shown in section in Figures 5-19 and 5-20. It is present beneath the 200-West Area where its lateral extent and thickness is shown in Figure 5-21. It is not present beneath the 200-East Area. The influence of this unit on groundwater flow and contaminant migration is discussed in Sections 5.3.5.2 and 5.5.2.1.9.

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| 172. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The "actual amount of recharge" needs to be revised based upon the new data that is now available.<br><br>DOE-RL/WHC Response: The text will be revised based upon the more recent studies of Gee and others, to indicate that the actual net recharge is not known, but is thought to vary locally from near zero to about 4 inches per year, depending upon the local soil and vegetative characteristics. | |
| 173. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The paragraph beginning on line 23 is unclear. Please clarify how the difference between high and low transmissivities effect the monitoring network.<br><br>DOE-RL/WHC Response: A higher and larger mound developed in the 200-West Area because a greater hydraulic gradient and aquifer thickness were required to move the same volume of water through a less transmissive medium. The effects of varying hydraulic properties on the monitoring network are discussed in Section 5.5.2 rather than in this section. The transmissivity may be a factor in determining an appropriate buffer zone width, and will affect the modeling results if the hypothetical plume moves so slowly that it does not reach a monitoring well. At the Hanford Site, the plumes would be expected to move with sufficient velocity that the network design developed with the help of the Monitoring Efficiency Model is not affected by the transmissivity. The discussions of this and other characteristics and assumptions of the model will be expanded and clarified in Section 5.5.2. | |
| 174. | Comment: Section 5.3.4, Regional Hydrogeology, Page 5-39<br><br>The quoted ranges of hydraulic conductivity and the information provided in Tables 5-3 and 5-4 are not relevant because they are provided as estimated ranges. Additional discussion should be presented to indicate the impact of this variability on the design of the monitoring system.<br><br>DOE-RL/WHC Response: The general ranges of hydraulic conductivity are relevant to the discussion on page 5-39 in Section 5.3.4 because that section addresses regional hydrogeology. The general water quality data presented in Tables 5-3 and 5-4 are also | |

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| | **relevant to the discussion of regional hydrogeology in Section 5.3.4. More detailed discussions of hydraulic properties at the LLBG begin in Section 5.3.5 where the results of aquifer tests performed in the LLBG monitoring wells and other nearby wells are presented. An expanded discussion of the effects of the variability in hydraulic conductivity on the design of the monitoring system will be provided in Section 5.5.2.** | |
| 175. | Comment: Section 5.3.5, Uppermost Aquifer, Page 5-42<br><br>The thickness of the sediments must be specified. This information can be found in Last (1989).<br><br>**DOE-RL/WHC Response: The total thicknesses of the sediments beneath each of the LLBG will be added to the text in Sections 5.3.5.1.1 (for those in the 200-East Area) and 5.3.5.2.1 (for those in the 200-West Area).** | |
| 176. | Deficiency: Section 5.3.5.1.4, Vadose Zone, Page 5-46<br><br>There is no data provided from recent drilling.<br><br>Requirement: The information from the most recent drilling program must be provided.<br><br>**DOE-RL/WHC Response: The text will be revised to provide additional data on the vadose zone obtained from recent drilling.** | |
| 177. | Deficiency: Section 5.3.5.1.5, Aquifer Properties, Page 5-48<br><br>The porosity was not tested, but estimated. This is not acceptable because these values should have been obtained after analyzing samples from recent drilling.<br><br>Requirement: The analysis of soil samples should include determining porosity from undisturbed samples obtained during recent drilling.<br><br>**DOE-RL/WHC Response: The text will be revised to provide available information on porosity determined from samples taken in the aquifer during recent drilling.** | |

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| 178. | Comment: Section 5.3.5.1.5, Aquifer Properties, Page 5-49<br><br>The text states that "The impact of the mound reduction on the local hydraulic gradient and velocity may be significant." Please elaborate on this comment.<br><br>DOE-RL/WHC Response: The text in Section 5.3.5.1.5 will be revised to further explain the potential effects of mound reduction on local hydraulic gradients and flow velocities. In general, hydraulic gradients would be expected to decrease in the vicinity of the mounds, groundwater flow directions may change, and groundwater flow velocities may decrease. | |
| 179. | Comment: Section 5.3.5.2.4, Vadose Zone, Page 5-57<br><br>The text indicates the presence of an 8-15 foot thick section of unconsolidated loess. Was this section analyzed for its effect on pollutant migration? The applicable data supporting this effect, or the absence of an effect, must be provided.<br><br>DOE-RL/WHC Response: The various stratigraphic horizons within the vadose zone in the 200 West Area, including the loess, sandy gravels, sands, and cemented calcium carbonate units, were considered in estimating the size of the source in the Monitoring Efficiency Model. Because the model assumes constant, steady state releases, retardation within the vadose zone was not considered. The horizons with smaller pore sizes such as the loess would tend to spread a release over a wider area because of lower hydraulic conductivities and stronger lateral capillary effects. However, with wider lateral spreading the contaminant flux per unit surface area of the aquifer decreases, reducing the contaminant concentration in the aquifer. Sensitivity studies that will be presented in the revised text have shown that the two effects of lateral spreading and reduced concentration offset each other, resulting in a low net sensitivity to lateral spreading for the final network design. The network design was not found to be sensitive to the presence of the loess, and a detailed evaluation of its properties was not considered necessary. | |
| 180. | Deficiency: Section 5.3.5.2.4, Vadose Zone, Page 5-58<br><br>The text indicates that the sediment thickness varies from 80-150 feet and the moisture content varies from 2-18.7%. This is not an adequate description of the unsaturated zone. | |

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| | Requirement: The results of soil sampling and analysis from new wells should be used for the description of the unsaturated zone. The changes of moisture content should be then mapped more precisely.<br><br>DOE-RL/WHC Response: The text will be revised to provide an expanded discussion of the properties of the vadose zone. This will include additional details on changes of moisture content and new data that have become available from recent drilling. | |
| 181. | Comment: Section 5.3.6, Underlying Aquifer, Page 5-60<br><br>The aquifer description should include how the new wells respond to monitoring. In addition, new data obtained during drilling and monitoring should be included.<br><br>DOE-RL/WHC Response: Several new wells not associated with this permit application have been drilled into the underlying Rattlesnake Ridge aquifer since the 1989 text was prepared. Although none of the wells in the Rattlesnake Ridge aquifer are part of the monitoring network for the LLBG, the text will be revised to incorporate more recent data that may be relevant. | |
| 182. | Deficiency: Section 5.4, Contaminant Plume Description, Page 5-62<br><br>The text states "Presently, water quality information is available for only the first quarter sampling event (October 1988)." New data is now available.<br><br>Requirement: The new data should be presented.<br><br>DOE-RL/WHC Response: Additional water quality data are now available and statistical analysis of the interim status indicator parameters has been completed. The text will be revised in Section 5.2.3 to present the new water quality data that has become available from the LLBG monitoring wells, and will be revised in Section 5.4 to present any new information regarding any contamination that may have entered the groundwater from one of the regulated units. | |

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183. Deficiency: Section 5.4.1.3, Vadose Zone, Page 5-63

The vadose zone description does not include any site specific information, nor soil testing results from the 36 new LLBG boreholes.

Requirement: The new information should be provided.

DOE-RL/WHC Response: The text will be revised to incorporate available site-specific information relating to plume travel times in the vadose zone, including results from the new LLBG boreholes.

184. Deficiency: Section 5.4.1.3.2. Measured Contaminant Plumes, Page 5-65

There is no supporting evidence for the example given in the text. Therefore, the conclusions are premature.

Requirement: The data which supports this example must be provided.

DOE-RL/WHC Response: The text will be revised to provide additional supporting information (plan and cross-section views of the extent of contamination) and to cite a recent modeling study of the 241-T-106 tank leak prepared by Pacific Northwest Laboratory that provides an analysis of the leak.

185. Deficiency: Section 5.4.2, Travel Time, Page 5-70

The estimated travel times given here are not substantiated because aquifer parameters and flow paths are not presently known.

Requirement: New travel times should be specified based on more accurate calculations.

DOE-RL/WHC Response: Travel times based upon actual plume migration rates at the Hanford Site on the scale of interest are more accurate than the results of calculations based upon averaged aquifer parameters and flow paths inferred from those plumes. Further, travel times based upon theoretical considerations can only be substantiated if actual plume data are available at a burial ground site on the same scale of interest. Thus it is preferable, where possible, to base travel time estimates upon actual plume migration rates rather than

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| | upon aquifer parameter and flow path data. The regional travel times given in the text are based upon actual large-scale plume migration rates for the Hanford Site in the uppermost aquifer. Their accuracy should be equal to or greater than that for travel times computed for similar flowpath lengths at other (not at Hanford) landfill sites, and is considered acceptable. Because these estimates are based upon actual plume migration rates, any new aquifer parameter or flowpath data that estimate significantly different rates would be of questionable validity. | |
| 186. | Comment: Section 5.4.4. Summary of travel, Page 5-70<br><br>See above comment.<br><br>DOE-RL/WHC Response: See response to Comment 185. | |
| 187. | Deficiency: Figures 5-28, 5-29 and 5-30, Pages 5-71 through 5-76<br><br>These figures provide no interpretation of plume behavior in different lithological formations.<br><br>Requirement: The modeling should include the behavior of the plume in different lithologies using field obtained parameters.<br><br>DOE-RL/WHC Response: The text will be revised to provide an interpretation of plume behavior in different lithological formations. The discussion and application of the model in Section 5.5.2 will be revised to incorporate dispersivity values obtained from Hanford Site plumes, and to evaluate the effects of changing lithologies and hydrologic parameters on the model results. | |
| 188. | Comment: Section 5.4.6, Conclusions, Page 5-77<br><br>The conclusions are unclear and need to be substantiated with new data.<br><br>DOE-RL/WHC Response: The text will be revised to clarify and update the conclusions, based upon the new data that have become available. | |

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189. Comment: Section 5.5.1, Indicator Parameters, Page 5-80

Were any volatile organic compounds or supplemental parameters present in the soil or water during the more recent drilling? Provide the justification for choosing these "indicator" parameters.

DOE-RL/WHC Response: The text will be revised to present groundwater monitoring data obtained since the 1989 draft was prepared. The indicator parameters will be reevaluated based on these new data and on a reanalysis of the quantity and chemical form of each parameter in the waste. The justification for developing the indicator parameter list will be presented.

190. Deficiency: Section 5.5.2. Groundwater Monitoring Program, Page 5-82

This section does not address the interim status monitoring program.

Requirement: The groundwater monitoring program should be based on the results of interim monitoring and incorporate all improvements necessary for the final detection system.

DOE-RL/WHC Response: The text will be revised to explain how the results of the interim status monitoring program are used to design the final detection system. Emphasis will be placed upon the use of the expanded groundwater level data to refine the directions of groundwater flow, and the use of the aquifer test data to assess the influence of permeability variations on monitoring network design.

191. Deficiency: Section 5.5.2.1.1, Background, Page 5-84

There is a need for monitoring the middle portion of the aquifer. The lithology between some "deep" and "shallow" portions might be such that it will retain pollutants.

Requirement: A portion of the monitoring wells must be screened to monitor the middle section of the aquifer if the aquifer thickness exceeds 40 feet.

DOE-RL/WHC Response: Retention of pollutants in the middle section of the aquifer would require (1) the presence of lithologic layers that could retain and laterally divert contaminants that would otherwise reach the bottom of the aquifer, and (2) the presence of

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contaminants in the middle section of the aquifer. The stratigraphy of the saturated zone is discussed in Sections 5.3.5.1.3 (for the 200-East Area) and 5.3.5.2.3 (for the 200-West Area), and illustrated in Figures 5-16 and 5-19. In both cases the sediments in the middle of the aquifer are sands, gravelly sands, and sandy gravels with no laterally extensive fine-grained silts or clays. There is therefore no evidence that a lithologic layer that could retain and laterally divert contaminants is present. The presence of contaminants in the middle section of the aquifer beneath the LLBG is also unlikely, for the reasons stated in the accepted DOE-RL/WHC response to Comments 68 and 78. In view of the lack of identified lithologic layers that could cause retention and lateral diversion of contaminants, and the small likelihood that contaminants could reach the middle section of the aquifer, monitoring wells completed in the middle section of the aquifer are not considered to be needed.

192. Comment: Section 5.5.2.1.1, Background, Page 5-84

The ranges of hydraulic conductivity should be based on the soils sampling from new wells. The aquifer properties should be described in greater detail after obtaining the new samples and lab analysis results. This will allow the calculation of transmissivity for each change of lithology within the Hanford or Ringold formation.

DOE-RL/WHC Response: Identification of hydraulic conductivity on the basis of sedimentary facies rather than geologic formations is being studied at the Hanford Site (see, for example, Poeter and Gaylord, Groundwater, Vol. 28 No. 6, 1990). These studies will be reviewed and the correlations adapted, where pertinent, to the LLBG. Both new and old soil sampling data at the LLBG will be used in this correlation.

193. Deficiency: Section 5.5.2.1.2, Monitoring Design Approach, Page 5-84

The assumptions about hydraulic conductivities can be misleading. As a consequence, some constituents can be missed in the monitoring wells.

Requirement: The text here must provide support for the assumptions.

DOE-RL/WHC Response: The text will be revised to more fully explain the monitoring design approach, which is based upon more factors than the hydraulic conductivity and depth considerations discussed here.

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| 194. | Comment: Section 5.5.2.1.3, Monitoring Efficiency, Page 5-87<br><br>The monitoring efficiency model is being reevaluated since a presentation to Ecology by the model's author.,<br><br>DOE-RL/WHC Response: No additional comments on the Monitoring Efficiency Model have been received. | |
| 195. | Comment: Section 5.5.2.1.9, Monitoring Design, Page 5-112<br><br>It is not appropriate to assume the shallow wells will be the most indicative of contamination. Deep wells need to be used in the monitoring system as extensively as shallow monitoring wells. This will depend upon what constituents will be detected in the first deep well that is drilled.<br><br>DOE-RL/WHC Response: The basis for the proposed relative density of shallow and deep wells was addressed in accepted Comments 68 and 78, and the text will be revised as stated in the responses to those comments to more fully support the design basis. The text will also be revised to present the monitoring results from the deep wells, and to evaluate the implications of those results on the adequacy of the deep well network. | |
| 196. | Comment: Section 5.5.2.1.9.1, Deep Well Locations, Page 5-113<br><br>Lines 40-48 are unclear and not defensible. Please clarify.<br><br>DOE-RL/WHC Response: The text will be clarified by rewording, providing additional supporting information on groundwater flow directions, and referring to Figure 5-20 as well as Figure 5-21. The direction of groundwater movement will be indicated on Figure 5-20. Both of these figures illustrate the extent of the lower Ringold sediments beneath LLWMA-3 and LLWMA-4. | |

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| 197. | Deficiency: Section 5.5.2.1.9.2, Deep Well Locations, Page 5-114<br><br>Two deep wells were constructed for the interim monitoring network, but no results from these wells are presented to support these conclusions. Deep wells might be extremely important in total network efficiency. If there are differences in the predicted distribution of aquifers, the results from sampling deep wells will also confirm or negate changes in transmissivities.<br><br>Requirement: The results from the deep wells must be presented.<br><br>DOE-RL/WHC Response: There are actually four deep LLBG monitoring wells, two at upgradient and two at downgradient locations. The text will be revised to present the monitoring results from the deep wells, and to evaluate the implications of those results on the adequacy of the total monitoring well network. | |
| 198. | Comment: Section 5.5.2.1.11, Well Installation Staging, Page 5-125<br><br>The text indicates that the monitoring system will consist of 69 shallow wells and 6 deep wells. Of these, 42 new shallow wells and 2 new deep wells will be installed. This means that 27 shallow wells and 4 deep wells were installed for the interim monitoring system. However, page 5-1 indicates that thirty-five wells were in the interim monitoring system. Please correct this discrepancy. | |

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DOE-RL/WHC Response: The monitoring system is explained in the following tabulation.

| | Shallow | Deep | Total |
|---|---|---|---|
| Number of Interim Status Wells Installed in 1987 | 31 | 4 | 35 |
| Number of Additional Wells to be Installed | 42 | 2 | 44 |
| Number of Wells within Final Line of Compliance to be Removed from System at Closure | (4) | (0) | (4) |
| Final Number of Wells in Monitoring System | 69 | 6 | 75 |

The text will be revised to more clearly explain the number of wells in the final system. Please note that the number of wells may change as a result of network reevaluations in response to the comments received.

199. Comment: Table 5-12, Well Installation Priority, Page 5-127

The preliminary results from drilling the priority 1 wells should serve as a base for drilling wells in the priority 2 list. Staging of wells should depend upon the results obtained during previous drilling.

DOE-RL/WHC Response: The priority of installation of monitoring wells that have not yet been drilled will be reviewed based upon the results obtained from the previous wells to determine if any changes should be made in the schedule.

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| 200. | Comment: Section 5.5.2.3, Representative Samples, Page 5-129<br><br>Sampling may be subject to revision depending upon results from the past two years of monitoring, 1991 monitoring, and one additional year for monitoring all the wells in the network.<br><br>DOE-RL/WHC Response: The sampling procedure will be reviewed for adequacy based upon the results obtained from previous monitoring. The text will be modified to provide for continuing review and evaluation of the representativeness of the samples based upon past monitoring results. | |
| 201. | Comment: Section 6.2.2.6.2, Leak Detection System, Page 6-4<br><br>The text here indicates that the leak detection system design was scheduled for completion in February 1990. If complete, it must be included in the revised text. If not complete, provide the new date for completion. This also applies to the LCRS referred to in Section 6.2.2.6.4.<br><br>DOE-RL/WHC Response: The information requested was provided to Ecology in September 1990 as the Supplement to the Permit Application for the LLBG, "Low Level Burial Waste Dangerous Waste Permit Application Design Documents, DOE/RL 88-20, Supplement 2." | |
| 202. | Comment: Section 6.3.1.3, Emergency Equipment, Page 6-5<br><br>List any emergency equipment located at each trench or burial ground, i.e., spill control material, fire suppressants, first aid. If there is none, this should be justified.<br><br>DOE-RL/WHC Response: The following text will be added to Section 6.3.1.3: "Emergency equipment is not located at burial ground trenches. Portable fire extinguishers are carried on all LLBG operations vehicles. The 200 area fire station with trained fire fighting and emergency medical personnel and equipment is located within five minutes of any location within the LLBG. Spill cleanup materials are readily available from the 272WA building and the Central Waste Complex staging area (overpack drums, protective clothing, handling and cleanup equipment). The Building Emergency Plan (Contingency Plan) lists the emergency equipment." | |

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| 203. | Comment: Section 7.2, Emergency Coordinators, Page 7-2<br><br>The identification of emergency coordinators is under development through the facility wide permit negotiations. The need to identify these individuals along with their addresses and phone numbers will be addressed upon resolution of this issue. WAC 173-303-350(3)(d)<br><br>**DOE-RL/WHC Response: The names of Building Emergency Directors and Building Wardens are maintained by the Hanford Patrol Operations Center and the Hanford Occurrence Notification Center (ONC) on a twenty four hour basis. These names may accessed by calling the ONC.** | |
| 204. | Deficiency: Section 7.4.1.3, Notification of Authorities, Page 7-19<br><br>The discussion in the first paragraph on this page does not address Ecology's Nuclear and Mixed Waste Program Policy for spill reporting. Also, WAC 173-303-082 is an incorrect citation for spill reporting.<br><br>Requirement: The above referenced policy, to be outlined in a forthcoming letter from Ecology, must be incorporated into the text. The correct regulatory citation is WAC 173-303-145.<br><br>**DOE-RL/WHC Response: The citation will be corrected as requested. The text will be revised as required to respond to the forthcoming letter that defines Ecology's Nuclear and Mixed Waste Program Policy.** | |

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205. Comment: Section 7.4.1.3, Notification of Authorities, Page 7-19

Spill reports should be submitted to Ecology's Kennewick office:

Washington State Department of Ecology
7601 West Clearwater
Suite 102
Kennewick, WA 99336
Phone: (509) 546-2990

Please note that the proper zip code for Ecology's Olympia Office is 98504-8711, not 98501-8711.

**DOE-RL/WHC Response: The address will be changed to identify the Kennewick office for reporting.**

206. Comment: Section 7.4.6, Treatment, Storage, or Disposal, Page 7-32

The text should indicate that releases of dangerous wastes or materials which, upon release, would be considered a dangerous waste, must be handled in accordance with WAC 173-303.

**DOE-RL/WHC Response: The text will be revised to comply with the revised regulations in WAC 173-303-340.**

207. Deficiency: Section 9.2.1.2.2, Migration Through the Vadose, Page 9-8

Based upon discussions in Section 2.1.2.1 regarding past practices, the statement that "no liquid waste is disposed of in the LLBG" is incorrect.

Requirement: Delete or edit the sentence containing this phrase on line 34 and 35.

**DOE-RL/WHC Response: The sentence will be edited as follows: "A leak of this magnitude is unlikely because free liquid currently in containers within the LLBG is to be retrieved. Since November 23, 1987, no free liquid has been accepted in the LLBG."**

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| 208. | Deficiency: Section 11.1.4.3, Gas Sampling, Page 11-27<br><br>Hydrogen gas generation recently created concerns in the tank farms and grout vaults. Therefore, it may not have been prudent to discontinue gas sampling.<br><br>Requirement: In light of the recent hydrogen gas concerns, justification should be provided for not taking gas samples until immediately before retrieval.<br><br>**DOE-RL/WHC Response: Unlike the tank farms, it is expected that radiogenic hydrogen will escape into the atmosphere through the relatively permeable soils and that dangerously high concentrations are unlikely. However, this issue will be addressed in the health and safety plan for waste retrieval, described in Section 11.1.4.6. The word "immediately" will be deleted from Section 11.1.4.3.** | |
| 209. | Comment: Section 11.1.5.2, Cover Design, Page 11-29<br><br>There is a reference on line 33 and throughout this application citing a 1982 EPA guidance document on landfill design. The EPA has published numerous technical guidance documents on this subject since that document was issued. In addition, a substantial amount of regulatory changes concerning dangerous waste landfills have occurred since that time. The LLBG permit application will be evaluated against the more recent documents. It is therefore recommended that past and future work be assessed against the most current guidance.<br><br>**DOE-RL/WHC Response: The cover design in the permit application is conceptual and was prepared in accordance with regulatory guidance existing at the time of writing (1988). Actual (detailed) cover design has yet to be done and will be performed in accordance with the most current regulations and guidance. The text in Section 11.1.5.2 will be modified to include this discussion.** | |
| 210. | Comment: Section 11.1.5.2.1, General Description, Page 11-30<br><br>Comment 146 also applies here.<br><br>**DOE-RL/WHC Response: 3H:1V slopes have been included around the margins of the covers because of limited horizontal distance between the waste trenches and the boundaries of the burial grounds. As shown on Figure 11-9, this slope is only about 5 feet high, so toe** | |

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support is substantial and stability will not be a problem. In addition, this slope will be covered with a 2-foot-thick riprap layer to prevent gullying and animal intrusion. Hence, these slopes are considered adequate as designed.

211. Comment: Figures 11-15 and 11-16, Pages 11-43/44 and 11/45/46

Typos. The burial ground in Figure 11-15 should be "218-W-5", not "218-E-5". The burial ground in Figure 11-16 should be "218-W-6", not "218-E-6".

DOE-RL/WHC Response: Corrections will be made as requested.

212. Comment: Section 11.1.5.2.2.1, Native Soil Grade Layer, Page 11-48

A statement should be made that Ecology will be notified and provided a copy of the construction test pad plan for review and approval prior to initiating construction of this pad.

DOE-RL/WHC Response: Ecology will be provided with a copy of the test pad plan for review prior to construction. This also applies to a number of other plans and designs, many of which have not been completed or even identified at this time. On this basis, it is not appropriate to attempt to identify such submittals in the permit application. EPA guidance suggests preparation of a CQA Plan for landfill and closure cover construction, and such a plan will therefore be prepared for the LLBGs. As an example, Ecology is referred to the CQA Plan for the non-dragoff landfill, which was recently submitted for review and includes detailed plans for a test fill.

213. Deficiency: Section 11.1.5.2.2.3, Soil/Bentonite Layer, Page 11-49

The disking method described for the soil/bentonite layer has been used with mixed results. The method of spreading bentonite on the ground and tilling it into the soil is fraught with inexactness. Soil/bentonite mixing can only be provided for with any certainty by processing in a pugmill. This method is being used for the LERF project and will also be used at the grout facility.

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| | Requirement: The soil/bentonite material must be mixed in a pugmill in accordance with current practice.<br><br>DOE-RL/WHC Response: At this time, material sources for the LLBG covers have not been identified and therefore the applicability of the LERF experience cannot be assessed. The disking method has been successfully used at commercial hazardous waste facilities in the western U.S. and should not be excluded at this time. The text will be revised to state "...(e.g., by disking or mixing in a pugmill)...".<br><br>The design, Specifications, and CQA Plan for the LLBGs will provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications will require a submittal to the WHC Project Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the LLBG covers are constructed. | |
| 214. | Deficiency: Section 11.1.5.2.2.4, FML, Page 11-51<br><br>The EPA currently recommends a 45-mil flexible membrane liner in situations where the liner will be exposed to weathering. Furthermore, standard practice dictates that a 60-mil liner be used even if not exposed (see Grout and LERF designs).<br><br>Requirement: This geomembrane must be 60-mil thick.<br><br>DOE-RL/WHC Response: EPA's recommendation for 45 mils is for bottom liners, not cover geomembranes. In addition, the cover geomembrane will not be exposed to weathering, as a landfill liner with no soil cover or a pond liner would be. The most recent (1989) EPA guidance for covers recommends a 20-mil FML for covers, which has been doubled for the LLBG. Use of a 40-mil FML is standard practice at RCRA hazardous waste landfills in arid regions of the western U.S. | |

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| 215. | Comment: Section 11.1.5.2.2.6, Drainage Layer, Page 11-52<br><br>Comment 157 also applies here.<br><br>DOE-RL/WHC Response: The cover design in the permit application is conceptual and was prepared in accordance with regulatory guidance existing at the time of writing (1988). Actual (detailed) cover design has yet to be done and will be performed in accordance with the most current regulations and guidance. The text in Section 11.1.5.2 will be modified to include this discussion. | |
| 216. | Comment: Section 11.1.5.2.2.9, Vegetative Cover, Page 11-54<br><br>The justification for vegetative specie selection should be provided or a document referenced which, at a minimum, discusses other vegetative varieties which were considered and the reasons for there dismissal.<br><br>DOE-RL/WHC Response: The selection of wheat grasses was based on successful past practice at the Hanford Site. Formal documentation of these practices has not been identified, but a comprehensive search will be conducted. In addition to the existing discussion in the permit application, the text will be modified to note that Russian wheat grasses develop a much higher root density than native wheat grasses and thus more rapidly extract water from the soil profile (Cadwell et al., 1983). The text will also be modified to note that other grasses, if proven more suitable, may be substituted if reseeding is required during the postclosure period.<br><br>Cadwell, M.M, Dean, T.J., Nowak, R.S., Dzurec, R.S., and Richards, J.H., 1983, "Bunchgrass Architecture, Light Interception, and Water Use Efficiency: Assessment by Fiber Optic Point Quadrants and Gas Exchange", Oecologia, Vol 59, pp. 178-184. | |

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| 217. | Comment: Section 11.1.5.2.2.10, Riprap Bedding Layer, Page 11-55<br><br>The bedding layers should also be designed as a filter. Otherwise the storm water runoff and wind will remove fines from beneath the riprap and eventually cause undermining of the riprap and failure.<br><br>DOE-RL/WHC Response: A geotextile layer will be placed between the bedding layer and the riprap to serve as a filter. Figure 11-9 and the text in Section 11.1.5.2.2.10 will be modified accordingly. | |
| 218. | Comment: Section 11.1.5.3, Minimization of Liquid, Page 11-56<br><br>The term "leakance factor" should be edited to read "leakage fraction".<br><br>DOE-RL/WHC Response: The correction will be made as requested. | |
| 219. | Comment: Section 11.1.5.3, Minimization of Liquid, Page 11-57<br><br>Although the regulations require the use of 24-hour, 25-year design storms, the text here specifies a 30-year storm event to match the design life of the covers. Although this makes sense, how does the 30-year design life compare to DOE's requirements for constructing mixed waste disposal facilities? (see comment 128). In addition, would it not be more conservative to design for a shorter duration storm (e.g. 6-hour duration as specified in DOE Order 6430.1A) as it is probably more indicative of the most intense storms received by the Reservation?<br><br>DOE-RL/WHC Response: With respect to DOE's long-term performance objectives for mixed waste facilities, the permit application does not attempt to address compliance with these requirements. Section 11.1.1.1 states that "compliance with these objectives will be demonstrated through a radiological performance assessment as specified by the Department of Energy" and discusses this issue in more detail.<br><br>For the purposes of HELP modelling discussed in Section 11.1.5.3, the 24-hour storm is more conservative than the 6-hour storm because it applies a greater total volume of precipitation to the cover (see Table 11.D.1). The intensity of the 24-hour storm is less than that of the 6-hour storm, but this consideration is not relevant to the proposed analysis. | |

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| 220. | Comment: Section 11.1.5.4.3, Deep-Rooted Plants, Page 11-58<br><br>Roots will not penetrate a coarse, clean, dry, uniformly graded gravel layer. Such a layer, one foot thick and placed above the drainage layer, should be considered. This layer could be keyed into the riprap bedding layer to provide a biotic barrier across the entire cover.<br><br>**DOE-RL/WHC Response: This type of barrier will be evaluated during detailed cover design. The text in Section 11.1.5.4.3 will be modified accordingly.** | |
| 221. | Requirement: Section 11.1.5.4.4, Burrowing Animals, Page 11-59<br><br>The biotic barrier discussed in comment 220 would also address the burrowing animal concern. In addition, the HPDE liner should be designed with the following criteria to reduce the potential for attack by burrowing animals: 1) underground installation of free edges should be avoided, 2) angles of 90 degrees and less should be avoided, and 3) any radius of curvature should be greater than 60mm.<br><br>**DOE-RL/WHC Response: See response to Comment 220. With respect to the suggestions about HDPE liner design, the conceptual design incorporates all of these features, and it is expected that the detailed design will as well.** | |
| 222. | Deficiency: Section 11.1.5.5.1, Cover Drainage, Page 11-60<br><br>The text does not identify where the cover drainage goes. In addition, a means must be provided to monitor the amount of liquid collected from the cover.<br><br>Requirement: Define where the cover drainage will go and how the amount of cover drainage will be measured.<br><br>**DOE-RL/WHC Response: Cover drainage is shown on Figures 11-10 through 11-16. Drainage patterns were designed to conform to the extent possible with existing topography and to discharge into natural channels presently draining the cover areas. More comprehensive surface water management plans will be prepared as part of detailed cover design.** | |

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| | Measurement of drainage from the covers could be performed using standard methods (weirs, flowmeters, gaging, and similar techniques) in the discharge pipes. However, the usefulness of doing this needs to be established. | |
| 223. | Comment: Section 11.1.5.4.3, Page 11-61<br><br>In regards to the choice of storm duration, comment 219 also applies here.<br><br>DOE-RL/WHC Response: The type of storm depends on the type of analysis and the model being used. In Appendix 11, appropriately conservative storms were always selected, for example, the 50-year, 20 minute rainfall for sheet erosion (Appendix 11.D) where intensity is critical. Also see response to Comment 219. | |
| 224. | Comment: Section 11.1.5.6, Settlement and Subsidence, Page 11-67<br><br>Comment 107 also applies here.<br><br>DOE-RL/WHC Response: Lift thickness for the grade layer will be selected so that the compaction specification can be satisfied. The compaction specification of 95% of modified Proctor density was selected as the maximum potentially achievable with conventional methods, and has been found to effectively minimize settlements under structures far less tolerant than the closure cover. Increasing the cover slope from 1.5% to 3%, as discussed above, will also lessen the impact of any areal settlements. | |
| 225. | Deficiency: Section 11.1.6, Schedule for Closure, Page 11-68<br><br>It is unacceptable to defer closure of trenches containing mixed waste for extended periods of time in order to fill low-level waste trenches near the mixed waste trench. Overall, the current closure schedule does not provide for the timely isolation of the mixed waste trenches.<br><br>Requirement: The configuration of proposed trenches must be reevaluated to reduce the amount of time the trenches will remain open. In addition, acceleration of the retrieval schedule must be assessed to shorten the time mixed waste trenches are uncovered. | |

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| | **DOE-RL/WHC Response: The schedule for LLBG closure is in review. A revised schedule may be forthcoming after the impact of acceleration has been completely evaluated.** | |
| 226. | Deficiency: Section 11.2.1.2, Erosion Damage, Page 11-77<br><br>There is insufficient detail provided on the surveying to be conducted.<br><br>Requirement: A drawing of the final cover should be provided indicating where each monument will be located. A drawing or additional text should also be added detailing the design and installation of the monuments. In addition, surveying should be conducted quarterly for at least the first two years and then reduced to annually if no significant changes are noted.<br><br>**DOE-RL/WHC Response: As noted in Section 11.2.1.2, surveying monuments will generally be installed on a 100-foot grid. More exact locations cannot be specified until the final cover designs are completed. The design and installation of survey monuments will also be addressed during final cover design. Quarterly surveying is not considered necessary given the long periods of time during the year when there is little or no precipitation at the Hanford Site.** | |
| 227. | Comment: Section 11.2.1.4, Vegetative Cover Condition, Page 11-77<br><br>The means to determine adequate vegetative cover must be discussed. Two possible methods are identified in the 183-H Basins Closure Plan.<br><br>**DOE-RL/WHC Response: Methods for assessing the vegetative cover as described in the 183-H Basins closure plan will be incorporated as appropriate in the LLBG Permit Application.** | |
| 228. | Deficiency: Section 11.2.1.9, Benchmark Integrity, Page 11-78<br><br>It is insufficient to rely solely on visual inspections when determining benchmark integrity.<br><br>Requirement: Each benchmark should be surveyed to ascertain its integrity.<br><br>**DOE-RL/WHC Response: Benchmark integrity refers to the absence of physical deterioration, for example spalling from frost action. Visual inspections are necessary to determine if changes in survey data are actually ground displacements or the result of other physical** | |

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| | processes affecting the monument itself. The survey monuments will be designed to be robust and weather resistant to the extent practical. | |
| 229. | Comment: Section 11.3, Notice in Deed, Page 11-83<br><br>This section should be rewritten in accordance with the language found in the 183-H Basins Closure Plan (Rev. 3).<br><br>DOE-RL/WHC Response: The notice in deed section from the 183-H Basins closure plan will be incorporated in the LLBG Permit Application. | |
| 230. | Deficiency: Section 11.5, Closure Cost Estimates, Page 11-84<br><br>Closure cost estimates must be provided as agreed to for the facility wide permit.<br><br>Requirement: A statement to this effect must be provided in the text.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text on page 11-84, Section 11.5 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |

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| 231. | Comment: Section 11.7, Post-Closure Cost Estimate, Page 11-84<br><br>Comment 230 also applies to post-closure cost estimates.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text in Section 11.7 on page 11-84 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |
| 232. | Comment: Section 12.3, Transporter Requirements, Page 12-6<br><br>Although transporter requirements are not required per WAC 173-303-260 and -270 at the Hanford Reservation, these requirements must still be fulfilled as requirements under WAC 173-303-395. This statement must be incorporated into the text.<br><br>DOE-RL/WHC Response: The requirements to comply with other environmental protection laws and regulations as stated in WAC 173-303-395(2) pertain to receiving, storing, handling, treating, processing, and disposing of waste at a TSD facility; requirements for transport of waste are not specified. Additional clarification is requested. | |
| 233. | Comment: Section 12.4.1.5.1, Immediate Notification, Page 12-11<br><br>Comment 204 is also applicable to this section and section 12.4.1.6.1.<br><br>DOE-RL/WHC Response: The text will be revised as required to respond to the forthcoming letter that defines Ecology's Nuclear and Mixed Waste Program Policy and WAC 173-303-145. | |

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| 234. | Comment: Section 12.4.2.3.3., Closure and Post-Closure, Page 12-18<br><br>Comment 230 also applies.<br><br>DOE-RL/WHC Response: The permit application will be revised to indicate that closure cost information will be provided as part of the annual reporting requirements of WAC 173-303-390. The schedule for initial submittal of projections of anticipated costs for closure will be established as part of discussions associated with the development of the Hanford Facility Permit. The text in Section 12.4.2.3.3 will be changed to the following: "It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated costs for closure will be provided annually during closure activities." | |
| 235. | Comment: Appendix 4A, List of Mixed Waste, Page 4A-ii<br><br>It is unclear what the term "UNSEG" means. Does this term identify trenches which could have any type of waste including TRU, mixed, etc.? Please clarify.<br><br>DOE-RL/WHC Response: The following definition will be added to Appendix 4B: "Unseg is an abbreviation of unsegregated. The term arises from the description of waste buried prior to 1970 which did not have the transuranic waste component segregated from the low level component of the waste matrix." | |
| 236. | Comment: Appendix 4A, List of Mixed Waste, Page 4A-18, 38, 44<br><br>Trenches CU1 and TV7 are not identifiable on Figure 2-9. These trenches should be identified on the figure or the proper identification numbers provided in this appendix. In addition, trenches T05 and T10 are listed in this appendix but only trenches T05E and T10E exist on Figure 2-8. The text or the figure should be clarified.<br><br>DOE-RL/WHC Response: "Trench CU1" is not a standard trench, but is a caisson that contains low level waste. This number 1 caisson is located in the area where trench 14 of burial ground 218-W-4B would be located as shown in Figure 2-9. Appendix 4B, page APP 4B-9 provides additional information. "Trench TV7" is a concrete portion of trench 7 in burial ground 218-W-4B as shown in Figure 2-9. The "E" will be removed from Figure 2-8. | |

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| 237. | Comment: Appendix 4B, Trench Classifications, Page 4B-3<br><br>Trenches 1D and 16 in burial ground 218-E-12B should be classified as LL-MW (low-level mixed waste) based upon information provided on page 4A-1. In addition, if trench 28 is closed, why is part of its classification "*" (trench will be dug)? Please clarify or correct.<br><br>**DOE-RL/WHC Response: Trench 1D and 16 will be revised and classified as UG-MW which means unsegregated mixed waste. Trench 28 classification will be revised to be LL-MW and appropriate dates added.** | |
| 238. | Comment: Appendix 4B, Trench Classifications, Page 4B-9<br><br>Based upon information provided in Appendix 4A, trenches 3, 4, 8, 9, 10, 12, and 13 should also be classified as LL-MW (low-level mixed waste). Please correct or clarify.<br><br>**DOE-RL/WHC Response: Trenches 3, 4, 6, 8, 9, 10, 12, and 13 will be redesignated UG-MW in the table.** | |
| 239. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-1<br><br>The specific gravity of the liner must be no less than 0.94 and the maximum melt flow index must be no more than 0.3 grams per 10 minutes.<br><br>**DOE-RL/WHC Response: A detailed set of Specifications has been prepared for the Project W-025 Landfill. These specifications require that the specific gravity of the FML resin be greater than 0.94. Melt index is required to be within the range of 0.1 to 1.1 g/10min, based on typical values reported by geomembrane manufacturers.** | |

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| 240. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-2<br><br>The geosynthetic quality assurance consultant must not only verify the specifications identified, or to be identified, in Table 4F-1, but also every fingerprinting parameter (see comment 161).<br><br>DOE-RL/WHC Response: Melt index and specific gravity are considered "fingerprinting" tests and will be required submittals from the FML manufacturer as discussed in the Specifications (Section 02275) and the CQA Plan (Section 4.4.1.1). Other 'fingerprinting' tests such as thermogravimetric analysis and differential scanning calorimetry will be performed as part of the 9090 testing program for evaluating chemical changes in the FML. These tests are also required for each lot of geomembrane as noted in Appendix A of the CQA Plan. | |
| 241. | Comment: Appendix 4F, Liner Material Specifications, Table 4F-1<br><br>Why are four identical values given for some parameters? The fingerprinting parameters must also be listed, with limits, on this table.<br><br>DOE-RL/WHC Response: The Specifications prepared for the Project W-025 Landfill now contain only information pertinent to the geosynthetics actually used in the design. With respect to "fingerprinting" parameters, see responses to comments 239 and 240. | |
| 242. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-8<br><br>One factor of the geomembrane layout which could be "detrimental to the project" is excessive seam footage. To reduce this problem, a minimum liner roll width should be specified. A list of other possible detrimental aspects should be listed.<br><br>DOE-RL/WHC Response: This discussion has been eliminated in the revised Specifications. As described in Section 02275, the Geosynthetics Installer will be required to submit a panel layout plan for approval prior to construction, and general requirements for panel layout are explicitly stated. The specified geomembrane is supplied in 34-ft-wide rolls, among the widest in the industry. | |

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| 243. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-9<br><br>The preferred method of seaming is double hot wedge welding. Any other method of welding will have to be justified over this method.<br><br>DOE-RL/WHC Response: The 'best' seaming method for geomembranes is still an open issue, particularly for textured FMLs. It also depends on factors other than equipment, such as crew experience. Any seaming method used at the Project W-025 Landfill will be demonstrated and proved satisfactory by test seams, as well as ongoing destructive and non-destructive tests of actual seams. These requirements are in Section 02275 of the Specifications and Section 4.4 of the CQA Plan. | |
| 244. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-10<br><br>The specifications must include extreme temperatures (absolute maximum and minimum ambient temperatures) beyond which no seaming will occur. In addition, the methods must be specified which will be used during temperatures between the optimal range and the extreme range.<br><br>DOE-RL/WHC Response: Construction Specification WHC-S-045, Section 02275, page 20, specifies the absolute maximum and minimum ambient temperatures for seaming and specifies methods that the installer must satisfactorily demonstrate for use during weather conditions between the optimal range and this extreme range. | |
| 245. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-20<br><br>Comment 213 also applies here. In addition, moisture adjustments cannot be made at the borrow site, but must be made at the pugmill.<br><br>DOE-RL/WHC Response: The Design Report, Specifications, and CQA Plan provide a great deal of latitude for the Contractor (or Construction Manager) to determine the most suitable types of equipment and procedures for preparing and placing the admix liner. The Specifications require a submittal to the WHC Project Engineer and the CQA Engineer describing these activities. With this approach, the pertinent experience from the LERF Project will be incorporated as appropriate when the Project W-025 Landfill is constructed (see response to comment 19 in regards to an individual test fill). | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 246. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-21<br><br>In-situ permeability testing must be done with a sealed double ring infiltrometer.<br><br>DOE-RL/WHC Response: A Sealed Double Ring Infiltrometer (SDRI) test will be performed on the test fill (see response to comment number 19). | |
| 247. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-22<br><br>Comment 157 also applies here and to Table 4F-7.<br><br>DOE-RL/WHC Response: EPA guidance allows use of either granular or synthetic drainage layer materials. The Project W-025 Landfill design includes both. As noted in response to comment 31, the transmissivity of the geocomposite exceeds the EPA proposed requirement, and thus would be adequate by itself. However, the drainage gravel has been added for redundancy. Hence, the design provides high flow capacity and substantially exceeds the proposed EPA requirements. | |
| 248. | Comment: Appendix 4F, Liner Material Specification, Page 4F-23<br><br>Transmissivity should be measured with the geonet sandwiched between the actual boundary materials, not steel plates. Explain why the condition in footnote "a" must be met. Comments 239 and 240 also apply here.<br><br>DOE-RL/WHC Response: This is a manufacturer's test method and is intended as a conformance test, not a simulation test. In other words, if the geonet has this transmissivity under these conditions, it is an acceptable product. With respect to Note (a), it has been found that a higher specific gravity produces a harder HDPE. To avoid the geonet embedding into the FML under load and thereby restricting flow, the geonet specific gravity is specified to be less than that of the FML. Responses to comments 239 and 240 apply here as well. | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 249. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-25<br><br>The drainage net must be stored above ground in a dust-proof wrapper.<br><br>DOE-RL/WHC Response: This requirement has been included in the Specifications (Section 02275). | |
| 250. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-27<br><br>Frozen material will be removed from the fill and reprocessed through the pugmill or discarded.<br><br>DOE-RL/WHC Response: The CQA Plan discusses restrictions on construction activity during freezing weather and establishes the requirement to protect the completed admix layer from freezing. See also response to comment 151. | |
| 251. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-29<br><br>The list of actual specifications to avoid desiccation cracking should be provided.<br><br>DOE-RL/WHC Response: Measures to minimize desiccation as well as repair criteria are described in the CQA Plan (Section 4.3.2) and Specifications (Section 02224). | |
| 252. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-44<br><br>Ecology shall be notified of the date, time, and place of resolution meetings. If Ecology plans to attend, the meeting must be delayed a reasonable length of time to allow their attendance. This is also applicable to the preconstruction meeting and problem/work deficiency meetings. This requirement must be reflected in the application.<br><br>DOE-RL/WHC Response: The application will include that Ecology will be notified within a reasonable amount of time of the date, time, and place of resolution meetings, so that their non-attendance will not result in a delay of the meeting. | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 253. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-49<br><br>The facility design and specifications will be part of the dangerous waste permit. Therefore, any changes to or deviations from the design or specifications must be approved by Ecology. Ecology will treat these changes as Class I permit modifications requiring pre-approval. Ecology assumes that these changes and deviations will be handled through the Engineer Change Notice (ECN) process and Nonconformance Report (NCR) process such as used for the Grout project. If this is true, Ecology must be provided a copy of the draft ECN/NCR to allow response, if necessary, prior to implementing the change or dispositioning the nonconformant condition. This requirement may be fulfilled by either 1) hand delivering the draft ECN/NCR to Ecology's on-site construction inspector, if one is present, or 2) sending a facsimile copy (fax) to Ecology's LLBG unit manager. Ecology will notify DOE-RL if the modification should be upgraded to a Class II or III modification. This method of handling modifications is limited to design and specification changes which occur during construction. All other changes must be handled in accordance with WAC 173-303-830. A statement reflecting this discussion must be made in the application.<br><br>**DOE-RL/WHC Response: ECN/NCRs will be provided to the on-site inspector prior to implementation by the construction contractor. If the on-site inspector is unavailable, the ECN/NCR will be faxed to the Ecology office in Lacy, Washington for their immediate review. The turnaround time for this review is expected to be within 8 hrs.** | |
| 254. | Comment: Appendix 4F, Liner Material Specifications, Page 4F-51<br><br>Comment 246 also applies here.<br><br>**DOE-RL/WHC Response: A Sealed Double Ring Infiltrometer (SDRI) test will be performed on the test fill (see response to comment number 19).** | |
| 255. | Comment: Appendix 4G, Construction Procedures, Page 4G-1<br><br>These procedures must be approved by Ecology before construction begins.<br><br>**DOE-RL/WHC Response: Construction procedures are described in both the CQA Plan and the Specifications. Ecology will be provided with an opportunity to examine these procedures before construction begins.** | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|

**********

The following comments refer to Supplement 1 of the LLBG permit application, Request for Exemption from Lined Trench Requirements.

256. Deficiency: Section 2.3.2, Long-Term Migration, Page 2-8

This section discusses the reasons for requiring liner systems at dangerous waste land-based units. In addition to the reasons provided, the bottom liner system provides the function of detecting leachate. This liner system is, in fact called the leachate detection, collection and removal system (LDCRS). Although Ecology agrees that the SRC's are designed such that we can be reasonably sure liquids will not leach from/through the SRC's, the most prudent practice in this case is to provide a means to verify that the SRC system performs as asserted in this document.

Requirement: A means to monitor the amount of liquids, if any, that could pass from/through an SRC needs to be included in the disposal design. Ecology recommends that a catch basin similar to those beneath the grout vaults be installed beneath one of the SRC's as a demonstration project. The basin would need to be capable of collecting liquids as well as provide a means to measure the quantity and assess the composition of any liquids which could reach the basin.

DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation.

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 257. | Comment: Section 3.1, General Description, Page 3-1<br><br>Typo. "U.S. Ecology" should be edited to read "US Ecology".<br><br>DOE-RL/WHC Response: The text will be corrected to read US Ecology. | |
| 258. | Comment: Section 4.1, Waste Characteristics, Page 4-1<br><br>Are the bulkheads which are added at Bremerton Navy Yard welded with the same specifications and performance standards utilized in welding the original hull? Describe any differences between the specifications and standards used for the original hull and those used on the bulkheads welded for disposal purposes.<br><br>DOE-RL/WHC Response: The new welding to install shipyard fabricated disposal bulkheads is also accomplished using Navy shipbuilding and repair welding processes and electrodes to produce the same high-integrity welding as found on original ship construction.<br><br>Since the initial construction of nuclear powered submarines, the Navy has established the highest standards for critical welds, including submarine hull welds and reactor plant welds. In general, these Navy welding standards are more rigorous than private sector critical welding standards.<br><br>The strength of the Navy standards lies not only in the proper selection and qualification of materials and welding parameters, but also in the rigorous personnel training and qualification process, nondestructive testing (NDT) and audit and surveillance programs. Most importantly, official records for each of these areas are maintained as objective quality evidence that welding and NDT were completed satisfactorily.<br><br>All weld materials are tested and maintained to ensure the materials meet specified standards. Welding procedures are formally developed and qualified in accordance with Navy requirements. The personnel performing the welds must be qualified, and periodically requalified, to demonstrate the ability to perform the welding in accordance with the weld procedure. Finally, nondestructive testing is performed by personnel who are qualified, and periodically requalified on the use of nondestructive test equipment. In addition, in-process surveillances are conducted by independent quality assurance personnel to evaluate work performance and to verify welding is being performed in accordance with specifications. | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| | The original welding of the SRC hull was accomplished to Navy standards designed to ensure the integrity of deep diving hull structures, which must resist submergence pressures and potential battle shock while protecting human life and the operating reactor plant. The only significant difference between original hull welding and new welding is that since the new welds will not be subjected to the cyclic stresses experienced by deep diving hulls, they do not require the radiographic inspection used on original hull welds. It should be noted that all containment boundary welds (both original and new) are subjected to a package air test to verify their integrity. | |
| 259. | Comment: Section 5.1.1, Integrity of the SRC, Page 5-2<br><br>This section should include a discussion regarding: 1) the effects of radiation on corrosion rates; and, 2) the corrosion potential of original hull and new bulkhead welds.<br><br>DOE-RL/WHC Response: The text will include:<br><br>a. "The corrosion rate of the hull, containment bulkheads, and containment bulkhead welds is not affected since these materials are basically non-irradiated."<br><br>b. "There is no difference in corrosion potential between the ship's original welds and new welds accomplished in preparing the SRC package for disposal." | |
| 260. | Comment: Section 5.1.2.1, Lead, Page 5-5<br><br>Typo. The word "At" in line 6 should be edited to read "As".<br><br>DOE-RL/WHC Response: The text will be changed to "As". | |
| 261. | Comment: Appendix 5A, Conceptual Design of Cathodic Protection, Page 5A-1<br><br>The specifications for the epoxy-polyamide paint should be provided to include a discussion of the durability of this paint under the handling, transportation and disposal scenarios expected.<br><br>DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation. | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| | The original welding of the SRC hull was accomplished to Navy standards designed to ensure the integrity of deep diving hull structures, which must resist submergence pressures and potential battle shock while protecting human life and the operating reactor plant. The only significant difference between original hull welding and new welding is that since the new welds will not be subjected to the cyclic stresses experienced by deep diving hulls, they do not require the radiographic inspection used on original hull welds. It should be noted that all containment boundary welds (both original and new) are subjected to a package air test to verify their integrity. | |
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| 261. | Comment: Appendix 5A, Conceptual Design of Cathodic Protection, Page 5A-1<br><br>The specifications for the epoxy-polyamide paint should be provided to include a discussion of the durability of this paint under the handling, transportation and disposal scenarios expected.<br><br>DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation. | |

| No. | Comment/Response | Ecology Concurrence |
|---|---|---|
| 262. | Comment: Appendix 5A, Conceptual Design of Cathodic Protection<br><br>The report states that if the passive cathodic protection fails, an impressed current can be substituted. If the conductors fail, how will an impressed current work? If the sacrificial anodes fail, why not replace them?<br><br>DOE-RL/WHC Response: Ecology comments 143, 256, 261, and 262 require further technical evaluation. | |

Distribution:

| | |
|---|---|
| R.C. Bowman | WHC (H4-57) |
| R.M. Carosino | RL (A4-52) |
| C.E. Clark | RL (A6-95) |
| D.L. Duncan | EPA (HW-074) |
| [redacted] | [redacted] |
| M. French | DOE-NR |
| R.A. Gilbert | RL (A5-21) |
| T.M. Greager | WHC (G6-47) |
| R.D. Izatt | RL (A6-95) |
| J.D. King | SWEC (A4-35) |
| B. Koch | PSNS |
| M. Jaraysi | Ecology |
| R.D. Pierce | WHC (N3-13) |
| J.J. Witczak | Ecology |
| T.J. Woebkenberg | SWEC (A4-35) |
| T.L. Yount | WHC (G6-47) |

ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

Final

**Meeting Minutes Transmittal/Approval**
**Unit Managers Meeting: Low Level Burial Grounds**

**Meeting Held September 11, 1991**
**EPA Region 10**
**712 Swift, Suite 700**
**Richland, Washington**

---

Appvl. _____ Date: 11/7/91
Clifford E. Clark, Environmental Policy and Permitting, RL

Appvl. Not Present
_____ Date: _____
Daniel L. Duncan, EPA Region 10, RCRA Program Manager

Appvl. _____ Date: _____
Joe Witczak, Unit Manager, Washington State Department of Ecology

Appvl. _____ Date: _____
Richard Pierce, Unit Manager, Contractor Representative, WHC

---

PURPOSE:
Meeting Minutes are attached. These minutes are from the Unit Managers Meeting held Septmeber 11, 1991. Minutes are comprised of the following:

Attachment 1 - Summary of Discussion and Commitments
Attachment 2 - Attendance List
Attachment 3 - Agenda
Attachment 4 - Action Items List with Status
Attachment 5 - Project W-025 Landfill (Presentation Synopsis)

Distribution:

| | |
|---|---|
| R.C. Bowman | WHC (H4-57) |
| R.M. Carosino | RL (A4-52) |
| C.E. Clark | RL (A6-95) |
| D.L. Duncan | EPA (HW-074) |
| G.C. Evans | WHC (H4-57) |
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ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

Attachment #1

**Low Level Burial Grounds**
**Unit Managers Meeting**
**EPA Region 10 Office, 712 Swift, Suite 700**
**Richland, Washington**
**September 11, 1991**

**Summary of Discussion and Commitments**

- The first topic of discussion was the Notice of Deficiency Responses. There were no Notice of Deficiency comments referred to by number for comments during discussion. Ecology's comments on the Design Package for the LLBG leachate liner and collection will be combined with the NOD comments. Ecology expects the combined package to be ready by the end of the first week of October 1991.

- Ecology (Moses Jaraysi) gave some heads-up comments on the CQA Plan. Mr. Jaraysi stated that one of the lessons learned from LERF's CQA Plan was the incompatibility between the test sampling and the testing procedure as related to actual on-site operations; the speed with which the tests were carried out was not compatible with progress on site. Mr. Jaraysi gave the example that a membrane should be tested for certain properties before it is buried, but the length of time taken to gather results of this test were incompatible with the progress on site. This left the choice of either delaying work on site or going ahead, and the latter choice took the risk of coming up with failing results on these tests. This is the major item in the CQA for this project that Mr. Jaraysi noted.

- Golder (Frank Shuri) gave a presentation on the 9090 test results and design life for Project W-025 Landfill. (See Attachment 5). Mr. Shuri noted that the W-025 Landfill site is located in the 200 West Area; it will be a double-lined RCRA-compliant facility; it will cover approximately two acres (450 feet x 300 feet at ground level); and it will have the capacity for 50,000 to 150,000 55-gallon drums, depending on cover slopes and backfilling practices.

  Mr. Shuri of Golder covered some information about 9090 testing. The purpose of EPA 9090 testing is to evaluate chemical compatibility of geomembranes and leachate and to eliminate clearly incompatible materials. 9090 testing applies to geomembranes, but is extrapolated to other materials. The 9090 testing protocol establishes in detail: The test duration, test temperatures, types of tests (strength and dimensional, and the number of samples. The data analysis approach and acceptance criteria are not specified by the 9090 method.

  The materials for 9090 Test on W-025 was discussed. WHC (Tim Greager) noted the legal restriction against designating in the construction specification a specific manufacturer. Ecology (Joe Witczak) stated that Ecology doesn't like to use a different material than was tested. Mr. Witczak suggested for future projects possibly going through vendor selection before doing 9090 testing and then having a contract specify

doing 9090 testing as well as providing the material. Ecology (Moses Jaraysi) stated that from experience on the LERF project, it is not a good idea to be limited to a single vendor. Golder (Frank Shuri) also covered in his presentation the subjects of: Leachate development, the number of tests, test results on HDPE materials and on polyester geotextiles, comparison of 9090 testing programs between the Grout Treatment Facility and the W-025 Landfill, W-025 design life study, intended approach, and preliminary testing results.

- The next meeting is scheduled for October 22, 1991 at 9 a.m. at the Department of Ecology office conference room in Kennewick, Washington.

Attachment 2

Low Level Burial Grounds
(W-025 Mixed Waste Trench)
Unit Managers Meeting
September 11, 1991

Attendence List

| NAME | ORGANIZATION | PHONE # |
|---|---|---|
| D. Armstrong | WHC | (509) 373-9240 |
| R. Bowman | WHC | (509) 376-4876 |
| C. Clark | RL | (509) 376-9333 |
| J. Divine | ChemMet | (509) 967-2309 |
| E. Erpenbeck | WHC | (509) 376-8032 |
| G. Evans | WHC | (509) 376-8939 |
| D. Fassett | SWEC | (509) 376-5011 |
| T. Greager | WHC | (509) 376-0312 |
| M. Jaraysi | Ecology | (509) 546-2995 |
| K. Knox | CNES | (509) 376-5011 |
| R. Pierce | WHC | (509) 376-5681 |
| F. Shuri | Golder | (206) 883-0777 |
| J. Witczak | Ecology | (206) 438-7557 |

Attachment 3

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**September 11, 1991**

**Agenda**

LOW-LEVEL BURIAL GROUNDS

I Opening Remarks (C. Clark)

II Discuss Responses to the Notice of Deficiencies (J. Witczak)

III Status of Ecology Comments on Design Package for LLBG Leachate Liner and Collection System (J. Witczak)

IV Discuss 9090 Test results and Design Life for Mixed Waste Trench (W-025). (T. Greager and Golder & Associates)

Attachment 4

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**September 11, 1991**

**Commitments/Agreements Status**

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

# Attachment 5

## Notice of Deficiency Response Table with Responses

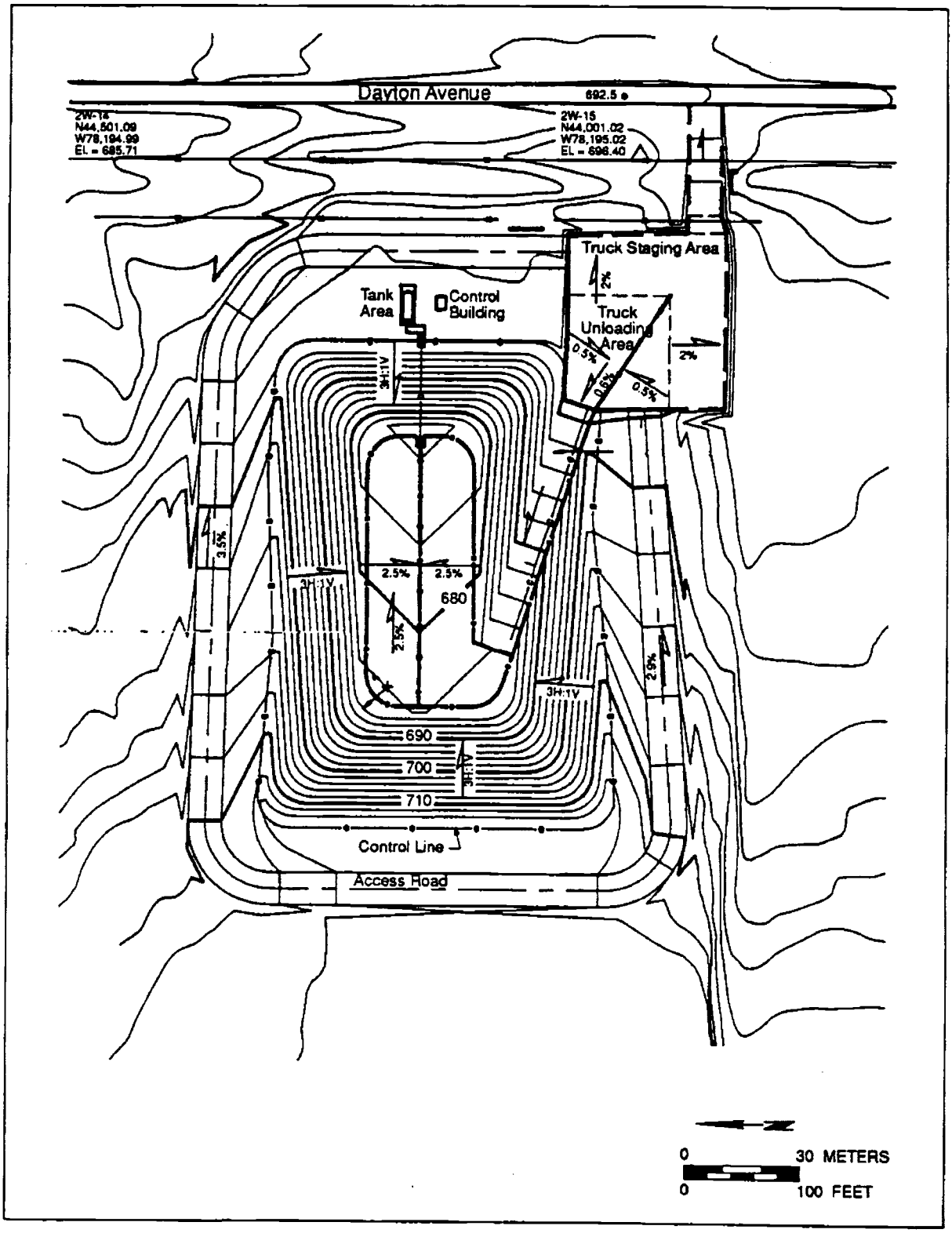
Attachment #5



# Project W-025 Landfill

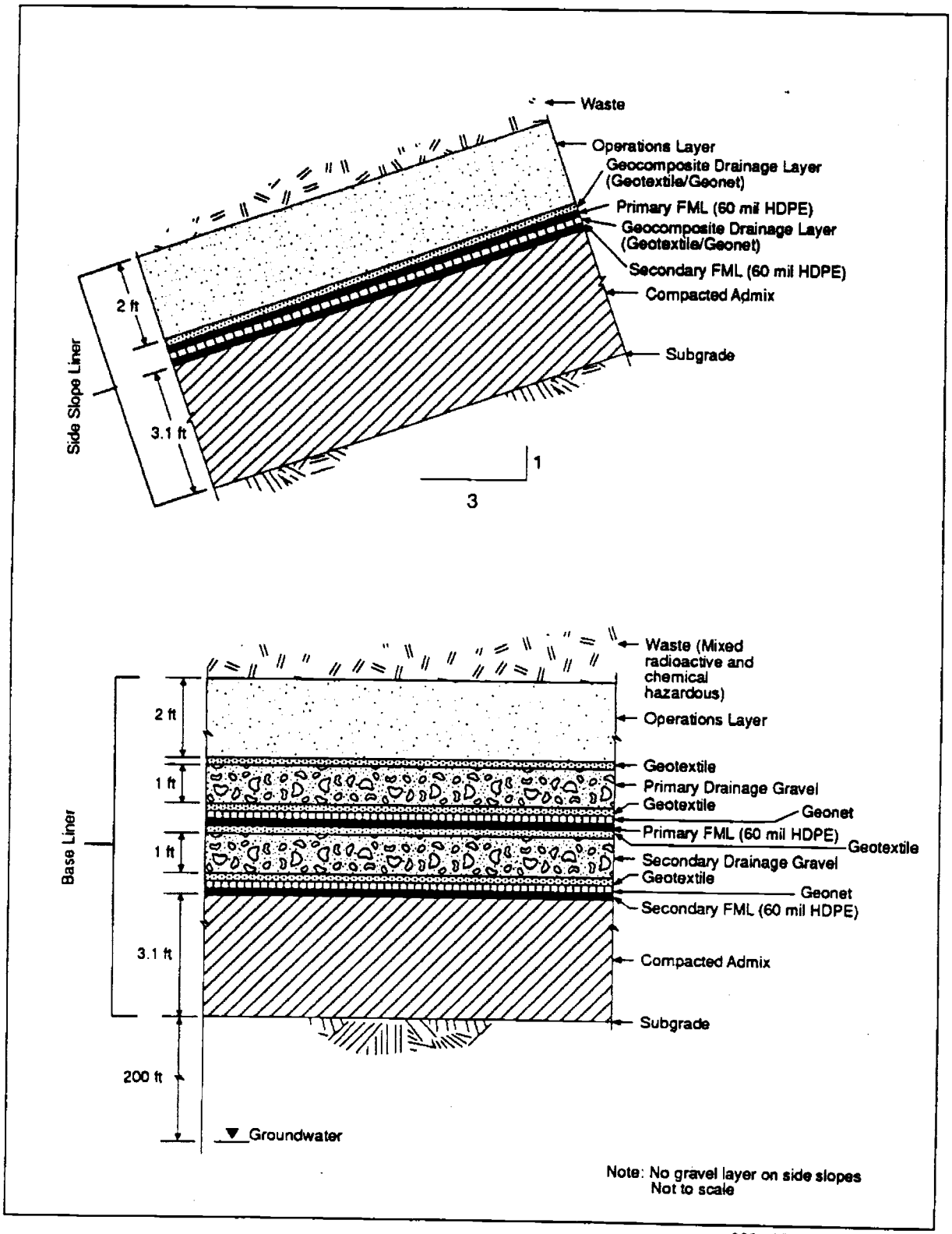
- Located in 200 West Area
- Double Lined RCRA-Compliant Facility
- 450 ft x 300 ft at Ground Surface (About 2 Acres)
- 30 ft deep, 3H:1V Sideslopes
- Capacity About 50,000 to 150,000 55-gal Drums (Depends on Cover Slopes and Backfilling Practice)

903 1264




903-1250/26459/9-6-91

**Figure 3-2a.** Current Landfill Design - Plan View.

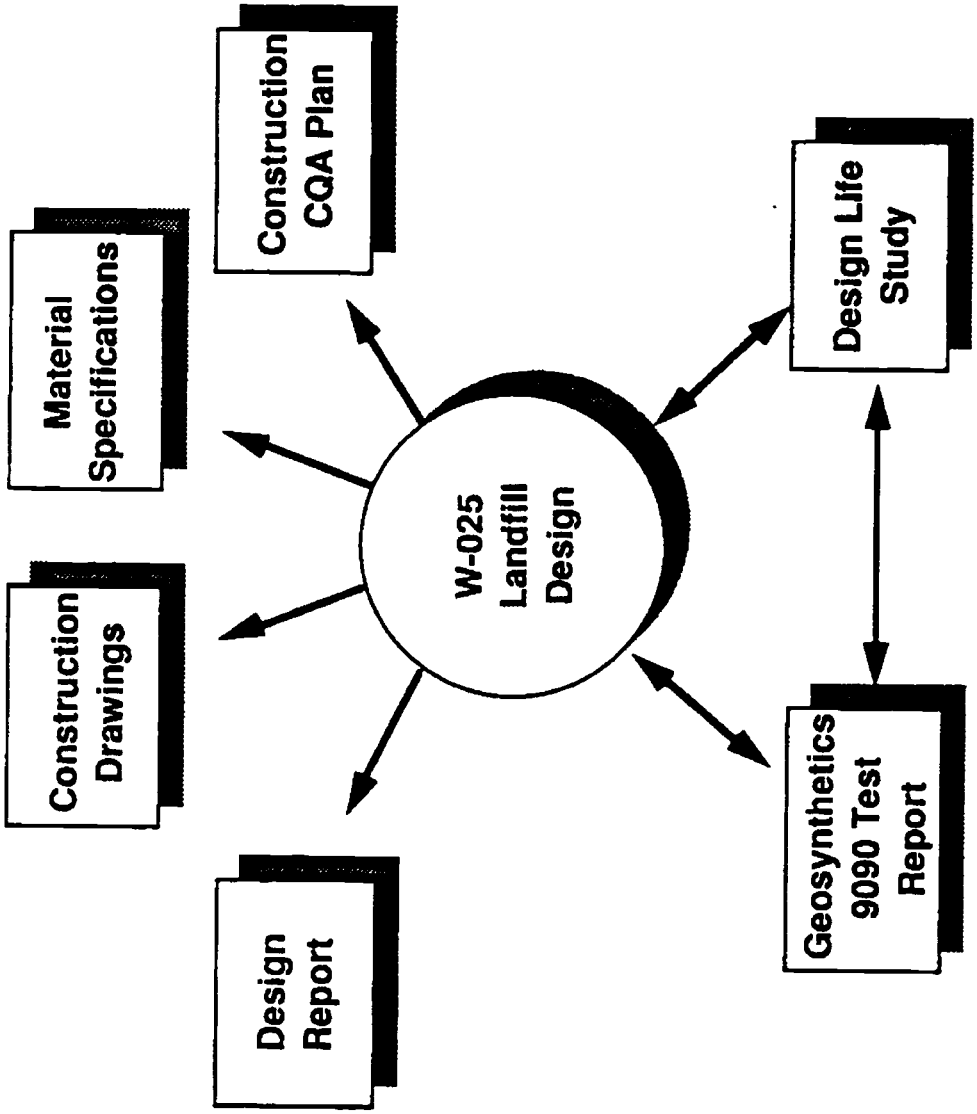



903 1250.300/26043/8-13-91

**Figure 3-2b.** Current Landfill Design-Liner Sections.

# Liner System

- **2-ft-Thick Operations Layer: Protection**
- **Primary LCRS: Leachate Collection and Removal**
- **Primary 60 mil HDPE Geomembrane: Moisture Barrier**
- **Secondary LCRS: Leachate Detection, Collection and Removal**
- **Secondary Liner System: Moisture Barrier**
  - 60 mil HDPE Geomembrane
  - 3-ft-Thick Low Permeability Soil/Bentonite Admix Layer
- **Geotextiles: Cushioning, Separating Soils, Providing Interface Shear Strength**


Material Specifications
Construction Drawings
Design Report
Construction CQA Plan
W-025 Landfill Design
Design Life Study
Geosynthetics 9090 Test Report

903 1264

# EPA Test Method 9090

- **Purpose:**
  - Evaluate Chemical Compatibility of Geomembranes and Leachate
  - Eliminate Clearly Incompatible Materials
- **Applies to Geomembranes, Extrapolated to Other Materials**
- **Testing Protocol Established in Detail**
  - Duration
  - Test Temperatures
  - Types of Tests (Strength and Dimensional)
  - Number of Samples
- **Data Analysis Approach and Acceptance Criteria not Specified by EPA Method 9090**

# 9090 Test Program for W-025 Materials

- Tests at 0, 30, 60, 90, and 120 days
- Immersion Temperatures of 23° C or 50° C
- Radiation Exposure of 50kRad
- Synthesized Leachate
- Standard Suite of 9090 Strength and Dimensional Tests
- Non-Standard "Fingerprinting" Tests on HDPE Geomembrane (DSC, TGA)

# Leachate Development

- Review WHC Waste Profile
- Define Results of Disposal Processes & Treatments
- Prepare Waste Mix
- Filter
- Analysis & Results
- Production of Large Volumes of Leachate

# Number of Tests

| | |
|---|---|
| ● HDPE Geomembrane | 734 |
| ● Polyester Geotextiles | 1021 |
| ● HDPE Geonet | 120 |
| ● HDPE Drainage Pipe | 247 |
| Total: | 2122 |

# Results

- **HDPE Materials:** Stable, No Deterioration
- **Polyester Geotextiles:** Slight Change in Properties Over Time

# Comparison of 9090 Testing Programs

| Grout Facility | W-025 Landfill |
|---|---|
| • Materials: HDPE, Polypropylene, Polyester, XR-5 | HDPE, Polyester |
| • Max. Temp: 70°C and 90°C | 50°C |
| • Radiation: 930 kRad and 39,000 kRad | 50kRad |
| • Leachate Composition: W-025 + Heavy Metals + Inorganic Salts + Organics | $NaNO_3$ + Minor Anions |
| • Leachate pH: >13.9 | 9.2 |

903 1264

# W-025 Design Life Study

- Effects of Increasing Operating Life From 2 to 20 Years
- If Concerns Exist, Identify Potential Engineering Modifications

# Approach

- Develop Conceptual Model of Landfill System and Processes
- Identify Potential Deterioration Mechanisms (Include 9090 Test Results)
- Identify Detailed Parameters That Affect Deterioration
- Determine Most Significant Parameters
- Assess Likelihood of Changes With Time
- Evaluate Engineering Options to Mitigate Adverse Changes

# Preliminary Results

- **Deterioration**
  - Admix Layer:
    - Desiccation
    - Freeze/Thaw
  - Geomembrane:
    - Stress Cracking
    - Landfill Operations
  - Geotextile:
    - Chemical Deterioration

- **Design Modifications**
  - Increase Operations Layer Thickness
  - Bentonite Mat of Admix Layer Under Primary FML
  - Increase Operations Layer Thickness
  - Use Polypropylene Geotextile
  - Increase Geotextile Thickness

Distribution:

| | |
|---|---|
| R.C. Bowman | WHC (H4-57) |
| R.M. Carosino | RL (A4-52) |
| C.E. Clark | RL (A6-95) |
| D.L. Duncan | EPA (HW-074) |
| [redacted] | |
| M. French | DOE-NR |
| R.A. Gilbert | RL (A5-21) |
| T.M. Greager | WHC (G6-47) |
| R.D. Izatt | RL (A6-95) |
| J.D. King | SWEC (A4-35) |
| B. Koch | PSNS |
| M. Jaraysi | Ecology |
| R.D. Pierce | WHC (N3-13) |
| J.J. Witczak | Ecology |
| T.J. Woebkenberg | SWEC (A4-35) |
| T.L. Yount | WHC (G6-47) |

ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

**Meeting Minutes Transmittal/Approval**
**Unit Managers Meeting: Low Level Burial Grounds**

**Meeting Held December 11, 1991**
**Washington State Department of Ecology Office**
**7601 W. Clearwater Avenue**
**Kennewick, Washington**

Appvl. _____ Date: 1/22/92
Clifford E. Clark, Environmental Policy and Permitting, RL

Appvl. Not Present
_____ Date: _____
Daniel L. Duncan, EPA Region 10, RCRA Program Manager

Appvl. _____ Date: 1/ /92
Joe Witczak, Unit Manager, Washington State Department of Ecology

Appvl. _____ Date: 1/22/92
Richard Pierce, Contractor Representative, WHC

PURPOSE:
Meeting Minutes are attached. These minutes are from the Unit Managers Meeting held December 11, 1991. Minutes are comprised of the following:

Attachment 1 - Summary of Discussion and Commitments
Attachment 2 - Attendance List
Attachment 3 - Agenda
Attachment 4 - Action Items List with Status

Attachment #1

**Unit Managers Meeting: Low-Level Burial Grounds**
**Washington State Department of Ecology Office**
**7601 W. Clearwater Avenue**
**Kennewick, Washington**
**Meeting Held December 11, 1991**

**Summary of Discussion and Commitments**

Discussion of Responses To Notice of Deficiency (NOD) Comments

WHC/RL questioned Ecology's request for more extensive vadose zone monitoring since a 20-year tracer test study for tritium already exists and also because there are monitoring wells already being sampled. Ecology suggested that this issue could be resolved by including Krystyna Kowalik (Ecology) in future discussions of vadose zone monitoring, and Ms. Kowalik should be available at the next Unit Managers Meeting.

Regarding NOD comment 144, WHC expressed concern about a statement that monitoring would continue as long as the waste is hazardous rather than establishing a time frame for monitoring. WHC also stated that the regs are set up so that waste is hazardous if leachate is being produced. Also, RL cannot commit to spending money which has not been appropriated. For the lined trench, Ecology envisions an approach wherein if no leachate is detected that monitoring would slowly go from monthly to quarterly to annually and gradually be phased out.

Status of Exemption from Lined Trench Requirements for SRCs

Preparation is under way on the request for exemption from the lined trench requirements for the submarine reactor compartments, and the request should issued to Ecology by March 1992.

Justification for 3:1 Slope for Lined Trench

WHC stated that there are several commercial waste landfills with 3:1 side slopes which have been operating for a number of years, the designs of which used safety factors of 1.5 and 1.1 for static loading and met industry standards used by federal and state regulators. WHC would appreciate further input from Ecology on specific justifications for preferring 4:1 slopes which WHC could then address, i.e., concerns about particular failures at other facilities or relevant technical data. Ecology has seen guidance and design documents which suggest that a safety factor of 1.5 is minimally acceptable and therefore believes that a safety factor of 2.0 is desirable and can be achieved either through a side slope ratio of 4:1 or by other parameters such as choice of materials. RL questions the effectiveness of increasing the safety factor from 1.5 to 2.0 and stated that doing so would greatly increase cost.

Responses to NOD comments will need to be provided to Ecology at least 60 days before start of construction in order to allow for review.

The next Low-Level Burial Grounds UMM is scheduled for January 22, 1992 in Richland, Washington.

Attachment 2

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**December 11, 1991**

Attendance List

| NAME | ORGANIZATION | PHONE # |
|---|---|---|
| R. Bowman | WHC | (509) 376-4876 |
| C. Clark | RL | (509) 376-9333 |
| K. Donato | SWEC | (509) 376-8210 |
| E. Erpenbeck | WHC | (509) 376-8032 |
| G. Evans | WHC | (509) 376-8939 |
| M. Jaraysi | Ecology | (509) 546-2995 |
| J. King | SWEC | (509) 376-4726 |
| R. Pierce | WHC | (509) 376-5681 |
| S. Price | WHC | (509) 376-1653 |
| J. Witczak | Ecology | (206) 438-7557 |

Attachment 3

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**December 11, 1991**

**Agenda**

| | | |
|---|---|---|
| I | Opening Remarks | C. Clark |
| II | Discuss responses to the Notice of Deficiencies | G. Evans |
| III | Discuss status of Request for Exemption from Lined Trench Requirements for SRC | C. Clark |
| IV | Discuss justification of 3:1 slope for lined trench | E. Erpenbeck |

Attachment 4

**Low Level Burial Grounds**
**(W-025 Mixed Waste Trench)**
**Unit Managers Meeting**
**November 7, 1991**

**Commitments/Agreements Status**

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

Distribution:

| | |
|---|---|
| R.C. Bowman | WHC (H4-57) |
| R.M. Carosino | RL (A4-52) |
| C.E. Clark | RL (A6-95) |
| D.L. Duncan | EPA (HW-074) |
| E.G. Erpenbeck | WHC (G6-47) |
| G.C. Evans | WHC (H4-57) |
| M. French | DOE-NR |
| R.A. Gilbert | RL (A5-21) |
| T.M. Greager | WHC (G6-47) |
| R.D. Izatt | RL (A6-95) |
| J.D. King | SWEC (A4-35) |
| B. Koch | PSNS |
| M. Jaraysi | Ecology |
| R.D. Pierce | WHC (N3-13) |
| J.J. Witczak | Ecology |
| T.L. Yount | WHC (G6-47) |

ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

**Meeting Minutes Transmittal**
**Unit Managers Meeting**
**Low-Level Burial Grounds**
**Ecology Office**
**7601 West Clearwater, Suite #102**
**Kennewick, Washington**

**Meeting Held May 28, 1992**
**From 1:00 p.m. to 3:00 p.m.**

Date: 6/18/92
Clifford E. Clark, Environmental Policy and Permitting, RL

Date: 7/15/92
Daniel L. Duncan, EPA Region 10, RCRA Program Manager

Date: 6/18/92
Joe Witczak, Unit Manager, Washington State Department of Ecology

Date: 6/18/92
Richard Pierce, Contractor Representative, WHC

PURPOSE: Discuss permitting process
Meeting Minutes are attached. Minutes are comprised of the following:

Attachment 1 - Summary of Discussion and Commitments
Attachment 2 - Attendance List
Attachment 3 - Agenda
Attachment 4 - Action Items List with Status

Distribution:

| | | |
|---|---|---|
| R. C. Bowman | WHC | (H4-57) |
| R. M. Carosino | RL | (A4-52) |
| C. E. Clark | RL | (A5-15) |
| D. L. Duncan | EPA | (HW-074) |
| E. G. Erpenbeck | WHC | (G6-47) |
| G. C. Evans | WHC | (H4-57) |
| M. French | DOE-NR | |
| R. A. Gilbert | RL | (A5-21) |
| R. D. Izatt | RL | (A5-15) |
| J. D. King | SWEC | (A4-35) |
| R. J. Benze | PSNS | |
| M. Jaraysi | Ecology | |
| R. D. Pierce | WHC | (N3-13) |
| J. J. Witczak | Ecology | |

ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

Attachment #1

**Unit Managers Meeting**
**Low-Level Burial Grounds**
**Ecology Office**
**7601 West Clearwater, Suite #102**
**Kennewick, Washington**

**Meeting Held May 28, 1992**
**From 1:00 p.m. to 3:00 p.m.**

**Summary of Discussion and Commitments**

1. E. Erpenbeck introduced C. Knitter to discuss Golder Construction Services experience with sealed double ring infiltrometer (SDRI) and Shelby tube testing results in construction of RCRA compliant landfills. Golder Construction Services is the largest third party construction quality assurance company in the United States. The Shelby tube, SDRI test and their operation were explained. Experience with these tests in the 1980's showed that the SDRI was more indicative of the admix performance than the Shelby tubes because the SDRI measured a larger area of the admix. During the 1980's the poor construction practices allowed bad bonding between layers which the SDRI detected and the Shelby tube did not. Because of the improved construction practices (from the 80's to the 1990's) such as; good CQA, good material characterization, good compaction and construction techniques; the Shelby tube tests are more reliable than they were in the 1980's. The Shelby tube test results provide a fairly accurate test representation of the admix permeability that can be verified at a later date by the SDRI results. Hence, DOE-RL is inclined to proceed, at risk, with installing the admix liner in the actual landfill based on results from the Shelby tube tests. Of course, the regulatory acceptance criteria will be based on the results from the SDRI. If the SDRI has unacceptable result, DOE-RL would have to repair any installed admix liner. Recent experience indicates that there is little risk that the 3 day long Shelby tube test will disagree significantly (more than a half order of magnitude) with the 90 day long SDRI test.

   R. Pierce asked if the SDRI was an industry standard.

   C. Knitter answered "no".

   C. Knitter thinks the SDRI tests are a good idea.

   C. Clark remarked that our main concern was waiting for the SDRI test completion before starting construction.

   M. Jaraysi said "We never asked for that, because after a couple of weeks you will get the general picture".

C. Clark said "I think there is a general understanding that we do not have to wait".

J. Witczak asked, "So if your Shelby shows better than 10 to the minus seven and the SDRI comes back and says 10 to the minus 5, then what"?

C. Clark replied that RL is inclined to take the risk of the SDRI indicating a permeability greater than regulatory requirements after construction has begun with the understanding that repairs may have to be made. RL needs to know that Ecology will let RL take the risk.

Ecology agreed that RL could take the risk after the SDRI has stabilized, which normally takes 2 weeks, and that both the SDRI and the Shelby tube tests indicate the permeability will be acceptable. However, if the final results of the SDRI test indicate that the permeability does not satisfy regulatory requirements, then the repairs will be required. RL agreed that repairs would have to be made.

The frequency, depth, and expected permeability results were discussed for testing with Shelby tubes.

2. Ecology asked about the schedule for construction and WHC replied that construction would begin in February 1993 to avoid construction in cold weather. WHC would like to have a letter from Ecology in September 1992 that indicates that construction can begin.

3. Ecology inquired about when the performance assessment (PA) for landfills would be completed and R. Pierce replied that the PA would be approved in 1994, but that he was not sure that using the landfill has to wait for the PA. C. Clark added that other reports, such as the safety analysis report and readiness review, that had to be completed before the landfill could be used.

4. Ecology requested a copy of the nine month logic schedule that was used in the presentation. RL said that Ecology could have it.

5. G. Evans explained that review of the waste reports that Ecology requested revealed that trenches 13 and 22 in 218-W-5 contained mixed waste that was not reported in the response to NOD-15. Both the NOD Response table and the colored maps previously given to Ecology have this error which WHC will correct. The error occurred because the waste was considered low-level waste that contained lead shielding that was not waste. Now that lead shielding is classified as waste by Ecology, it will be reported as mixed waste.

6. G. Evans requested that Ecology discuss our response to NOD-15 in which we proposed a solution to when RL would state that the existing portion of the LLBG would not be used for disposal of mixed waste after Ecology issues the LLBG permit. WHC is concerned that Ecology might require a single liner under the Shippingport reactor which WHC feels would be counter productive.

J. Witczak replied that he could not comment on the proposal at this time, but that he did not think that Ecology would make RL move waste that has been placed in the existing portion of the LLBG after November 23, 1987. However, he would continue resisting disposal of additional mixed waste in these unlined trenches.

7. G. Evans explained that the schedule for installing a cover on 218-E-10 will not be achieved in 1995 as shown in the permit application closure schedule. The burial ground did not receive waste as projected; so we are still planning to use the land before putting a cover on it.

   J. Witczak replied that he would consider this when he proposed an accelerated schedule for closing all the burial grounds.

8. J. Witczak said that we could expect a response to NOD response table about 90 days after it was submitted an that a letter regarding construction could be sent in September 1992.

9. E. Erpenbeck asked about Ecology accepting the 3:1 slopes for design and Ecology said that they expected to accept the response.

10. It was agreed that the next LLBG unit managers meeting would follow Grout on June 18, 1992.

Attachment 2

**Unit Managers Meeting**
**Low-Level Burial Grounds**
**Ecology Office**
**7601 West Clearwater, Suite #102**
**Kennewick, Washington**

**Meeting Held May 28, 1992**
**From 1:00 p.m. to 3:00 p.m.**

Attendance List

| NAME | ORGANIZATION | PHONE # |
|---|---|---|
| R. C. Bowman | WHC | 509-376-4876 |
| D. W. Claussen | RL | 509-372-0938 |
| M. S. Collins | RL | 509-376-6536 |
| K. Donato | SWEC | 509-376-8210 |
| D. L. Duncan | EPA | 206-553-6693 |
| E. G. Erpenbeck | WHC | 509-376-8032 |
| G. C. Evans | WHC | 509-376-8939 |
| J. Geisbush | DOE-NR | 206-476-3660 |
| R. A. Gilbert | RL | 509-372-0618 |
| J. Hensley | Ecology | 206-546-4311 |
| J. R. Hunter | RL | 509-376-7434 |
| M. Jaraysi | Ecology | 509-546-2995 |
| J. D. King | SWEC | 509-376-4726 |
| G. Kirk | PSNS | 206-476-3767 |
| C. Knitter | Golder | 206-861-5756 |
| R. D. Pierce | WHC | 509-376-5681 |
| F. Shuri | Golder | 206-883-0777 |
| J. Witczak | Ecology | 206-438-7557 |

Attachment 3

**Unit Managers Meeting**
**Low-Level Burial Grounds**
**Ecology Office**
**7601 West Clearwater, Suite #102**
**Kennewick, Washington**

**Meeting Held May 28, 1992**
**From 1:00 p.m. to 3:00 p.m.**

**Agenda**

| | | |
|---|---|---|
| I | Opening Remarks. | C. Clark |
| II | Discuss proposed construction schedule using SDRI and Shelby Tube tests | E. Erpenbeck |
| III | Discuss responses to the Notice of Deficiencies.<br>o Data report on recent waste disposal (NOD 15)<br>o Using existing portion of landfill (NOD 122)<br>o Schedule on definitive design revision<br>o Schedule for LLBG closure of 218-E-10 | G. Evans |
| IV | Schedule for response by Ecology to NOD Response Table. | J. Witczak |
| V | Discuss schedule and agenda for next unit managers meeting. | C. Clark |

Attachment 4

**Unit Managers Meeting**
**Low-Level Burial Grounds**
**Ecology Office**
**7601 West Clearwater, Suite #102**
**Kennewick, Washington**

**Meeting Held May 28, 1992**
**From 1:00 p.m. to 3:00 p.m.**

**Commitments/Agreements Status**

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

**Meeting Minutes Transmittal**
**Unit Managers Meeting**
**Low-Level Burial Grounds**

**The Energy Technology Center**
**Building: ETC-2, Room 24**
**2920 George Washington Way**
**Richland, Washington**

**Meeting Held June 18, 1992**
**From 2:30 p.m. to 3:30 p.m.**

---

Clifford E. Clark Date: 7/23/92
Clifford E. Clark, Environmental Policy and Permitting, RL

Not Present at Meeting
Date:
Daniel L. Duncan, EPA Region 10, RCRA Program Manager

Date: 7/23/92
Joe Witczak, Unit Manager, Washington State Department of Ecology

Date: 8/7/92
Richard Pierce, Contractor Representative, WHC

---

PURPOSE: Discuss permitting process
Meeting Minutes are attached. Minutes are comprised of the following:

Attachment 1 - Summary of Discussion and Commitments
Attachment 2 - Attendance List
Attachment 3 - Agenda
Attachment 4 - Action Items List with Status

Distribution:

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|---|---|---|
| R. C. Bowman | WHC | (H4-57) |
| R. M. Carosino | RL | (A4-52) |
| C. E. Clark | RL | (A5-15) |
| D. L. Duncan | EPA | (HW-074) |
| E. G. Erpenbeck | WHC | (G6-47) |
| [redacted] | WHC | (H4-57) |
| M. French | DOE-NR | |
| R. A. Gilbert | RL | (A5-21) |
| R. D. Izatt | RL | (A5-15) |
| J. D. King | SWEC | (A4-35) |
| R. J. Benze | PSNS | |
| M. Jaraysi | Ecology | |
| R. D. Pierce | WHC | (N3-13) |
| J. J. Witczak | Ecology | |

ADMINISTRATIVE RECORD (Low Level Burial Grounds)
[Care of Susan Wray, WHC (H4-22C)]

Washington State Department of Ecology, Nuclear And Mixed Waste Library, Mail Stop PV-11

Environmental Protection Agency, Region 10, HW-074

Attachment #1

**Unit Managers Meeting**
**Low-Level Burial Grounds**

**The Energy Technology Center**
**Building: ETC-2, Room 24**
**2920 George Washington Way**
**Richland, Washington**

Meeting Held June 18, 1992
From 2:30 p.m. to 3:30 p.m.

**Summary of Discussion and Commitments**

1. J. Witczak passed out the following list of Notice-of-Deficiency comments which are unresolved on June 18, 1992. He said that there would probably be no new comments other than resolving the existing comments. Of the 81 comments listed, he estimated that 40 would remain unresolved for the next cycle. He expects to have a formal response by the end of July 1992.

   OUTSTANDING COMMENTS AS OF 6/18/92
   15, 16, 21, 31, 119, 122, 138, 141, 144, 145, 149, 151, 158, 161, 169, 171, 172, 179, 185, 191, 204, 205, 208, 210, 225, 230, 231, 232, 234, 236, 239, 240, 241, 245, 253, 256, 262, 263, 264, 266, 270, 271, 272, 283, 285, 286, 290, 293, 294, 296, 298, 299, 301, 309, 310, 316, 319, 320, 321, 323, 327, 328, 332, 333, 334, 339, 342, 343, 347, 348, 351, 352, 353, 354, 355, 359, 364, 373, 383, 385, 389.

   The construction comments of principal concern are: 151, 270, 271, 285, 286, 298, 309, and 310.

2. Ecology is concerned that WHC is planning to modify the pump that is identified in NOD's 270 and 271. They are concerned that the pump may not operate as specified after the check valve is removed. The LERF project had problems with their pumps. E. Erpenbeck agreed to check with the LERF project to better understand the problems that they had.

3. Ecology is concerned that placing an 8-inch pipe above a 2-inch pipe (addressed in NOD 286) will create a maintenance problem. Ecology thinks the 2-inch pipe should be offset from the 8 inch pipe.

4. Ecology thinks the rebar (addressed in NOD 298) is too close to the surface OF THE CONCRETE and does not follow the design requirements of the Uniform Building Code. Golder Associates and WHC think the design meets the intent of the requirements.

5. Ecology thinks the cover addressed in NOD 310 is not adequate to prevent particulates from entering the riser pipe and damaging the pump. The difference of opinion appears to revolve around the significance of the gap in the cover.

6. Ecology wants to restrict the latitude of the contractors as described in NOD 151. WHC and DOE think the latitude given the contractor is appropriate and necessary to obtain competitive bids on the construction contract. Ecology's primary concern is that we do not repeat the mistakes that were made on LERF and Grout construction. DOE and WHC are concerned that if we give very specific specifications rather performance standards, the contractor will not be liable if he follows the specifications and does not meet the performance standards.

7. The schedule of when final comments on the design would be delivered and the potential schedule impact to submitting a revised design to Ecology were discussed. J. Witczak said he planed to deliver final comments a the end of July 1992, and that he expected to give us draft comments at mid July. C. Clark proposed to deliver the revised design documents at the end of August 1992.

8. C. Clark said that we were still working on revising the "Request for Exemption from Lined Trench Requirements for Submarine Reactor Compartments."

9. G. Evans gave Ecology the revised sketches of the LLBG that show the location of the various types of waste and the data to support the recently identified mixed waste in burial ground 218-W-5. The revised sketches are of burial grounds 218-W-5, 218-W-4C, and 218-E-12B. This information is part of the responses to NOD's 15 and 16.

10. J. Witczak invited Rick Pierce to give a presentation on disposal of evaporators in the LLBG. Ecology would like to understand why we can not decontaminate the evaporators. C. Clark suggested that R. Pierce give the presentation at the next unit managers meeting.

11. It was agreed that the next LLBG unit managers meeting will be on July 23, 1992 at 11:00 AM.

Attachment 2

**Unit Managers Meeting**
**Low-Level Burial Grounds**

**The Energy Technology Center**
**Building: ETC-2, Room 24**
**2920 George Washington Way**
**Richland, Washington**

Meeting Held June 18, 1992
From 2:30 p.m. to 3:30 p.m.

Attendance List

| NAME | ORGANIZATION | PHONE # |
|---|---|---|
| R. C. Bowman | WHC | 509-376-4876 |
| B. J. Broomfield | WHC | 509-376-4966 |
| C. E. Clark | RL | 509-376-9333 |
| K. Donato | SWEC | 509-376-8210 |
| E. G. Erpenbeck | WHC | 509-376-8032 |
| G. C. Evans | WHC | 509-376-8939 |
| J. D. King | SWEC | 509-376-4726 |
| D. E. Plowman | WHC | 509-372-1292 |
| J. Witczak | Ecology | 206-438-7557 |

Attachment 3

**Unit Managers Meeting**
**Low-Level Burial Grounds**

**The Energy Technology Center**
**Building: ETC-2, Room 24**
**2920 George Washington Way**
**Richland, Washington**

Meeting Held June 18, 1992
From 2:30 p.m. to 3:30 p.m.

**Agenda**

| | | |
|---|---|---|
| I | Opening Remarks. | C. Clark |
| II | Status of Notice of Deficiency (NOD) Response Table. | J. Witczak |
| III | Status of "Request for Exemption from Lined Trench Requirements for Submarine Reactor Compartments. | C. Clark |
| IV | Revised response to NOD 15 for location of mixed waste disposed since 11-23-92. | G. Evans |
| V | Discuss schedule and agenda for next unit managers meeting. | C. Clark |

Attachment 4

**Unit Managers Meeting**
**Low-Level Burial Grounds**

**The Energy Technology Center**
**Building: ETC-2, Room 24**
**2920 George Washington Way**
**Richland, Washington**

Meeting Held June 18, 1992
From 2:30 p.m. to 3:30 p.m.

**Commitments/Agreements Status**

| ACTION ITEM | COMMITMENTS/AGREEMENTS STATUS LIST |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA)<br><br>OPEN |

START

0028157

# ENGINEERING CHANGE NOTICE

Page 1 of 10

1. ECN 164938

Proj. ECN

* Per telecon w/E. G. Erpenbeck - jb - 8/3/92

| | | | |
|---|---|---|---|
| 2. ECN Category (mark one) | Supplemental * [X] jb | Change ECN ~~[X]~~ | Supersedure [] |
| Cancel/Void [] | Direct Revision [] | Temporary [] | Discovery [] |

| | | |
|---|---|---|
| 3. Originator's Name, Organization, MSIN, and Telephone No. W24950<br>EG ERPENBECK, SWP, G6-47, 6-8032 | | 4. Date<br>JULY 7, 1992 |
| 5. Project Title/No./Work Order No. ML6DP<br>W025/RMW LAND DISPOSAL FACILITY | 6. Bldg./Sys./Fac. No.<br>200W/218-W-5 | 7. Impact Level<br>3 |
| 8. Document Number Affected (include rev. and sheet no.)<br>WHC-SD-W025-QAPP-001, REV 1 | 9. Related ECN No(s).<br>152876 | 10. Related PO No.<br>N/A |

| | | | |
|---|---|---|---|
| 11a. Modification Work<br>[] Yes (fill out Blk. 11b)<br>[X] No (NA Blks. 11b, 11c, 11d) | 11b. Work Package Doc. No.<br>N/A | 11c. Complete Installation Work<br>N/A<br>Cog. Engineer Signature & Date | 11d. Complete Restoration (Temp. ECN only)<br>N/A<br>Cog. Engineer Signature & Date |

12. Description of Change

THIS ECN AFFECTS THE FOLLOWING DOCUMENT: WHC-SD-W025-QAPP-001, REV 1, PAGES 91-96:

PROCEDURE P-10.0-3 HAS BEEN COMPLETELY REWRITTEN TO CLARIFY ACTION ITEM PROTOCOLS, RESOLUTION OF ACTION ITEMS AND SURVEILLANCE INSPECTION REPORT CLOSEOUTS.

THE REVISED PROCEDURE (REVISION LEVEL 3) IS ATTACHED WITH THIS ECN AND COMPLETELY REPLACES REVISION LEVEL 2 ON PAGES 91-96 IN WHC-SD-W025-QAPP-001, REV 1.

MAY 1993 RECEIVED EDMC

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13a. Justification (mark one) | Criteria Change | [] | Environmental | [] | Facilitate Const. | [X] | |
| Design Error/Omission | [] | Design Improvement | [] | As-Found | [] | Const. Error/Omission | [] |

13b. Justification Details

TO CLARIFY ACTION ITEMS DURING CONSTRUCTION FOR CONDUCTING SURVEILLANCE INSPECTIONS OF IN-PROCESS PROJECT ACTIVITIES, INCLUDING FIELD OPERATIONS AND LABORATORY TESTING.

14. Distribution (include name, MSIN, and no. of copies)

| | | |
|---|---|---|
| EG ERPENBECK | G6-47 | (3) |
| JR MCGEE | G6-47 | (2) |
| SR BRIGGS | G6-47 | (1) |
| GC EVANS | H4-57 | (2) |
| MS COLLINS | A5-18 | (1) |
| PROJECT FILES | R1-28 | (1) |

RELEASE STAMP

OFFICIAL RELEASE BY WHC (20)
DATE AUG 03 1992
Sta. 21

A-7900-013-2 (11/88) (EF) GEF095
Engineering Change Notice

A-7900-013-1 (11/88)

9312937203 9

# ENGINEERING CHANGE NOTICE



1. ECN (use no. from pg. 1) 164938

| 15. Design Verification Required | 16. Cost Impact | | 17. Schedule Impact (days) |
|---|---|---|---|
| | ENGINEERING | CONSTRUCTION | |
| [] Yes | Additional [] | Additional [] $ | Improvement [] NONE |
| [X] No | Savings [] $ | Savings [] $ | Delay [] NONE |

N/A

N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

| | | | | | |
|---|---|---|---|---|---|
| SDD/DD | [] | Seismic/Stress Analysis | [] | Tank Calibration Manual | [] |
| Functional Design Criteria | [] | Stress/Design Report | [] | Health Physics Procedure | [] |
| Operating Specification | [] | Interface Control Drawing | [] | Spares Multiple Unit Listing | [] |
| Criticality Specification | [] | Calibration Procedure | [] | Test Procedures/Specification | [] |
| Conceptual Design Report | [] | Installation Procedure | [] | Component Index | [] |
| Equipment Spec. | [] | Maintenance Procedure | [] | ASME Coded Item | [] |
| Const. Spec. | [] | Engineering Procedure | [] | Human Factor Consideration | [] |
| Procurement Spec. | [] | Operating Instruction | [] | Computer Software | [] |
| Vendor Information | [] | Operating Procedure | [] | Electric Circuit Schedule | [] |
| OM Manual | [] | Operational Safety Requirement | [] | ICRS Procedure | [] |
| FSAR/SAR | [] | IEFD Drawing | [] | Process Control Manual/Plan | [] |
| Safety Equipment List | [] | Cell Arrangement Drawing | [] | Process Flow Chart | [] |
| Radiation Work Permit | [] | Essential Material Specification | [] | Purchase Requisition | [] |
| Environmental Impact Statement | [] | Fac. Proc. Samp. Schedule | [] | | [] |
| Environmental Report | [] | Inspection Plan | [] | | [] |
| Environmental Permit | [] | Inventory Adjustment Request | [] | | [] |

N/A

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

| Document Number/Revision | Document Number/Revision | Document Number Revision |
|---|---|---|
| N/A | | |

20. Approvals

| | Signature | Date | | Signature | Date |
|---|---|---|---|---|---|
| OPERATIONS AND ENGINEERING | | | ARCHITECT-ENGINEER | | |
| Cog./Project Engineer | [illegible] | 7/8/92 | PE | | |
| Cog./Project Engr. Mgr. | [illegible] | 7/9/92 | QA | | |
| QA | Jack Bonesa | 7/8/92 | Safety | | |
| Safety | | | Design | | |
| Security | | | Other | | |
| Proj. Prog./Dept. Mgr. | | | | | |
| Def. React. Div. | | | | | |
| Chem. Proc. Div. | | | | | |
| Def. Wst. Mgmt. Div. | | | DEPARTMENT OF ENERGY | | |
| Adv. React. Dev. Div. | | | | [illegible] | 26 JUL 1992 |
| Proj. Dept. | | | | | |
| Environ. Div. | [illegible] | 7-15-92 | ADDITIONAL | | |
| IRM Dept. | | | | | |
| Facility Rep. (Ops.) | | | | | |
| Other | | | | | |

9 3 1 2 9 5 7 2 0 3 9

## RECORD OF REVISIONS

| Revision Level | Page No. | Section No. | Revision |
|---|---|---|---|
| 3 | throughout | | Completely rewritten to clarify action item protocols, resolution of action items, and SIR closeout. |

9 3 1 2 9 6 7 2 0 5 0

## 1. PURPOSE

This procedure defines the requirements for conducting surveillance inspections of in-process project activities, including field operations and laboratory testing.

## 2. APPLICABILITY

This procedure shall be used by all Golder Associates Inc. (Golder) Quality Assurance (QA) personnel requested to perform surveillance inspection of field, laboratory, or other in-process activities requiring compliance with established procedures or methods. This procedure may also be used to implement systems audit requirements invoked by QA Project Plans for environmental investigations.

## 3. DEFINITIONS

### 3.1 Surveillance Inspection

A surveillance inspection is the documented act of monitoring or witnessing the performance of work in process to verify that activities are being conducted in accordance with approved procedures, methods or instructions.

### 3.2 Systems Audit

In environmental investigations, a systems audit is a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established QA program and procedure requirements.

## 4. REFERENCES

4.1 Golder Associates QA Procedure P-15.0-1, "Control of Nonconformances, Incident Reports, and Corrective Action".

## 5. DISCUSSION

Surveillance inspection is a management tool that may be used during the course of project activities to verify that work in process is being performed in accordance with specified procedures, methods, or instructions. Surveillance inspections are also used to identify and

correct both real and potential deficiencies at the earliest possible opportunity to minimize any adverse impacts on the quality of the work performed. The types of activities subject to surveillance inspection include development of procedures, study plans, or other project documents; field activities including instrument installations, testing, and sampling; laboratory activities, including testing and calibration of measurement and test equipment; and subcontractor or consultant activities in any of the areas mentioned above.

## 6.0 RESPONSIBILITY

### 6.1 QA Manager

The QA Manager is responsible for establishing surveillance requirements and policies in compliance with client QA requirements and the technical needs of the project. The QA Manager is also responsible for directing the performance of surveillance inspections and when necessary, coordinating schedules with Project Managers, Task Leaders, and Laboratory Managers. The QA Manager may designate inspection responsibility to qualified personnel who are independent from the work being examined; all designated inspectors must be trained in the requirements of this procedure.

### 6.2 Designated Inspector

The designated inspector has primary responsibility for conducting surveillance inspections in accordance with this procedure. The designated inspector is responsible for confirming surveillance inspection schedules with the QA Manager and affected Project Managers; making detailed arrangements to witness specific portions of an activity; documenting inspection results; assignment of action items and monitoring action item resolution; reporting nonconformances; and for verifying that corrective actions for dispositioned nonconformances have been properly implemented.

### 6.3 Project Managers, Task Leaders or Laboratory Managers

Project Managers, Task Leaders, or Laboratory Managers are responsible for coordinating surveillance schedules with the QA Manager and the designated inspector. In case of a stop work order, they are responsible for halting operation in a logical and orderly manner that will protect the safety of personnel, the integrity of the data already obtained, and/or that will prevent further damage. They are also responsible for ensuring that action item resolutions and corrective actions for dispositioned nonconformances are properly implemented.

## 7. EQUIPMENT OR MATERIALS

Approved QA, technical, testing, or laboratory plans and procedures; applicable Specific Work Instructions (SWIs) and/or procurement documents; project schedules or reference materials as required; Surveillance Inspection Report (SIR) forms (see Exhibit A).

## 8. PROCEDURE

### 8.1 Surveillance Inspection Scheduling

All project activities, including document preparation, records management, field testing, and laboratory work may be subjected to surveillance inspection at any point during the activity. It is the intent of this procedure that the surveillance inspection be conducted without significantly interfering with technical work. Surveillance inspections shall in no case compromise the safety of personnel or adversely affect data acquisition activities. Reasonable advance notice shall be provided to the Project Manager, Task Leader, or Laboratory Manager, who shall provide schedule information, procedure documentation, or such other support as required. Frequency and scheduling of surveillance inspections shall be determined by the QA Manager based on QA program or project plan requirements, project schedules, type of activity, and results of past surveillance inspections or audits.

### 8.2 Inspection Guidelines

At a minimum, surveillance inspections shall verify compliance of the activity with applicable plans, procedures, methods, and SWIs. The following additional items shall be considered during surveillance inspections of laboratory or field testing activities:

Equipment or instrumentation calibration status and general condition;

Status or stage of completion of the test or activity must be apparent from test data sheets or logs;

Test operations and sequencing for the phase of the activity observed must comply with approved procedure requirements; and

Test data sheets and records required by the test plans or procedures must be filled out properly, to the extent necessary for the phase of the test observed.

### 8.3 Nonconformances and Stop-work Orders

Nonconformances and incidents shall be documented and handled as indicated in procedure P-15.0-1 "Control of Nonconformances, Incident Reports, and Corrective Action." Deficiencies of a minor nature that would not affect a permanent or significant change in quality if not corrected and can be brought into conformance in a timely manner shall not be categorized as nonconformances but shall be identified as action items requiring effective resolution as described in Section 8.4. If a nonconformance requires stopping work in order to prevent future discrepancies, danger to personnel, loss of data, or similar problems, the designated inspector shall immediately notify the QA Manager, obtain concurrence, and issue stop work instructions. The affected Project Manager, Laboratory Manager, or Task Leader(s) shall be immediately notified.

### 8.4 Action Items

Minor deficiencies as described on 8.3 shall be identified as action items on the SIR and shall be assigned to appropriate individuals for resolution within an appropriate time period. An information copy of the SIR with all action items identified shall be provided to the QA Manager at the completion of the inspection. The designated inspector shall track all action items through completion and shall attach documentation supporting action item closure as appropriate, prior to submitting the completed SIR to the QA Manager for final review and closure.

### 8.5 Closure

The QA Manager shall review the draft SIR for the adequacy of proposed action items, and as appropriate, shall provide direction to the designated inspector whenever modifications to action item requirements are required. The QA Manager shall review the final SIR with all supporting documentation, and if acceptable, shall sign to indicate closure.

## 9. DOCUMENTATION

### 9.1 Surveillance Inspection Report (SIR) Forms

An SIR form shall be filled out by the inspector for each surveillance. At a minimum the report shall contain the following information:

Name of the inspected activity or test, with associated job number;
Personnel contacted using the surveillance inspection;
Date and start/stop times of the surveillance inspection;
References to governing plans or procedures inspection;

Observations of equipment condition and calibration status;
General observations and comments;
NCIR numbers for any nonconformances resulting from the surveillance inspection;
Discussions of any immediate action taken to correct minor deficiencies or to stop work;
Action items requiring correction; and
Signature of designated inspector and inspection date, and the signature of the QA Manager and action item closure date.

Closed SIRs along with all supporting closure documentation shall be routed for retention in both the corporate QA records and applicable project QA records.

9 3 1 2 9 3 7 2 0 5 5

Exhibit A

## SURVEILLANCE INSPECTION REPORT

**SIR**

Page 1 of ___

No.:

Inspected Activity or Test: _____

Job Number: _____

Personnel Contacted: _____

Reference Requirements: _____

Insp. Date: _____ Start Time: _____ End Time: _____

Equipment Condition/Calibration Status: _____

Observation and Comments (Use Extra Sheets as Required): _____

NCIR Reference (if any): _____

Action Items Requiring Correction (Use Extra Sheets as Required): _____

Inspector: _____ Date: _____

Closed By QA Manager: _____ Date: _____

Action Item Closure Date: _____

Comments: _____

GOLDER ASSOCIATES INC.



9 3 1 2 9 3 7 2 0 5 6

Date Request Received
cw
4-30-92.

# TECHNICAL INFORMATION RELEASE REQUEST

Reference: WHC-CM-3-4

**Complete for all Types of Release**

**Purpose**

- ☐ Speech or Presentation
  - ☐ Full Paper
  - ☐ Summary
  - ☐ Abstract
  - ☐ Visual Aid
- ☐ Speakers Bureau
- ☐ Poster Session
- ☐ Reference
- ☒ Technical Report
- ☐ Thesis or Dissertation
- ☐ Manual
- ☐ Brochure/Flier
- ☐ Software/Database
- ☐ Controlled Document
- ☐ Other: _____

**Intended Audience**

- ☒ Public
- ☐ Sponsor-limited
- ☐ Internal

New Document Number (Document Clearance Administration will assign)

Existing Identification Number: WHC-SD-W025-QAPP-001, Rev. 1

If Previously Cleared, List Document No

Date Clearance Required: 5-14-92

Title: Quality Assurance Program Plan, RMW Land Disposal Facility-Non-Drag-Off

| Lead Author Name | Impact Level | Phone | MSIN | Other Author(s) Name (s) |
|---|---|---|---|---|
| EG Erpenbeck | 3 | 6-8032 | G6-47 | Golder Associates, Inc. |

| Project or Program | Lead Org Code | Sponsor Agency |
|---|---|---|
| W-025, Solid Waste Projects | 24950 | (DOE) DOT, NRC, USGS, |

| Editor Name | Phone | DOE/HQ Assistant Secretary For: |
|---|---|---|
| | | DP, EH, ER, (EM), RW, NE |

New or novel (patentable) subject matter? ☒ No ☐ Yes
If "Yes", has disclosure been submitted by WHC or other company?
☐ No ☐ Yes Disclosure No(s).

Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions?
☒ No ☐ Yes (Identify)

Copyrights? ☒ No ☐ Yes
If "Yes", has written permission been granted?
☒ No ☐ Yes (Attach Permission)

Trademarks?
☒ No ☐ Yes (Identify)

**Complete for Speech or Presentation**

Complete Title of Conference or Meeting

Group or Society Sponsoring

Dates of Conference or Meeting

City/State

Will a Proceedings be Published? ☐ Yes ☐ No
Will you hand out material at the meeting? ☐ Yes ☐ No

For a journal submission, provide complete title of journal

**Cognizant Line Management**

Author: T.W. Thorson For EG ERPENBECK — Date 4/20/92

Peer Review: N/A — Date

Cognizant Manager: L.R. Day — Date 4/20/92

Auth. Derivative Classifier — Date 4-20-92

| | Yes | No |
|---|---|---|
| Unclassified | ☒ | ☐ |
| Classified | ☐ | ☒ |
| UCNI | ☐ | ☒ |

WHC Technical Program — Date 4/21/92

| | Yes | No | |
|---|---|---|---|
| Applied Technology | ☐ | ☒ | ☒ Approve |
| Limited Disclosure | ☐ | ☒ | ☐ Disapprove |

**Document Clearance Administration**

General Counsel — Date 4/27/92

| | Remove | Affix |
|---|---|---|
| Copyright License Notice | ☐ | ☐ |
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| Patent Status | ☒ | ☐ |
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| Proprietary Information | ☐ | ☐ |
| Computer Software Notice | ☐ | ☐ |

☒ Approve ☐ Disapprove

DOE Technical Program — Date 4/30/92
☒ Approve ☐ Disapprove

Communications — Date
☐ Approve N/A cw ☐ Disapprove

Publications Services — Date
☐ Editorial Review Only ☐ Approve ☐ Disapprove

Other — Date
☒ Approve ☐ Disapprove

Comments (Please Initial)

This SD Document was produced by Golder Associates, Inc. to impose Quality Assurance procedures upon the A/E firm (GAI) during the definitive design and construction.

Document Clearance Administration Release Stamp

INFORMATION

APPROVED FOR RELEASE — OFFICIAL DOCUMENT — cw — Date 5-5-92

BD 7600 062 (03/90)

**Unit Managers Meeting**
**Low-level Burial Grounds**
**HAPO Building, Room 319**
**Richland, Washington**

**Meeting Held October 26, 1992**
**From 3:00 p.m. to 4:00 p.m.**

---

The undersigned indicate by their signatures that these meeting minutes reflect the actual occurrences of the above dated Unit Managers Meeting.

Clifford E. Clark, Unit Manager, RL — Date: 4/14/93

Not Present — Date:
Daniel L. Duncan, RCRA Program Manager, EPA Region 10

Robert E. Cordts, Unit Manager, Washington State Department of Ecology — Date: 12 May 93

---

Low-level Burial Grounds, WHC Concurrence

Richard D. Pierce, Contractor Representative, WHC — Date: 4/19/93

---

Purpose: Discuss Permitting Process

Meeting Minutes are attached. The minutes are comprised of the following:
Attachment 1 - Agenda
Attachment 2 - Summary of Discussion and Commitments/Agreements
Attachment 3 - Attendance List
Attachment 4 - Action Items
Attachment 5 - Handouts (as handed out at meeting, if any)

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Distribution:

| | | |
|---|---|---|
| B. A. Austin | WHC | B2-35 |
| J. D. Bauer | RL | A5-15 |
| R. C. Bowman | WHC | H6-24 |
| B. J. Broomfield | WHC | N3-13 |
| R. C. Brunke | WHC | H6-23 |
| R. M. Carosino | RL | A4-52 |
| C. E. Clark | RL | A5-15 |
| D. W. Claussen | RL | A5-21 |
| R. E. Cordts | Ecology | |
| A. K. Crowell | RL | A5-21 |
| D. L. Duncan | EPA | HW-074 |
| E. G. Erpenbeck | WHC | G6-47 |
| G. C. Evans | WHC | H6-23 |
| R. M. Gordon | RL | A6-55 |
| R. F. Guercia | RL | A5-21 |
| M. N. Jaraysi | Ecology | |
| S. J. Lijek | MACTEC | A4-35 |
| P. J. Mackey | WHC | B3-15 |
| M. M. McCarthy | WHC | N3-13 |
| R. D. Pierce | WHC | N3-13 |
| B. E. Poremba | WHC | T4-03 |
| B. B. Powell | WHC | T4-03 |
| S. M. Price | WHC | H6-23 |
| H. T. Tilden II | PNL | P7-68 |

ADMINISTRATIVE RECORD: Low-level Burial Grounds, D-2-9 [Care of EDMC, WHC (H6-08)]

Washington State Department of Ecology Nuclear and Mixed Waste Library, P.O. Box 47600, Olympia, Washington 98504-7600

Environmental Protection Agency Region 10, Seattle, Washington 98101, Mail Stop HW-074

Please send comments on distribution list to J. Scott H6-24,(509) 372-0562.

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**Attachment 1**

**Unit Managers Meeting**
**Low-level Burial Grounds**
**HAPO Building, Room 319**
**Richland, Washington**

**Meeting Held October 26, 1992**
**From 3:00 p.m. to 4:00 p.m.**

**Agenda**

| | | |
|---|---|---|
| I | Opening Remarks. | C. Clark |
| II | Approval of meeting minutes. | Unit Managers |
| III | Status of Notice of Deficiency (NOD) Response Table. | J. Witczak |
| IV | Disposal of K-3 filters in unlined trenches. | J. Witczak |
| V | Strategy for disposal of mixed waste as described in the HANFORD SOLID RADIOACTIVE MIXED WASTE STORAGE STRATEGY letter of January 26, 1988 (Appendix 4D in LLBG permit application). | J. Witczak |

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**Attachment 2**

**Unit Managers Meeting**
**Low-level Burial Grounds**
**HAPO Building, Room 319**
**Richland, Washington**

**Meeting Held October 26, 1992**
**From 3:00 p.m. to 4:00 p.m.**

**Summary of Discussion and Commitments/Agreements**

1. Previous Unit Manager Meeting Minutes:

The minutes from the July 1992 Low-Level Burial Ground Unit Manager Meeting were not available for review and signature. There were no Unit Manager Meetings held in August and September, 1992, by mutual consent of the Unit Managers.

2. Disposal of K-3 Filters at the Low-Level Burial Grounds (LLBG):

RL\WHC presented a strategy for disposal of the K-3 filters at the LLBG. RL\WHC requested that Ecology allow the LLBG to accept the K-3 filters for disposal. RL\WHC stated that, according to their interpretation, disposal of this waste is consistent with the "Hanford Solid Radioactive Mixed Waste Storage Strategy" (Letter from R. D. Izatt and R. E. Lerch to Roger Stanley and Janet O'Hara dated January 26, 1988. Appendix 4D in LLBG Permit Application.) Ecology stated that they will send a letter to RL\WHC stating their approval of this request by the next Unit Manager Meeting. Ecology gave verbal approval to proceed with the disposal of the K-3 Filters, but they want to arrange a meeting to discuss the "Hanford Solid Radioactive Mixed Waste Storage Strategy."

3. Notice of Deficiency (NOD) Response Table:

Ecology (Witczak) provided draft NOD comments to RL\WHC on the LLBG Part B Permit Application. Witczak stated that formal NOD comments would be provided to RL\WHC within a week of this meeting. A short discussion of the NOD comments followed.

4. Construction Quality Assurance Plan:

Eric Erpenbeck (WHC) described the content and purpose of Project W-025 Construction Quality Assurance Plan. RL/WHC provided copies of WHC-S-045, Rev 0, "Material Specifications and Construction Requirements for the Radioactive Mixed Waste Land Disposal Facility Non-drag-off" and WHC-SD-W025-PLN-001, Rev 1, "Construction Quality Assurance Plan (CQAP) for Project W-025, Radioactive Mixed Waste Land Disposal Facility - Non-drag-off" to Ecology.

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5. Set next meeting date

The next Unit Managers meeting is tenetatively scheduled for December 1, 1992.

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## Attachment 3

**Unit Managers Meeting**
**Low-level Burial Grounds**
**HAPO Building, Room 319**
**Richland, Washington**

**Meeting Held October 26, 1992**
**From 3:00 p.m. to 4:00 p.m.**

**Attendance List**

| Name | Organization | Phone # |
|---|---|---|
| R. C. Bowman | WHC | (509) 376-4876 |
| B. J. Broomfield | WHC | (509) 376-4966 |
| C. E. Clark | RL | (509) 376-8939 |
| R. E. Cordts | Ecology | (206) 459-6863 |
| Joe Witczak | Ecology | (206) 438-7765 |
| E. G. Erpenbeck | WHC | (509) 376-8032 |
| G. C. Evans | WHC | (509) 376-8939 |
| M. N. Jaraysi | Ecology | (509) 736-3016 |
| K. R. Donato | SWEC | (509) 376-8210 |
| J. D. King | SWEC | (509) 376-4726 |
| | | |
| | | |
| | | |
| | | |
| | | |
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# Attachment 4

## Unit Managers Meeting
## Low-level Burial Grounds
## HAPO Building, Room 319
## Richland, Washington

**Meeting Held October 26, 1992**
**From 3:00 p.m. to 4:00 p.m.**

## Action Items

| Action Item # | Description |
|---|---|
| 5-30-91:1 | Provide a letter on interim status construction authorization and regulatory criteria for design. Action: Joe Witczak (Ecology) and Dan Duncan (EPA) |

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ORIGINAL

| Date Received: 8-4-92 cw | INFORMATION RELEASE REQUEST | Reference: WHC-CM-3-4 |
|---|---|---|

Complete for all Types of Release

**Purpose**

[] Speech or Presentation
- [X] Full Paper
- [] Summary
- [] Abstract
- [] Visual Aid

(Check only one suffix)

[] Speakers Bureau
[] Poster Session
[] Videotape

[] Reference
[X] Technical Report
[] Thesis or Dissertation
[] Manual
[] Brochure/Flier
[] Software/Database
[] Controlled Document
[] Other

ID Number (include revision, volume, etc.): WHC-SD-W025-PLN-001, REV 2

List attachments: WHC-SD-W025-PLN-001, REV 1

Date Release Required: JUNE 30, 1992

Title: CONSTRUCTION QUALITY ASSURANCE PLAN

Unclassified Category: UC-

Impact Level: 3 E1

New or novel (patentable) subject matter? [] No [] Yes
If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions?
[] No [] Yes (Identify)

Copyrights? [] No [] Yes
If "Yes", has written permission been granted?
[] No [] Yes (Attach Permission)

Trademarks?
[] No [] Yes (Identify)

Complete for Speech or Presentation

Title of Conference or Meeting

Group or Society Sponsoring

Date(s) of Conference or Meeting

City/State

Will proceedings be published? [] Yes [] No
Will material be handed out? [] Yes [] No

Title of Journal

CHECKLIST FOR SIGNATORIES

| Review Required per WHC-CM-3-4 | Yes | No | Reviewer - Signature Indicates Approval: Name (printed) | Signature | Date |
|---|---|---|---|---|---|
| Classification/Unclassified Controlled Nuclear Information | [] | [X] | | | |
| Patent - General Counsel | [X] | [] | SW BERGLUN | SWBergLun | 8/4/92 |
| Legal - General Counsel | [X] | [] | | | |
| Applied Technology/Export Controlled Information or International Program | [] | [X] | | | |
| WHC Program/Project | [X] | [] | [illegible] | | 8-6-92 |
| Communications | [] | [X] | | | |
| RL Program/Project | [X] | [] | M.S COLLINS | [illegible] | [illegible] |
| Publication Services | [] | [X] | | | |
| Other Program/Project | [] | [X] | | | |

Information conforms to all applicable requirements. The above information is certified to be correct.

| | Yes | No |
|---|---|---|
| References Available to Intended Audiance | [X] | [] |
| Transmit to DOE-HQ/Office of Scientific and Technical Information | [] | [X] |

Author/Requestor (Printed/Signature) Date

EG ERPENBECK / Eric H. Erpenbeck 6/15/92

Intended Audience

[] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature) Date

SR BRIGGS LR Briggs 6/15/92

INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP

Stamp is required before release. Release is contingent upon resolution of mandatory comments.

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
UW
Date 8-6-92

Date Cancelled

Date Disapproved

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# ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 164937

Proj. ECN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2. ECN Category (mark one) | Supplemental | [] | Change ECN | [] | Supersedure | [] |
| Cancel/Void | [] | Direct Revision | [X] | Temporary | [] | Discovery | [] |

| | | |
|---|---|---|
| 3. Originator's Name, Organization, MSIN, and Telephone No.<br>EG ERPENBECK, SWP, 24950, G6-47, 6-8032 | | 4. Date<br>JUNE 15, 1992 |
| 5. Project Title/No./Work Order No. M L6 E G<br>CQAP FOR RMW LAND DISPOSAL FACILITY | 6. Bldg./Sys./Fac. No.<br>218-W-5/200W | 7. Impact Level 3 ~~ESS~~ |
| 8. Document Number Affected (include rev. and sheet no.)<br>WHC-SD-W025-PLN-001, REV 1 | 9. Related ECN No(s).<br>109386 | 10. Related PO No.<br>N/A |

| 11a. Modification Work | 11b. Work Package Doc. No. | 11c. Complete Installation Work | 11d. Complete Restoration (Temp. ECN only) |
|---|---|---|---|
| [] Yes (fill out Blk. 11b)<br>[X] No (NA Blks. 11b, 11c, 11d) | N/A | N/A<br>Cog. Engineer Signature & Date | N/A<br>Cog. Engineer Signature & Date |

12. Description of Change

THIS ECN AFFECTS THE FOLLOWING DOCUMENT: WHC-SD-W025-PLN-001, REV 1

Changes to the CQA Plan were made to make it consistent with the construction specifications, increasing the operating life of the facility from 2 to 20 years. It also incorporates comments from Ecology (i.e., pugmill, SDRI).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13a. Justification (mark one) | Criteria Change | [] | Environmental | [] | Facilitate Const. | [X] |
| Design Error/Omission | [] | Design Improvement | [] | As-found | [] | Const. Error/Omission | [] |

13b. Justification Details

Consistency between specifications and CQA Plan.
To allow public release of the document. ~~SE~~ GBG.

14. Distribution (include name, MSIN, and no. of copies)

| | | | |
|---|---|---|---|
| EG ERPENBECK | G6-47 (2) | JR MORTON | E2-30 |
| JR MCGEE | G6-47 | PG BEAUDET | E2-30 |
| KD JOHNSON | E1-01 | MS COLLINS | A5-18 |
| GC EVANS | H4-57 | AG PINES | R3-20 |
| AV LINCOLN | S2-62 | MD AICHELE | T4-01 |
| DB POWELL | T3-02 | PROJECT FILES | R1-28 |
| GH SAITO | N1-83 | J.J. DORIAN | B2-16 |

RELEASE STAMP

OFFICIAL RELEASE BY WHC (20)
DATE AUG 20 1992
Sta. 21

A-7900-013-2 (11/88) (EF) GEF095
Engineering Change Notice

# ENGINEERING CHANGE NOTICE

Page 2 of 2

1. ECN (use no. from pg. 1): 164937

| 15. Design Verification Required | 16. Cost Impact | | | | 17. Schedule Impact (days) | |
|---|---|---|---|---|---|---|
| | ENGINEERING | | CONSTRUCTION | | | |
| [] Yes | Additional | [] $None | Additional | [] $None | Improvement | [] |
| [] No | Savings | [] $None | Savings | [] $None | Delay | [] |

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

| | | | | | |
|---|---|---|---|---|---|
| SDD/DD | [] | Seismic/Stress Analysis | [] | Tank Calibration Manual | [] |
| Functional Design Criteria | [] | Stress/Design Report | [] | Health Physics Procedure | [] |
| Operating Specification | [] | Interface Control Drawing | [] | Spares Multiple Unit Listing | [] |
| Criticality Specification | [] | Calibration Procedure | [] | Test Procedures/Specification | [] |
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| Vendor Information | [] | Operating Procedure | [] | Electric Circuit Schedule | [] |
| OM Manual | [] | Operational Safety Requirement | [] | ICRS Procedure | [] |
| FSAR/SAR | [] | IEFD Drawing | [] | Process Control Manual/Plan | [] |
| Safety Equipment List | [] | Call Arrangement Drawing | [] | Process Flow Chart | [] |
| Radiation Work Permit | [] | Essential Material Specification | [] | Purchase Requisition | [] |
| Environmental Impact Statement | [] | Fac. Proc. Samp. Schedule | [] | | [] |
| Environmental Report | [] | Inspection Plan | [] | | [] |
| Environmental Permit | [] | Inventory Adjustment Request | [] | | [] |

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

| Document Number/Revision | Document Number/Revision | Document Number Revision |
|---|---|---|
| | | |

20. Approvals

| | Signature | Date | | Signature | Date |
|---|---|---|---|---|---|
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| Cog./Project Engr. Mgr. SR Briggs | SR Briggs | 8/3/92 | QA | | |
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| Safety | | 7-10-92 | Design | | |
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| Environ. Div. | HC Evans | 7-9-92 | ADDITIONAL | | |
| IRM Dept. | | | | | |
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| Other (Site Planning) ~~SW Seiler~~ | | | | | |
| Environ. Assurance | | 7/14/92 | | | |
| Electrical Utilities | | 7/27/92 | | | |

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1. Total Pages 114 ~~112~~

| 2. Title | 3. Number | 4. Rev No. |
|---|---|---|
| CQAP FOR RMW LAND DISPOSAL FACILITY NON-DRAG-OFF | WHC-SD-W025-PLN-001 | 2 |

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6. Author

Name: EG ERPENBECK

Signature

Organization/Charge Code 24950/ML6EG

7. Abstract

The CQAP documents that the facility is constructed to all applicable design criteria, plans, and specifications, using specified construction techniques and materials. Procedures invoked by this document are intended to identify problems that may occur during construction and to document that these problems are corrected before construction is complete. It satisfies the requirements specified by the EPA in Technical Guidance Document Construction Quality Assurance for Hazardous Waste Land Disposal Facilities.

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| RECORD OF REVISION | (1) Document Number WHC-SD-W025-PLN-001 | Page 1 |
|---|---|---|

(2) Title

CQAP for RMW Land Disposal Facility-Non-Drag-Off

CHANGE CONTROL RECORD

| (3) Revision | (4) Description of Change – Replace, Add, and Delete Pages | Authorized for Release (5) Cog./Proj. Engr. | (6) Cog./Proj. Mgr. | Date |
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WHC-SD-W025-PLN-001
Rev. 2

# CONSTRUCTION QUALITY ASSURANCE PLAN FOR PROJECT W-025, RADIOACTIVE MIXED WASTE (RMW) LAND DISPOSAL FACILITY - NON-DRAG-OFF

Revision -2-

prepared for the
U.S. Department of Energy - Richland Operations Office
Contract No. DE-AC06-89RL11615

by

GOLDER ASSOCIATES INC.
Seattle (Redmond), Washington
Richland, Washington

APPROVAL:

| | |
|---|---|
| Project Director | 6/26/92 Date |
| Project Manager | 6-26-92 Date |
| QA Manager | 6-26-92 Date |
| Westinghouse Hanford Company | 7-8-92 Date |
| DOE-RL | 4 Aug 92 Date |

June 19, 1992

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# 1. INTRODUCTION

Golder Associates Inc. (GAI) is under contract to the United States Department of Energy - Richland Operations Office to prepare a design and provide Construction Quality Assurance (CQA) services for the Radioactive Mixed Waste Land Disposal Facility, Non-Drag-Off (Project W-025). The facility will be located in the 200W area of the Hanford Reservation, near Richland, Washington. The facility is intended to accept hazardous waste as well as low level radioactive mixed waste, and is designed to meet all of the requirements for disposal of hazardous waste as specified by the EPA and State of Washington Department of Ecology (Ecology).

## 1.1 Purpose

As part of the CQA services to be provided for the facility GAI has prepared this Construction Quality Assurance Plan (CQAP). The plan will be used during construction of the facility; it addresses the applicable requirements specified by the Quality Assurance Program Plan (QAPP) that was prepared for this project (Golder, 1990). In addition, the CQAP meets the plan requirements specified by the EPA in Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities, (EPA, 1986).

The purpose of the CQAP is to document that the facility is constructed to all applicable design criteria, plans, and specifications, using specified construction techniques and specified materials. Procedures invoked by the CQAP are intended to identify problems that may occur during construction and to document that these problems are corrected before construction is complete.

## 1.2 Scope

The scope of this plan covers all elements of construction associated with the facility as outlined below:

- Earthworks
  - Excavation and backfilling
  - Admix liner preparation and placement
  - Drainage layer placement and testing
  - Operations layer placement and testing

- Geosynthetics
  - Placement and seaming of HDPE liner
  - Placement and seaming of geotextile
  - Placement and tieing of geonet
  - Placement and welding of HDPE pipe

- Associated materials
  - Vertical riser pipe
  - Temporary leachate collection tank
  - Leachate monitoring and control facilities

## 1.3 Relationship to QA Program Plan

This CQAP is a secondary document, developed under the requirements of the project QA program embodied in the current approved version of Quality Assurance Program Plan for Project W-025, Radioactive Mixed Waste (RMW) Land Disposal Facility - Non Drag Off (GAI, 1990), referred to throughout this document as the QAPP. The CQAP draws upon the records management, document control, technical review, and other procedural resources invoked by the QAPP wherever appropriate. Specific references to applicable QAPP plan sections and/or implementing procedures are provided wherever required. The regulatory basis for the development of the QAPP and a discussion of its objectives is provided in QAPP Sections 2.1 and 2.2.

## 1.4 Change Control Requirements

The CQAP, the QAPP, and all implementing procedures are subject to the change control requirements defined by the procedures referenced in Section 5.0 of the QAPP. QAPP or CQAP changes that may be required in response to unexpected site conditions or revisions in construction methodology shall be documented as Interim Change Notices (ICNs) and reviewed, approved, and distributed as required by P-5.0-1, "Document Preparation, Distribution, and Change Control".

# 2. RESPONSIBILITY AND AUTHORITY

## 2.1 Organizations Involved

The principal organizations involved in permitting, designing, and constructing the Radioactive Mixed Waste (RMW) Land Disposal Facility, Non-Drag-Off are the Owner, Permitting Agencies, Facility Manager, Design Engineer, CQA Engineer, Construction Manager, and Contractors.

### 2.1.1 Owner

The owner of the RMW facility is the U.S. Department of Energy - Richland Operations Office (DOE-RL). The DOE-RL Contract Officer's Technical Representative (COTR) during the construction of the facility is the Westinghouse Hanford Company (WHC).

### 2.1.2 Permitting Agencies

The RMW facility is being constructed to meet regulations set out by the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology). This CQAP is specifically designed to support those regulatory needs.

### 2.1.3 Facility Manager

The Westinghouse Hanford Company (WHC) will provide coordination and project management support during construction and will manage the completed facility. The WHC representative will have the authority to review and approve all engineering change notices. In addition, the WHC representative will provide direction to the Construction Manager.

### 2.1.4 Design Engineer

The RMW facility, Non-Drag-Off has been designed by Golder Associates Inc. (GAI). All baseline drawings and design specifications will be provided by GAI to WHC. All subsequent design updates and changes shall be managed by WHC under the requirements of their own change control procedures. GAI will have the authority to review and modify the design drawings, specifications, CQA Plan, cost estimates, and construction schedules with the concurrence of the Owner and his representative.

### 2.1.5 CQA Personnel

CQA Personnel, support, and equipment are provided by GAI through its subsidiary Golder Construction Services, Inc. (GCS). The organizational structure, specific responsibilities, and authority of GCS CQA Personnel are shown in the organizational chart included as Figure 2-1 and are discussed below. Specific specification and certification requirements for CQA personnel are addressed in Section 3.0 of this plan. The CQA Engineer and Personnel do not have the authority to direct the Contractors. They do have the authority to identify nonconformances, and notify the COTR via initiation of a nonconformance report for resolution (ref. Section 5.3).

CQA is considered to be a discrete engineering discipline under the direct control of the CQA Project Manager. All CQA activities are subject to verification through auditing and surveillance, inspection processes implemented at the direction of the Project QA Manager in compliance with QAPP requirements.

#### 2.1.5.1 Project Director

The Project Director has ultimate responsibility for technical and quality performance on this project, and for monitoring that all DOE-RL quality assurance, schedule, and budgetary requirements are satisfied.

#### 2.1.5.2 Project Manager

The Project Manager is responsible for conducting technical activities in compliance with all contractual technical and quality requirements, for coordinating all technical staff activities, for continuing liaison with the DOE-RL contract officer's technical representative (COTR) through the completion of all tasks, submittal of routine progress reports, and assessment of all change requests. The Project Manager may delegate specific duties in support of these responsibilities through the Specific Work Instruction (SWI) process as described in Section 3.1 of the QAPP "Task Management Process". SWIs are approved by the Project Manager and Project QA Manager, and are used to initiate project activities.

#### 2.1.5.3 Project QA Manager

The Project QA Manager retains overall responsibility for the preparation and update of the overall Quality Assurance Program Plan (QAPP) and for review and approval of this CQAP and all supporting procedures. The Project QA Manager is responsible for verification of compliance with QAPP and CQAP requirements through the monitoring, review, inspection, surveillance, and auditing procedures described in the QAPP. Specific duties in support of these responsibilities may be delegated within the guidelines of governing procedures.

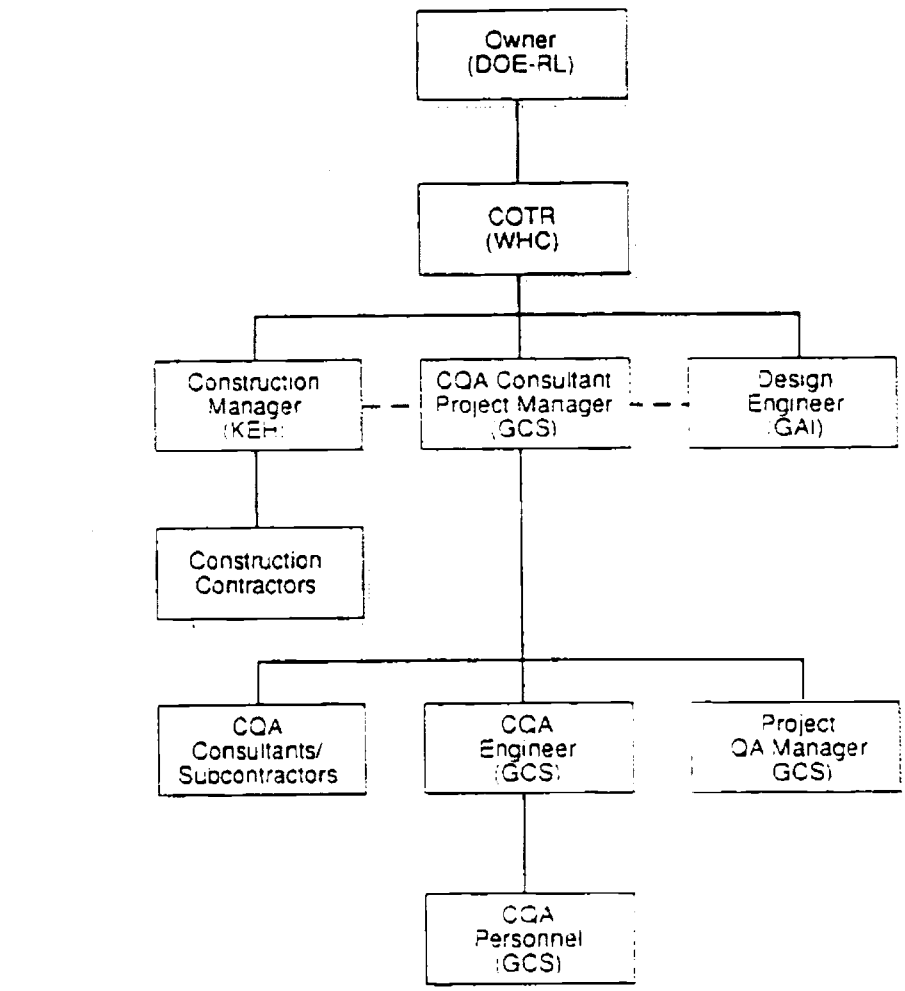


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**Figure 2-1.** CQA Project Organization.

2.1.5.4 CQA Engineer

The CQA Engineer shall be responsible to the Project Manager for the organization and coordination of on-site CQA Personnel and activities. The CQA Engineer shall be responsible for training CQA observation personnel on CQA requirements and procedures, for confirming test data accuracy, for identifying acceptance or rejection status of all work, and for providing periodic reports on CQA inspection results.

2.1.5.5 CQA Personnel

CQA Personnel shall be responsible for inspecting and testing materials and ongoing construction to assess compliance with specifications, and for verifying that the tests and testing equipment used conform to the requirements of the CQA plan and/or specifications. CQA Personnel will report directly to the CQA Engineer.

2.1.5.6 Consultants/Subcontractors

Consultants and/or subcontractors from outside of the GAI organization may be used to facilitate the CQA process; procurement of such services shall be in compliance with the controls of QAPP Sections 4.0, "Procurement Document Control", and 7.0., "Control of Purchased Materials, Items and Services". Specific training and qualification requirements shall be defined in procurement documents, approved by the Project Manager and the Project QA Manager.

Subcontractors will be required to complete the conformance testing of the geosynthetics materials which will be used in construction of the facility. Construction surveying services will be supplied by the earthworks contractor. CQA surveying, concrete testing, asphalt testing, and other related testing will be subcontracted by GAI.

### 2.1.6 Construction Manager

The Construction Manager for the Non-Drag-Off Facility is Kaiser Engineers - Hanford (KEH). KEH will hire and manage the contractors that will build the facility; see Section 2.1.7 below. The Construction Manager shall have the authority to provide direction to the various Contractors.

### 2.1.7 Contractors

2.1.7.1 Earthworks

The earthworks contractor will be responsible for excavation, placement of backfill, preparation and placement of the admix soil liner, and placement of the operations layer. In addition, the earthworks contractor will be responsible for installing the leachate

collection gravel and sump gravel, excavating and backfilling the anchor trenches, and surfacing of the roads, access ramp, and staging area.

2.1.7.2 Geomembrane Installer

The geomembrane installer will install the HDPE geomembrane, geonet, geotextile, and the geocomposite drainage layer according to the project plans and specifications. In addition, the geomembrane installer will perform selected tests on the HDPE liner seams. These tests, which include test seams, non-destructive seam tests, and optional destructive test seams, are described in Section 4.4.2.

2.1.7.3 Leachate Collection System Fabricator/Installer

The earthworks contractor will procure, fabricate, install, and test the leachate collection and removal piping and pump system as well as the temporary leachate storage tank and all electrical controls.

## 2.2 Project Meetings

### 2.2.1 Pre-Construction Meeting

A meeting shall be held to resolve any uncertainties following the completion and approval of the facility design, completion and approval of the site-specific CQA plan, and award of the construction contract, but prior to the start of construction. At a minimum, the meeting shall be attended by the Owner or Owners' Representative, the Design Engineer, the CQA Engineer, and the Construction Contractor(s). Separate pre-construction meetings may be held for the earthworks, geomembrane installation, and leachate collection system contractors. The topics of this meeting shall include but are not limited to:

- Providing each organization with all relevant CQA documents and supporting information;
- Familiarizing each organization with the site-specific CQA plan and its role relative to the design criteria, plans, and specifications;
- Determining any changes to the CQA plan that may be needed to document that the facility will be constructed to meet or exceed the specified design requirements;
- Reviewing the responsibilities of each organization;
- Reviewing lines of authority and communication for each organization;
- Discussing the established procedures or protocol for observations and tests including sampling strategies;

- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting;
- Reviewing methods for documenting and reporting inspection data;
- Reviewing methods for distributing and storing documents and reports;
- Reviewing work area security and safety protocol;
- Reviewing the proposed project schedule;
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events; and
- Conducting a site walk-around to review construction material and inspection equipment storage locations.

The meeting shall be documented in compliance with QAPP Section 6.0, "Document Control", which requires documentation of all quality-related meetings. Minutes shall be transmitted to all parties.

### 2.2.2 Daily Progress Meetings

A progress meeting shall be held daily at the work area. At a minimum, progress meetings shall be attended by the Construction Manager, construction contractor(s), and CQA monitoring personnel. The purpose of such meetings is to:

- Review the previous day's activities and accomplishments;
- Review the work location and activities for the day;
- Discuss the contractor's personnel and equipment assignments for the day;
- Review any new test data; and
- Discuss any potential construction problems.

This meeting shall be documented in daily field reports by a member of the CQA staff in compliance with QAPP Section 6.0, "Document Control".

### 2.2.3 Weekly Progress Meetings

Weekly progress meetings shall be held at the site. At a minimum weekly progress meetings shall be attended by the CQA Engineer, the Earthworks and Geosynthetics Contractors, the Construction Manager, and the COTR. The purpose of the meeting is to:

- Review the previous weeks activities and accomplishments;
- Review claims, change orders, delays, and similar items;
- Review planned activities for the upcoming week;
- Finalize resolution of problems from the previous week; and
- Discuss the potential problems with the work planned for the upcoming week.

This meeting shall be documented in compliance with QAPP Section 6.0, "Document Control," and minutes shall be transmitted to all parties.

### 2.2.4 Problem or Work Deficiency Meetings

Meetings shall be convened as necessary to address inspection deficiencies and nonconformances. Deficiencies observed during general earthworks construction and HDPE deployment inspection, seam welding, repair, and seam/repair weld testing shall be brought to the attention of the contractors on a real-time basis as described in Section 4 below. If the requested corrective action is not completed to the CQA Engineer's satisfaction, the deficiency shall be considered a nonconformance, documented on a WHC nonconformance report (NCR) form, and submitted to the COTR for resolution. All receiving inspection discrepancies shall be documented directly on a NCR and submitted to the COTR for resolution. In addition, all deficiencies requiring an engineering resolution by the Design Engineer shall be documented on a NCR. The CQA Engineer and GAI design engineers shall attend all subsequent nonconformance review meetings as requested by the COTR. All routine HDPE inspection and nonconformance activity shall be documented in the daily summary reports provided to the COTR.

## 2.3 Hold and Witness Points

Mandatory COTR hold points are required for the following items: soil/bentonite admix liner installation, HDPE liner installation and welding, electrical system testing, pressure testing of the leachate collection system, and acceptance testing. Mandatory COTR witness points shall be established for asphalt pavement installation, heat trace testing, leachate collection system pipe welding, and leachate collection tank integrity testing.

The requirements for hold and witness points are outlined in Appendix A. The schedule for the hold and witness points will be determined when the Contractor(s) develop the construction schedule for the project. The schedule shall be updated and presented to the Construction Manager on a weekly basis. The construction schedule will serve as notice to the Owner or Owner's Representative as to when the above hold and witness construction activities will take place.

The CQA schedule of tests and their frequency is summarized in Appendix A.

# 3. PERSONNEL QUALIFICATIONS AND CERTIFICATION

## 3.1 CQA Engineer

The CQA Engineer shall possess, at a minimum, a Bachelor's degree in engineering, engineering geology, or a closely related discipline, and shall have sufficient practical, technical, and managerial experience to successfully direct the CQA activities discussed in this plan. The CQA Engineer shall receive formal training in the requirements of the QAPP; procedure P-10.0-4, "Receiving Inspection"; and the CQAP in compliance with the requirements of Section 2.3 of the QAPP, "Training and Qualification of Project Personnel". This section of the QAPP requires that project personnel be trained in QA requirements applicable to their work assignments. The CQA Engineer's qualifications shall be documented by training records and professional resume. Qualification documentation shall be reviewed by the Project Manager and Project QA Manager; if acceptable, a project certification (see Figure 3-1) shall be completed and retained in the project QA records as required by Section 17.0 of the QAPP, "Quality Assurance Records". Certifications shall be valid for period of one year, after which they must be renewed.

## 3.2 CQA Personnel

Prior to undertaking project activities, all CQA Personnel shall receive formal training in the requirements of the QAPP procedure P-10.0-4, "Receiving Inspection", the CQAP, and all applicable technical procedures in compliance with the requirements of Section 2.3 of the QAPP. In addition, CQA Personnel must be trained in the use of visual-manual soil classification techniques. As a minimum, CQA personnel will have a high school diploma and at least two years of construction related experience and one year of experience conducting CQA monitoring for landfill construction involving both soil and geosynthetic components, or a Bachelor of Science degree from a four year college or University and one year of experience conducting CQA monitoring for landfill construction involving both soil and geosynthetic components. Qualifications of CQA Personnel shall be documented by training records and professional resumes, shall be reviewed by the Project Manager and Project QA Manager, and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of one year, after which they must be renewed.

## 3.3 Consultants

All consultants or subcontractors performing CQA inspection activities shall be qualified and certified as required by Section 3.2 above.

Figure 3-1 CQA Qualification Certification Form

Project W-025 RMW Land Disposal Facility - Non-Drag-Off

## CQA QUALIFICATION CERTIFICATION

I have determined that _____ meets or exceeds the qualification requirements for the project assignment of _____ as stated in the Construction Quality Assurance Plan for the referenced project, and have verified that the above employee's education and experience is accurate as documented in the attached resume. This certification is valid for a period of one year beyond the signature date below.

Approved by:
Project Manager_____Date_____

Reviewed by:
Project QA Manager_____Date_____

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# 4. INSPECTION ACTIVITIES/SAMPLING STRATEGIES

This section describes the inspection activities (observations and tests) that will be conducted by the CQA Personnel during construction of the RMW Non-Drag-Off facility. The scope will include monitoring activities related to the following construction elements:

- Pre-construction activities
- Earthworks
- HDPE Geomembrane Liner Installation
- Leachate Collection and Removal System
- Temporary Leachate Storage Facility

The following subsections address each facility component separately and are further subdivided into sections on pre-construction, construction, and post-construction testing and observation activities unique to each component. Specific test methods that will be used for these activities are listed in Appendix A.

## 4.1 Sampling Strategies

The sampling strategies employed in the various types of inspection situations discussed in this section include both periodic sampling and 100 percent inspection methods. Because of the criticality of most inspected characteristics to the acceptability of the completed facility, probabilistic or statistical methods, which involve random selection of the individual items or features to be inspected, will not yield the assurance of quality or confidence in performance that will be required for a completed facility, and are therefore not considered to be appropriate. Discussions of the strategies required for each different inspected attribute and/or inspection category are provided below. Discrepancies observed as a result of periodic and 100 percent inspection strategies will be expressed as in-process inspection defects. In-process inspection defects not corrected to the satisfaction of the CQA Engineer within the allowance of this CQA plan shall be considered nonconformances and shall be documented on WHC NCR forms and submitted to the COTR for disposition and corrective action.

## 4.2 General Pre-Construction Activities

Prior to the start of construction activities, the CQA Engineer and construction contractors will review for clarity the design drawings and specifications for the RMW Non-Drag-Off facility. If there are any questions or items that are unclear, the CQA Engineer will submit the questions in writing to the Design Engineer for clarification or modification.

All CQA Personnel shall be trained in the requirements of construction observation and testing for the RMW Non-Drag-Off facility. The training shall be conducted and documented in compliance with QAPP Section 2.3. The purpose of the training is to provide CQA staff with a clear understanding of expected conditions, methods of

construction, and the scope of plans and specifications. Specific requirements for the various methods of construction and testing documentation are as outlined in Section 5.

## 4.3 Earthworks

The primary earthworks tasks that will be performed during construction of the RMW Non-Drag-Off facility include the following:

- Excavation, Backfilling, and Grading
- Admix Soil Liner Preparation and Placement
- Gravel Drainage Layers
- Operations Layer
- Anchor Trench and Side Slope Riser Pipe Trench Backfill
- Surfacing of Road, Access Ramp, and Staging Area
- Drainage Facilities

Each of these items will be completed by the earthworks contractor and observed by the CQA Personnel. A description of activities to be performed by the CQA Personnel is presented in the following sections.

### 4.3.1 Excavation, Backfilling, and Grading

Pre-Construction

Approximately 85,000 cubic yards of soil will be excavated from the footprint of the RMW Non-Drag-Off facility and approximately 5,000 cubic yards of structural backfill will be placed. The upper 17 feet of material is expected to consist of a silty, fine sand (Eolian Deposit). Below the Eolian Deposits is a mixture of coarse sand to fine gravel. These materials will be separated during the excavation process and stockpiled at different locations. The CQA Personnel shall be trained in the identification of these materials so that they can document that the soils are being appropriately separated. Visual observation and classification of the excavated soils will be performed at least once each shift. This will also enable the CQA Personnel to identify any unexpected site conditions that may be encountered and which might require modification of the facility design or construction procedures by the Engineer and construction Contractors.

Prior to the start of the excavation, the contractor shall submit an earthworks operation plan and a schedule to the CQA Engineer for review. This plan shall include a description of the methods to be used for all excavation, backfilling, and grading operations.

Samples of the material to be used for structural backfill and roadway top course material, including the material to be used as the backfill for the side slope riser trench, shall be obtained and tested by CQA Personnel prior to placement of any material. The following

laboratory tests shall be performed to evaluate the suitability of the material for use as backfill and to determine control values for placement of the material.

- Grain Size Distribution
- Atterberg Limits
- Modified Proctor Compaction

One test series (grain size, Atterberg limits, and compaction) shall be conducted for every 2000 cubic yards of material placed. Laboratory test results will normally be available approximately one week after samples are delivered to the laboratory. The results shall be used for classification of the soils, for compaction testing if the soils are used as backfill, and for comparison purposes if the soils will be used as admix source material. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Prior to placement of any structural backfill, the foundation materials shall be moisture conditioned and compacted to 90 percent of ASTM D1557 to a minimum depth of 8-inches. The CQA Personnel shall test the subgrade with in-place density methods at least once every 10,000 square feet of subgrade surface.

Construction

During the excavation, backfilling, and grading operations, the CQA Personnel shall generally observe the excavated material and foundation conditions and shall perform the following activities:

- Observe stripping and excavation to document that there are no moisture seeps and that all soft, organic, and otherwise undesirable materials are removed.

- Observe soil types for segregation to appropriate stockpile. Record depth and location of changes in soil type, as well as any other pertinent geologic information.

- Coordinate with the CQA Surveyor to measure the depth and slope of the excavation, the anchor trench, the side slope riser trench, the surface water drainage ditches, and the access road anchor trench to document that they meet design requirements.

- Conduct tests and observations to document that the quality of compacted fill meets project specifications. This may include measurement of lift thickness and clod size. Field in-place density tests shall be conducted (during placement of structural fill) at a frequency of one test for every 500 cubic yards of fill placed or as directed by the CQA Engineer. Tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

- Conduct tests and observations to document the quality of roadway top course. This will include measurements of compacted density at a frequency of one test for every 10,000 square feet of placement area. Tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Post Construction

After excavation and backfilling have been completed, the CQA Personnel shall coordinate with the CQA Surveyor to confirm that all lines and grades have been achieved. In addition, the surface of the subgrade shall be visually observed to document that it has not been disturbed due to rain, weather, or equipment traffic such that remedial work will be required prior to placement of additional material.

### 4.3.2 Admix Soil Liner

Preconstruction

Preconstruction CQA activities include receiving inspection of liner materials and test fill construction. Each is described below:

Material Inspection

All liner materials shall be inspected to document that they satisfy the requirements of the specifications. Material inspection shall continue throughout the liner construction period. If liner material is obtained onsite, the inspections can be performed as the material is excavated or as it is placed in the storage pile. Visual observation and classification of the excavated soils will be performed as described in Section 4.3.1. Unsuitable material shall be rejected. If liner material is obtained offsite, inspection of the soil shall be conducted as it arrives at the construction site. For borrow areas containing nonuniform materials, unacceptable soil material shall be segregated as it is excavated. CQA Personnel shall observe segregation operations carefully and continuously to document that only suitable material is retained for liner construction. Changes in color or texture may be indicative of a change in soil type or soil moisture content. The soil shall be inspected for roots, stumps, large rocks, and other deleterious materials.

CQA Personnel shall inspect bentonite used for the admix to confirm that it meets specifications. The raw bentonite materials will be tested for bentonite fines content, bentonite filtration, and bentonite viscosity. In addition, the Contractor shall submit to the CQA Engineer the manufacturer's certificates on the bentonite. During mixing, CQA Personnel shall observe production and shall test the admix to document that the specified amount of bentonite is mixed uniformly with the natural soil, and that water is uniformly added to the admix in the amount necessary to achieve the

specified design. The bentonite content of the admix liner material shall be determined by hydrometer and sieve analysis.

A sufficient number of samples of the constituent materials and finished admix, as determined by the CQA Engineer, shall be tested to document that material properties are within the ranges stated in the specifications. These tests shall include at least the following:

- Bentonite filtration - 1 test/500 tons
- Bentonite fines content - test/500 tons
- Bentonite viscosity - 1 test/500 tons
- Bentonite yield manufacturer's certificates - 1/500 tons
- Recompacted Permeability (Admix) - 1 test/5000 cubic yards
- Soil density/moisture content relationships (Admix) - 1 test/5000 cubic yards
- Maximum clod size (Admix) - Periodic visual monitoring
- Particle size distribution (Eolian sand and admix) (hydrometer and - #200 sieve) - 1 test/1000 cubic yards
- Atterberg limits (Admix) - 1 test/5000 cubic yards
- Natural water content (Admix) - 1 test/1000 cubic yards

Samples will be collected and tested by CQA Personnel. With the exception of the maximum clod size, all tests will be performed in the laboratory. Test results will normally be available approximately two weeks after completion of liner material production. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A. All testing shall be completed and compliance with the specifications established prior to any placement of admix material.

Test Fill

A test fill shall be constructed to demonstrate the adequacy of the materials, design, equipment, and construction procedures proposed for the admix liner. The primary purpose of the test fill is to document that the specified soil density, moisture content, and permeability values can be achieved consistently in the full-scale facility with the full-scale compaction equipment and procedures.

So that the test fill will accurately represent the performance of the full-scale facility, the following guidelines shall be followed:

- Construction of the test fill shall use the same soil material, design specifications, equipment, and procedures as proposed for the full-scale facility.

- The test fill shall be constructed at least four times wider than the widest piece of construction equipment to be used for the full-scale facility. This is done to

ensure a sufficient area to conduct all testing after a buffer area has been left along the edges of the test fill.

- The test fill shall be long enough to allow construction equipment to achieve normal operating speed before reaching the area that will be used for testing.

- The test fill shall be constructed with at least six lifts to evaluate the methodology used to tie lifts together.

- The test fill shall be constructed to allow determination of the relationship among density, moisture content, and permeability. Field variables can affect this relationship and must be carefully measured and controlled both in the test fill and during construction of the full-scale liner. As a minimum, the following shall be observed:

  - the compaction equipment type, configuration, and weight

  - the number of passes of the compaction equipment

  - the method used to breakdown clods before compaction and the maximum allowable clod size

  - the method used to control and adjust moisture content, including equilibration time, and the quantity of water to be used in any adjustment

  - the speed of the compaction equipment traveling over the liner

  - the uncompacted and compacted lift thicknesses.

- Relatively undisturbed samples of the test fill shall be collected using Shelby tubes for laboratory permeability tests.

- Following collection of permeability samples, the methodology for repairing holes in the soil liner shall be evaluated. The evaluation of a repaired area shall include all tests previously required for undisturbed portions of the test fill. The methods and materials that will be used in the repair process shall be documented by the CQA Engineer. Performance of repaired soil liner sections shall be equal to or exceed the performance of undisturbed liner sections. The resulting procedures shall be followed during repair of testing or sampling holes during full-scale liner construction.

- The test fill construction shall include the removal and replacement of a portion of the soil liner to evaluate the method proposed for repair of defective portions of the full-scale liner.

- A Sealed Double Ring Infiltrometer Test shall be performed on the test fill to evaluate large-scale permeability. CQA Personnel shall direct installation of the equipment, perform the test, and evaluate the data with support from the earthworks contractor.

- Evaluation of layer bonding shall be determined by CQA Personnel using test pits to make visual observations. A minimum of two test pits shall be excavated in each test fill after test fill construction has been completed. The test pits shall be excavated entirely through the test fill using a backhoe or other approved method. Test pit locations shall be determined by the Construction Manager and CQA Engineer.

The number and frequency of field and laboratory tests to be conducted during the test fill are listed below:

- Visual observation - continuous
- Field in-place moisture-density (nuclear) - 3 per lift (minimum)
- Field in-place moisture-density (rubber balloon) - 1 for every lift (minimum)
- Laboratory permeability test of in-place admix - 1 for every lift (minimum)
- SDRI test - one per test fill

Additional tests may be conducted at the direction of the CQA Engineer. Test results for the field in-place moisture-density tests will normally be available within 24 hours. The laboratory permeability of in-place admix and any other additional laboratory test results will normally be available approximately two weeks after completion of the test fill. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A. The CQA Engineer shall compare the results of field and laboratory testing to the required specifications. Any failing tests shall be reported to the COTR.

Additional test fills shall be constructed for each borrow source and whenever significant changes occur in the liner material, equipment, or procedures used to construct the soil liner.

Construction

Low-permeability admix liner shall be constructed by using the materials equipment and procedures used in the test fill and as documented by CQA Personnel. Criteria to be used for determining the acceptability of the liner shall be as identified in the project specifications.

To document that proper construction practices are followed, CQA Personnel shall continuously observe the liner material placement and compaction process. During material spreading, the following shall be documented:

- Liner material is spread adequately to obtain complete coverage and the specified loose lift thickness;

- Oversize clods in the liner material are discarded or reduced in size;

- Soil moisture content is adjusted appropriately in the event of a significant prolonged rain or drought during construction;

- When required, water is adequately spread and incorporated to obtain full penetration through clods and uniform distribution;

- Significant water loss and desiccation cracking before and after compaction are prevented through the use of water application, covering, or other appropriate methods.

During the soil liner compaction process, the following shall be documented:

- Compaction equipment is of the same type, configuration, and weight as used in the test fill;

- The equipment speed and number of passes for compaction is the same as used in the test fill;

- Coverage by compaction equipment is uniform, especially at compacted fill edges, in equipment turnaround areas, and at the tops and bottoms of slopes;

- The specified soil density, water content, and permeability throughout each completed lift is achieved. This will be determined by laboratory and field testing;

- Permeability values obtained for undisturbed soil liner samples are consistent with values obtained for undisturbed samples from the test fill. Undisturbed sample locations are staggered from lift to lift so holes do not align vertically;

- Penetrations or holes resulting from the collection of undisturbed soil samples or the use of density or moisture probes are repaired using the same materials and methods used for repairs on the test fill. CQA personnel shall repair all holes resulting from sampling or testing activities;

- Repaired sections are tied-in with undisturbed sections of the liner;

- Compacted lifts are tied together by scarifying the top of each lift, if necessary, with appropriate equipment prior to applying the following lift;

- Sufficient liner strength to maintain stable sidewalls and to supply a stable base for supporting overlying materials is maintained while achieving the minimum specified density. This shall be monitored with moisture-density testing in accordance with the procedures outlined in Appendix A. In place field density tests and moisture content tests shall be conducted at a frequency of at least one test per 250 cubic yards of material placed. Additional tests may be conducted as directed by the CQA Engineer. If a nuclear density gauge is used to measure the in-place density of the admix, then at least one rubber balloon or sand cone density test shall be conducted per day to confirm the results of the nuclear gauge;

- Protective covers to prevent desiccation of liner material after completion of the liner are placed in a timely manner where necessary; and

- Equipment traffic is routed and controlled such that accidental damage of installed portions of the soil liner is prevented.

Climatic conditions shall be considered when construction methods are chosen. Construction methods may be restricted on work performed during and just after a rainfall, during very hot or windy conditions, or during freezing weather. For example, more compactive effort must sometimes be applied to achieve the same density as soil temperature falls. In very dry weather, the surface water content of each compacted fill layer can be altered in a short time by drying, making continuous watering and blending necessary. Atmospheric conditions shall be observed and recorded by CQA Personnel, and appropriate actions shall be taken when unsuitable weather conditions exist.

At locations where the field testing indicates that moisture contents or densities are outside the acceptable limits of the specifications, the failing area shall be reworked or removed and replaced. These areas shall be retested and the repair process repeated as necessary until passing results are achieved.

Shelby tube samples of the in place soil liner shall be obtained at a minimum frequency of one sample for every 5000 cubic yards of material placed. Additional samples may be obtained at the discretion of the CQA Engineer. At least one sample shall be taken from a corner area. Laboratory permeability tests shall be conducted on these samples to document compliance with the specifications. Laboratory permeability tests results will normally be available approximately two weeks after the sample is obtained. Field density and moisture content results will normally be available within 24 hours after the test is performed.

The CQA Engineer shall monitor on a periodic basis the soil liner surface for desiccation and irregularities to document compliance with the specifications. The completed liner shall be protected from desiccation, erosion, and freezing immediately following completion of the uppermost lift.

Post Construction

Immediately before placement of any geomembrane, the soil liner shall be inspected for cracks, holes, defects, or any other features that may increase its permeability. All defective areas shall be repaired. If the underlying foundation is defective (e.g., soft or wet), then this material shall be removed and the resultant volume replaced. Excavated areas of the soil liner shall be repaired by the method demonstrated during test fill construction; inspection shall document that there is continuity between the repaired and undisturbed areas.

Special attention shall be paid to the final inspections of the sidewall and bottom slopes, liner coverage, and liner thickness. The CQA Engineer shall coordinate with the CQA Surveyor to confirm that minimum design thicknesses and grades are achieved prior to placement of any additional material over the soil liner.

### 4.3.3 Gravel Drainage Layers

Pre-construction

Samples of the drainage layer gravel and the sump gravel shall be obtained at the borrow source pit or stockpile. Samples shall be obtained and tested to document compliance with the specifications at a frequency of one sample for every 500 cubic yards of material that will be used for construction. Tests shall consist of the following:

- Grain size
- Permeability.

The laboratory grain size and permeability test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Construction

As the drainage material is delivered to the site and placed in the facility, the CQA Personnel shall perform the following activities:

- Visually observe the material for contamination by debris or deleterious material;
- Visually observe the material for uniformity;
- Sample the material for grain size and permeability tests at a frequency of one test for every 250 cubic yards of material delivered to the site;

- Observe the placement of the material to confirm minimum thickness under spreading and hauling equipment to prevent damage to the underlying liner materials and components of the leachate collection system; and

- Observe placement and compaction of the material around piping and risers in the sumps.

The laboratory grain size and permeability test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Post-Construction

The CQA Engineer shall coordinate with the CQA Surveyor to document that minimum thicknesses and design grades in the gravel layer have been achieved prior to the placement of any additional materials over the top of the gravel.

### 4.3.4 Operations Layer Placement

Pre-Construction

CQA Personnel shall obtain samples of the proposed operations layer material prior to placement in the landfill. Samples shall be obtained at a frequency of one sample per 2,000 cubic yards and tested to document that the material meets the gradation requirements in the specifications.

The laboratory grain size test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Construction

During placement of the operations layer material, CQA Personnel shall observe the placement operations on a full-time basis and perform the following:

- Visually observe the material for contamination with debris or deleterious material;

- Visually observe the material for particle size;

- Sample the material for grain size tests at a frequency of one test for every 2,000 cubic yards of material placed in the facility;

- Observe the placement of the material to confirm minimum thickness under equipment to prevent damage to the underlying liner materials;
- Visually observe that the operations layer placement on the slopes is conducted in compliance with the procedures outlined in the specifications;
- Visually observe to detect any damage to the underlying liner materials; and
- Visually observe the moisture conditioning, placement, and compaction of the material placed adjacent to the primary slope riser pipes.

The laboratory grain size test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Post-Construction

The CQA Engineer shall coordinate with the CQA Surveyor to confirm that minimum thicknesses and design grades in the operations layer have been achieved prior to the placement of any waste materials.

### 4.3.5 Anchor Trench/Side Slope Riser Pipe Trench

Pre-Construction

CQA Personnel shall obtain samples of the proposed backfill materials for anchor trenches and side slope riser pipe trenches prior to backfilling these trenches. Samples shall be obtained at a frequency on one sample per 2,000 cubic yards for each material or a minimum of one sample, whichever is greater. Samples shall be tested to confirm that the material meets the gradation requirements in the specifications.

The laboratory grain size test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Construction

During placement of backfill in the anchor trenches and riser pipe trenches, CQA Personnel shall observe the placement operations on a periodic basis and perform the following:

- Visually observe the material for contamination with debris or deleterious material;

- Visually observe the material for particle size;
- Sample the material for grain size tests at a frequency of one test for every 2,000 cubic yards of each material placed in the trenches or a minimum of one sample, whichever is greater;
- Visually observe that the material is moisture conditioned and compacted as specified;
- Visually observe that backfill around riser pipes does not contain voids;
- Observe the placement of the material to document minimum thickness under equipment to prevent damage to the underlying materials; and
- Visually observe to detect any damage to the underlying liner materials.

The laboratory grain size test results will normally be available approximately one week after the sample is obtained. All tests shall be conducted in accordance with the methods and procedures specified in Appendix A.

Post-Construction

There are no specific post-construction requirements for trench backfill.

### 4.3.6 Asphalt

The asphalt concrete pavement for the truck unloading area shall be observed and tested by CQA Personnel. The following tasks shall be performed by CQA Personnel during preparation and placement of the asphalt concrete:

- As part of the submittal process, evaluate the proposed top course aggregate and the asphalt concrete mix design;
- During delivery to site, sample and submit for testing to a qualified laboratory two representative bulk samples of the pavement mix to check for conformance to the submitted mix design;
- Visually observe the top course aggregate during placement and compaction for particle size, lack of contamination, and finished surface;
- Visually observe primer application;
- Visually observe asphalt concrete compaction during placement; and

- Visually observe seal coat application.

Specific ASTM test procedures and test frequencies are presented in Appendix A.

### 4.3.7 Concrete

Several small volumes of structural concrete will be placed at the site for foundations of various structures including the control building, the leachate storage tank, the piping area, and the vertical riser pipe. The following activities shall be performed by CQA Personnel or subconsultants to the CQA Engineer for these concrete structures:

- Evaluate the mix design submittal for conformance to the specifications.
- Observe formwork and reinforcing steel prior to placement of fresh concrete to check for conformance with the drawings and specifications.
- Obtain delivery ticket from transit mixer certifying mix design.
- Perform field testing and observation of the concrete placement using methods and frequencies in conformance with ACI 301.
- Field check forms and concrete placement dates prior to removal of forms.
- Monitor the curing methods and times to document that satisfactory moisture and temperature conditions are maintained.

## 4.4 HDPE Geomembrane Liner

### 4.4.1 Preconstruction

Preconstruction activities for HDPE geomembrane liner include inspection of the raw materials, manufacturing operations, fabrication operations, and final product quality; observations related to transportation, handling, and storage of the membrane; observation of foundation preparation; and review of the personnel and equipment to be used to install the HDPE geomembrane liner. In addition, CQA Personnel shall perform conformance tests and "fingerprinting" analysis on samples of the HDPE liner material submitted by the geomembrane installer. These activities are discussed in the following subsections.

4.4.1.1 HDPE Manufacture

Quality assurance requirements for the geomembrane manufacturer initially consist of evaluating the raw polymer materials. The resin supplier shall provide documentation with each shipment and/or production lot confirming that the raw materials comply with the manufacturers' product properties and performance requirements. The Manufacturer shall test each batch of resin to verify that the raw material meets or exceeds the specifications. At WHC's direction, the CQA Engineer may inspect the raw polymer materials in the manufacturer's facilities. Any source inspection activities so required shall be performed in compliance with the surveillance inspection procedures referenced in Section 10.2 of the QAPP "Surveillance Inspection", with the exception that all nonconformances shall be documented on WHC Nonconformance Report (NCR) forms and submitted to the COTR for disposition and resolution.

CQA Personnel shall review testing results and other documentation submitted by the geomembrane Manufacturer for conformance to the specification requirements. Submittals from the Manufacturer include the following:

- the origin (Resin Supplier's name, resin production plant), identification (brand name, number) and production date of the resin;
- a list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane;
- a copy of the quality control certificates issued by the Resin Supplier;
- reports on the tests conducted by the Manufacturer and/or the CQA Engineer to confirm that the quality of the resin used to manufacture the geomembrane satisfies the specifications;
- a statement that no recycled polymer is added to the resin or that recycled polymer is clean and does not exceed 2% by weight;
- a properties sheet including, at a minimum, all properties listed in the specifications, measured using test methods indicated in the specifications, or equivalent;
- reports on the tests, including sampling procedures, conducted by the Manufacturer and/or the CQA Engineer to confirm that the geomembrane meets the project specifications;
- a certification that property values given in the properties sheet are guaranteed by the Geomembrane Manufacturer.

Other QA requirements are described in the specifications.

4.4.1.2 Receiving Inspection and Conformance Testing

The CQA Personnel shall perform receiving inspection on all geomembrane material in compliance with procedure P-10.0-4, "Receiving Inspection", specified in Section 10.3 of the QAPP, with the exception that all nonconformances shall be documented on WHC NCR forms and submitted to the COTR for disposition and resolution. CQA Personnel shall also confirm that transportation, handling, and storage of geomembrane is performed in accordance with the specifications, and shall determine the condition of rolls of geomembrane upon delivery to the site. Details of these activities are described in the specifications.

CQA Personnel shall remove samples to be tested to determine conformance to the design specifications and the manufacturer's specifications. The properties which shall be tested include:

- Specific Gravity;
- Carbon black content and dispersion;
- Thickness;
- Tensile/elongation properties;
- Friction angle of the Type I geomembrane with soil liner material (direct shear methods as specified by the Design Engineer).

Upon delivery of the rolls of geomembrane, CQA Personnel shall remove samples and forward them to the geosynthetics testing laboratory. Samples of geomembrane shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. Samples shall be taken at a rate of one per lot or one per 50,000 square feet, whichever results in the greater number of tests. All tests shall be completed in accordance with the methods and procedures specified in Appendix A.

CQA Personnel shall examine all results from laboratory conformance testing, shall document all nonconformances on WHC NCR forms, and shall notify the COTR of any such nonconformance. Rolls of geomembrane which do not meet or exceed all required specifications shall be rejected and brought to the attention of the COTR.

4.4.1.3 Factory Fabrication

Sheets of geomembrane may be joined to form larger panels prior to delivery and installation at the landfill. CQA Personnel shall document that such fabrication activities are performed in accordance with the specifications, particularly that required materials, methods, and testing procedures are employed. CQA Personnel shall also review documentation submitted by the Fabricator, testing laboratories, and other parties as listed in the specifications. All nonconformances shall be documented on WHC NCR forms. Geomembrane panels which do not meet or exceed all required specifications shall be rejected and brought to the attention of the COTR. Requirements for fabrication and

testing are described in detail in the specifications and are summarized in the following paragraphs.

Unless otherwise approved, the fabrication of rolls of geomembrane into panels shall be performed by the geomembrane Manufacturer or Fabricator under controlled factory conditions. All seams shall meet or exceed the specifications required for field seams. Fabrication shall be performed by experienced personnel. Approved fabrication seaming processes are extrusion welding and fusion welding. Any proposed alternate processes must be submitted for approval by the COTR. Details of the specific apparatus and methods to be used for seaming, shall be submitted for approval prior to use.

The geomembrane Manufacturer or Fabricator shall allow the CQA Engineer to visit the fabrication plant during the production of panels for this project in order to review the fabrication and quality control procedures.

Prior to shipment of fabricated panels to the site, the Fabricator shall provide written certification that quality control testing has been performed. Quality control certification shall include: panel numbers and complete identification features such as roll numbers, dimensions and fabrication methods, etc.; all sampling and testing procedures including location and results of the testing; and documentation of the temperature and humidity conditions under which fabrication was performed. Quality control certificates shall be signed by an authorized representative of Fabricator.

4.4.1.4 Bedding Surface

CQA Personnel shall confirm that the surface upon which the geomembrane will be installed is suitably prepared and will not damage the geomembrane. Details of required observations are presented in the specifications and are summarized in the following paragraphs.

The geomembrane bedding layer shall be free of clods, rocks, sticks, sharp changes in grade, desiccation cracks, and standing water. Where the bedding surface is the low permeability soil liner, methods shall be taken to prevent the soil liner surface from drying and cracking prior to installing the geomembrane. These methods may include the use of a temporary cover. All desiccation cracks outside of specifications shall be repaired using approved methods.

The Geomembrane Installer shall inspect and provide written certification to the COTR and the CQA Engineer that the prepared surface under consideration is suitable for installation of the geomembrane.

After acceptance of the prepared surface, it shall be the Installer's responsibility to notify COTR and the CQA Engineer of any deterioration in the prepared surface resulting from weather or other causes beyond the Installer's control. Repairs required to restore the surface as a result of such causes shall be made as directed by COTR. Any damage to the

prepared surface caused by installation or other causes relating to performance of the work shall be the responsibility of the Geomembrane Installer.

### 4.4.2 Construction

Sheets of geomembrane will be welded together after they are placed in the landfill to form a continuous moisture barrier. CQA Personnel shall document that the placement and seaming activities are performed in accordance with the specifications, particularly that required materials, methods, and testing procedures are employed. CQA Personnel shall also review documentation submitted by the Geomembrane Installer, testing laboratories, and other parties as listed in the specifications. Seams or repaired areas which do not pass the tests shall be repaired and retested as described in the specifications until a passing result is achieved. Requirements for geomembrane installation and testing are described in detail in the specifications and are summarized in the following subsections.

#### 4.4.2.1 Placement of Geomembranes

Prior to placing geomembranes in the landfill, the Geomembrane Installer shall provide scale drawings showing the proposed placement pattern and field seam locations (including all dimensions and details) to the COTR and the CQA Engineer for review. These drawings shall be submitted in a reproducible form.

Each field panel and field seam shall be given an identification code which is consistent with the proposed sequence of installation. A field panel is defined as the area of geomembrane which is to be cut and seamed in the field by the Installer. Unless otherwise directed, the Installer shall place the field panels in the sequence shown on the installation drawings.

On slopes or grades steeper than ten percent, all seams shall be oriented down and not across the slope. No horizontal seam shall be less than five feet from the top of the slope or other area of potential stress concentration. The number of field seams shall be minimized in such areas such as corners and odd-shaped geometric locations. In anchor trenches, the geomembrane shall be continuous through the trench, over the crest, and down the slope.

Geomembrane shall not be placed when ambient temperatures are less than 40°F or more than 104°F. Placement shall not be attempted in rain or snow or under conditions of excessive fog or dew. Placement will not be permitted in areas of ponded water or in the presence of excessive winds.

Equipment used for placement shall not damage the geomembrane or the subgrade by handling, trafficking, leakage of hydrocarbons, or in other ways. Personnel working on the geomembrane shall not engage in any activities or wear footwear which could damage the

geomembrane. Direct contact of any heavy mechanical equipment with the geomembrane shall not be allowed.

Panels shall be carefully unrolled according to the Manufacturer's and/or Fabricator's instructions, and in a manner that does not scratch or crimp the geomembrane. Panels shall be aligned to minimize wrinkles or "fishmouths", especially along the field seams. Adequate precautions that are not likely to damage the geomembrane (such as placement of sand bags), shall be taken to minimize the likelihood of wind uplift.

Any field panel or part of a field panel which becomes seriously damaged shall be replaced at the direction of COTR. Minor damage such as small wrinkles, crimps, etc., shall be repaired according to Section 4.4.2.5 Damaged field panels which have been rejected for use shall be removed from the site.

CQA Personnel will measure field panel thickness by obtaining five (5) thickness measurements along the leading edge, five (5) thickness measurements along the trailing edge, and five (5) side thickness measurements spaced along the length of the panel. The panel thickness will be the average of the five (5) measurements at the particular location.

4.4.2.2 Field Seaming of Geomembrane

Personnel

The Geomembrane Installer shall provide the COTR and CQA Engineer with a list of the Installer's proposed seaming personnel and their previous seaming experience. All seaming personnel shall be required to pass a seaming test prior to commencement of field seaming operations. The superintendent and lead welder foreman shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus in use at the site. These individuals shall provide direct supervision, as required, over less experienced seamers. No field seaming shall take place without one of these individuals being present.

Field Seaming Methods and Equipment

General: Only seaming methods and equipment which have been previously approved by the COTR shall be used for field seaming of the geomembrane panels. Approved seaming methods are extrusion welding and fusion welding. Alternate methods may be proposed by the Installer. Seaming shall be a continuous process with a minimum of interruptions along any given seam. The Installer shall maintain at least one operable spare seaming unit on site at all times.

Where conditions warrant, the Installer may be allowed to use a temporary support surface between the geomembrane and the subgrade to achieve proper support conditions during seaming operations. The use of such support methods shall be subject to the approval of

the COTR who shall also decide whether the support may be left in place or shall be removed on completion of seaming.

Wherever possible, all wrinkles or "fishmouths" shall be pulled out of the overlap area prior to seaming. Where this cannot be done, they shall be cut along the ridge of the wrinkle in order to achieve a flat surface. All such cuts shall be seamed. Where the overlap is inadequate, an oval or round patch of the same geomembrane, extending a minimum of six inches beyond the cut in all directions, shall be seamed onto the geomembrane.

Extrusion Welding Process: Extrusion welding apparatus shall be equipped with gauges to measure the barrel and nozzle temperatures of the apparatus. The CQA Engineer shall monitor the extrudate and ambient temperature at appropriate intervals. The extruder shall be purged of all heat degraded extrudate at the beginning of each seaming sequence.

Artificially induced cooling of extrudate welds (using water or any other means) shall not be allowed. Sufficient time between welding and non-destructive testing shall be taken so that nondestructive testing procedures do not cause artificial cooling of the extrudate.

Fusion Welding Process: Fusion welding apparatus shall be automated, self-propelled devices which produce a double seam with an enclosed central air space. The apparatus shall be equipped with gauges which indicate the equipment temperatures during welding. For the seaming of cross-seams, the top and bottom edges of the cross-seam shall be ground to a smooth incline prior to seaming.

The CQA Engineer shall log ambient and seaming apparatus temperatures, as well as seaming apparatus speed.

Seam Overlap and Preparation: Prior to seaming, geomembrane rolls or panels shall be overlapped by a minimum of three inches for extrusion welding and five inches for fusion welding. Procedures used to temporarily bond adjacent rolls together shall not result in damage to the geomembrane. If mechanical devices such as hot air leisters are used for temporary bonding, the air temperature at the nozzle of such equipment shall be controlled so as not to damage the geomembrane. Solvents and/or adhesives shall not be used.

Seams shall be aligned so as to create a smooth surface as practicable with a minimum of wrinkles and "fishmouths". The area in the immediate vicinity of the seam shall be free of moisture, dust, dirt, debris, or any other foreign material and, if necessary, sheltered from wind and dust immediately prior to and during the seaming operation. If grinding is required along the seam, this shall be done according to the Manufacturer's recommendations, within one hour of the seaming operation and in a way which does not damage the geomembrane. This process also shall include cleaning the seam area with a brush or forced air immediately prior to seaming.

The CQA Engineer shall document geomembrane seam overlaps and preparation procedures.

Climatic Conditions

In general, seaming shall not be attempted when ambient temperatures are below 40°F or above 104°F. Between 40°F and 50°F, seaming shall be allowed provided that the geomembrane is preheated by either the sun or the use of a hot air device, and provided that excessive cooling resulting from wind does not affect the seaming operation. CQA Personnel shall determine when preheating is required and whether wind affects may be deleterious to seaming operations.

The Installer may be allowed to proceed with seaming operations when the ambient temperature is less than 40°F provided that suitable precautions are taken and he is able to certify in writing that seaming under these conditions will not cause any chemical or physical alteration to the geomembrane which may deleteriously affect its short- or long-term performance. Such precautions shall be subject to prior approval by COTR.

Seaming shall not be attempted during wet weather where the geomembrane is exposed to the elements.

Test Seams

Test seams shall be made to verify that adequate conditions exist for field seaming to proceed. Each seamer shall produce a test seam at the beginning of each shift. Additional test seams shall be made every four hours or, if a breakdown of the seaming equipment occurs, prior to resumption of seaming operations. The CQA Engineer shall monitor and log the test seam results.

Test seams shall be made on pieces of geomembrane identical to the installed product measuring at least two feet long by one foot wide (after seaming) with the seam centered lengthwise and overlapped as required for the particular seaming process.

Two samples, each one inch wide, shall be cut from the test seam and tested in shear and peel using a tensiometer. The samples shall not fail in the seam. If a seam failure occurs, then a second seam shall be produced and tested. If a second failure results, the apparatus or seamer shall be rejected and shall not be used for field seaming until any deficiencies have been corrected. This shall be verified by the production and successful testing of two consecutive test seams.

4.4.2.3 Nondestructive Testing of Field Seams

General

All seams shall be nondestructively tested by the Installer over their full length to verify their continuity. It should be noted that this testing does not provide any information regarding seam strength. Nondestructive testing shall be performed concurrently with field seaming using the equipment and procedures described below. Testing equipment

and procedures other than those given below shall be subject to approval by COTR prior to their use. Any seam which fails the nondestructive test shall be repaired in accordance with the procedures given in Section 4.4.2.5. All repairs shall be retested to determine the success of the repair.

Where CQA Personnel determine that seams cannot be nondestructively tested due to physical constraints, the seams shall be capped with the same geomembrane or double seamed. CQA Personnel shall observe the seaming and capping of such seams to assess their adequacy and determine whether additional action is required. Where such a seam is accessible for testing prior to final geomembrane deployment, testing shall be performed prior to deployment.

The non-destructive testing shall be conducted by the Installer and continuously monitored by CQA Personnel.

Vacuum Testing

For extrusion welded seams, all seams shall be evaluated using vacuum box testing. The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, flexible gasket attached to the bottom of the housing. A port hole and valve assembly along with a calibrated vacuum gauge shall be provided at one end of the housing. The vacuum gauge shall be calibrated prior to initial use on the project and recalibrated on at least an annual basis or at the discretion of the CQA Engineer. The Installer shall supply vacuum gauge calibrations to the CQA Engineer for review prior to the start of testing. A steel vacuum tank and pump assembly complete with all the necessary pressure controls, pipe connections, pressure hoses, and fittings shall be provided. A soapy solution and a method of dispensing the solution is also required.

To perform the test, the pressure in the vacuum tank shall be reduced to approximately five inches of mercury. The soapy solution shall be applied to the test section and the vacuum box placed over the wetted area. The bleed valve shall then be closed and the vacuum valve opened. Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution is occurring. The vacuum valve shall then be closed and the bleed valve opened. The vacuum box shall be removed and the process repeated on the next adjacent test section. A minimum three-inch overlap shall be provided on all test sections. All locations where bubbling of the soapy solution is observed shall be clearly marked for repairs to be performed in accordance with Section 4.4.2.5

Air Pressure Testing

This test method shall apply only when the double hot wedge fusion seaming method is used to form the seam. The testing equipment shall consist of an air pump capable of generating and sustaining a constant pressure of between 60 and 65 psi complete with a pressure gauge and the necessary pressure hose, fittings, and connections. An approved

pressure feed device such as a sharp hollow needle shall be provided to penetrate into the central air channel at one end of the seam. A second pressure gauge shall be provided to detect any pressure loss at the opposite end of the seam from the pressure feed device. The pressure gauges shall be calibrated prior to initial use on the project and recalibrated on at least an annual basis or at the discretion of the CQA Engineer. The Installer shall supply pressure gauge calibrations to the CQA Engineer for review prior to the start of testing.

To perform the test, a section of the seam shall be sealed off at both ends. The pressure feed device shall be inserted into the air channel at one end of the sealed section, and the second pressure gauge shall be inserted into the opposite end of the air channel. If the seam is 1/2-inch-wide, it shall be pressurized to a pressure of between 25 and 30 psi. If the seam is 1-inch-wide, it shall be pressurized to between 55 and 60 psi. The pressure valve shall be closed and the pressure monitored for a period of not less than 5 minutes. If a pressure loss greater than 2 psi is observed at either end or if the required pressure cannot be reached, then the seam shall be rejected. All faulty areas along the seam shall be identified, repaired in accordance with Section 4.4.2.5, and retested. All holes created during nondestructive testing shall be repaired in accordance with Section 4.4.2.5 upon completion of the test.

4.4.2.4 Destructive Testing of Field Seams

Destructive testing of field seams shall be performed at selected locations in order to verify that seams satisfy the strength requirements listed in the specifications. All sampling and testing shall be done concurrently with field seaming operations so that corrective action, if required, may be implemented as the work progresses. Samples shall be taken for testing so as to achieve a minimum average frequency of one test location per 500 feet of seam length. Sample locations shall be determined by CQA Personnel based on the required sampling frequency and seaming observations. The Installer shall not be informed in advance of the locations where the seam samples will be taken. Additional test locations may be required during seaming operations. The necessity for such additional sampling and testing shall be determined by CQA Personnel, and extra testing shall be performed when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect. The COTR may increase the minimum frequency of destructive testing as the work progresses based on the results of previous testing.

Samples shall be cut by the Installer under the observation of CQA Personnel. Samples may be cut prior to nondestructive seam testing. Each sample shall be numbered and identified. The sample number and location shall be recorded by CQA Personnel on the layout drawings.

The test sample shall measure approximately 12 inches wide by 42 inches long with the seam centered lengthwise. Two one-inch wide strips shall then be cut, one from either end of the sample. Both of these strips shall be tested by the Installer in the field using a tensiometer to determine the mode of failure in both peel and shear. The remaining

portion of the sample shall be cut into three equal parts having a minimum length of 12 inches. One sample shall be taken by CQA Personnel for destructive testing under laboratory conditions. One sample shall be given to the Installer to perform his own laboratory testing if he so chooses. The third sample shall be kept in storage by the COTR.

The area from which the test sample was cut shall be immediately repaired in accordance with the procedures described in Section 4.4.2.5. All seams created for these repairs shall be nondestructively tested in accordance with Section 4.4.2.3.

Neither of the field tests shall fail in the seams. The results of the laboratory testing by CQA Personnel shall in any case determine the acceptability of the field seam. The tests shall be performed in accordance with the methods listed in Appendix A. The results of the laboratory destructive testing shall be made available to the Installer by the COTR not more than 48 hours after the samples have been received by the laboratory facility where the testing is to be performed.

A field seam shall only be considered acceptable when it is bounded by two destructive test locations which meet the seam strength requirements listed in the specifications, as well as passing the nondestructive tests described in Section 4.4.2.3. If field tests are performed and a failure is recorded, the following procedures shall be employed. The Installer shall have two options at his disposal as follows:

- The Installer may cap the failing seam between any two passed test locations; or

- The Installer may elect to trace the seam to two intermediate locations a minimum of 10 feet in either direction from the point of the failed test and take a small sample for an additional field test at each location. If these additional samples pass the test, then full samples shall be taken for CQA laboratory testing. If these laboratory samples pass the tests, then the seam shall be capped between these locations. If either sample fails, then the sampling and testing process shall be repeated to establish the zone over which the seam shall be capped.

The continuity of all capped seams shall be verified by nondestructive testing in accordance with Section 4.4.2.3. In addition, if the total capped seam length exceeds 150 feet, a destructive sample shall be taken for laboratory testing as described above.

The CQA Engineer shall document all actions taken in conjunction with destructive test failures.

4.4.2.5 Repairs

The entire geomembrane surface shall be examined by CQA Personnel in order to confirm that the geomembrane is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter. Whenever possible, the examination of the geomembrane surface shall be done prior to any seaming in that area. If necessary, the geomembrane

surface shall be cleaned by the Installer so that it is free of dust, mud, or any other materials which may inhibit a thorough examination of the surface. Any suspect areas shall be clearly marked by CQA Personnel and nondestructively tested by the Installer in accordance with Section 4.4.2.3. Any location which fails to pass the nondestructive testing or from where a destructive test sample has been removed shall be repaired using one of the procedures described below.

Small tears, wrinkles, or pinholes shall be repaired by the Installer using spot welding, seaming, or patching, as appropriate. Blisters, large holes and tears, undispersed raw materials, and any areas which have been contaminated by foreign matter shall be repaired by the Installer using patches or by capping the area. All patches shall be round or oval in shape, shall consist of the same geomembrane material, and shall extend a minimum of 6 inches beyond the edge of the defect in all directions. Temporary bonding methods used to hold patches in place prior to seaming shall be approved methods only, in accordance with Section 4.4.2.2. Geomembrane surfaces to be patched shall be abraded in accordance with the specifications. All surfaces shall be clean and dry at the time the repair work is performed. All seaming shall be performed using approved extrusion welding methods and equipment.

All repairs shall be nondestructively tested using the appropriate methods described in Section 4.4.2.3. Unless additional destructive testing is required as described in Section 4.4.2.4, repairs which pass the nondestructive test shall be accepted as being adequate. Any repairs which fail the nondestructive test shall not be accepted, and the Installer shall perform the necessary remedial work and retest the repaired area until it passes the nondestructive testing criteria.

Upon completion of field seaming and testing, and prior to any placement of materials on top of the geomembrane, CQA Personnel shall identify any large wrinkles or "fishmouths" which may have been built into the geomembrane. Any such features shall be cut out, repaired, and tested by the Installer.

In any given area, no work shall proceed with any materials which may cover the geomembrane until all repairs in that area have been successfully made. As the work progresses, CQA Personnel shall document all locations requiring repair work and shall confirm that all repairs have been successfully made.

4.4.2.6 Materials in Contact with Geomembrane

The requirements of this section are intended only to minimize the risk of geomembrane damage during installation on existing surfaces or during placement of overlying materials. The construction and material specifications for the Non-Drag-Off Facility shall govern the adequacy of construction using these overlying materials.

The installation of geomembrane on rough surfaces such as concrete shall be carefully performed so as to prevent any damage to the geomembrane. The Installer, with prior

approval from COTR, may elect to use a remnant piece of geosynthetic material as a "rub-sheet" beneath the geomembrane to act as a cushion. All foreign objects and particles in excess of the maximum size allowed in the material specifications shall be removed from the bedding surface prior to geomembrane placement.

Placement of materials on top of the geomembrane shall not be allowed when the ambient temperature is below 40°F or above 104°F.

Equipment used for placing and compacting overlying soil materials shall not be driven directly on to any geosynthetic material. A minimum thickness of one foot of soil shall be maintained between the geomembrane and the low contact pressure bulldozer or light motor grader used to place granular materials. No sharp turning of the spreading equipment will be allowed on the initial (one-foot) cover. No heavy rubber-tired vehicles shall be allowed in areas underlain by geomembrane until a minimum of 3 feet of soil cover material has been placed, with the exception that a light grader may be used on the one-foot cover for fine grading and trimming operations. Earth moving equipment shall be observed during placement to document that no leakage of hydrocarbons occurs, particularly on top of the geomembrane.

Placement of soil materials on top of the geomembrane shall not be allowed within 50 feet of any unseamed edge of geomembrane until field seaming of that edge is complete. This is required to allow sufficient room to work out any large wrinkles or "fishmouths" prior to seaming.

In all cases, the placement of cover materials shall be done with caution and in a manner which is least likely to cause wrinkles in, or damage to, the geomembrane. The CQA Engineer shall monitor the placement of cover materials over the geomembrane on a regular basis.

### 4.4.3 Post-Construction

Site Clean-up

As the work progresses, the Installer shall remove all excess or waste materials, debris, "rub-sheets", discarded sand bags, or any other extraneous materials from the work area on a daily basis or whenever they are no longer required. Upon completion of work in any given area, CQA Personnel shall examine that area to determine whether all waste and extraneous materials have been removed and that the area has been left in a satisfactorily clean condition to allow placement of materials on top of the geomembrane.

Completion of Work

The installation of the geomembrane shall be considered as complete when (1) all required deployment, field seaming, testing and repairs, and site clean-up have been completed by

the Installer; (2) the Installer has submitted all the required quality control certificates to the COTR; and (3) the COTR and the CQA Engineer are satisfied that the geomembrane has been installed in accordance with the plans and specifications.

## 4.5 Leachate Collection System (LCS)

### 4.5.1 Pre-Construction

CQA Personnel shall inspect All leachate collection system materials when they are delivered to the site to confirm that these materials conform to the design criteria and specifications. Receiving inspection shall be performed in compliance with the procedures specified in Section 10.3 of the QAPP, with the exception that all nonconformances shall be documented on WHC NCR forms and submitted to the COTR for disposition and resolution. In general, activities performed by CQA Personnel shall include the following:

- Inspect all materials upon arrival at the site to confirm conformance to the specifications;

- Inspect all piping components to confirm (from appearance and shipping documents) that they are constructed of materials as listed in the plans, specifications, and procurement documents and that they are not damaged. Take measurements to confirm that pipe is of specified size and wall thickness and that perforations are sized and spaced as specified;

- Observe and test to confirm that sand and gravel materials conform to the specifications, are of the proper size and gradation, and do not contain unacceptable types of materials. Testing requirements for the drainage layers are outlined in Section 4.3.3; and

- Inspect to confirm that all prefabricated structures are as specified in the design. Such items include, but are not limited to, non-HDPE piping systems, prefabricated HDPE components, electrical equipment, monitoring equipment, and concrete structures. Inspection shall include visual observation of any corrosion-resistant coatings to document that they are present and without flaw. The COTR shall be informed of the acceptance status of all such items prior to installation.

### 4.5.2 Construction

#### 4.5.2.1 Pipe Network Installation

The HDPE pipe network shall be placed according to the design. CQA monitoring activities shall include:

- Review of contractor's submittals concerning joining methods and type of perforations;
- Review of manufacturer's certification to document that the HDPE pipe meets the specifications;
- Visually observe that the geonet and geotextile layers are placed over the geomembrane prior to pipe installation;
- Observe and measure to confirm that the pipes are placed at specified locations and in specified configurations, and that all pipe grades are as specified;
- Visually observe that all pipes are joined together and perforated in accordance with the approved procedures;
- Observe that the placement of any filter materials around the pipe proceeds as shown on the plans;
- Review testing of all HDPE piping (see Appendix A) prior to being buried or covered with liner;
- Observe that backfilling and compaction are completed as specified and that, in the process, the pipe network is not damaged.

#### 4.5.2.2 Drainage Layer

Inspection of the drainage layer shall include:

- Testing the material to confirm that has the specified particle size and is free from excessive amounts of fines or organic materials (See Section 4.3.3);
- Measuring the thickness and observing coverage of each drainage layer as it is placed in the LCS (coordinate with CQA Surveyor); and
- Surveying the completed layer to document that specified slopes and grades are obtained (coordinate with CQA Surveyor).

Placement of the drainage layers shall not damage any component of the underlying composite liner or the piping.

4.5.2.3 Geotextile, Geocomposite, and Geonet

Manufacture

The geotextile, geocomposite, and geonet manufacturers shall provide a list of guaranteed properties for the type of geotextile, geocomposite, or geonet to be delivered. The manufacturers shall also provide written certification signed by a responsible party that the materials actually delivered have properties which meet or exceed the guaranteed values.

All rolls of geotextile, geocomposite, and geonet shall be marked or tagged with the following information:

- manufacturer's name,
- product identification,
- lot number,
- roll number, and
- roll dimensions.

If any special handling of the materials is required, it shall be so marked, e.g., "This Side Up" or "This Side Against Geonet".

Shipment, Handling, and Storage

The geotextile and geocomposite material shall be protected from ultraviolet light exposure, precipitation or inundation by water, mud, dirt, dust, puncture, cutting, and any other damaging or deleterious conditions. Geotextile and geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings. Geotextile and geocomposites shall not be exposed to precipitation prior to being installed. Wrappings protecting geotextile and geocomposite rolls shall be removed less than one hour prior to unrolling the material. After the wrapping has been removed, a geotextile shall not be exposed to sunlight for more than 15 days, unless otherwise specified and guaranteed by the geotextile manufacturer.

Geonet rolls shall be covered in polyethylene sheet or otherwise protected against dust and dirt during shipping and storage. The covering shall be removed less than one hour before placement. CQA Personnel shall document that geonets are free of dirt and dust just before installation. If the geonets are judged dirty or dusty, they shall be washed by the Installer prior to installation.

Conformance Testing

Upon delivery of the geotextile, geocomposite, and geonet, CQA Personnel shall remove samples and forward them to an approved geosynthetic laboratory for testing to document conformance to both the design specifications and the list of guaranteed properties. Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 50,000 square feet, whichever results in the greater number of tests. Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. The machine direction shall be marked on the samples with an arrow.

As a minimum, the following tests shall be performed on geotextiles:

- Mass per unit area;
- Grab strength;
- Tear strength;
- Burst strength;
- Puncture strength;
- Thickness;
- Permittivity; and
- Apparent opening size (AOS).

As a minimum, the following tests shall be performed on geocomposites:

- AOS
- Friction angle with operations layer; and
- friction angle with Type I HDPE.

As a minimum, the following tests shall be performed on geonets:

- Polymer specific gravity;
- Thickness;
- Transmissivity; and
- Mass per unit area.

All tests shall be conducted in accordance with the procedures listed in Appendix A. CQA Personnel shall examine all results from laboratory conformance testing and shall report any nonconformance to the CQA Engineer and the COTR.

Installation

The geosynthetics Installer shall handle all geotextiles, geocomposites, and geonets in such a manner that they are not damaged. On slopes, the geocomposite material shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the geocomposite sheet in tension. In the presence of wind, all

geotextiles, geocomposites, and geonets shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material. Geotextiles, geonets, and geocomposites shall be cut using approved cutters only. Special care shall be taken to protect other materials from damage which could be caused by the cutting of the geotextile, geocomposite, and geonet materials. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile, geocomposites, or the geonet. During placement of geotextile and geocomposite materials, care shall be taken not to entrap stones, excessive dust, or moisture that could damage the geomembrane, generate clogging of drains or filters, or that might hamper subsequent seaming.

CQA Personnel shall visually examine the entire surface of the geotextile and geocomposite layers after installation to confirm that no potentially harmful foreign objects, such as needles, are present. In addition, the CQA Personnel may undertake a sweep of the entire geotextile surface using a metal detector, to determine the presence of any such items.

During placement of geonets, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care should be taken with the handling of sandbags, to prevent rupture or damage. Care shall be taken not to leave tools in the geonet. CQA personnel shall confirm that all geonet is covered with geotextile on the same day it is deployed.

Seams

All geotextiles shall be continuously sewn (i.e., spot sewing is not allowed) with a locking stitch. Geotextiles shall be overlapped three inches prior to seaming. No horizontal seams shall be allowed on side slopes (i.e., seams shall be along, not across, the slope), except as part of a patch. On the landfill floor, no horizontal seam shall be less than three feet from the toe of the slope or other area of potential stress concentrations, unless otherwise authorized.

Any sewing shall be done using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. The Manufacturer shall provide written certification that the thread complies with the specifications.

Adjacent geonets shall be joined according to the specifications. As a minimum, the following requirements shall be met:

- Adjacent rolls shall be overlapped by at least four inches;
- All overlaps shall be secured by spot welding or tying with strings, plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed;

- Spot welding or tying shall be every five feet along the slope and floor of the landfill, and every six inches in the anchor trenches;

CQA Personnel shall visually examine both the geotextile and geonet seams to document that the above requirements have been met.

Repair

All holes or tears in the geotextile shall be repaired as follows. A patch made from the same geotextile shall be double seamed into place, with each seam 1/4 to 3/4 inch apart and no closer than 1 inch from any edge. Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

Any holes or tears in the geonet shall be repaired by placing a patch extending two feet beyond the edges of the hole or tear. Ribs in the patch shall be parallel to ribs in the existing geonet. The patch shall be secured to the original geonet by spot welding or tying every six inches using tying devices as indicated above. If the hole or tear width across the roll is more than 50 percent the width of the roll, the damaged area shall be cut out and the two portions of the geonet shall be joined as described in the specifications.

All holes or tears in geocomposites shall be repaired by first removing the damaged area. A piece of geonet shall then be cut so that the ribs are in the same orientation as the existing geocomposite and the geonet surface is flush with the geocomposite when placed into the repair area. A geotextile patch shall be cut to cover the repair area and extend a minimum of 6 inches onto the undamaged geocomposite in all directions. This geotextile patch shall be heat seamed to the geocomposite around its entire perimeter.

CQA Personnel shall visually observe geotextile, geocomposite, and geonet repair procedures.

Soil Placement

Soil shall not be placed in direct contact with geonets.

The Installer shall place all soil materials on top of geotextiles or geocomposites in such a manner that there is:

- no damage to the geotextile, geocomposite, or underlying layers;
- minimal slippage of the geotextile or geocomposite on the underlying layers; and
- no excess tensile stresses in the geotextile or geocomposite.

CQA Personnel shall visually observe that the above conditions are satisfied.

### 4.5.3 Post-Construction

The post-construction inspection of the LCS shall include observations to confirm that all systems and components have been installed in the proper locations and according to design and Manufacturer's specifications.

## 4.6 Temporary Leachate Collection Tank and Associated Equipment

CQA Personnel shall review certifications and shop drawings submitted by the tank fabricator to confirm that the tank and associated equipment are designed in accordance with design requirements and the specifications.

Construction inspection activities shall include the following:

- Observe that the tank and associated equipment were not damaged during shipment;
- Take measurements as required to confirm that the tank and associated equipment have the specified dimensions and capacity;
- Observe to the extent possible that the items are made of the specified materials; and
- Confirm by visual observation that any corrosion-inhibiting coatings are free from defects such as flaking, scratches, or blisters. If defects are present, repairs shall be performed in accordance with fabricator's recommendations.

CQA Personnel shall observe collection tank installation to confirm that the components are installed as specified in the design and that they are not damaged during the process. Installation of the footings or foundations for these structures shall also be observed to confirm that the HDPE containment liner is not damaged. Survey data shall be reviewed to verify that all structures are installed in the proper locations.

## 4.7 Paint and Protective Coatings

Coatings will be applied to several project surfaces. These surfaces are generally classified as (1) prefinished or factory coatings, (2) shop or field applications of specified coatings, and (3) interior and exterior coating of the leachate temporary storage tank. These general classifications are treated separately with respect to the CQA plan.

### 4.7.1 Prefinished or Factory Coatings

CQA Personnel shall perform the following activities for factory coated items:

- Upon delivery to the site, observe the items to verify that the finished surfaces are the same as those shown in the submittals; and
- After installation, observe the items for damage, especially damage to finished surfaces.

### 4.7.2 Shop or Field Application of Specified Coatings

This includes such items as the walls of the control building for the leachate collection system and the protective coating applied to all surfaces of concrete structures within the landfill. CQA Personnel shall perform the following activities in conjunction with such items:

- Review contractor's coating submittals for compliance with the specifications. Store coating samples for future reference;
- Attend a precoating conference;
- Inspect the surface to receive the coating after surface preparation by the contractor and before application of the primer coat;
- Visually observe the quality of the coatings to check for coverage, thickness, and quality, including lack of over-spray on adjacent, non-coated areas. Coatings shall be uniform in application, blend well with adjacent areas, and be free from drips and runs; and
- Determine the dry film thickness (DFT) of the coatings on the finished surface by estimating the application rate, i.e. the number of square feet of coverage per gallon. In addition, measure the paint coating thickness at random locations on metal items using a magnetic gauge.

### 4.7.3 Coating of Leachate Temporary Storage Tank

This includes the interior and exterior coating of the leachate temporary storage tank. CQA Personnel shall perform the following in conjunction with tank fabrication:

- Review contractor's coating submittals for compliance with the specifications. Store coating samples for future reference;

- Attend a precoating conference;
- Visually observe the interior and exterior of the tank after surface preparation and prior to application of the primer;
- Visually observe the interior and exterior of the tank after the final coatings have been applied, but before the tank has been insulated and shipped. Measure the DFT at 10 locations interior and 10 locations exterior; compare the results to the minimum DFT permitted by the specification and in the submittals. DFT shall be measured with a magnetic gauge; and
- Visually observe the interior and exterior (to the extent possible) of the tank after the tank has been installed to note any damage that may have occurred as a result of transportation or installation.

## 4.8 Electrical System and Pump Controls

The electrical system which controls the leachate pumps shall be checked for proper installation and operation. CQA Personnel shall perform the following activities:

- Review contractor's submittals and proposed equipment to document compliance with the specifications;
- Systematically examine wiring and conduits before covering or backfilling to confirm proper routing, wire size, and connection methods;
- Perform or review component checks of resistance, grounding, and load prior to complete system check; and
- Witness and review acceptance testing of the pump control system as described in the Acceptance Test Procedure (ATP) for this system.

## 4.9 Pumps, Piping, Meters, and Valves

The pumps, piping, instruments (such as the flow meter), and valves that are included in the leachate removal and transfer system shall be examined and/or tested at both the component level and the system level for conformance to the specifications and proper performance. CQA Personnel shall perform the following activities in conjunction with these items:

- Review contractor submittals and equipment deliveries to the site for conformance to the specifications;

- Observe connections and components for proper assembly, usage, and construction;
- Review individual component performance checks to confirm operation in accordance with the specifications;
- Document the pressure test of the piping as described in the specifications;
- Review the complete leachate removal system performance using the installed pumps as described in the specifications.

## 4.10 Control Building

CQA Personnel shall perform activities related to the control building construction and materials as follows:

- Review contractor submittals;
- Confirm that materials delivered to the site conform to the requirements of the specifications; and
- Observe building construction and erection to verify construction and assembly quality. Examine seals and connections at corners and joints to confirm that the building is weather tight.

# 5. DOCUMENTATION

## 5.1 Daily Reports

Daily reports shall be completed by each of the CQA Personnel when they are on site. CQA Personnel shall be assigned field books which will be labeled with a unique number issued by the CQA Engineer. The field CQA Personnel shall record all field observations and the results of field tests either in their assigned field book or on standard data sheets as included in Appendix B of this plan. After each book is filled (or at the end of the project), the field book shall be returned to the CQA Engineer and routed to the project files.

Each page of the field book shall be numbered, dated, and initialed by CQA Personnel. At the start of a new work shift, CQA Personnel shall list the following information at the top of the page:

- Job Name
- Job Number
- Date
- Name
- Weather conditions
- Page number (if pages are not prenumbered)

The remaining individual entries shall be prefaced by an indication of the time at which they occurred. If the results of test data are being recorded on separate sheets, it shall be noted in the field book.

Entries in the field book shall include but not be limited to the following information:

- Reports on any meetings held and their results;
- Equipment and personnel being used in each location, including subcontractors;
- Descriptions of areas being observed and documented;
- Description of materials delivered to the site, including any quality verification (vendor certification) documentation;
- Descriptions of materials incorporated into landfill construction;
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration;

- Decisions made regarding use of material and/or corrective actions to be taken in instances of substandard quality;

- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.

At the end of each day, field CQA Personnel shall summarize the day's activities on a daily Field Report Form (see Appendix B). The field report shall include a brief summary of the day's activities and highlight any unresolved issues that must be addressed by the CQA Engineer or CQA Personnel the following day. In addition, the summary report shall reference the field book number and page numbers that cover that day's activities. The summary field reports shall be turned into the CQA Engineer at the end of each day.

The daily field report shall be filled out in a triplicate form. The individual initiating the report shall attach three copies of his field book notes for that day. The three copies shall be distributed as follows:

- Original shall be filed in field office.

- One copy transmitted to the COTR.

- One copy transmitted to the project quality records in compliance with Section 17.0 of the QAPP, "Quality Assurance Records".

The CQA Engineer shall review and initial each summary field report before distributing to the project quality records and the COTR.

## 5.2 Inspection Data Sheets

All observed field and laboratory test data shall be recorded on an inspection data sheet.

At a minimum, each inspection data sheet shall include the following information:

- Unique identifying sheet number for cross-referencing and document control;

- Description of the inspection activity;

- If appropriate, location of the inspection activity or location from which the sample was obtained;

- Type of inspection activity and/or procedure used (reference to standard method when appropriate);

- Any recorded observation or test data, together with all necessary calculations;
- Results of the inspection activity and comparison with specification requirements;
- Identification of any personnel involved in the inspection activity; and
- Signature of the CQA Personnel performing the activity and concurrence by the CQA Engineer.

Examples of typical data inspection sheets are presented in Appendix B.

## 5.3 Nonconformance Reporting

A nonconformance is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. If a deficiency cannot be repaired or replaced to the satisfaction of CQA Personnel within the guidelines established by this CQAP, then such a deficiency shall be considered a nonconformance and shall be documented on a WHC nonconformance report (NCR) form and referred to the COTR for disposition and initiation of corrective action processes. All nonconforming situations shall be brought to the attention of the CQA Engineer, Project Manager, and QA Manager for concurrence prior to initiation of the NCR. The Project Manager, QA Manager, and CQA Personnel and Engineer shall participate in NCR disposition, resolution, and corrective action processes to the extent required by the COTR. All documentation relating to NCR situations shall be retained in the project quality records in compliance with Section 17.0 of the QAPP, "Quality Assurance Records". In the event of a conflict, the nonconformance reporting requirements of this section take precedence over Sections 15.0 and 16.0 of the QAPP.

## 5.4 Design Changes/Clarifications

Requests for changes to the specifications or drawings shall be referred to the Project Manager and initiated on a WHC Engineering Change Notice (ECN) form. All design changes shall be approved by the COTR prior to implementation. Approval by the DOE-RL may also be required at the discretion of the COTR.

Requests for modifications to the CQA Plan shall be made by memorandum to the Project Manager with copies to the CQA Engineer and Project QA Manager.

If during the course of construction questions arise regarding interpretation of the plans and/or specifications, the COTR and Design Engineer shall be contacted by the CQA Engineer. Any clarification of the drawings shall be documented by memorandum or telecon records, and routed to the contractor, COTR, and Construction Manager. The

memorandum or telecon shall also be routed to the Design Engineer and Project Manager for concurrence and then to the project files for record.

## 5.5 Photographic Report

A pictorial record of construction progress, including problems and resolution, shall be maintained by the CQA Engineer. The record shall be in general chronological order, subheaded by specific tasks, problems, work areas, etc. The medium in the main file shall be color prints.

At a minimum, photographic reporting data sheets shall include the following information:

- A unique identifying number on data sheets and photographs for cross-referencing and document control;
- The date, time, and location where the photograph was taken;
- The size, scale, and orientation of the subject matter photographed;
- Location and description of the work; and
- The purpose of the photograph.

A complete copy of the pictorial record shall be supplied to the COTR at the completion of construction.

## 5.6 Progress Reports

The CQA Engineer shall prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report shall include the following information:

- A unique identifying sheet number for cross-referencing and document control;
- The date, project name, location, and other information;
- A summary of work activities accomplished during progress reporting period;
- Identification of areas or items inspected and/or tested during the reporting period that are addressed by the report;
- A summary of the quality characteristics being evaluated, with appropriate cross-references to specifications and/or drawings;

- References to the specifications or drawings defining the acceptance criteria for each inspected characteristic;
- A summary of inspection and test results, failures, and retests;
- A summary of construction situations, deficiencies, and/or defects occurring during progress reporting period;
- A summary of other problem resolutions and dispositions; and
- The signature of the CQA Engineer.

## 5.7 Final Documentation

All daily inspection summary reports, inspection sheets, problem identification and corrective measures reports, acceptance reports, deviations from design and material specifications (with justifying documentation), NCRs, ECNs, photographic records, progress reports, drawings, drawing revisions, and other pertinent documentation shall be retained as permanent project quality records in compliance with Section 17.0 of the QAPP. At the completion of the project, a final summary report shall be prepared by the Project Manager and submitted to the COTR that incorporates all such information, along with as-built drawings. The as-built drawings, which will be generated by a licensed land surveyor, shall include scale drawings depicting depths, plan dimensions, elevations, and soil component thicknesses. In addition, CQA Personnel shall generate as-built scale drawings that depict the geomembrane panel deployment pattern. The report shall include documentation of each construction component monitored by CQA Personnel and shall be signed by a registered professional engineer. This report shall be subject to independent technical review in compliance with Section 10.1 of the QAPP, "Technical Review", prior to submittal to the COTR and DOE-RL.

## 5.8 Storage of Records

During the construction of the RMW facility, the CQA Engineer shall be responsible for all facility CQA documents. This includes the CQA Engineer's copy of the design criteria, plans, procedures, and specifications; the CQA plan; and the originals of all the data sheets and reports. All completed documents shall be routed to the project quality records in compliance with Section 17.0 of the QAPP, "Quality Assurance Records", which addresses project QA records management, including maintenance of a records index, access control, and duplicate records requirements. Working copies shall be retained at the field office to the extent necessary to properly support ongoing activities.

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## 6. REFERENCES

1. Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities, EPA/530-SW-86-031, OSWER Policy Directive 9472.00-3, (U.S. EPA, 1986).

2. Quality Assurance Program Plan for Project W-025, Radioactive Mixed Waste (RMW) Land Disposal Facility - Non Drag Off, Revision 3, Golder Associates Inc., April, 1991.

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# APPENDIX A

## CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE BY SPECIFICATION SECTION

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CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02220
GENERAL EXCAVATION AND BACKFILL

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| General requirements | | | | | | |
| Earthworks operations plan and schedule | Prior to earthwork operations | CQA Engineer's review | Contractor submittal per Section 01300 | 4.3.1 | 02220 1-2 | NA |
| Review plans & specs. with Contractor | Prior to earthwork operations | For clarity as required | Meeting | 4.2 | | NA |
| Coordination of Surveyor during excavation, backfilling, and prior to liner placement | As required | lines and grades specified on Design Drawings | Daily Field Report/ Surveyor's field notes and drawings | 4.3.1 | | NA |
| Observe quality of compacted fill | As required | Max. clod size = 4 inches<br>Max. lift thickness = 8 inches<br>No moisture seeps or debris | Daily Field Report | 4.3.1 | 02220 2-1<br>02220 3-6 | G/R |
| Materials evaluation | | | | | | |
| Backfill ASTM D1557 Modified Proctor | 1 test per 2000 CY placed | NA | Lab form | 4.3.1 | 02220 3-6 | G/R |
| Backfill ASTM D422 Hydrometer and Sieve | 1 test per 2000 CY placed | GM, GP, SW, SM, SP | Lab form | 4.3.1 | 02220 2-1 | G/R |
| Backfill ASTM D4318 Atterberg Limits | 1 test per 2000 CY placed | GM, GP, SW, SM, SP | Lab form | 4.3.1 | 02220 2-1 | G/R |
| Excavation ASTM D2487 Classification of Eolian sand during excavation | Once per shift | Silty Sand to Sandy Silt | Daily Field Report | 4.3.1 | 02220 3-2 | G/R |
| Excavation ASTM D2487 Classification of Gravelly Sand to Sandy Gravel during excavation | Once per shift | Gravelly Sand to Sandy Gravel | Daily Field Report | 4.3.1 | 02220 3-2 | G/R |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02220
GENERAL EXCAVATION AND BACKFILL

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para | IP |
|---|---|---|---|---|---|---|
| Excavation Subgrade ASTM D2922 Subgrade compaction testing by nuclear gauge | 1 test for every 10,000 SF of subgrade | 90% of mod. Proctor (ASTM D1557) | Field test form | 4.3.1 | 02220 3-2 | G/R |
| Backfill ASTM D2922 Backfill compaction testing by nuclear gauge | 1 test for every 500 CY placed | 90% of mod. Proctor (ASTM D1557) | Field test form | 4.3.1 | 02220 3-2 | G/R |
| ASTM D2922 Top course compaction testing by nuclear gauge | 1 test for every 10,000 SF of placement area | 95% of mod. Proctor (ASTM D1557) | Field test form | 4.3.1 | 02511 3-1 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02222
TRENCHING AND BACKFILLING

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **Excavation and fill dimension tolerances** | | | | | | |
| Subgrade side slope riser pipe trench | As excavated | 0.0 to 0.30 ft. of design elevation | Daily Field Report/ Surveyor's drawings | 4.3.1<br>4.3.5 | 02222 1-4-A | G/R |
| Admix liner side slope riser pipe trench | As excavated | 0.00 to +0.30 ft of design elevation | Daily Field Report/ Surveyor's drawings | 4.3.1 | 02222 1-4-B | G/R |
| 8% access road anchor trench | As excavated | 0.00 to +0.30 ft. of design elevation | Daily Field Report/ Surveyor's drawings | 4.3.1 | 02222 1-4-C | G/R |
| Excavation of crest anchor trench | As excavated | ± 0.20 ft. of design elevation | Daily Field Report/ Surveyor's drawings | 4.3.1 | 02222 1-4-D | G/R |
| **Backfill materials** | | | | | | |
| Secondary side slope trench backfill classification | One per source | General backfill (max. particle size 1 inch) | Lab Form | 4.3.1 | 02222 2-3 | G/R |
| Drainage Layer Materials | see 02226 | see 02226 | see 02226 | 4.3.3 | 02226 | G/R |
| **Construction** | | | | | | |
| Sump drainage gravel compaction | Periodic | Track rolled | Daily Field Report | 4.3.3 | 02222 2-5A | G/R |
| Secondary side slope trench sand compaction | Periodic | Hand compacted | Daily Field Report | 4.3.1<br>4.3.5 | 02222 2-5A | G/R |
| Secondary side slope trench admix plug compaction | Periodic | Hand compacted | Daily Field Report | 4.3.2 | 02222 2-5A | G/R |
| Anchor trench backfill compaction | Periodic | - Rubber tired compaction w/ moist. conditioning<br>- 6 inch thick lifts | Daily Field Report | 4.3.5 | 02222 2-5A | G/R |

| CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE<br>SPECIFICATION SECTION 02222<br>TRENCHING AND BACKFILLING | | | | | | |
|---|---|---|---|---|---|---|
| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif Sect. & Para. | IP |
| Other trench backfill | Periodic | 98% of mod Proctor (ASTM D1557) | Nuclear Field Density/Moisture form | 4.3.1 | 02222 2.5A | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W). Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02224
ADMIX PRODUCTION, PLACEMENT, COMPACTION AND TRIMMING

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Admix materials: Prior to mixing | | | | | | |
| ASTM D2488 Visual Classification | Min. once per day | Eolian silty sand | Daily Field Report | 4.3.1<br>4.3.2 | 02224 2-3 &<br>02220, 3-2-B | G/R |
| Grain Size Distribution - Eolian Sand<br>ASTM D422<br>Hydrometer and #200 Sieve | Every 1,000 CY | 1-inch maximum particle size | Lab form | 4.3.2 | 02224 2-3 | G/R |
| API 13A, sect. 4<br>Bentonite yield | Every 500 tons | 91 barrel minimum | Manuf. certif. | 4.3.2 | 02224 2-2 | G/R |
| API 13A, sect. 4<br>Bentonite fines content | Every 500 tons | 4% maximum | Lab form | 4.3.2 | 02224 2-2 | G/R |
| API 13A, sect. 4<br>Bentonite filtration | Every 500 tons | 15 ml. maximum | Lab form | 4.3.2 | 02224 2-2 | G/R |
| API 13A, sect. 4<br>Bentonite viscosity | Every 500 tons | 30 minimum | Lab form | 4.3.2 | 02224 2-2 | G/R |
| Admix: Pre-placement mixing | | | | | | |
| Bentonite Content<br>ASTM D422<br>Hydrometer and Sieve | Min. of one for every 1,000 CY | 8% min by dry wt. as determined by #200 sieve | Lab form | 4.3.2 | 02224 3-1 | H-initial mixing<br>G/R - after initial hold point |
| ASTM D698<br>Standard Proctor | Every 5,000 CY | None | Lab form | 4.3.2 | 02224 3-5 | G/R |
| ASTM D2216<br>Moisture Content | Every 1,000 CY | 1% - 5% over optimum | Lab form | 4.3.2 | 02224 3-2 | G/R |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02224
ADMIX PRODUCTION, PLACEMENT, COMPACTION AND TRIMMING

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| ASTM D4318 Atterberg limits | Every 5,000 CY | SC, CL, CH, ML | Lab form | 4.3.2 | 02224 2-3 | G/R |
| ASTM D5084 Hydraulic Conductivity | Every 5,000 CY | $1 \times 10^{-7}$ cm/sec or less | Lab form | 4.3.2 | 02224 2-3 | W-First Test G/R -All other tests |
| **Test Fill Construction** | | | | | | |
| Visual observation of placement and compaction | Continuous | 8"-10" loose lifts 6" or less compacted | Daily Field Report | 4.3.2 | 02224 3-3 02224 3-5 | H |
| ASTM D2167 Rubber Balloon Density | 1 every lift | 90% of stand. Proctor (ASTM D698) | Field test form | 4.3.2 | 02224 3-3 | G/R |
| ASTM D2922 Density: Nuclear Gauge | 3 per lift minimum | 90% of stand. Proctor (ASTM D698) | Field test form | 4.3.2 | 02224 3-3 | H-First test G/R-After hold test |
| ASTM D5084 Hydraulic Conductivity | 1 every lift | $1 \times 10^{-7}$ cm/sec or less | Lab form | 4.3.2 | 02224 3-3 | H-First test G/R-After hold test |
| Test Pits | Minimum of 2 | Good layer bonding Minimum depth = 1 ft. | Daily Field Report | 4.3.2 | 02224 3-3 | G/R |
| ASTM D 5093 Sealed Double Ring Infiltrometer | 1 per test fill | $1 \times 10^{-7}$ cm/sec or less | Field test from | 4.3.2 | 02224 3-3 | NA |
| **Soil Liner Construction** | | | | | | |
| Admix composition and placement methods | Period monitoring | Same procedures as test fill<br>- max particle size 1 inch<br>- no off-specification material<br>- uniform/homogeneous material<br>- lift bonding | Daily Field Report | 4.3.2 | 02224 2-3/3-5 | H at start up |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02224
ADMIX PRODUCTION, PLACEMENT, COMPACTION AND TRIMMING

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Subgrade Compaction ASTM D2922 Density by Nuclear Gauge | Every 10,000 SF | 90% of mod Proctor/ASTM D1557 | Field test form | 4.3.1 | 02224 3-4/3-5 | G/R |
| Lift thickness | Periodic monitoring | 8 - 10 in. loose, 6 in. max compacted | Daily Field Report | 4.3.2 | 02224 3-5 | G/R |
| ASTM D5084 Hydraulic Conductivity | Every 5,000 CY | $1 \times 10^{-7}$ cm/sec or less | Lab form | 4.3.2 | 02224 2-3/3-5 | G/R |
| ASTM D2167 Density by Rubber Balloon ASTM D2922 Density by Nuclear Gauge ASTM D1556 Density by Sand Cone | Every 250 CY one of these methods, min. of 1 per day D2167 or D1556 | 90% of stand. (ASTM D698) | Field test forms | 4.3.2 | 02224 3-5 | G/R |
| ASTM D3017 Moist. Content by Nuclear Gauge | Every 250 CY | 1% - 5% over optimum | Field test forms | 4.3.2 | 02224 3-5, B | G/R |
| Desiccation Cracks | Periodic visual monitoring | less than 0.1 ft deep or 0.25 in. wide | Daily field Report | 4.3.2 | 02224 3-6, C | G/R |
| Coordination of Surveyor after trimming | As required | Per lines and grades specified on Design Drawings | Daily Field Report Surveyor's field notes and drawings | 4.3.2 | 02224 3-6 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02226
GRANULAR DRAINAGE LAYERS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect & Para. | R* |
|---|---|---|---|---|---|---|
| **General Requirements** | | | | | | |
| Visual observation of sump and drainage layer gravel during placement | Continually as the material is placed | low ground pressure dozer or tracked vehicle<br>no damage to geosynthetics<br>min thickness = 1 foot<br>- min thickness (roadways) = 3 feet<br>- minimize wrinkle generation | Daily Field Report | 4.3.3 | 02226 3-1 | G/R |
| Coordination of surveying of sump and drainage layer gravels | Once: post construction | Within specified tolerances on Design Drawings | Surveyor's field notes and drawings | 4.3.3 | NA | G/R |
| **Material and Placement Evaluation** | | | | | | |
| ASTM C136<br>Sieve of drainage layer gravel | Every 500 CY preconstruction<br>Every 250 CY during construction | Meet requirements for rounded, washed gravel in 02226 2-1-A | Lab form | 4.3.3 | 02226 2-1 | G/R |
| ASTM C136<br>Sieve of sump gravel | Every 500 CY preconstruction<br>Every 250 CY during construction | Meeting requirements for rounded, washed gravel in 02226 2-2-A | Lab form | 4.3.3 | 02226 2-2 | G/R |
| ASTM D2434<br>Permeability of drainage layer gravel | Every 500 CY preconstruction<br>Every 250 CY during construction | $1 \times 10^{2}$ cm/sec minimum | Lab form | 4.3.3 | 02226 2-1 | G/R |

| CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE<br>SPECIFICATION SECTION 02226<br>GRANULAR DRAINAGE LAYERS | | | | | | |
|---|---|---|---|---|---|---|
| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect & Para. | IP |
| ASTM D2434<br>Permeability of sump gravel | Every 500 CY preconstruction<br>Every 250 CY during construction | $1 \times 10^{-2}$ cm/sec minimum | Lab form | 4.3.3 | 02226 2.2 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

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Golder Associates

| CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE<br>SPECIFICATION SECTION 02228<br>OPERATIONS LAYER | | | | | | |
|---|---|---|---|---|---|---|
| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
| General Requirements | | | | | | |
| Earthwork operations plan and schedule | Prior to construction | CQA Engineer's Review | Contractor submittal per section 01300 | 4.3.1 | 02228 1.2 | NA |
| Grading tolerances | Post construction | Lines and grades shown on Design Drawings | Surveyor's as-built drawings | 4.3.4 | 02228 1.4 | G/R |
| Materials and Placement | | | | | | |
| ASTM D 422 Hydrometer and Sieve | One test for every 2,000 CY placed | Meet requirements for General Backfill. Section 02220 | Lab forms | 4.3.4 | 02228 2-1 | G/R |
| Visual observations during placement | Periodically while material is being placed | · Hauling and placement equip. operating on min. of 3 feet of material<br>· Grading equip. operating on min. of 2 feet of material<br>· Wrinkle concentration<br>· Placement of material adjacent to primary side slope riser pipe<br>· Operations layer on slopes pushed from bottom of slope to top of slope | Daily Field Report | 4.3.4 | 02228 3-1 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

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CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02275
GEOSYNTHETICS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Coordination of post-construction surveying of the in-place admix | Once: post construction | Within tolerances specified on Drawings | Daily Field Report | 4.3.2 | 02275 3-1 | NA |
| Visually observe placement of anchor trench backfill | Periodically as material is placed | No Damage to geosynthetics | Daily Field Report | 4.3.5 | 02275 3-1 | G/R |
| Coordination of post-construction surveying of anchor trench backfill | Once: post construction | Within tolerances specified on Drawings | Daily Field Report | 4.3.5 | 02275 3-1 | NA |
| Review Supplier's documentation confirming that raw materials for geomembrane comply with Manufacturer's product properties and performance requirements | Once: before geomembrane is delivered to site | Properties listed in Section 02275, 2-1 | Supplier's submittal | 4.4.1<br>4.4.1.1 | 02275 2-1 | NA |
| Perform receiving inspection on all geomembrane material | As geomembrane is delivered to site | ·Check for conformance to submittals and specifications<br>·No damage | Geosynthetic inventory control record | 4.4.1.2<br>4.4.1.4 | 02275 2-1 | G/R |
| Geomembrane conformance testing:<br>ASTM D792 Method A or ASTM D1505, ASTM D1603, ASTM D1593, ASTM D638, and direct shear testing as specified by Designer | One sample per 50,000 SF | Properties listed in Section 02275, 2-1 | Lab forms | 4.4.1.2 | 02275 2-1 | G/R |
| Obtain sample of HDPE for "fingerprint" analysis and testing | One sample for each production lot of HDPE | Comparison with previous fingerprint analysis by Owner | Lab forms | 4.4.1.2 | 02275 1-7 | G/R |
| Collect and review Quality Control Certificates for each batch of resin | Before material is delivered to site | Section 02275, 2-1 | Manufactures submittal per Section 01300 | 4.4.1.2 | 02275 2-1 | G/R |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02275
GEOSYNTHETICS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | H* |
|---|---|---|---|---|---|---|
| Collect and review written certification that the extrudate rod and/or bead complies with specifications | Before material is delivered to site | Section 02275, 2-1 | Manufactures certificates | 4.4.1.2 | 02275 2-1 | G/R |
| Collect and review Quality Control Certificates from Fabricator if using factory fabricated panels | Before material is delivered to site | Section 02275, 2-1 | Fabricator's certificates | 4.4.1.3 | 02275 2-1 | G/R |
| Collect Subgrade Acceptance Certificate From Contractor | Prior to placement of geomembrane | Completed form by Contractor | Subgrade Acceptance Certificate | 4.4.1.5 | 02275 3-1-B | G/R |
| Review Contractor's proposed panel layout | Prior to placement of geomembrane | Section 02275, 3-1 | Contractor's submittal per Section 01300 | 4.4.2.1 | 02275 3-1 | G/R |
| Measure panel thickness | As panels are deployed - every panel | Section 02275, 2-1 | Geomembrane Deployment Record | 4.4.2.1 | 02275 2-1-B | H first panel only |
| Assign each field panel an "identification code" consistent with layout plan | As panels are deployed | NA | Geomembrane Deployment Record | 4.4.2.1 | 02275 3-1 | H first panel only |
| Monitor ambient air temperature | Periodically during deployment | 40°F to 104°F | Daily Field Report and Geomembrane Deployment Record | 4.4.2.1 | 02275 3-1-D-2 | H first panel only |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02275
GEOSYNTHETICS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Record identification code, location, and date of installation of each field panel | As panels are deployed | NA | Geomembrane Deployment Record | 4.4.2.1 | 02275 3-1 | H first panel only |
| Review resumes of proposed seaming personnel | Prior to seaming of geomembrane | Master Seamer - min. of 1,000,000 SF | Contractor's submittal per Section 01300 | 4.4.2.2 | 02275 3-1 | G/R |
| Monitor extrudate and ambient temperature during extrusion welding | At least once per seam and randomly thereafter during welding operation | Ambient air temperature 40°F to 104°F | Daily Field Report | 4.4.2.2 | 02275 3-1 | H first seam only |
| Monitor ambient and seaming apparatus temperature and speed during fusion welding | At least once per seam and randomly thereafter during welding operation | Ambient air temperature 40°F to 104°F | Daily Field Report | 4.4.2.2 | 02275 3-1 | H first seam only |
| Monitor seam overlap and preparation | Periodically | 3 inches - Extrusion weld<br>5 inches - Fusion Welding | Geomembrane Deployment Record | 4.4.2.2 | 02275 3-1 | H first seam only |
| Monitor and log test seam results | At the beginning of each shift and every fours hours thereafter | Failure not in seam | Geomembrane Seam Destructive Sample Summary | 4.4.2.2 | 02275 3-1 | H first seam only |
| Monitor and log nondestructive testing of field seams | Continuously | No leaks observed | Geomembrane Seam Pressure Testing Record | 4.4.2.3 | 02275 3-1 | G/R |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02275
GEOSYNTHETICS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Locate, sample, and perform destructive tests on field seams | A minimum average frequency of one test location per 500 feet of seam length | Section 02275, 3-1-E-10 see table and text | Geomembrane Destructive Sample Summary | 4.4.2.4 | 02275 3-1 | G/R |
| Examine entire geomembrane surface for defects/repairs: document areas in need of repair by location and identification code | Periodically | No evidence of defects | Geomembrane Defect/Repair Record | 4.4.2.5 | 02275 3-1 | G/R |
| Document that all repairs have been successfully made and nondestructively tested | Continuously | No leaks | Geomembrane Defect/Repair Record | 4.4.2.5 | 02275 3-1 | G/R |
| Identify wrinkels or "fishmouths" for repair and testing | Periodic monitoring | Cut and repair | Geomembrane Defect/Repair Record | 4.4.2.5 | 02275 3-1 | G/R |
| Monitor placement of materials over geomembrane | Continuously | No wrinkles buried | Daily Field Report | 4.4.2.5 | 02275 3-1 | G/R |
| Collect and review certificates stating that geotextile, geocomposite, and geonet delivered have properties which meet or exceed guaranteed values | Before material is delivered to site | Meet or exceed material specifications | Manufacturer's certificates | 4.5.2.2 | 02275 3-1 | G/R |
| Verify that geonets are free of dirt and dust | Prior to installation | Visual observation | Daily Field Report | 4.5.2.2 | 02275 3-1 | G/R |

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02275
GEOSYNTHETICS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Geotextile conformance testing<br>ASTM D3776<br>ASTM D4632<br>ASTM D4533<br>ASTM D3786<br>ASTM D4833<br>ASTM D1777<br>ASTM D4491<br>ASTM D4751 | One per 50,000 SF | Meet or exceed material specifications | Lab forms | 4.5.2.2 | 02275 2-2 | G/R |
| Geocomposite conformance testing<br>ASTM D4751<br>Direct shear testing with operations layer and TYPE I geomembrane | One per 50,000 SF | Meet or exceed material specifications | Lab forms | 4.5.2.2 | 02275 2-2 | G/R |
| Geonet conformance testing<br>ASTM D792<br>ASTM D1777<br>ASTM D4716<br>ASTM D3776 | One per 50,000 SF | Meet or exceed material specifications | Lab forms | 4.5.2.2 | 02275 2-2 | G/R |
| Confirm that all geonet is covered with geotextile on same day it is deployed | Periodic (daily) | covered geonet | Daily Field Report | 4.5.2.2 | 02275 3-1 | G/R |
| Visually examine geotextile and geonet overlap and seams | Periodic | Geonet - 4 inches overlap<br>Geotextile - 3 inches overlap | Daily Field Report | 4.5.2.2 | 02275 3-1 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02511
TRUCK UNLOADING AREA SURFACING [1]

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Contractor submittal of asphalt mix design and methods of placement and compaction | Prior to construction | Meet Washington DOT Specifications | Contractor's submittal per Section 01300 | 4.3.6 | 02511 1-2-B | G/R |
| Extraction/gradation with percent asphalt and maximum density | Two samples | Meeting Specifications of (Washington DOT Class B) | Lab form | 4.3.6 | 02511 | G/R |
| Top course ASTM D1557 modified Proctor | At least one test prior to construction<br>One test per 2,000 CY | NA | Lab form | 4.3.1 | 02220 2-2 & 3-7 | G/R |
| Top course ASTM C136 Sieve analysis of aggregate | At least one test prior to construction<br>One test per 2,000 CY | Meeting requirements of WSDOT 9-03.9(3) | Lab form | 4.3.1 | 02511 2-4 | G/R |
| Top course ASTM D 2922 Compaction testing by nuclear gauge methods | One test per 500 CY | 95% of mod. Proctor (ASTM D1557) | Field test form | 4.3.1<br>4.3.6 | 02220 3-1 | G/R |
| Asphalt concrete construction tolerances | As required | Flatness: 1/4" in 10 ft<br>Thickness: 4" +/- 1/4"<br>Elevation: +/- 1/2" from design elevation | Surveyor's drawings and Daily Field Report Forms | 4.3.6 | 02511 3-6 | W |
| Compaction of asphalt concrete pavement ASTM D1559 | Every 25,000 SF | 93% of ASTM D1559 | Field test form | 4.3.6 | 02511 3-4D | W |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02720
DRAINAGE DITCH FACILITIES

| Reference Standard subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| General Requirements | | | | | | |
| Submittal of ditch construction methodology | Prior to construction | CQA Engineer's review | Included in Contractor's excavation plan submittal | 4.3.1 | 02720 1.2 | NA |
| Ditch dimensions | Periodic | Dimensions equal to or greater than design dimensions | Daily Field Report | 4.3.1 | 02720 3.1 & 3.2 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities

(5) NA: Not Applicable.

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CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02725
HDPE PIPE

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **General** | | | | | | |
| Submittal of Manufacturer's certification and Contractor's methods | Prior to delivery onsite | Pipe and methods meets requirements of 02725 2.1, 2.2. | Contractor's submittal per section 01300 | 4.5.1 | 02725 1-3, 2-1, 2-2 | G/R |
| **Materials** | | | | | | |
| HDPE pipe | Receiving inspection, each piece | Sizes meet requirements of 02725 2.4 and match previous submittals | Daily Field Report | 4.5.1 | 02725 2-4 | G/R |
| **Construction** | | | | | | |
| Pipe welding thermal butt fusion | Periodic | Visual Observation<br>- Continuous<br>- Free from obvious defects | Daily Field Report | 4.5.2.1 | 02725 3-1 | W |
| Pipe perforations | As constructed, before covering | Meet requirements of 02725 2-3 | Daily Field Report | 4.5.1 | 02725 2-3 | G/R |
| Discharge pipe pressure test | Before covering | 50 psi | Daily Field Report | 4.5.2.1 | 02725 3-4 | H |
| Acceptance Testing of HDPE Piping | Before covering | per specifications | Daily Field Report | 4.5.2.1 | 02725 3-4 | H |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 02777
VERTICAL RISER PIPE

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect & Para | IP |
|---|---|---|---|---|---|---|
| **General** | | | | | | |
| Submittal of Manufacturer's information | Prior to delivery onsite | CQA Engineer's review | Contractor's submittal per Section 01300 | 4.5.1 | 02777 1-2 | NA |
| **Materials** | | | | | | |
| Precast concrete riser pipe | Upon delivery to site | Conform to ASTM C478 | Daily Field Report | 4.5.1 | 02777 2-1A | G/R |
| Precast concrete riser pipe joints | Upon delivery to site | Conform to ASTM C443 | Daily Field Report | 4.5.1 | 02777 2-1A | G/R |
| Precast concrete riser pipe coating | Upon delivery to site | Conform to Section 09900 | Daily Field Report | 4.5.1 | 02777 2-1B<br>09900 2-2 | G/R |
| Riser pipe cover | Upon delivery to site | Visual inspection for general dimensions | Daily Field Report | 4.5.1 | 02777 2-1C | G/R |
| Precast riser pipe foundation | Three cylinders per 50 C Y or once per day. Slump and air content on every truckload. | 3000 psi minimum fc', concrete meeting ACI standards | Daily Field Reports and Lab Forms | 4.5.1 | 02777, 2-2A & 03310<br>3-1 & 3-5E | G/R |
| **Construction** | | | | | | |
| Riser pipe tolerence | After construction | ± 1" of vertical between top and bottom | Daily Field Report | 4.5.1 | 02777-3 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTIONS 03100, 03210, 03310
CONCRETE FORMWORK, REINFORCING STEEL, STRUCTURAL CONCRETE

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **Formwork** | | | | | | |
| Formwork materials and field inspection | Prior to ordering concrete, forms not to be removed from concrete until CQA Engineer reviews | Meet requirements of Section 03100 | Daily Field Report | 4.3.7 | 03100 | G/R |
| **Reinforcing Steel** | | | | | | |
| Manufacturer's certificates and Contractor's shop drawings | Prior to construction | CQA Engineer's review | Contractor's submittal per Section 01300 | 4.3.7 | 03210 1-2 | NA |
| Reinforcing bars and welded wire fabric | Upon delivery to site | Meet requirements of Section 03210 | Daily Field Report | 4.3.7 | 03210 2-1, 2-2, 2-3 | G/R |
| Field inspection of placement and dimensions of reinforcing steel | Prior to ordering concrete | Construct per drawings and Section 03210 | Daily Field Report | 4.3.7 | 03210 3-1, 3-2 | G/R |
| **Structural Concrete** | | | | | | |
| Submittal of mix design, anchor bolt type, and waterstops | Prior to formwork | Meet requirements of Section 03310 | Contractor's submittal per Section 01300 | 4.3.7 | 03310 1-2 through 3-1 | NA |
| Field inspection of cast-in-place concrete | Continuously as placed, 3 cylinders per 50 C.Y | Max slump 4" 3 cylinders to verify fc' | Daily Field Report | 4.3.7 | 03310 3-1 through 3-5-E | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTIONS 05500, 08100
METAL FABRICATIONS, DOORS AND FRAMES

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **Metal Fabrications** | | | | | | |
| Submittal of shop drawings, steel specifications | Prior to delivery | CQA Engineer's review | Contractor's submittal per Section 01300 | 4.5.1 | 05500 | NA |
| Receiving inspection of metal fabrications | Upon delivery at site | Check conformance to design and shop drawings | Daily Field Report | 4.5.1 | 05500 | G/R |
| **Metal Doors and Frames** | | | | | | |
| Submittal of manufacturer's information | Prior to delivery | Check conformance to design drawings and Section 08100 | Daily Field Report | 4.5.1 | 08100 | NA |
| Receiving inspection of metal doors and frames | Upon delivery at site | Check conformance to design and shop drawings | Daily Field Report | 4.5.1 | 08100 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 09900
PAINT COATING SYSTEMS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Submittal of product and manufacturer information on all paint or painted products | Prior to delivery onsite | Meet requirements of 09900 | Contractor's submittal per Section 01300 | 4.5.1 | 09900 1-6 | NA |
| Pre coating conference | Prior to application in field or shop | NA | Meeting minutes | 4.5.1 | 09900 1-9 | NA |
| Test coating panels | Post conference, pre-application | CQA Engineer's review | Daily Field Report, Photographs | | 09900 1-10 | NA |
| Precoating tank inspection | After surface preparation | CQA Engineer's review | Daily Field Report, Photographs | 4.7.3 | 09900-2-2 | NA |
| Application of paint coatings thickness measurement | Post application, random locations | CQA Engineer's review of workmanship and products DFT for specifications | Daily Field Report | 4.5.2.1 | 09900 3-1 through 3-4-B-2 | G/R |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTIONS 11210, 13120, 13205, 13340
LEACHATE PUMPS, CONTROL BUILDING, STORAGE TANK, PUMP CONTROLS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| Submittals | | | | | | |
| Information on pumps, motors, building and hardware, storage tank, pump and piping, controls | Prior to delivery | CQA Engineer's review, meet requirements of design drawings and specifications | Contractor's submittal per Section 01300 | 4.5.1, 4.6, 4.7, 4.8, 4.9, 4.10 | 09900 1-4, 1.6 11210 1-2, 13120 1-3, 13205 1-3, 13340 1-6A | NA |
| Receiving inspection of pumps, controls, building components, and storage tank | Upon delivery to site | Conform to submittals and specifications | Daily Field Report | 4.5.1, 4.6, 4.7, 4.8, 4.9, 4.10 | 11210, 13120, 13205,13340 | G/R |
| Test of leachate system as installed | After completely installing and prior to covering | Proper operation, cycling, and performance of safety and backup features | Daily Field Report | 4.9 | 13340 3-3-A 15060 3-1 | W |
| Technical Representative's certificate of compliance | After installation and testing are completed | System operates in accordance with intended and specified parameters of specifications and drawings | Contractor's certification | 4.6 | 13340 3-3-B-4 | G/R |
| System performance testing | After installation of all components | Performance per ATP | ATP form | 4.8 | 13340 | H |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTION 15060, 15066, 15100, 15104, 15150, 15250
PIPING, INSULATION, VALVES, METERS AND SUPPORTS

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **Submittals** | | | | | | |
| Contractor submittal of manufacturers information on pipe, pipe fittings, pipe supports, valves, butterfly valves, turbine meter, and piping insulation | Prior to delivery onsite | CQA Engineer's review and conformance to the design specifications and drawings | Contractor's submittal per Section 01300 | 4.9 | 15060 1-4, 15066 1-2, 15100 1-2, 15104 1-2, 15150 1-2, 15250 1-3 | NA |
| Receiving inspection of pipe, pipe fittings, pipe supports, valves, butterfly valves, turbine meter, piping insulation | As delivered to site | Conform to submittals, design drawings, and specifications | Daily Field Report | 4.5.1, 4.9 | 15060 1-4, 15066 1-2, 15100 1-2, 15104 1-2, 15150 1-2, 15250 1-3 | G/R |
| Performance pressure testing of piping systems | After installation and before covering | Meet the requirements of 15060 3-1 | Daily Field Report | 4.9 | 15060 3-1 | H |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.

(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.

(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.

(4) G/R: General or random monitoring points taken during construction activities.

(5) NA: Not Applicable.

CONSTRUCTION QUALITY ASSURANCE SUMMARY TABLE
SPECIFICATION SECTIONS 16010 TO 16859
ELECTRICAL EQUIPMENT, RACEWAYS, TRANSFORMERS, LIGHTING, ETC.

| Reference Standard/Subject | Frequency | Acceptance Criteria | Report Format | CQA Ref. | Specif. Sect. & Para. | IP |
|---|---|---|---|---|---|---|
| **Submittals** | | | | | | |
| Manufacturers' information on all electrical equipment, lighting, raceways, switchboxes, etc. Contractor's shop and construction drawings. | Prior to delivery onsite or construction | CQA Engineer's review and conformance to design drawings and specifications | Contractor's submittal per Section 01300 | 4.8 | 16010 1.5 B, 16100 2.4 A, 16100 2.4 B, 16160 1.2, 16460 2.2, 16471 2.2, 16500 1.4, 16859 1.3 | NA |
| Contractor's as-built drawings and O&M Manuals | Upon completion of work | CQA Engineer's review | Contractor's submittal per Section 01300 | 4.5.3, 4.8 | 16010 1.7 13340 1.5B | NA |
| Receiving inspection | Upon delivery to site | Conformance to submittals, design drawings, and specifications | Daily Field Report | 4.8 | 16100 13340 | G/R |
| Components performance testing | Before and/or after installation as appropriate | Conformance with design drawings, and specifications | Contractors submittal per Section 01300 | 4.8 | 16100 3.10 16859 3.5 13340 3.3 | G/R |
| System performance testing | After installation of all components | Perform per ATP | ATP form | 4.8 | 13340 | H |

Construction Inspection Points (IP):

(1) Hold point (H): Observation and review of specific construction features required, before further construction is allowed to proceed.
(2) Witness point (W): Construction feature selected for inspection at option of KEH. Work may proceed upon verbal release by KEH or upon expiration of one hour beyond scheduled time of witness.
(3) H and W points apply to onsite work. Except where longer period is specified, notify KEH at least four working hours before each point.
(4) G/R: General or random monitoring points taken during construction activities.
(5) NA: Not Applicable.

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# APPENDIX B

# FIELD AND LABORATORY FORMS

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# INDEX OF LABORATORY AND FIELD FORMS

## FIELD FORMS

- Daily Field Report
- In Situ Density Tests - Balloon Method
- In Situ Density Tests - Sand Cone Method
- Nuclear Field/Density/ Moisture Test Data
- Subgrade Acceptance Certificate
- Geomembrane Defect/Repair Record
- Geomembrane Deployment Record
- Conformance Test Record
- Geomembrane Seam Destructive Sample Summary
- Geomembrane Seam Pressure Testing Record
- Geosynthetic Inventory Control Record
- NCR
- Leak/Pressure Test Certification
- ECN

## LABORATORY FORMS

- Atterberg Limits
- Moisture Content
- Sieve Analysis Worksheet
- Sieve and Hydrometer Worksheet
- Grain Size Distribution
- Moisture - Density Relationship of Soil
- Constant Head Test Rigid Wall Permeability
- Flexible Wall Permeability Test
- Geomembrane Destructive Test Record

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GOLDER ASSOCIATES
4104 148th Avenue NE
Redmond, Washington 98052

(206) 883-0777

WHC-SD-WO25-PLN-001

| | |
|---|---|
| DATE | WHC-SD-W025-PLN-001 Rev. 2 Revision 2 Page 82 |
| PROJECT | |
| LOCATION | |
| CONTRACTOR | OWNER |
| WEATHER | TEMP °at AM °at PM |
| PRESENT AT SITE | |

TO

THE FOLLOWING WAS NOTED

COPIES TO 82

# FIELD REPORT

SIGNED

MATERIAL TESTED: _____ MAX. DRY DENSITY: _____ OPT. M.C.: _____

WEATHER: _____

| | | | | |
|---|---|---|---|---|
| Test Number | | | | |
| Elevation | | | | |
| Location | | | | |
| Final readings ($ft^3$) | | | | |
| | | | | |
| | | | | |
| Avg. final reading ($ft^3$) | | | | |
| Initial reading ($ft^3$) | | | | |
| Uncorrected volume ($ft^3$) | | | | |
| Correction factor ($ft^3$) | | | | |
| Corrected volume ($ft^3$) | | | | |
| Wt. soil + tare (gm) | | | | |
| Tare (gm) | | | | |
| Wt. wet soil (gm) | | | | |
| Wet density (pcf) | | | | |
| Tin number | | | | |
| Wt. wet soil + tare (gm) | | | | |
| Wt. dry soil + tare (gm) | | | | |
| Wt. of water (gm) | | | | |
| Tare (gm) | | | | |
| Wt. dry soil (gm) | | | | |
| Moisture content | | | | |
| Dry density (pcf) | | | | |
| | | | | |
| Max. dry density (pcf) | | | | |
| Percent compaction | | | | |
| | | | | |
| Pass/Fail | | | | |

Figure
**IN-PLACE DENSITY TESTS**
**RUBBER BALLOON METHOD**

Project: _____ 83

Project No. _____ Date _____ Tested By _____ Reviewed By _____ Golder Associates

9031387\ 34833

MATERIAL TESTED: _____ MAX. DRY DENSITY: _____ OP

| TEST NUMBER/ELEVATION | | | |
|---|---|---|---|
| LOCATION | | | |
| a. Weight of apparatus with sand, gm. | | | |
| b. Weight of apparatus with remaining sand, gm. | | | |
| c. Weight of sand used (a-b), gm. | | | |
| d. Weight of sand in cone (calibrated), gm. | | | |
| e. Weight of sand in sample hole (c-d), gm. | | | |
| f. Unit weight of sand (calibrated), pcf | | | |
| g. Volume of sample hole $\frac{(e)}{453.5\ (f)}$, cf. | | | |
| h. Wet weight of total sample + tare, gm. | | | |
| i. Tare of container, gm. | | | |
| j. Wet weight of total sample (h-i), gm. | | | |
| o. Moisture container number | | | |
| p. Wet weight + tare, gm. | | | |
| q. Dry weight + tare, gm. | | | |
| r. Weight of water (p-q), gm. | | | |
| s. Tare of moisture container, gm. | | | |
| t. Dry weight (q-s), gm. | | | |
| u. Moisture content (r/t x 100), % | | | |
| v. Dry weight of sample (0.2205j), lbs. | | | |
| w. Dry density of sample v/g, pcf | | | |
| x. Percent compaction, $\frac{w}{\text{max. dry density}}$ | | | |
| y. Pass/Fail | | | |

Figure
**IN-PLACE DENSITY TESTS**
**- FIELD DATA SHEET -**
**SAND CONE METHOD**

Project: _____ 84

Project No. _____ Date _____ Tested By _____ Reviewed By _____ Golder Associates

9031387\ 34844

TROXLER MODEL 3440-B, SERIAL NO.: _____ SHEET NO.: _____

STANDARD COUNT: DENSITY - _____ MOISTURE - _____

WEATHER: _____

REQUIRED COMPACTION (%): _____

FIELD ENGINEER: _____

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test number | | | | | | | | | | | | | | | | | | | | | |
| General test location | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: I.D. number | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: North coordinate | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: East coordinate | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: Elevation | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: Bearing (to test) | | | | | | | | | | | | | | | | | | | | | |
| Reference stake: Distance | | | | | | | | | | | | | | | | | | | | | |
| Mode & depth | | | | | | | | | | | | | | | | | | | | | |
| Wet density (pcf) | | | | | | | | | | | | | | | | | | | | | |
| Dry density (pcf) | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB | TROX | LAB |
| % Moisture | | | | | | | | | | | | | | | | | | | | | |
| % Compaction | | | | | | | | | | | | | | | | | | | | | |
| Optimum moisture (%) | | | | | | | | | | | | | | | | | | | | | |
| Max. dry density (pcf) | | | | | | | | | | | | | | | | | | | | | |
| Pocket pen. (tsf) | | | | | | | | | | | | | | | | | | | | | |
| Pass/Fail | | | | | | | | | | | | | | | | | | | | | |

## NUCLEAR FIELD DENSITY/MOISTURE TEST DATA

Project _____

Project No. _____ Date _____ Tested By _____ Reviewed By _____ Golder Associates

CERTIFICATE OF ACCEPTANCE
OF SOIL SUBGRADE BY INSTALLER

| INSTALLER | PROJECT |
|---|---|
| NAME _____ | LOCATION _____ |
| ADDRESS _____ | PROJECT _____ |
| _____ | |
| _____ | OWNER _____ |

AUTHORIZED REPRESENTATIVE _____

I, the Undersigned, the duly authorized representative of _____
_____,
do hereby accept the area of soil subgrade bounded by _____
_____
_____
_____
_____
and shall be responsible for its integrity and suitability, except for weather caused damage, in accordance with these specifications from this date to completion of the installation.

_____
NAME SIGNATURE TITLE DATE

CERTIFICATION ACCEPTED BY INSPECTOR-COMPANY _____
_____

_____
NAME SIGNATURE TITLE DATE

# GEOMEMBRANE DEFECT/REPAIR RECORD

PROJECT: DOE/CQAP/WA
PROJECT NO.: 903-1387
CONTRACTOR:

OWNER: DOE
LOCATION: RICHLAND, WA
INSPECTOR: _____

SHEET NO.: _____
DATE: _____
WEATHER: _____
TEMP.: ____ deg F @: _____

| DEFECT | | | REPAIR | | TEST | |
|---|---|---|---|---|---|---|
| SEQ. | DATE / REASON | LOCATION | DATE / TECH | SIZE / CODE | DATE / TECH | ADDITIONAL DEFECTS |
| A | | | | | | |
| B | | | | | | |
| C | | | | | | |
| D | | | | | | |
| E | | | | | | |
| F | | | | | | |
| G | | | | | | |
| H | | | | | | |
| J | | | | | | |
| K | | | | | | |
| L | | | | | | |
| M | | | | | | |
| N | | | | | | |

REPAIR CODE: P-PATCH C-CAP D-DESTRUCTIVE TEST H-PIN HOLE G-GRIND & WELD

OF ONE ALL

REVISED: 4-24-90, JMB

GOLDER ASSOCIATES

# GEOMEMBRANE DEPLOYMENT RECORD



PROJECT: DOE/CQAP/WA
PROJECT NO.: 903-1387
OWNER: DOE
LOCATION: RICHLAND, WA
CONTRACTOR:

GEOMEMBRANE: ☐ PRIMARY ☐ SECONDARY ☐ CLOSURE ☐ OTHER _____

SUBGRADE: ☐ ACCEPTABLE ☐ NOT ACCEPTABLE

DATE: _____
WEATHER: _____
TEMP.: _____ deg F @: _____
INSPECTOR: _____
TRANSPORT EQUIP.: _____

| DESCRIPTION | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROLL NO. | | | | | | | | | | | | | | | |
| LENGTH/WIDTH (ft) | / | | | / | | | / | | | / | | | / | | |
| VISUAL INSP. | | | | | | | | | | | | | | | |
| THICKNESS (mil) | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL |
| #1 | | | | | | | | | | | | | | | |
| #2 | | | | | | | | | | | | | | | |
| #3 | | | | | | | | | | | | | | | |
| #4 | | | | | | | | | | | | | | | |
| #5 | | | | | | | | | | | | | | | |
| AVERAGE | | | | | | | | | | | | | | | |
| FUSION WELD/TEMP. BOND | | | | | | | | | | | | | | | |
| WELD/BOND ID | | | | | | | | | | | | | | | |
| TECH. ID | | | | | | | | | | | | | | | |
| OVERLAP (in.) | | | | | | | | | | | | | | | |
| ACCEPT/REJECT | | | | | | | | | | | | | | | |

| DESCRIPTION | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | | PANEL _____ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROLL NO. | | | | | | | | | | | | | | | |
| LENGTH/WIDTH (ft) | / | | | / | | | / | | | / | | | / | | |
| VISUAL INSP. | | | | | | | | | | | | | | | |
| THICKNESS (mil) | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL | LEAD | SIDE | TRAIL |
| #1 | | | | | | | | | | | | | | | |
| #2 | | | | | | | | | | | | | | | |
| #3 | | | | | | | | | | | | | | | |
| #4 | | | | | | | | | | | | | | | |
| #5 | | | | | | | | | | | | | | | |
| AVERAGE | | | | | | | | | | | | | | | |
| FUSION WELD/TEMP. BOND | | | | | | | | | | | | | | | |
| WELD/BOND ID | | | | | | | | | | | | | | | |
| TECH. ID | | | | | | | | | | | | | | | |
| OVERLAP (in.) | | | | | | | | | | | | | | | |
| ACCEPT/REJECT | | | | | | | | | | | | | | | |

# CONFORMANCE TEST RECORD

PROJECT: DOE/CQAP/WA

PROJECT NO.: 903-1387

OWNER: DOE

LOCATION: RICHLAND, WA

| LOAD NUMBER | MATERIAL TYPE | DATE RECEIVED | INSPECTOR I.D. | ROLL I.D. | BATCH I.D. | DATE SAMPLE SENT OUT | DATE RESULTS BACK | DATE RESULTS REVIEWED | REVIEWED BY | PASS/FAIL |
|---|---|---|---|---|---|---|---|---|---|---|
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# GEOMEMBRANE SEAM DESTRUCTIVE SAMPLE SUMMARY

PROJECT: DOE/CQAP/WA

PROJECT NO.: 903-1387

OWNER: DOE

LOCACATION: RICHLAND, WA

PAGE NO.: _____/_____

CONTRACTOR:

| SAMPLE I.D. | SEAM I.D. | DATE TAKEN | FIELD TEST RESULTS | | | INSP. I.D. | DATE SHIPPED | LAB RESULTS | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PEEL | | SHEAR | | | PASS / FAIL | DATE TESTED | DATE NOTIFIED | |
| | | | INSIDE | OUTSIDE | | | | | | | |
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REVISED: 1-30-1991

WHC-SD-W025-PLN-001
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GOLDER ASSOCIATES

# GEOMEMBRANE SEAM PRESSURE TESTING RECORD



PROJECT: DOE/CQAP/WA
PROJECT NO.: 903-1387
OWNER: DOE
LOCATION: RICHLAND, WA
CONTRACTOR:

DATE: _____
WEATHER: _____
TEMP.: _____deg F @ _____
PAGE NO.:_____/_____FOR DAY
INSPECTOR: _____

| SEAM I.D. | TIME | | PRESSURE | | TECH I.D. | PASS /FAIL | COMP. (Y/N) | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | START | STOP | START | STOP | | | | |
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REVISED: 1-26-00/RS



GOLDER ASSOCIATES

# GEOSYNTHETIC INVENTORY CONTROL RECORD

PROJECT:

PROJECT NO.:

OWNER:

LOCATION:

CONTRACTOR:

SHIPMENT NO.:

DATE:

WEATHER:

TEMP.: deg F @

INSPECTOR:

## MATERIALS

☐ HDPE ☐ VLDPE ☐ GEONET ☐ GEOGRID ☐ NONWOVEN GEOTEXTILE ☐ WOVEN GEOTEXTILE ☐ OTHER:

MANUFACTURER/MATERIAL:

ROLL CONDITION IN TRUCK:

TRUCK TYPE AND UNLOADING METHOD:

DRIVER COMMENTS:

| ROLL I.D. | | ROLL DIMENSIONS | | | REMARKS | |
|---|---|---|---|---|---|---|
| ROLL NUMBER | BATCH NUMBER | LENGTH (ft) | WIDTH (ft) | THICKNESS (mils) | X | (CHECK IF CONFORMANCE SAMPLED) |
| | | | | | | |
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FORM A

REVISED: 1-27-90/TLS



GOLDER ASSOCIATES

# NONCONFORMANCE REPORT

Page 1 of

| Project No | W.O. No. | Location (Bldg./Area) | Safety Class | NCR No. |
|---|---|---|---|---|
| | | | | |

Job Title

Requirement(s) (including source document numbers, revision, paragraph, etc.)

Distribution

Description of Nonconformance:

| Originator | Date | Supervisor | Date |
|---|---|---|---|
| | | | |



REH 1964 01 (04/90)

# NONCONFORMANCE REPORT (continued)

Disposition
☐ Use-as-is* ☐ Reject ☐ Repair* ☐ Rework
*Justification Required

ASME Code Related ☐ No ☐ Yes
(ASME Code Section _____)

Cause Code

NCR No.

Disposition Instructions (generally not required for use-as-is and reject dispositions):

ECN (generally required for repair and use-as-is dispositions).
☐ Yes ☐ No If yes, ECN No _____.
If no, provide explanation: _____

Disposition Justification (if applicable):

Approval/Concurrence

Construction Approval

CE/CM Engineer _____ Date _____
Field Quality Engineer _____ Date _____

Operations Approval

Engineer _____ Date _____
QA _____ Date _____

Design Approval

Design Engineer _____ Date _____
Lead Engr./Discpl. Mgr _____ Date _____
Quality Engineer _____ Date _____
Safety Engineer _____ Date _____

Other Concurrence

DOE _____ Date _____
AIA/II(ASME) _____ Date _____
ECH Code Engr _____ Date _____
Environmental _____ Date _____

Closure
☐ Disposition Completed as Directed
☐ Other (Explain) _____

Originator or Representative Date
Supervisor Date



ECH 1964 01R (04/5

WHC-SD-W025-PLN-001, Rev 2

**KAISER ENGINEERS HANFORD**

# LEAK/PRESSURE TEST CERTIFICATION

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Page 1 of

| Project or W.O. no | Title | Dwg Reference | Test Procedure/Rev |
|---|---|---|---|
| | | | |

| Construction Spec/Rev | Code or Standard | Year | Addenda | Class | Stamp Required |
|---|---|---|---|---|---|
| | | | | | ☐ Yes ☐ N |

Description of System or Component(s) Test Boundaries

## TEST PREPARATION

**Notification Requirements**

- ☐ Quality Control
- ☐ Acceptance Inspection
- ☐ Safety Engineer
- ☐ Client _____
- ☐ Authorized Inspector
- ☐ _____

**Valve Line up Requirements (for permanent valves installed)**

| Valve I.D. | | |
|---|---|---|
| _____ | ☐ Open | ☐ Close |
| _____ | ☐ Open | ☐ Close |
| _____ | ☐ Open | ☐ Close |
| _____ | ☐ Open | ☐ Close |
| _____ | ☐ Open | ☐ Close |
| _____ | ☐ Open | ☐ Close |

Required Test Medium: Medium _____

Required Test Medium Temp.: Temp _____

Flushing Requirements: Flushing _____

☐ Blue Chalking Required
☐ Soap Solution Required

Design System Pressure _____

Design Test Pressure _____

Specified Hold Time _____

Prepared By _____ Date _____

## PRETEST CHECKLIST

| Item or Requirement | Craft Supervision | Quality Control Accept | Quality Control Date |
|---|---|---|---|
| Valve line-up per design requirements (see above line up) | | | |
| Flushing of system and/or component completed per design requirements | | | |
| All lines or components not to be tested are properly isolated or disconnected | | | |
| Vents and openings checked, proper Pressure Relief Valve installed and discharge checked | | | |
| Test medium per design requirements, temperature equalized<br>Medium _____ Medium Temp _____ _____ (ASME only) | | | |
| Test gauge(s) correct range and currently calibrated<br>SN _____ Range _____ Cal Due Date _____<br>SN _____ Range _____ Cal Due Date _____<br>SN _____ Range _____ Cal Due Date _____ | | | |
| Pressure Relief Valve properly set and currently calibrated<br>SN _____ PSI Set _____ Check'd Date _____<br>SN _____ PSI Set _____ Check'd Date _____<br>SN _____ PSI Set _____ Check'd Date _____ | | | |



REH-1757 01 (2

WHC-SD-W025-PLN-001, Rev. 2

| KAISER ENGINEERS HANFORD | LEAK/PRESSURE TEST CERTIFICATION | ~~WHC-SD-W025-PLN-001~~ Revision 2 Page 28 | Page 2 of 2 |
|---|---|---|---|

## TEST PERFORMANCE

| Item or Requirement | Quality Control Accept | Quality Control Date |
|---|---|---|
| ADTME and other if specified. | | |
| 50% Tp obtained and examination conducted = Tp _____ | | |
| Pressure increments at 0 10 Tp: = Tp _____ | | |
| = Tp _____ | | |
| = Tp _____ | | |
| = Tp _____ | | |
| = Tp _____ | | |
| Hydrostatic testing - areas to be inspected chalked prior to application of pressure. | | |
| Hydrostatic testing - examination conducted while system/component pressurized. Specified Tp _____ PSI obtained at _____ a.m. p.m. | | |
| Pneumatic Testing - soap solution applied to areas to be tested and system/components examined while pressurized. Specified Tp _____ PSI obtained at _____ a.m. p.m. | | |

| Pressure Test ☐ Accepted ☐ Rejected | Quality Control Signature | Stamp or PR No | Date |
|---|---|---|---|

## INSPECTION VERIFICATION

| | | | |
|---|---|---|---|
| Documentation properly prepared | ☐ Yes ☐ No | Actual Tp during final inspection _____ PSI | |
| All joints and welded attachments to pressure retaining components chalked/dropped as applicable | ☐ Yes ☐ No | | |
| All joints and welded attachments to pressure retaining components visually inspected for leakage | ☐ Yes ☐ No | Specified hold time verified at _____ a.m. p.m. | |

| Pressure Test ☐ Accepted ☐ Rejected | Acceptance Inspection Signature | Stamp or PR No. | Date |
|---|---|---|---|

## OTHER

Comments

| NCR No (if applicable) | Client Representative | | Date |
|---|---|---|---|
| | Witness - ASME Authorized Inspector | | Date |
| ☐ Document Reviewed ☐ Drawings Highlighted | Construction Engineering | PR No | Date |



KEI-1757-02

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WHC-SD-W025-PLN-001, Rev.2

# ENGINEERING CHANGE NOTICE

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| | | | |
|---|---|---|---|
| 2 ECN Category (mark one)<br>☐ Supplemental<br>☐ Direct Revision<br>☐ Change ECN<br>☐ Temporary<br>☐ Supersedure<br>☐ Discovery<br>☐ Cancel/Void | 3 Originator's Name, Organization, MSIN, and Telephone No | | 4 Date |
| | 5 Project Title/No./Work Order No | 6 Bldg./Sys./Fac No | 7 Impact Level |
| | 8 Document Number Affected (include rev and sheet no.) | 9 Related ECN No(s) | 10 Related PO No |

| | | | |
|---|---|---|---|
| 11a Modification Work<br>☐ Yes (fill out Blks 11b, 11c, 11d)<br>☐ No (N/A Blks 11b, 11c, 11d) | 11b Work Package Doc No | 11c Complete Installation Work<br>Cog Engineer Signature & Date | 11d Complete Restoration (Temp ECN only)<br>Cog Engineer Signature & Date |

12 Description of Change

| | |
|---|---|
| 13a Justification (mark one)<br>☐ Criteria Change<br>☐ Design Improvement<br>☐ Environmental<br>☐ As-Found<br>☐ Facilitate Const<br>☐ Const Error/Omission<br>☐ Design Error/Omission | 13b Justification Details |

| | |
|---|---|
| 14 Distribution (include name, MSIN, and no. of copies) | RELEASE STAMP |



A-7900-013 (11/88)

WHC-SD-W025-PLN-001 Rev-2

# ENGINEERING CHANGE NOTICE

Page 2 of

1 ECN (use no. from pg 1)

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| 15 Design verification Required | 16 Cost Impact | | 17 Schedule impact (days) |
|---|---|---|---|
| | ENGINEERING | CONSTRUCTION | |
| ☐ Yes | Additional ☐ $ _____ | Additional ☐ $ _____ | Improvement ☐ _____ |
| ☐ No | Savings ☐ $ _____ | Savings ☐ $ _____ | Delay ☐ _____ |

18 Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

| | | | | | |
|---|---|---|---|---|---|
| SDD/DD | ☐ | Seismic/Stress Analysis | ☐ | Tank Calibration Manual | ☐ |
| Functional Design Criteria | ☐ | Stress/Design Report | ☐ | Health Physics Procedure | ☐ |
| Operating Specification | ☐ | Interface Control Drawing | ☐ | Spares Multiple Unit Listing | ☐ |
| Criticality Specification | ☐ | Calibration Procedure | ☐ | Test Procedures/Specification | ☐ |
| Conceptual Design Report | ☐ | Installation Procedure | ☐ | Component Index | ☐ |
| Equipment Spec | ☐ | Maintenance Procedure | ☐ | ASME Coded Item | ☐ |
| Const Spec | ☐ | Engineering Procedure | ☐ | Human Factor Consideration | ☐ |
| Procurement Spec | ☐ | Operating Instruction | ☐ | Computer Software | ☐ |
| Vendor Information | ☐ | Operating Procedure | ☐ | Electric Circuit Schedule | ☐ |
| OM Manual | ☐ | Operational Safety Requirement | ☐ | ICRS Procedure | ☐ |
| FSAR/SAR | ☐ | IEFD Drawing | ☐ | Process Control Manual/Plan | ☐ |
| Safety Equipment List | ☐ | Cell Arrangement Drawing | ☐ | Process Flow Chart | ☐ |
| Radiation Work Permit | ☐ | Essential Material Specification | ☐ | Purchase Requisition | ☐ |
| Environmental Impact Statement | ☐ | Fac Proc Samp Schedule | ☐ | _____ | ☐ |
| Environmental Report | ☐ | Inspection Plan | ☐ | _____ | ☐ |
| Environmental Permit | ☐ | Inventory Adjustment Request | ☐ | _____ | ☐ |

19 Other Affected Documents (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

| Document Number/Revision | Document Number/Revision | Document Number/Revision |
|---|---|---|
| | | |
| | | |
| | | |

20 Approvals

| Signature | Date | Signature | Date |
|---|---|---|---|
| OPERATIONAL ENGINEERING | | ARCHITECT-ENGINEER | |
| Cog Project Engineer | | PE | |
| Cog Project Engr Mgr | | QA | |
| QA | | Safety | |
| Safety | | Design | |
| Security | | Other | |
| Proj Prog Dept Mgr | | | |
| Def Reach Div | | | |
| Chem Proc Div | | | |
| Def Wst Mgmt Div | | DEPARTMENT OF ENERGY | |
| Adv Reach Dev Div | | | |
| Proj Dept | | | |
| Environ Div | | ADDITIONAL | |
| IRM Dept | | | |
| Facility Rep Dept | | | |
| Other | | | |

A-7900-013R (11/88)

ENGINEERING CHANGE NOTICE CONTINUATION SHEET

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Revision 2
Page 99



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# ATTERBERG LIMITS

FIGURE

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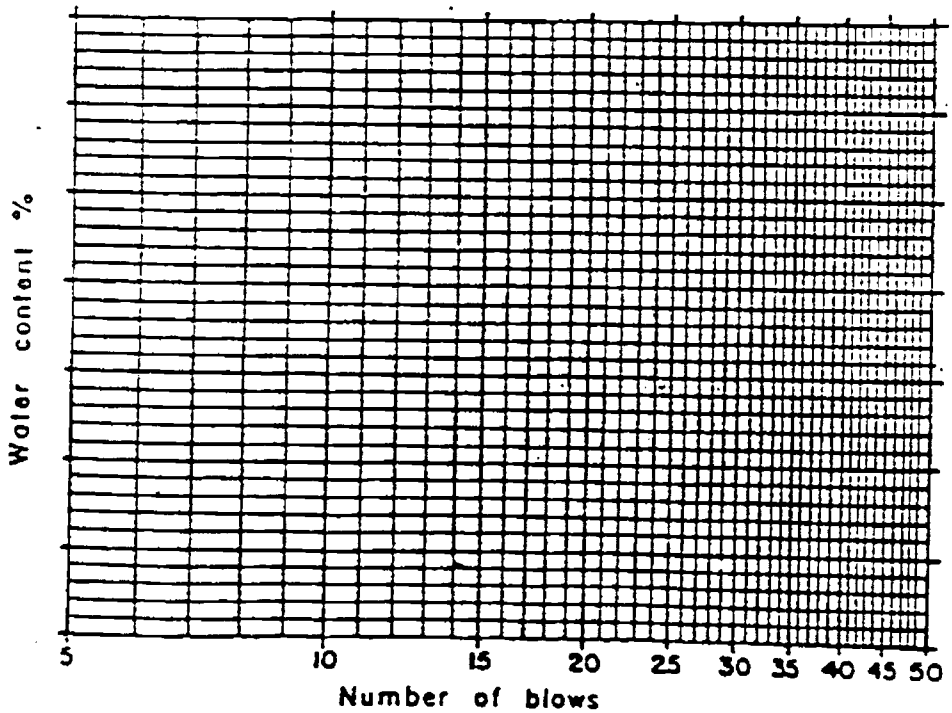
~~WHC-SD-W025-PLN-001~~ Revision 2 Page 100

| Type of Test | LL | LL | LL | LL | NOT MC |
|---|---|---|---|---|---|
| Container # | | | | | |
| Number of blows | | | | | |
| Wt. sample wet + tare | | | | | |
| Wt. sample dry + tare | | | | | |
| Weight of water | | | | | |
| Tare | | | | | |
| Wt. of dry soil | | | | | |
| Water content % | | | | | |

| Type of Test | PL | PL | Borehole # | |
|---|---|---|---|---|
| Container # | | | Sample # | |
| Wt. sample wet + tare | | | Depth | |
| Wt. sample dry | | | Liquid limit | |
| Wt. of water | | | Plastic limit | |
| Tare | | | Plasticity index | |
| Weight of dry soil | | | Moisture content | |
| Water content | | | Liquidity index | |




Sample Description: _____

Project No. _____
Project _____

Golder Associates

Date _____
By _____

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Borehole no. | | | | | | | |
| Sample no. | | | | | | | |
| Depth of sample | | | | | | | |
| Container no. | | | | | | | |
| Wt. wet soil + tare | | | | | | | |
| Wt. dry soil + tare | | | | | | | |
| Wt. water | | | | | | | |
| Wt. dry soil | | | | | | | |
| Water content w-% | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Borehole no. | | | | | | | |
| Sample no. | | | | | | | |
| Depth of sample | | | | | | | |
| Container no. | | | | | | | |
| Wt. wet soil + tare | | | | | | | |
| Wt. dry soil + tare | | | | | | | |
| Wt. water | | | | | | | |
| Wt. dry soil | | | | | | | |
| Water content w-% | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Borehole no. | | | | | | | |
| Sample no. | | | | | | | |
| Depth of sample | | | | | | | |
| Container no. | | | | | | | |
| Wt. wet soil + tare | | | | | | | |
| Wt. dry soil + tare | | | | | | | |
| Wt. water | | | | | | | |
| Wt. dry soil | | | | | | | |
| Water content w-% | | | | | | | |

Figure
**WATER CONTENT DETERMINATION**

Project _____

Project No. _____ Date _____ Tested By _____ Reviewed By _____ Golder Associates



9031387\ 34846

GOLDER ASSOCIATES INC., REDMOND, WA

ASTM D-1140/C-136
SIEVE ANALYSIS

| SIZE OF LARGEST PARTICLE | MINIMUM MASS OF SAMPLE REQUIRED |
|---|---|
| #10 | 200g |
| #4 | 500g |
| 3/4" | 1500g |
| 1" | 2000g |
| 2" | 4000g |
| 3" | 5000g |

PROJECT
PROJECT NUMBER
ENGINEER
DATE
TECHNICIAN
REVIEWER

| | | | | | | |
|---|---|---|---|---|---|---|
| BOREHOLE NUMBER | | | | | | |
| SAMPLE NUMBER | | | | | | |
| DEPTH (ft) | | | | | | |
| TARE NUMBER | | | | | | |
| TARE WT (g) | | | | | | |
| WET WT + TARE (g) | | | | | | |
| DRY WT + TARE (g) | | | | | | |
| MOISTURE (%) | ERR | ERR | ERR | ERR | ERR | ERR |

| | CUMULATIVE WEIGHT (g) | PERCENT FINER | CUMULATIVE WEIGHT (g) | PERCENT FINER | CUMULATIVE WEIGHT (g) | PERCENT FINER | CUMULATIVE WEIGHT (g) | PERCENT FINER | CUMULATIVE WEIGHT (g) | PERCENT FINER | CUMULATIVE WEIGHT (g) | PERCENT FINER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TARE (g) | | | | | | | | | | | | |
| 3" | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| 2" | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| 1" | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| 3/4" | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| 3/8" | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #4 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #10 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #20 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #40 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #60 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #100 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| #200 | | ERR | | ERR | | ERR | | ERR | | ERR | | ERR |
| MEETS ASTM SAMPLE SIZE REQUIREMENT? | | | | | | | | | | | | |
| D10 | | D10 | | D10 | | D10 | | D10 | | D10 | | D10 |
| D30 | | D30 | | D30 | | D30 | | D30 | | D30 | | D30 |
| D60 | | D60 | | D60 | | D60 | | D60 | | D60 | | D60 |
| Cu | ERR | Cu | ERR | Cu | ERR | Cu | ERR | Cu | ERR | Cu | ERR | Cu |
| Cz | ERR | Cz | ERR | Cz | ERR | Cz | ERR | Cz | ERR | Cz | ERR | Cz |

1C2

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Revision 2

WORKSHEET FOR MOISTURE CONTENT OF SOILS
ASTM D-2216
WORKSHEET FOR SIEVE AND HYDROMETER
ASTM D-422 (MODIFIED FOR TEMPERATURE CHANGE)
WORKSHEET FOR DRY PREPARATION OF SOILS
ASTM D-421
UPDATED 3/20/90 BY D. OSTER

PART A: NATURAL MOISTURE CONTENT

TARE #: _____
TARE (g): _____
MOIST WT. (g): _____
OVEN DRY WT (g): _____
MC: %

PART C: FINE FRACTION MOISTURE

TARE #: _____
TARE (g): _____
MOIST WT. (g): _____
OVEN DRY WT (g): _____
MC: %

PART D: COARSE FRACTION MOISTURE

TARE #: _____
TARE (g): _____
MOIST WT. (g): _____
OVEN DRY WT (g): _____
MC: %

PART B: SEPARATION OF FRACTIONS

WEIGHT TOTAL SAMPLE + TARE, AIR DRY (g): _____
WEIGHT OF AIR DRY TARE (g): _____
WEIGHT OF -#10 TARE (g): _____
WEIGHT OF -#10 FRACTION + TARE (g): _____
WEIGHT OF -#10 FRACTION, AIR DRY (g):
WEIGHT OF +#10 FRACTION, AIR DRY (g):
OVEN DRY WEIGHT OF FINES (g):
OVEN DRY WEIGHT OF COARSE FRACTION (g):
OVEN DRY WEIGHT OF TOTAL SAMPLE (g):

PART E: HYDROMETER TEST ON FINE FRACTION

HYDROMETER TYPE: _____
HYDROMETER NUMBER: _____
BEAKER NUMBER: _____
FLASK NUMBER: _____
SPECIFIC GRAVITY: _____
PORTION TESTED: _____
MOIST WT. OF SOIL (g): _____
CORRECTED DRY WT. (g):
Rw: 1.00
STANDARD SOLUTION
ZERO CORRECTION

TEMP. READ.

PART F: SIEVE OF COARSE FRACTION SAMPLE: _____

| | CUMULATIVE WEIGHT (g) | PERCENT FINER |
|---|---|---|
| TARE (g) | _____ | |
| 3" | _____ | |
| 2" | _____ | |
| 1" | _____ | |
| 3/4" | _____ | |
| 3/8" | _____ | |
| #4 | _____ | |
| #10 | _____ | |
| PAN | _____ | |

| SIZE | FINAL RESULTS PERCENT FINER |
|---|---|
| 3" | 0.0% |
| 2" | 0.0% |
| 1" | 0.0% |
| 3/4" | 0.0% |
| 3/8" | 0.0% |
| #4 | 0.0% |
| #10 | 0.0% |
| #20 | 0.0% |
| #40 | 0.0% |
| #60 | 0.0% |
| #100 | 0.0% |
| #200 | 0.0% |

| SIZE OF LARGEST PARTICLE | MINIMUM MASS +#10 PORTION REQUIRED |
|---|---|
| 3" | 5000g |
| 2" | 4000g |
| 1" | 2000g |
| 3/4" | 1000g |
| 3/8" | 500g |

MEETS ASTM REQUIREMENT? _____

D10: _____
D30: _____
D60: _____
Cu:
Cc:

PART G: SIEVE ON FINE FRACTION

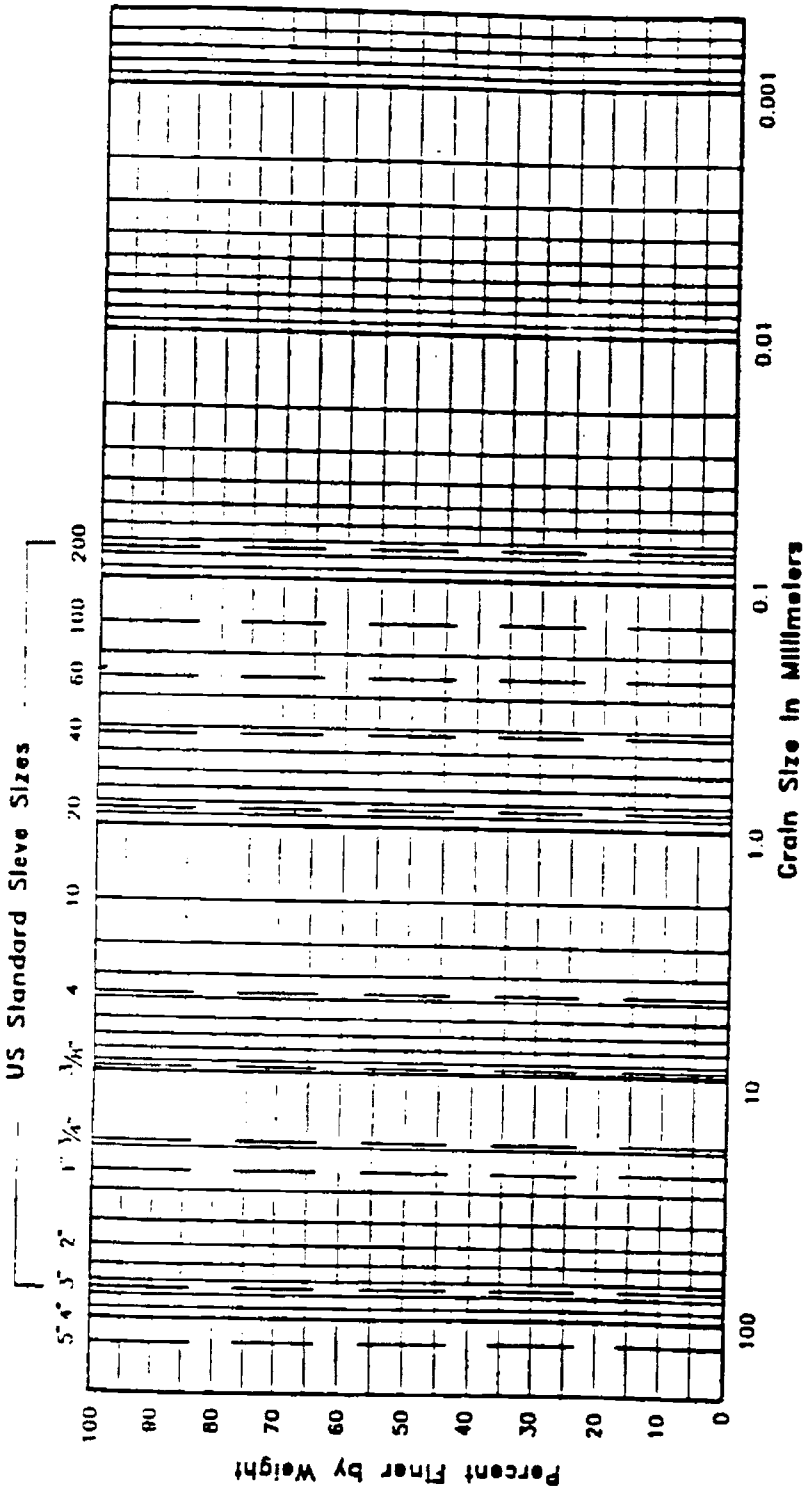
| | CUMULATIVE WEIGHT | PERCENT FINER |
|---|---|---|
| TARE (g) | _____ | |
| #20 | _____ | |
| #40 | _____ | |
| #60 | _____ | |
| #100 | _____ | |
| #200 | _____ | |

NOTES:

| #D | SZ | S | G | ELAPSED TIME (min) | TEMP. (C) | HYDRO READING | ZERO CORR. (CONTROL) | CORR. FACTOR t | CORR. FACTOR A | % FINER | EFF. DEPTH L,cm | CONSTANT (TAGs) K | DIAM. (mm) | LOG DIAM. | %TOTAL SAMPL. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.00 | | | | | | | | | | | |

PROJECT:
PROJECT NUMBER: _____ / _____ / _____
TECHNICIAN: _____
TASK: _____ DATE: _____
REVIEWED BY: _____

GOLDER ASSOCIATES INC.
GEOTECHNICAL TESTING LABORATORY
REDMOND, WASHINGTON




| Sample No. | Elev. or Depth | $W_n$ | $W_L$ | $W_p$ | $I_p$ | Description |
|---|---|---|---|---|---|---|
| | | | | | | |

Figure

**GRAIN SIZE DISTRIBUTION**

Project _____

Project No. _____ Date _____ Tested By _____ Reviewed By _____

Golder Associates

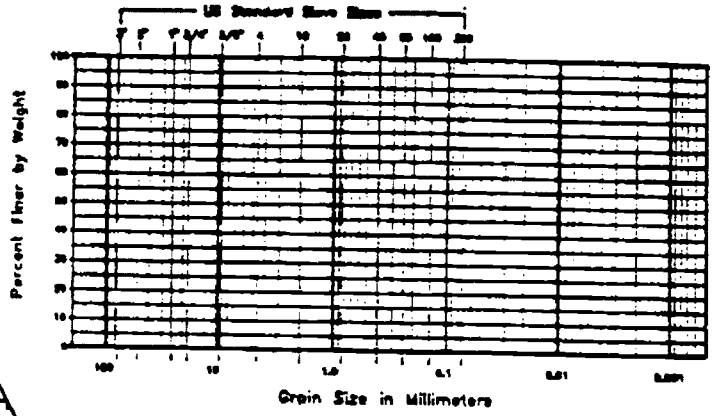


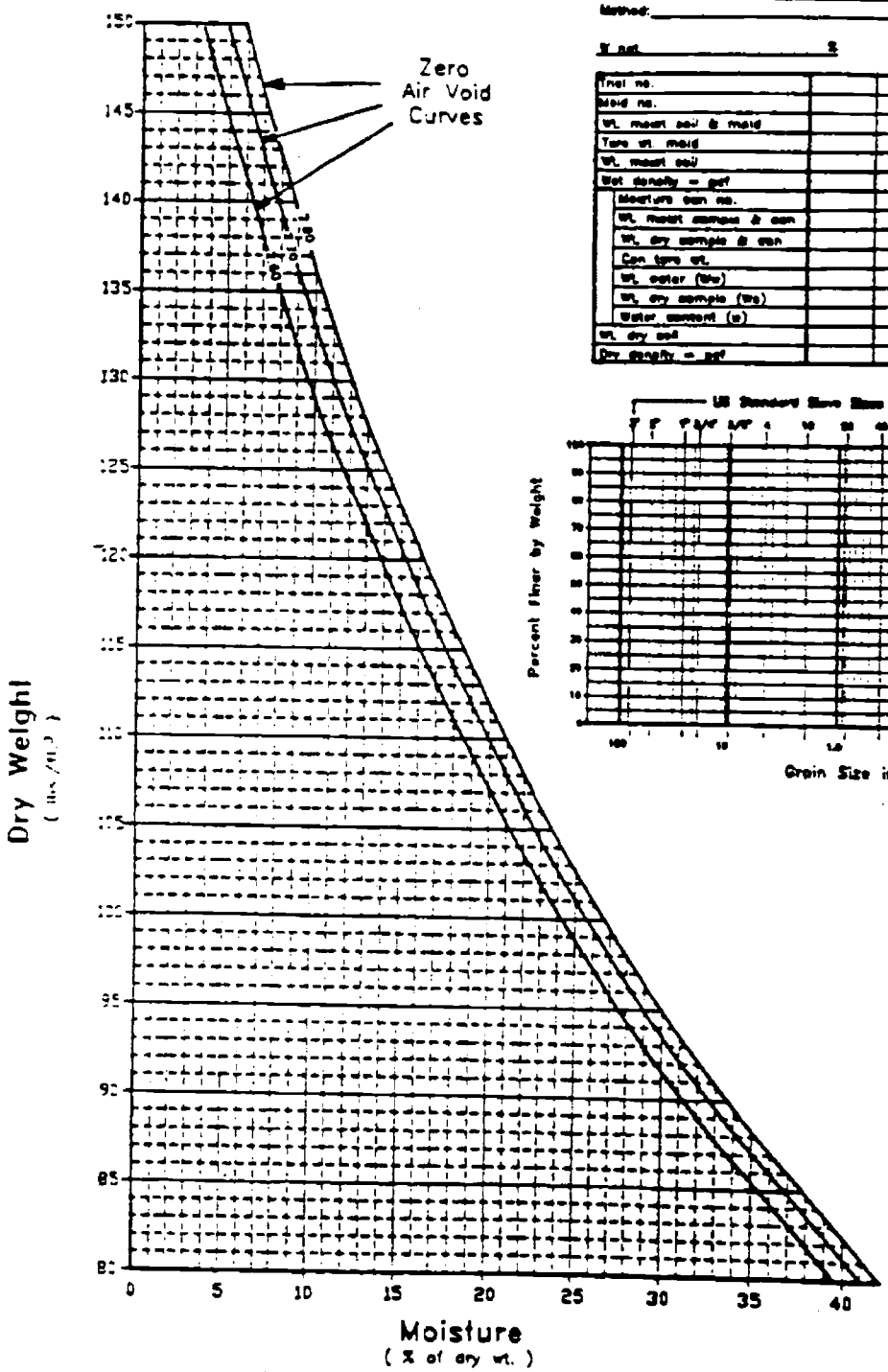
9031387\ 34847

Sample number: _____
Description: _____
Method: _____

W est. _____ % MOLD volume _____ cf

| | | | | | | |
|---|---|---|---|---|---|---|
| Trial no. | | | | | | |
| Mold no. | | | | | | |
| Wt. moist soil & mold | | | | | | |
| Tare wt. mold | | | | | | |
| Wt. moist soil | | | | | | |
| Wet density = pcf | | | | | | |
| Moisture can no. | | | | | | |
| Wt. moist sample & can | | | | | | |
| Wt. dry sample & can | | | | | | |
| Can tare wt. | | | | | | |
| Wt. water (lbs) | | | | | | |
| Wt. dry sample (lbs) | | | | | | |
| Water content (w) | | | | | | |
| Wt. dry soil | | | | | | |
| Dry density = pcf | | | | | | |




| | |
|---|---|
| $D_{10}$ | |
| $D_{30}$ | |
| $D_{60}$ | |
| $C_u$ | |
| $C_c$ | |

| SUMMARY | |
|---|---|
| Maximum Density (pcf) | |
| Optimum Moisture (%) | |

Figure
**MOISTURE-DENSITY RELATIONSHIP OF SOIL**

Project _____
Project No. _____ Date _____ Tested By _____ Reviewed By _____

Golder Associates

9031387\ 34846

Golder Associates Inc., Redmond, WA

CONSTANT HEAD / RIGID WALL PERMEABILITY TEST

Project title: _____
Project number: _____ . _____

Date:
Tested by: _____
Reviewed by: _____

Sample number: _____
Sample description: _____

NATURAL MOISTURE

| | |
|---|---|
| tare # | |
| tare wt. (g) | _____ |
| wet wt. + tare (g) | _____ |
| dry wt. + tare (g) | _____ |
| % moisture | ERR |

$$k = \frac{qL}{th\Delta}$$

, where:
q = volume of water (ml)
L = length of sample (cm)
t = elapsed time (sec)
h = head of water (cm)
A = cross-sectional area (sq cm)

PERMEANT: _____

H2O TEMP: _____

$$\frac{1}{k\ total} = \frac{1}{k\ system} + \frac{1}{k\ sample}$$

$$k\ sample = \frac{1}{\frac{1}{k\ total} - \frac{1}{k\ system}}$$

, where: k system = 2.26 cm/sec

| | |
|---|---|
| initial wt. of natural soil + permeameter (g): | _____ |
| post test, drained wt., soil + permeameter (g): | _____ |
| weight of permeameter (g): | _____ |
| dry weight of soil (g): | ERR |
| initial dry density of sample (pcf): | ERR |
| final dry density of sample (pcf): | ERR |
| final wet density of sample (pcf): | ERR |

q = _____ ml
pretest L = _____ cm
post test L = _____ cm
h = _____ cm
D = _____ cm
A = ERR sq cm

k sample = ERR cm/sec

| Trial | time (sec) | k total (cm/sec) |
|---|---|---|
| 1 | _____ | ERR |
| 2 | _____ | ERR |
| 3 | _____ | ERR |
| 4 | _____ | ERR |
| 5 | _____ | ERR |
| Average | 0.0 | ERR |

Notes: _____

GOLDER ASSOCIATES
PERMEABILITY TEST SPREADSHEET
(Single sample)

Project Number: _____
Project Description: _____

Sample Number: _____
Sample Description: _____

| Sample Dimensions (cgs): | Initial | Final |
|---|---|---|
| Height: | _____ | _____ |
| Diameter: | _____ | _____ |
| Area: | 0.00 | 0.00 |
| Volume: | 0.0 | 0.0 |

| Sample Properties : | Pre Test | Post Test |
|---|---|---|
| Wet Weight (g): | _____ | _____ |
| Moisture (%): | ### | ### |
| Wet Density (pcf): | ### | ### |
| Dry Density (pcf): | ### | ### |
| Dry Weight (g): | _____ | - |
| Specific Grav.: | _____ | - |
| Void Ratio: | ### | ### |
| Saturation (%): | ### | ### |

TEST RESULTS

K : _____ cm/second

Tested by: _____
Reviewed by: _____

Spreadsheet updated 1-25-90, D. Outer

Board number: _____
Cell number: _____

| Target Test Cond. (psi): | Saturation | Test |
|---|---|---|
| Cell: | _____ | _____ |
| Top Stone: | _____ | _____ |
| Bottom stone: | _____ | _____ |
| B - coefficient: | _____ | N.A. |
| Gradient: | ### | ### |

Test Method: Flexible wall permeameter with back pressure saturation (const. head computations)

| yr mo da hr minsec | Elapsed (min.) | CELL VOLUMES (cc) Reading | Delta | Total | INFLOW VOLUMES (cc) Reading | Refill | Delta | Total | OUTFLOW VOLUMES (cc) Reading | Drain | Delta | Total | Transducer Reading (psi) Cell | Bottom | Top | Head (cm H20) | K (cm/s) Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | 0 |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |
| _____ 0 0 | ### | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | 0.0 | 0.0 | _____ | _____ | _____ | 0.0 | ### |

# GEOMEMBRANE DESTRUCTIVE TEST RECORD



DESTRUCTIVE TEST NUMBER: _____
PROJECT: DOE/CQAP/WA
PROJECT NO.: 903-1387

OWNER: DOE
LOCATION: RICHLAND, WA
CONTRACTOR:

## SAMPLE CONTROL

| SEAM I.D. | REPAIR I.D. | DATE LOCATED | DATE TAKEN | DATE SHIPPED TO LAB | INSPECTOR I.D. | DATE RECEIVED BY LAB | DATE RESULTS REPORTED |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## LOCATION

_____

_____

FIELD TEST RESULTS: _____

## LAB TEST RESULTS

| SHEAR | | | | PEEL (INSIDE TRACK) | | | |
|---|---|---|---|---|---|---|---|
| SPECIMEN NUMBER | LOAD (lbs) | LOAD (ppi) | CODE (P/F) | SPECIMEN NUMBER | LOAD (lbs) | LOAD (ppi) | CODE (P/F) |
| S1 | | | | P1 | | | |
| S2 | | | | P2 | | | |
| S3 | | | | P3 | | | |
| S4 | | | | P4 | | | |
| S5 | | | | P5 | | | |

| SPECIMEN WIDTH (in.) | | | TEST RESULT (P/F) | PEEL (OUTSIDE TRACK) | | | |
|---|---|---|---|---|---|---|---|
| 0.25 | 0.50 | 1.00 | | SPECIMEN NUMBER | LOAD (lbs) | LOAD (ppi) | CODE (P/F) |
| | | | | P1 | | | |
| SHEET THICKNESS (mils) | | | | P2 | | | |
| | | | | P3 | | | |
| 40 | 60 | 80 | 100 | P4 | | | |
| | | | | P5 | | | |

REMARKS: _____

_____

_____

LAB TECH: _____

BS FORM ALL

REVISED 5-25-90/BLS



GOLDER ASSOCIATES

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Date Received: 8-4-92 cw

# INFORMATION RELEASE REQUEST

ORIGINAL

Reference: WHC-CM-3-4

**Complete for all Types of Release**

**Purpose**

- [] Speech or Presentation
  - [X] Full Paper
  - [] Summary
  - [] Abstract
  - [] Visual Aid
  - (Check only one suffix)
- [] Speakers Bureau
- [] Poster Session
- [] Videotape
- [] Reference
- [X] Technical Report
- [] Thesis or Dissertation
- [] Manual
- [] Brochure/Flier
- [] Software/Database
- [] Controlled Document
- [X] Other DRAWINGS

ID Number (include revision, volume, etc.)
WHC-S-045 & H-2-131573 THROUGH H-2-131594 EEG, 7/8/92

List attachments.

Date Release Required
JUNE 30, 1992

Title DESIGN DRAWINGS AND CONSTRUCTION SPECIFICATIONS

Unclassified Category UC-

Impact Level 3E

New or novel (patentable) subject matter? [] No [] Yes
If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions?
[] No [] Yes (Identify)

Copyrights? [] No [] Yes
If "Yes", has written permission been granted?
[] No [] Yes (Attach Permission)

Trademarks?
[] No [] Yes (Identify)

**Complete for Speech or Presentation**

Title of Conference or Meeting

Group or Society Sponsoring

Date(s) of Conference or Meeting

City/State

Will proceedings be published? [] Yes [] No
Will material be handed out? [] Yes [] No

Title of Journal

**CHECKLIST FOR SIGNATORIES**

| Review Required per WHC-CM-3-4. | Yes | No | Reviewer - Signature Indicates Approval: Name (printed) | Signature | Date |
|---|---|---|---|---|---|
| Classification/Unclassified Controlled Nuclear Information | [] | [✓] | | | |
| Patent - General Counsel | [✓] | [] | SWBERGLIN | | 8/4/92 |
| Legal - General Counsel | [✓] | [] | | | |
| Applied Technology/Export Controlled Information or International Program | [] | [✓] | | | |
| WHC Program/Project | [✓] | [] | | | |
| Communications | [] | [✓] | | | 8-6-92 |
| RL Program/Project | [X] | [] | M.S. COLLINS | | 4 Aug 92 |
| Publication Services | [] | [] | | | |
| Other Program/Project | [] | [] | | | |

Information conforms to all applicable requirements. The above information is certified to be correct.

| | Yes | No |
|---|---|---|
| References Available to Intended Audience | [X] | [] |
| Transmit to DOE-HQ/Office of Scientific and Technical Information | [] | [X] |

Author/Requestor (Printed/Signature) Date
EG ERPENBECK / EG Erpenbeck 6/15/92

Intended Audience
[] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature) Date
SR BRIGGS SR Briggs 6/15/92

**INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP**

Stamp is required before release. Release is contingent upon resolution of mandatory comments.

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
CW
Date 8-6-92

Date Cancelled

Date Disapproved

BD-7600-062 (08/91) WEF074

Part 1

WHC-S-045, REV 1
H-2-131573 THROUGH H-2-131593
ID Number

| Lead Author | Phone | MSIN | Other Author(s) or Requestor |
|---|---|---|---|
| EG ERPENBECK | 6-8032 | G6-47 | GOLDER ASSOCIATES INC. |
| Project or Program: W-025 | Lead Org Code: 24950 | | Sponsor Agency (DOE, DOT, NRC, USGS, etc.) |
| Editor | Phone | MSIN | DOE/HQ Program (DP, EH, EM, NE, etc.) |

| Mandatory Comments (Only mandatory comments are to be documented. All other comments should be made on a copy of the information submitted for review and returned to the author.) | Reviewer Name & Signature | Date | Resolution | Reviewer Name & Signature | Date |
|---|---|---|---|---|---|
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Legends/Notices/Markings (required per WHC-CM-3-4 or guidance organization.) (Reviewer initials)

| | Affix Yes | Affix No | | Affix Yes | Affix No |
|---|---|---|---|---|---|
| Applied Technology | [ ] | [ ] | Predecisional Information | [ ] | [ ] |
| Business-Sensitive Information | [ ] | [ ] | Programmatic Notice | | |
| Computer Software Notice | [ ] | [ ] | Proprietary Information | [ ] | [ ] |
| Copyright License Notice | [ ] | [ ] | Purpose and Use | [ ] | X |
| Export Controlled Information | [ ] | [ ] | Thesis/Dissertation | [ ] | [ ] |
| Legal Disclaimer | [ ] | X | Trademark Disclaimer | [ ] | [ ] |
| Limited Disclosure | [ ] | [ ] | Unclassified Controlled Nuclear Information/Official Use Only | [ ] | [ ] |
| Patent Status | [ ] | X | | | |

Responsible Manager (Printed/Signature)

Additional Information

BD-7600-062 (08/91) WEF074

Part 2

IPF/CPF #0 **ENGINEERING CHANGE NOTICE**

Page 1 of 3

1. ECN 164934

Proj. ECN

| | | | | | |
|---|---|---|---|---|---|
| 2. ECN Category (mark one) | Supplemental [] | Change ECN [] | Supersedure [] |
| Cancel/Void [] | Direct Revision [X] | Temporary [] | Discovery [] |

| | | |
|---|---|---|
| 3. Originator's Name, Organization, MSIN, and Telephone No.<br>EG ERPENBECK, SWP, 24950, G6-47, 6-8032 | | 4. Date<br>JUNE 15, 1992 |
| 5. Project Title/No./Work Order No. ML6EG<br>RMW LAND DISPOSAL FACILITY/W-025 | 6. Bldg./Sys./Fac. No.<br>218-W-5/200W | 7. Impact Level<br>3 E |
| 8. Document Number Affected (include rev. and sheet no.)<br>WHC-S-045 AND DRWG H-2-131573 THROUGH H-2-131593, Rev. 0 | 9. Related ECN No(s).<br>133177 | 10. Related PO No.<br>N/A |

| 11a. Modification Work | 11b. Work Package Doc. No. | 11c. Complete Installation Work | 11d. Complete Restoration (Temp. ECN only) |
|---|---|---|---|
| [] Yes (fill out Blk. 11b)<br>[X] No (NA Blks. 11b, 11c, 11d) | N/A | N/A<br>Cog. Engineer Signature & Date | N/A<br>Cog. Engineer Signature & Date |

12. Description of Change

THIS ECN AFFECTS THE FOLLOWING DOCUMENTS: H-2-131573 through H-2-131593 and WHC-S-045.

WHC-S-045 and Drawings H-2-131573 through H-2-131593 have been revised due to the increase in the operating life of the RMW Facility from 2 years to 20 years. Major changes include:

- Increasing thickness of operations layer from 2 feet to 3 feet
- Adding a 1.5 foot thick admix liner
- Changing from polyester geotextiles to polypropylene

} As detailed in WHC-SD-W025-PD-001 REV 0

Existing hold points HLD-W025-001 and HLD-W025-002 shall be removed from the drawings and the specification.

In WHC-S-045, the Division I section has been removed from the original version of the specification. Division I will be part of the bid package and will be subjected to WHC approval upon issuance of bid package in accordance with KEH memorandum PCB-91-197.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13a. Justification (mark one) | | Criteria Change | [X] | Environmental | [] | Facilitate Const. | [] |
| Design Error/Omission | [] | Design Improvement | [] | As-Found | [] | Const. Error/Omission | [] |

13b. Justification Details

See ECN 133177 and PGB-91-197 and Change Requests SLW-92-002, SLW-92-037 and SLW-92-087.

14. Distribution (include name, MSIN, and no. of copies)

| | | | |
|---|---|---|---|
| EG ERPENBECK ½ size | G6-47 (2) | JR MORTON | E2-30 |
| JR MCGEE | G6-47 | PG BEAUDET | E2-30 |
| KD JOHNSON | E1-01 | MS COLLINS | A5-18 |
| GC EVANS | H4-57 | AG PINES | R3-20 |
| AV LINCOLN | S2-62 | MD AICHELE | T4-01 |
| DB POWELL | T3-02 | PROJECT FILES | R1-28 |
| GH SAITO | N1-83 | (see attached) | |

RELEASE STAMP

OFFICIAL RELEASE BY WHC (3)
DATE AUG 21 1992
Sta. 21

A-7900-013-2 (11/88) (EF) GEF095

# ENGINEERING CHANGE NOTICE

Page 2 of 3

1. ECN (use no. from pg. 1) 164934

| 15. Design Verification Required | 16. Cost Impact | | 17. Schedule Impact (days) |
|---|---|---|---|
| [X] Yes | ENGINEERING | CONSTRUCTION | |
| [] No | Additional [] $ | Additional [] $ | Improvement [] |
| | Savings [] $ | Savings [] $ | Delay [] |

N/A

N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

| | | | | | |
|---|---|---|---|---|---|
| SDD/DD | [] | Seismic/Stress Analysis | [] | Tank Calibration Manual | [] |
| Functional Design Criteria | [] | Stress/Design Report | [] | Health Physics Procedure | [] |
| Operating Specification | [] | Interface Control Drawing | [] | Spares Multiple Unit Listing | [] |
| Criticality Specification | [] | Calibration Procedure | [] | Test Procedures/Specification | [] |
| Conceptual Design Report | [] | Installation Procedure | [] | Component Index | [] |
| Equipment Spec. | [] | Maintenance Procedure | [] | ASME Coded Item | [] |
| Const. Spec. | [] | Engineering Procedure | [] | Human Factor Consideration | [] |
| Procurement Spec. | [] | Operating Instruction | [] | Computer Software | [] |
| Vendor Information | [] | Operating Procedure | [] | Electric Circuit Schedule | [] |
| OM Manual | [] | Operational Safety Requirement | [] | ICRS Procedure | [] |
| FSAR/SAR | [] | IEFD Drawing | [] | Process Control Manual/Plan | [] |
| Safety Equipment List | [] | Cell Arrangement Drawing | [] | Process Flow Chart | [] |
| Radiation Work Permit | [] | Essential Material Specification | [] | Purchase Requisition | [] |
| Environmental Impact Statement | [] | Fac. Proc. Samp. Schedule | [] | | [] |
| Environmental Report | [] | Inspection Plan | [] | | [] |
| Environmental Permit | [] | Inventory Adjustment Request | [] | | [] |

N/A

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

| Document Number/Revision | Document Number/Revision | Document Number Revision |
|---|---|---|
| | N/A | |

20. Approvals

| | Signature | Date | | Signature | Date |
|---|---|---|---|---|---|
| OPERATIONS AND ENGINEERING | | | ARCHITECT-ENGINEER | | |
| Cog./Project Engineer | [illegible] | 6/15/92 | PE | | |
| Cog./Project Engr. Mgr. | [illegible] | 6/15/92 | QA | | |
| QA | [illegible] | 7/2/92 | Safety | | |
| Safety | [illegible] | 7-10-92 | Design | | |
| Security | | | Other | | |
| ~~Proj.~~ Prog. ~~Dept.~~ Mgr. | [illegible] | 7/31/92 | | | |
| Def. React. Div. | | | | | |
| Chem. Proc. Div. | | | | | |
| Def. Wst. Mgmt. Div. | | | DEPARTMENT OF ENERGY | | |
| Adv. React. Dev. Div. | | | H.S. COLLINS | [illegible] | 4 Aug 92 |
| Proj. Dept. | | | | | |
| Environ. Div. | [illegible] | 29-92 | ADDITIONAL | | |
| IRM Dept. | | | | | |
| Facility Rep. (Ops.) | | | | | |
| Other ENVIRON ASSURANCE | [illegible] | 7/14/92 | | | |
| ELECTRICAL UTILITIES | [illegible] | 8/3/92 | | | |

**ENGINEERING CHANGE NOTICE CONTINUATION SHEET**



1. ECN 164934

GENERAL REVISION TO THE FOLLOWING DRAWINGS & SPECIFICATIONS:

H-2-131573, "COVER SHEET," REV 0, SHEET 1 OF 1
H-2-131574, "SITE PLAN AND EXPLORATIONS," REV 0, SHEET 1 OF 1
H-2-131575, "GRADING PLAN," REV 0, SHEET 1 OF 1
H-2-131576, "SECONDARY ADMIX CONTOURS," REV 0, SHEET 1 OF 1
H-2-131577, "OPERATIONS LAYER CONTOURS," REV 0, SHEET 1 OF 1
H-2-131578, "CROSS-SECTIONS," REV 0, SHEET 1 OF 1
H-2-131579, "LINER SYSTEM DETAILS," REV 0, SHEET 1 OF 1
H-2-131580, "SUMP LAYOUT," REV 0, SHEET 1 OF 1
H-2-131581, "SUMP CROSS-SECTIONS," REV 0, SHEET 1 OF 1
H-2-131582, "SUMP LEACHATE COLLECTION PIPES," REV 0, SHEET 1 OF 1
H-2-131583, "SIDE SLOPE AND VERTICAL RISER PIPES," REV 0, SHEET 1 OF 1
H-2-131584, "TRUCK STAGING AREA AND ACCESS RAMP," REV 0, SHEET 1 OF 1
H-2-131585, "LEACHATE COLLECTION TANK AND PIPING," REV 0, SHEET 1 OF 1
H-2-131586, "SUMP PUMP DETAILS," REV 0, SHEET 1 OF 1
H-2-131587, "ELECTRICAL," REV 0, SHEET 1 OF 4, Sh. 2 of 4, Sh. 3 of 4, Sh. 4 of 4
H-2-131588, "CONCEPTUAL FILL PLAN," REV 0, SHEET 1 OF 1
H-2-131589, "SUBGRADE GRID POINTS," REV 0, SHEET 1 OF 1
H-2-131590, "SECONDARY ADMIX GRID POINTS," REV 0, SHEET 1 OF 1
H-2-131591, "SECONDARY DRAINAGE GRAVEL GRID POINTS," REV 0, SHEET 1 OF 1
H-2-131592, "PRIMARY DRAINAGE GRAVEL GRID POINTS," REV 0, SHEET 1 OF 1
H-2-131593, "OPERATIONS LAYER GRID POINTS," REV 0, SHEET 1 OF 1
WHC-S-045, "MATERIALS SPECIFICATIONS AND CONSTRUCTION REQUIREMENTS," REV 0

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Westinghouse
Hanford Company

P.O. Box 1970
Richland, Washington 99352

WHC-S-045

Revision No. 1

Total Pages ~~239~~ 241

Hanford Operations and Engineering Contractor
for the U.S. Department of Energy
under Contract No. DE-AC06-87RL10930.

# SPECIFICATION FOR

RADIOACTIVE MIXED WASTE DISPOSAL FACILITY

System No.

Equipment No.

Building: 218- W5 Burial Ground

Project: W-025

Impact Level: 3E

OFFICIAL RELEASE BY WHC
DATE AUG 21 1992
Sta. 21

Prepared By:

Golder Associates Inc.

Approved By:

| | | Date |
|---|---|---|
| S. R. Briggs | SR Briggs | 8/7/92 |
| E. G. Erpenbeck | Edward G. Erpenbeck | 8/7/92 |

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| RECORD OF REVISION | (1) Document Number<br>WHC-S-045<br>~~H-2-131575~~<br>~~THROUGH~~<br>~~H-2-131593~~ | Page<br>1 |
|---|---|---|

(2) Title

DESIGN DRAWINGS AND THE MATERIAL SPECIFICATION AND CONSTRUCTION REQUIREMENTS FOR THE RMW LAND DISPOSAL FACILITY

CHANGE CONTROL RECORD

| (3) Revision | (4) Description of Change - Replace, Add, and Delete Pages<br>EDT-151914 05/21/90 | Authorized for Release<br>(5) Cog. Engr. | (6) Cog. Mgr. Date |
|---|---|---|---|
| 0 | | | |
| 1 RS | (7) Changes due to increasing the operating life of the facility from 2 to 20 years have been incorporated. EDT 151914 released the original REV 0 on May 21, 1990.<br>Inc. ECN-164934 | G.B. Carpenter 6/15/92 | L.R. Bing 6/15/92 |
| | | | |

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WHC-S-045

# MATERIAL SPECIFICATIONS AND CONSTRUCTION REQUIREMENTS FOR THE

# RADIOACTIVE MIXED WASTE LAND DISPOSAL FACILITY NON-DRAG-OFF

PROJECT W-025

REVISION 1

PREPARED FOR THE

U.S. DEPARTMENT OF ENERGY-RICHLAND OPERATIONS OFFICE
CONTRACT NO. DE-AC06-89RL11615

BY

GOLDER ASSOCIATES INC.
SEATTLE (REDMOND), WASHINGTON

Approval:

| | |
|---|---|
| Project Director | 6/26/92 Date |
| Project Manager | 6-26-92 Date |
| QA Manager | 6-26-92 Date |
| Westinghouse Hanford Company | 7-8-92 Date |
| DOE-RL | 4 Aug 92 Date |

923-1030

June 23, 1992

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WESTINGHOUSE HANFORD COMPANY
RADIOACTIVE MIXED WASTE
LAND DISPOSAL FACILITY
NON-DRAG-OFF
TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 0 BIDDING AND CONTRACT REQUIREMENTS

** BY OTHERS **

DIVISION 1 GENERAL REQUIREMENTS

DIVISION 2 SITE WORK

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02222 Trench Backfilling and Grading
02224 Admix Production, Placement, Compaction and Trimming
02226 Granular Drainage Layer
02228 Operations Layer
02275 Geosynthetics
02511 Truck Unloading Area Surfacing
02720 Drainage Facilities
02725 HDPE Pipe
02727 Vertical Riser Pipe

DIVISION 3 CONCRETE

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03210 Reinforcing Steel
03310 Structural Concrete

DIVISION 5 METALS

05500 Metal Fabrications

DIVISION 8 DOORS AND WINDOWS

08100 Metal Doors and Frames

DIVISION 9 FINISHES

09900 Paint Coating Systems

DIVISION 11 EQUIPMENT

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DIVISION 13 SPECIAL CONSTRUCTION

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16100 Basic Materials and Methods
16110 Raceways
16120 Conductors and Terminations Copper Only
16130 Outlet, Junction and Pull Boxes
16140 Switches and Receptacles
16160 Motor Controllers
16400 Overhead Service
16450 Grounding
16460 Dry Type Transformers
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16500 Lighting
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APPENDIX A

Grid Point Listing

# SECTION 02220
# GENERAL EXCAVATION AND BACKFILL

## PART 1: GENERAL

### 1-1 DESCRIPTION

This section describes the general requirements for clearing, grubbing, excavation, and backfill. For Trench Backfill and Grading, see Section 02222.

### 1-2 SUBMITTALS

An earthwork operations plan and schedule shall be submitted to the Construction Manager in accordance with Section 01300. All trenching and shoring operations shall be conducted in accordance with applicable Washington State and Federal government laws and regulations. Contractor shall submit trenching and shoring plans to the Construction Manager for approval prior to beginning these operations.

### 1-3 TOLERANCES

Tolerances for excavation or backfill grades are shown on the Drawings or are defined in the sections of these Specifications dealing with the individual materials.

### 1-4 QUALITY ASSURANCE

A. Testing will be provided by the CQA Engineer and will be performed in accordance with the CQA Plan.

B. Reference Standards and Documents:

1. American Society for Testing and Materials (ASTM) most current versions:

   a. ASTM D422 - Method for Particle-Size Analysis of Soils.

   b. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

   c. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.

   d. ASTM D2167 - Test Method for Density and Unit Weight of Soil In-Place by the Rubber Balloon Method.

e. ASTM D2487 - Classification of Soils for Engineering Purposes.

f. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

g. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

2. Construction Quality Assurance Plan for Project W-025, Radioactive Mixed Waste (RMW) Land Disposal Facility, Non-Drag-Off, WHC-SD-W025-PLN-001, most current revision, Westinghouse Hanford Company, Richland, Washington.

PART 2: PRODUCTS

2-1 BACKFILL

A. Soils shall be derived from approved on-site sources with following USCS classifications: GM, GP, GC, SW, SM, SP, and SC, or as approved by Owner or COTR. On-site sources shall be identified by Owner or COTR.

B. Soils shall be free of roots, wood, peat, cinders, frozen material, rubbish, or other deleterious material. Soils shall have a maximum particle size of 4 inches. Soils shall be capable of being moisture conditioned and compactable to minimum specified densities.

2-2 ROADWAY TOP COURSE

For perimeter roadway and truck parking areas, use TOP COURSE material. TOP COURSE material shall meet the requirements of the 1991 WSDOT Standard Specifications for Road, Bridge and Municipal Construction, Section 9-03.9(3): Crushed Surfacing.

PART 3: EXECUTION

3-1 CLEARING AND GRUBBING

All areas to be excavated, backfilled, or used for stockpiles shall be stripped of vegetation. Material collected during the clearing and grubbing operation shall be stockpiled at a location determined by the Construction Manager.

## 3-2 EXCAVATION

A. General

1. Excavate to elevations and dimensions necessary to complete construction. Excavation methods shall be consistent with soil types encountered and shall result in undisturbed foundation subgrade.

2. The entire surface of the subgrade to a minimum depth of 8 inches shall be moisture conditioned and compacted to 90 percent of ASTM D1557 prior to trimming.

3. Grade final surfaces to lines and elevations shown on site grading drawing.

4. Place excavated material in separate stockpiles for Eolian Sand and sandy gravel/gravelly sand. Maintain stockpiles in free-draining condition.

5. Final excavation surfaces shall be free of loose material, clods, and other debris including grade stakes and hubs.

6. Dewatering:

   a. Keep construction site free-draining.

   b. Contractor shall remove water from construction area regardless of source unless Construction Manager approves otherwise.

7. Upon completion of excavation, notify Construction Manager before proceeding with further work.

8. The CQA Engineer shall classify all excavated materials during excavation.

B. Silty Sand (Eolian Sand) Excavation

1. The Silty Sand (Eolian Sand) encountered in the excavation shall be stockpiled for reuse as admix material or as general fill.

C. Sandy Gravel to Gravely Sand Excavation

1. The Sandy Gravel to Gravely Sand encountered in the excavation shall be stockpiled for later use as roadway surfacing material or as wind erosion resistant material to cover stockpiles.

3-3 STOCKPILE

A. Stockpile excavated material on designated stockpile site. The sandy gravel to gravely sand shall be spread over the entire stockpile area including slopes to resist wind erosion. Place no material where trenches for sewers, water lines, or other utilities will be located.

B. Place excavated material not suitable for backfilling, admix, or other uses and other unsuitable materials in spoil areas designated by the Construction Manager and grade to drain. The CQA Engineer shall designate unsuitable materials.

3-4 SUBGRADE PREPARATION IN STOCKPILE AREAS

A. Remove all existing vegetation within areas of stockpile.

3-5 SUBGRADE PREPARATION IN BACKFILL AREAS

A. Remove and replace or compact natural soils or compacted fill softened by frost, flooding, or weather.

B. Scarify top 6 to 8 inches of natural subgrade, moisture condition, and compact to moisture content and minimum density specified herein.

3-6 BACKFILL (except trenches)

A. Notify Construction Manager 48 hours before placing fill material.

B. Place fill in accordance with procedures required to achieve specified density.

C. Hauling and spreading equipment will not be considered as compaction equipment.

D. Place backfill in maximum 8-inch uncompacted lift thickness, moisture condition as necessary, and compact to achieve a density of at least 90 percent of Modified Proctor density (ASTM D1557). Contractor shall be responsible for maintaining proper lift thickness to achieve compaction as stated above.

E. Grade final surfaces to lines and elevations shown on construction drawings.

F. Matèrial not meeting specified density shall be evaluated by the Contractor and CQA Engineer to determine what additional steps will be taken to meet these Specifications. Alternatively, this material shall be removed.

## 3-7 ROADWAY TOP COURSE

Prepare perimeter road subgrade in conformance with Sections 3-1 and 3-2 in cut areas and Sections 3-1 and 3-5 in fill areas. Place roadway top course in conformance with Section 02511 Part 3-1 to the limits of the perimeter road shown on the drawings and compact to a minimum of 95 percent of Modified Proctor Density (ASTM D1557).

- END -

# SECTION 02222
# TRENCHING AND BACKFILLING

## PART 1: GENERAL

### 1-1 DESCRIPTION

This section describes the requirements for trench excavation and backfilling.

### 1-2 SUBMITTALS

An earthwork operations plan and schedule shall be submitted to the Construction Manager in accordance with Section 01300. All trenching and shoring operations shall be conducted in accordance with applicable Washington State and Federal government laws and regulations. Contractor shall submit trenching and shoring plans to the Construction Manager for approval prior to beginning these operations.

### 1-3 QUALITY ASSURANCE

A. Testing will be provided by the CQA Engineer and will be performed in accordance with the CQA Plan.

B. Reference Standards and Documents:

1. American Society for Testing and Materials (ASTM) most current versions:

a. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.

b. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

### 1-4 TOLERANCES

Tolerances for the excavation of trenches and backfilling are shown on the Drawings or are listed below.

A. Excavation of side slope riser trench in the subgrade shall be within 0.00 to -0.30 feet of dimensions on Drawings.

B. Excavation of the side slope riser trench in the admix liner shall be within 0.00 to +0.30 feet of the design dimensions.

C. Excavation of the geosynthetics anchor trench on the access road shall be within 0.00 to +0.30 feet of the design dimension.

D. Excavation of the geosynthetics anchor trench at the crest of the landfill side slopes shall be within ±0.20 feet of the design dimensions.

PART 2: PRODUCTS

2-1 GENERAL BACKFILL

General backfill shall conform to the requirements of Section 02220, Part 2-1.

2-2 DRAINAGE GRAVEL

Drainage gravel shall conform to the requirements of Section 02226, Part 2-1.

2-3 SAND

Sand for backfill of secondary side slope riser pipe trench shall meet the requirements of general backfill, Section 02220 Part 2-1, except that the maximum particle size shall be 1 inch.

2-4 ADMIX

Admix shall conform to requirements of Section 02224.

2-5 TRENCH BACKFILL SCHEDULE

A. Conform to the following schedule.

| Item | Material | Compaction Requirements/Procedures |
|---|---|---|
| Sumps | Drainage Gravel | Track Walked |
| Secondary Side Slope Trench | Sand | Hand Compacted |
| Secondary Side Slope Trench (Plug) | Admix | Hand Compacted |
| Anchor Trenches | General Backfill | Rubber Tire Compaction with Moisture Conditioning |
| Other Trenches | General Backfill | 90% Modified Proctor Density |

B. Unsuitable Materials: Topsoil, peat, frozen material, organic soils, and materials containing slag, cinders, foundry sand, debris, and/or rubble, or soil with less than required bearing capacity as determined by the Design Engineer.

## PART 3: EXECUTION

### 3-1 GENERAL

A. Perform operations in manner to prevent damage to adjacent synthetic materials or in-place leachate collection system riser pipes. Contractor shall repair or replace materials damaged during backfilling operations to requirements of the Specifications and Drawings.

B. Remove and replace or compact natural soils or compacted fills softened by frost, flooding, or weather as directed by Construction Manager.

C. Remove unsuitable material from within trenches.

D. Dewatering:

1. Keep construction site free draining.

2. Keep excavations free from water.

3. Protect adjacent properties from damage resulting from dewatering operations.

### 3-2 TRENCHING

A. Excavate to elevations and dimensions necessary to complete construction and as shown on the Drawings.

B. Do not excavate within influence zone of existing footings or foundations without prior approval of Construction Manager.

C. Upon completion of excavation, notify Construction Manager before proceeding with further work.

## 3-3 TRENCH AND SUMP BACKFILLING AND GRADING

A. Materials shall be placed in trenches and/or sumps by mechanical or hand methods that will not damage the pipes or underlying geosynthetic or soil liners.

B. Backfill materials shall be placed and compacted in accordance with the procedures listed in Part 2-5.

C. Backfill shall be graded to the tolerances shown on the Drawings.

## 3-4 BACKFILLING ANCHOR TRENCHES

A. Notify Construction Manager before placing backfill material.

B. Do not use frozen material or place backfill on frozen subgrade or in standing water.

C. Place backfill in maximum 6-inch thick lifts after compaction.

D. Place and compact backfill in accordance with the requirements of Part 2-5.

- END -

# SECTION 02224
# ADMIX PRODUCTION, PLACEMENT COMPACTION, AND TRIMMING

## PART 1: GENERAL

### 1-1 DESCRIPTION

A. Admix consists of bentonite enriched soil which is mixed, moisture conditioned, placed, compacted, and trimmed to form the soil liner for the W-025 landfill.

B. This section describes the requirements for the production, placement, and trimming of admix to form the soil liner for the W-025 Landfill.

### 1-2 SUBMITTALS

A. The Contractor shall submit a detailed plan for preparation of the admix material, including a description of the equipment and procedures to be used, personnel qualifications, and methods for monitoring bentonite additions and moisture conditioning. This plan shall be approved by the COTR prior to the start of admix production.

B. The Contractor shall submit a soil liner placement plan to specify lift thickness control and to allow for required testing, listed below and described in Section 4.3.2 of CQA Plan, on the soil liner during placement operations. This plan shall be approved by the Construction Manager prior to the start of admix placement.

C. An overall earthworks operations plan and schedule shall be submitted to the Construction Manager in accordance with Section 01300. All trenching and shoring operations shall be conducted in accordance with applicable Washington State and Federal government laws and regulations. The Contractor shall submit trenching and shoring plans to the Construction Manager for approval prior to beginning these operations.

### 1-3 QUALITY ASSURANCE

A. Testing will be provided by the CQA Engineer and shall be performed in accordance with the CQA Plan. The Contractor shall make allowances for sampling and testing by the CQA Engineer in both his production operations and schedule.

B. Reference Standards and Documents

1. American Society for Testing and Materials (ASTM) most current versions:

a. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.

b. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

c. ASTM D2167 - Test Method for Density and Unit Weight of Soil In-Place by the Rubber Balloon Method.

d. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.

e. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

f. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

g. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

h. ASTM D5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

## 1-4 TOLERANCES

A. Grading tolerances for the compacted admix are shown on design Drawings.

B. Minimum required thicknesses of admix layers shall be maintained. The as-built elevations of immediately underlying layers shall be used as the basis for determining final elevations of admix layers.

# PART 2: PRODUCTS

## 2-1 ADMIX STOCKPILE

A. The admix stockpile shall consist of a sufficient quantity of prepared admix to place the entire soil liner for the W-025 facility, including material lost during placement, material that cannot be recovered at the base of the stockpile, and any unsuitable materials. Prepared admix shall be moisture conditioned as described in Section 3-2.

B. The stockpile of admix material shall be prepared and all testing completed in accordance with the CQA Plan prior to the placement of the material in the facility.

2-2 BENTONITE

A. The bentonite to be used in the admix shall consist of a commercially prepared material meeting the requirements of American Petroleum Institute (API) Specification 13A, Section 4, with a minimum yield of 91 barrels. Acceptable products include Bara-Kade 90™ manufactured by Bentonite Corporation or other products having equivalent or superior characteristics, as approved by the COTR.

2-3 SOIL LINER MATERIAL

A. The admix shall consist of the excavated silty sand (Eolian Deposit) with a nominal bentonite content of 12 percent by dry weight. The acceptable range for bentonite content shall be a minimum of 11 percent and maximum of 14 percent by dry weight. It is the intent, that when the admix is mixed uniformly and placed according to the specifications, it will be capable of achieving a permeability of $1x10^{-7}$ cm/sec or less and have a USCS classification of ML, CL, CH, or SC.

B. The admix shall be prepared by the Contractor and tested by the CQA Engineer in compliance with the CQA Plan. The Contractor shall make the admix stockpiles available to the CQA Engineer at all times for sampling, testing, or visual observation.

C. The admix shall be free of roots, woody vegetation, rocks greater than 1 inch in diameter, frozen material, rubbish, and other deleterious material.

D. The admix shall be a uniform homogenous material.

E. The admix shall be prepared at a moisture content of 1 to 5 percent above optimum.

PART 3: EXECUTION

3-1 ADMIX PREPARATION

A. Admix shall be prepared using a pugmill with the following characteristics and ancillary equipment:

1. Aran ASR 280E continuous mixing plant or approved equal. Production capability of 300 tons per hour.

2. Belt scales on soil, bentonite, and finished product belts.

3. Feed rate meters and totalizers for bentonite, aggregate, and water.

4. Production rate meters and totalizers for finished product.

5. Variable speed hydraulic supply water pump.

6. All measuring equipment shall be calibrated and results provided to the Construction Manager prior to starting admix production.

B. Pugmill operator shall have completed three similar projects with a minimum of 50,000 tons of acceptable amended soil on each project.

C. The Contractor shall provide all necessary equipment and labor to load material into pugmill, to off load admix, and to stockpile admix.

D. The Contractor shall provide suitable containers on site to store bentonite in a dry condition prior to use.

E. Admix that does not meet specification shall not be reused as feed stock unless approved by the Construction Manager.

F. The Contractor shall provide all equipment, materials, and personnel for testing, on an ongoing basis, during admix production to demonstrate to the satisfaction of the Construction Manager and CQA Engineer that the admix meets the requirements of these specifications.

## 3-2 MOISTURE CONDITIONING

A. If necessary, stockpiled prepared-admix shall be moisture conditioned to 1 to 5 percent over optimum moisture content at least 24 hours prior to placement in the landfill.

B. The optimum moisture content and the mixed moisture content shall be determined by the CQA Engineer during pre-construction testing as specified in the CQA Plan.

C. The moisture content of the material shall be uniform and homogenous. If dry zones are encountered within the admix, they shall be moisture conditioned and mixed with the surrounding material.

## 3-3 TESTFILL

A. A testfill shall be constructed by the Contractor to determine acceptable placement and compaction methods. The testfill shall be constructed in accordance with the requirements listed in the CQA Plan.

B. The testfill shall be constructed by the Contractor. All testing will be conducted by the CQA Engineer. The testfill shall be constructed and all testing except long-term permeability tests completed prior to the start of actual construction.

C. The location of the testfill will be designated by the COTR or Construction Manager. After all testing is completed and approved for the testfill, the material can be used by the Contractor for construction of the W-025 Landfill provided that the material is moisture conditioned as described in Section 3-2.

## 3-4 SUBGRADE PREPARATION (Secondary Admix Only)

A. The top 8 inches of the excavated subgrade surface shall be recompacted to at least of 90 percent of the maximum dry density as determined by the Modified Proctor density test (ASTM D1557).

B. The surface of the subgrade shall be graded to lines, grades, and tolerances shown on the Drawings.

## 3-5 PLACEMENT AND COMPACTION

A. The admix material shall be placed in maximum 10 inch loose lifts and compacted such that the compacted lift thickness is 6 inches or less. However, the first lift of primary admix placed over geosynthetic materials shall be sufficiently thick that the compacted lift thickness is 12 inches ± 2 inches. The Contractor shall be responsible for preventing damage to the underlying materials when placing the primary admix layer.

B. The admix shall be compacted to at least 90 percent of the maximum dry density as determined by the Standard Proctor density test (ASTM D698) at a moisture content of between 1 to 5 percent over the optimum moisture content.

C. The in-place compacted admix liner shall achieve a permeability of $1 \times 10^{-7}$ cm/sec or less.

E. The compacted admix distribution and gradation throughout the liner shall be free from lenses, pockets, streaks, layers, or material differing substantially in texture or gradation from surrounding material.

F. The moisture content of the admix shall be uniform throughout each lift prior to and during compaction of the material. The Contractor shall be responsible for meeting moisture content, compaction, and bentonite concentration specifications. If the admix cannot be conditioned to meet the placement specifications, the material shall be removed and replaced with new admix.

G. The Contractor shall place layers of admix to form a continuous monolithic material. If the moisture content of a lift of compacted admix falls below the acceptable limit during placement operations, the Contractor shall moisture condition the dry soil and recompact the lift prior to placement of additional lifts. If the moisture content of a lift of compacted admix exceeds the acceptable limit due to precipitation or over watering, the Contractor shall allow the wet soil to dry back before placement of additional lifts.

H. All admix shall be placed and compacted with a self-propelled pegfoot or padfoot roller compactor having a minimum operating weight of 40,000 pounds, such as a Caterpillar 815B or 825C Compactor or equal. Hauling and spreading equipment will not be considered as compaction equipment. The compactor feet shall be sufficiently long to knead (bond) new lifts into previously placed lifts. If necessary, the Construction Manager may direct that the top of each lift be scarified with suitable equipment prior to placing the next lift.

I. Production, mixing, and stockpiling of admix will not be allowed within the W-025 Landfill.

J. Admix may be placed on the side slopes in either horizontal lifts (along the contour) or in lifts parallel to the slope (up and down the slope). If admix is placed parallel to the slope, compaction equipment shall not spin their wheels or in any other way disturb the previously placed lifts. If this occurs, the Contractor shall place all of the admix in horizontal lifts.

## 3-6 TRIMMING

A. The surface of the admix shall be trimmed to the design grades and tolerances as shown on the Drawings. The surface of the admix shall be rolled with a smooth drum roller to remove all ridges and surface irregularities. The CQA Engineer shall determine if the surface preparation meets the acceptance criteria below and if it is sufficient to place the geomembrane.

B. All wheel ruts on the surface of the admix liner from grading equipment shall be repaired by the earthworks Contractor prior to placement of the geomembrane. Methods for repair of the admix are specified in Part 3-7. Alternative methods for repair of the admix liner will be allowed if submitted by the Contractor and approved by the COTR.

C. The Contractor shall maintain the admix liner surface in a condition suitable for geomembrane installation until the surface is covered. Desiccation cracks larger than 0.1 feet deep or 0.25 inches wide shall be excavated to the full depth of the crack and repaired.

## 3-7 REPAIR OF ADMIX LINER

A. The Contractor shall repair the surface of any areas identified by the CQA Engineer to be out of tolerance as follows:

- Remove admix that does not meet specifications.
- Scarify surface and spray with water.
- Place additional approved admix.
- Compact admix with self-propelled pegfoot or padfoot type compactor as described in Part 3-5.
- Trim surface, as described in Part 3-6, to design grades and tolerances.

B. CQA Personnel will repair small holes resulting from sampling and other CQA activities.

- END -

# SECTION 02226
# GRANULAR DRAINAGE LAYERS

## PART 1: GENERAL

### 1-1 DESCRIPTION

This section describes the requirements for placement of granular drainage layers associated with construction of the W-025 Landfill.

### 1-2 SUBMITTALS

An earthwork operations plan and schedule shall be submitted to the Construction Manager in accordance with Section 01300. Submit gravel samples prior to full scale production for testing by CQA Engineer in accordance with CQA Plan.

### 1-3 QUALITY ASSURANCE

A. Manufacture and installation of the drainage layer materials shall be in accordance with the CQA Plan. The Contractor shall make allowances for sampling and testing by the CQA Engineer in both the operations plan and schedule.

### 1-4 TOLERANCES

A. Grading tolerances for the granular drainage layers are shown on the design Drawings.

B. Minimum required thicknesses of granular drainage layers shall be maintained. The as-built elevations of immediately underlying soil layers shall be used as the basis for determining final elevations of granular drainage layers.

## PART 2: PRODUCTS

### 2-1 DRAINAGE LAYER GRAVEL (PRIMARY AND SECONDARY)

Gravel shall consist of rounded material that is mechanically stable and chemically inert. In general, hard rock types such as basalt and granite are preferred; siltstones, mudstones, and carbonate rocks are not acceptable.

A. Drainage layer material shall consist of rounded washed gravel meeting the following gradation requirements.

| U.S. Sieve Size | % Passing |
|---|---|
| 3/4 in. | 100 |
| 3/8 in. | 80-100 |
| No. 4 | 20-85 |
| No. 40 | 0-10 |
| No. 100 | 0-5 |
| No. 200 | 0-5 |

B. Material shall exhibit a permeability of $1x10^{-2}$ cm/sec or greater.

2-2 SUMP GRAVEL

A. Sump gravel shall be rounded washed gravel meeting the following gradation requirements.

1. Washington DOT standard specification 9-03.12(4).

| U.S. Sieve Size | % Passing |
|---|---|
| 1 in. | 100 |
| 3/4 in. | 80-100 |
| 3/8 in. | 10-40 |
| No. 4 | 0-4 |
| No. 40 | 0-4 |
| No. 200 | 0-2 |

B. Material shall exhibit a permeability of $1x10^{-2}$ cm/sec or greater.

PART 3: EXECUTION

3-1 PLACEMENT OF GRANULAR DRAINAGE GRAVEL AND SUMP GRAVEL

A. Place over secondary and primary geosynthetic materials across base of landfill and in sumps as shown on Drawings.

B. Spread granular layers with low ground pressure dozer or tracked vehicle.

C. Protect leachate collection well, side slope riser pipes, 4-in. perforated primary drain pipe, and other pipes and structures from mechanical damage.

D. Do not use dozer or other vehicle to compact granular material within 1.5 feet of 4-in. drain pipes. In these locations, compact with a walk-along vibratory roller or power tamper after full thickness of granular material has been placed.

E. Protect primary and secondary geosynthetics from mechanical damage.

F. Hauling and placing equipment shall operate on a minimum of 3 feet of material above any geosynthetic layer. Grading equipment shall operate on no less than 1 foot of material over any geosynthetic layer.

G. The Contractor shall take steps to minimize wrinkle generation in the geosynthetic materials during placement of the drainage layer. The measures may include placing material in the early morning hours when the geosynthetic materials are cool and monitoring and walking out wrinkles in the geosynthetic materials that appear at the face of the placement operations.

H. Conform to requirements of Section 02222, Part 2-5.

- END -

# SECTION 02228
# OPERATIONS LAYER

## PART 1: GENERAL

### 1-1 DESCRIPTION

This section describes the requirements for placement of operations layer associated with construction of the W-025 Landfill.

### 1-2 SUBMITTALS

An earthwork operations plan and schedule shall be submitted to the Construction Manager in accordance with Section 01300. All trenching and shoring operations shall be conducted in accordance with applicable Washington State and Federal government laws and regulations. Contractor shall submit trenching and shoring plans to the Construction Manager for approval prior to beginning these operations.

### 1-3 QUALITY ASSURANCE

A. Manufacture and installation of the operations layer material shall be in accordance with the CQA Plan. The Contractor shall make allowances for sampling and testing by the CQA Engineer in both his production operations and schedule.

### 1-4 TOLERANCES

A. The grading tolerance for the operations layer is shown on the design Drawings.

## PART 2: PRODUCTS

### 2-1 OPERATIONS LAYER MATERIAL

A. Materials shall consist of on-site granular material meeting the requirements for Backfill in Section 02220.

B. Material for side slopes shall have maximum particle size of 1 in.

C. Material for landfill floor shall have maximum particle size of 4 in., provided large particles are in soil matrix.

# PART 3: EXECUTION

## 3-1 PLACEMENT OF OPERATIONS LAYER

### A. General

1. Operations layer shall be placed over geotextile across base areas and on side slopes.

2. Prior to placement of operations layer material, final inspection of geotextile by CQA Engineer will be made to verify that conditions stated in CQA Plan are satisfied.

3. Hauling and placing equipment shall operate on a minimum of 3 feet of material over any geosynthetic layer. Grading equipment shall operate on a minimum of 2 feet of material.

4. Operations layer material placed on the side slopes shall be pushed up from the bottom of the slope. In no case shall material be placed down the slope.

5. The Contractor shall take steps to minimize wrinkle generation in the geosynthetic materials during placement of the operations layer. These measures may include placing material in the early morning hours when the geosynthetic materials are cool and monitoring and walking out wrinkles in the geosynthetic materials that appear at the face of the placement operation.

6. The primary side slope riser pipe and the drainage pipe cleanout pipes shall be installed in trenches excavated in the operations layer after placement. Trenching and backfilling shall be performed in accordance with Section 02222.

- END -

# SECTION 02275
# GEOSYNTHETICS

## PART 1: GENERAL

### 1-1 DESCRIPTION OF WORK

The work includes manufacture, fabrication (if needed), supply, and installation of geomembrane, geonet, geotextile, geocomposite, and flatstock for lining of the waste disposal facility as shown on the Drawings.

### 1-2 CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

A CQA Plan has been prepared as part of the landfill design. The CQA Plan discusses the testing procedures that will be followed by the CQA Engineer during installation of the geosynthetics and the documentation of the process. The CQA Plan is made part of these Specifications by reference. The Contractor shall conform to the requirements of the CQA Plan for all aspects of the geosynthetics including submittals, supply, storage, installation, testing, documentation, covering, and protection.

### 1-3 GEOTEXTILE

Geotextile will be placed on top of the primary drainage gravel in the landfill basin to prevent the overlying operations layer soil from clogging the drainage system. In addition, geotextile will be placed under the primary geomembrane as a cushion to minimize the potential for damage from the drainage gravel. Geotextile will also be placed over the primary and secondary drainage net as a separator between the net and the drainage gravel. Geotextile will be placed under the primary admix layer on the landfill floor to prevent this layer from entering the secondary drainage gravel and sump gravel.

### 1-4 FLEXIBLE MEMBRANE LINERS (FML)

FML is also referred to as HDPE liner or geomembrane. These terms are used interchangeably on the Drawings and in these Specifications. Both the primary and secondary liners will consist of an HDPE geomembrane, which will be used to line the landfill basin and serve as a low permeability barrier for intercepting and concentrating leachate. An HDPE geomembrane will also be used under the truck unloading area and the containment area under the leachate storage tank.

### 1-5 GEONET

Geonet, which allows lateral drainage of leachate above the FML, will be installed above the primary and secondary HDPE liners on the landfill floor.

1-6 GEOCOMPOSITE

Geocomposite consists of geonet with a layer of geotextile thermally bonded to each side. Geocomposite is used on the side slopes of the landfill above the primary and secondary geomembrane.

1-7 SUBMITTALS

A. Manufacturers of the various geosynthetic materials shall submit all required quality assurance and quality control documentation as described in the following sections and the CQA Plan.

B. The Contractor shall submit samples of all proposed geosynthetic materials for "fingerprinting" analyses and conformance testing to determine acceptability. Sampling shall be preformed in accordance with the following sections of this specification and the CQA Plan. Conformance testing will be performed by the CQA Engineer. Acceptability shall be determined by the COTR. Unacceptable materials shall be removed and disposed of at Contractor's expense.

C. The Geosynthetics Installer shall submit a quality assurance program for installation of geosynthetic materials as well as a list of proposed geomembrane seaming personnel and their experience records.

D. All submittals shall conform to the requirements of Section 01300.

PART 2: PRODUCTS

2-1 GEOMEMBRANE LINER

A. General

Three types of geomembrane are shown on the Drawings: TYPE I geomembrane will be used for both primary and secondary FML on the landfill side slopes and access ramp. TYPE II geomembrane will be used for both primary and secondary FML on the base of the landfill. TYPE III geomembrane will be used to line the truck unloading area at the entrance to the landfill access ramp and to line the containment basin under the leachate storage tank. The three TYPES are defined as follows:

TYPE I - 60 mil thickness, textured (roughened) both sides

TYPE II - 60 mil thickness, smooth both sides

TYPE III - 80 mil thickness, smooth both sides

All geomembrane, regardless of type, shall consist of unreinforced high density polyethylene (HDPE) sheet.

The Geomembrane Manufacturer shall be a commercial entity normally engaged in manufacture of HDPE geomembranes for landfill applications. Examples of potential manufacturers include SLT Environmental Inc., Houston, Texas; Gundle Lining Systems Inc., Houston, Texas; and Poly-Flex, Inc., Grand Prairie, Texas. Use of these examples is not intended to restrict potential manufacturers.

B. Specific FML Properties

1. The raw material shall be new polyethylene resin containing no more than 2% clean recycled polymer by weight.

2. The resin shall meet the following specifications:

   - Specific Gravity (ASTM D792 Method A or ASTM D1505): > 0.94
   - Melt Index (ASTM D1238 Condition 190/2.16): 0.1 - 1.1 g/10 min

3. Physical, mechanical, and environmental properties shall meet or exceed the values specified in the table contained in this Part of the Specifications.

4. Geomembrane shall have a crystallinity of 50 to 60 percent, or as approved by the COTR, as determined by Differential Scanning Calorimetry (DSC).

5. The residual friction angle between the geomembrane and the soil/bentonite admix used in the landfill liner (see Section 02224) shall have a minimum value of 27.5° under a normal load of 400 psf ± 50 psf and a displacement of at least 2 inches. Friction angle shall be determined by direct shear testing.

C. Manufacturing Quality Control

1. Geomembrane Manufacturing

   Quality control testing shall be carried out by the Manufacturer to demonstrate that the product meets the specifications listed in Part 2-1.B. Additional testing may be carried out for purposes of determining conformance by the CQA Engineer. If the results of the Manufacturer's and the CQA Engineer's testing differ significantly, the testing shall be repeated by the CQA Engineer, and the Manufacturer shall be allowed to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

## REQUIRED GEOMEMBRANE PROPERTIES

| PROPERTY | QUALIFIER | UNIT | SPECIFIED VALUE TYPE I | TYPE II | TYPE III | TEST METHOD |
|---|---|---|---|---|---|---|
| **Physical Properties** | | | | | | |
| Thickness | minimum avg | mils | 60 | 60 | 80 | ASTM D1593 |
| Thickness | minimum | mils | 54 | 54 | 72 | |
| Specific Gravity | minimum | N/A | 0.94 | 0.94 | 0.94 | ASTM D792 Method A or ASTM D1505 |
| Melt Index | range | g/10 min | 0.1-1.1 | 0.1-1.1 | 0.1-1.1 | ASTM D1238 condition 190/2.16 |
| **Mechanical Properties** | | | | | | |
| Tensile Properties (each direction) | | | | | | ASTM D638 |
| 1. Force per unit width at yield | minimum | lb/in | 132 | 132 | 176 | |
| 2. Tensile strength (force per unit width at break) | minimum | lb/in | 228 | 228 | 304 | |
| 3. Elongation at yield | minimum | % | 12 | 12 | 12 | |
| 4. Elongation at break | minimum | % | 550 | 550 | 550 | |
| Tear Resistance | minimum | lb | 42 | 42 | 56 | ASTM D1004 Die C |
| Puncture Resistance | minimum | lb | 90 | 90 | 120 | FTMS 101C/2065 |
| **Environmental Properties** | | | | | | |
| Low Temperature | maximum | °F | -75 | -75 | -75 | ASTM D746 Procedure B |
| Carbon Black Content | range | % | 2-3 | 2-3 | 2-3 | ASTM D1603 |
| Carbon Black Dispersion | N/A | | A1/A2 | A1/A2 | A1/A2 | ASTM D3015 |
| Dimensional Stability (each direction) | max. change | % | ±1 | ±1 | ±1 | ASTM D1204 |
| Resistance to Soil Burial | % strength retained | | 95 | 95 | 95 | ASTM D3083 (as modified in NSF Appendix A) |
| Environmental Stress Crack | minimum | hrs | 3000 | 3000 | 3000 | ASTM D1693 (as modified in NSF Appendix A Condition C at 100°C) |

Prior to the delivery of any geomembrane material, the Manufacturer shall provide the COTR and the CQA Engineer with the following information:

- the origin (Resin Supplier's name, resin production plant), identification (brand name, number) and production date of the resin;
- a list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane;
- a copy of the quality control certificates issued by the Resin Supplier;
- reports on the tests conducted by the Manufacturer and/or the CQA Engineer to confirm that the quality of the resin used to manufacture the geomembrane satisfies these Specifications [these tests shall include specific gravity (ASTM D792 Method A or ASTM D1505) and melt index (ASTM D1238 Condition 190/2.16)];
- a statement that no recycled polymer is added to the resin or that recycled polymer is clean and does not exceed 2% by weight;
- a properties sheet including, at a minimum, all specified properties on the table in Section 2-1.B, measured using test methods indicated in the specifications, or equivalent;
- reports on the tests, including sampling procedures, conducted by the Manufacturer and/or the CQA Engineer to confirm that the geomembrane meets the project specifications;
- a certification that property values given in the properties sheet are guaranteed by the Geomembrane Manufacturer.

The CQA Engineer will review these documents and report any discrepancies with the above requirements to the COTR. The CQA Engineer will confirm that:

- the property values certified by the Geomembrane Manufacturer meet all of the specifications; and
- the measurements of properties by the Geomembrane Manufacturer are properly documented and that the test methods used are acceptable.

In addition, the CQA Engineer may, at the request of the COTR, visit the manufacturing plant, preferably during the production of the particular geomembrane for this project, in order to evaluate the Manufacturer's quality control procedures.

2. Rolls

Prior to shipment, the Geomembrane Manufacturer shall provide the COTR and the CQA Engineer with a quality control certificate for each roll of geomembrane provided. The quality control certificate shall be signed by a responsible party employed by the Geomembrane Manufacturer, such as the production manager. The quality control certificate shall include:

- roll numbers and identification; and
- sampling procedures and results of quality control tests. As a minimum, results shall be given for thickness, tensile strength, and tear resistance, evaluated in accordance with the methods indicated in these Specifications or equivalent methods approved by the Design Engineer. Tests shall be conducted on each production lot of geomembrane or every 50,000 square feet, whichever results in the greater number of tests.

The CQA Engineer will:

- confirm that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it; and
- review the quality control certificates and confirm that the certified roll properties meet the specifications.

3. Manufacturing Plant Visit

The Manufacturer shall allow the COTR or his designated representative to visit the manufacturing plant, if the COTR so chooses. If possible, the visit shall be prior to or during the manufacturing of the geomembrane rolls for the specific project. The COTR or his designated representative shall review the manufacturing process, quality control, laboratory facilities, and testing procedures.

During the visit, visiting personnel will also:

- confirm that the measurements of properties by the Manufacturer are properly documented and test methods used are acceptable;
- spot inspect the rolls and confirm that they are free of holes, blisters, or any sign of contamination by foreign matter;
- review packaging and transportation procedures to confirm that these procedures are not damaging the geomembrane;
- confirm that roll packages have a label indicating the name of the manufacturer, type of geomembrane, thickness, and roll number; and
- if applicable, confirm that extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

The Geomembrane Manufacturer shall accommodate these activities.

4. Conformance Testing.

a. Tests

Upon delivery of the rolls of geomembrane, the CQA Engineer will obtain samples at a frequency of one per production lot or one per 50,000 square feet of geomembrane, whichever results in the greater number of tests. The CQA Engineer will test the samples to determine conformance to both the design specifications and the list of guaranteed properties.

As a minimum, tests to determine the following characteristics will be performed on geomembranes:

- specific gravity (ASTM D792 Method A or ASTM D1505);
- carbon black content and visual inspection to evaluate carbon black dispersion (ASTM D1603);
- thickness (ASTM D1593);
- tensile characteristics (yield strength, elongation at yield, break strength, elongation at break; ASTM D638); and

- Friction angle of Type I geomembrane with soil liner material (see Section 02224; direct shear method as specified by the Design Engineer).

Where optional procedures are noted in the test method, the requirements of these Specifications will prevail.

b. Sampling Procedures

Samples will be taken across the entire width of the roll and will not include the first three feet (linear meter). Unless otherwise specified, samples will be 3 ft long by the roll width. The CQA Engineer will mark the machine direction on the samples with an arrow.

c. Test Results

The CQA Engineer will examine all results from laboratory conformance testing and will report any non-conformance to the COTR.

5. Fabrication Quality Control

Factory panel fabrication, if any, shall be performed in accordance with the pertinent sections of these Specifications for field panel placement and seaming (Parts 3-1, D and 3-1, E, respectively).

6. Transportation, Handling, and Storage

Transportation of the geomembrane shall be the responsibility of the Geomembrane Manufacturer, Installer, or other party as agreed upon. All handling on site will be the responsibility of the Geosynthetics Installer.

The CQA Engineer will confirm the following:

- handling equipment used on the site is adequate and does not pose any risk of damage to the geomembrane; and
- the Installer's personnel handle the geomembrane with care.

Upon delivery at the site, the Installer and the CQA Engineer shall observe the surfaces of all rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA Engineer will indicate to the COTR:

- rolls, factory panels, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and

- rolls or factory panels which include repairable flaws.

The Installer shall be responsible for the storage of the geomembrane on site. The Construction Manager will provide storage space in a location (or several locations) such that on-site transportation and handling are optimized to the extent possible. Storage space shall be protected from theft, vandalism, passage of vehicles, etc.

The CQA Engineer will confirm that storage of the geomembrane ensures adequate protection against dirt, shock, and other sources of damage.

## 2-2 GEOSYNTHETIC TRANSMISSION MEDIA

### A. General

Geosynthetic transmission media include geotextile, geonet, and geocomposite materials.

Two types of geotextile are identified on the Drawings: TYPE A geotextile will be used between the operations layer and primary drainage gravel on the floor of the landfill and also will be bonded on both sides of a geonet to form the geocomposite drainage material. TYPE B geotextile will be used above the secondary floor geonet, immediately under the primary floor admix, above the primary floor geonet, and under the top course of the access ramp and truck unloading area.

All geotextiles, regardless of type, shall be nonwoven needlepunched polypropylene. Geonet shall be high density polyethylene (HDPE). Geocomposite shall consist of TYPE A geotextile thermally bonded to each side of the HDPE geonet.

The geotextile, geonet, and geocomposite Manufacturers shall be commercial entities normally engaged in the manufacture of these products. Examples of potential manufacturers include Polyfelt, Inc., Evergreen, Alabama; Amoco Fabrics and Fibers Company, Atlanta, Georgia; Phillips Fibers Corporation, Sacramento, California; Gundle Lining Systems Inc., Houston, Texas; and Tensar Corporation, Morrow, Georgia. Use of these examples is not intended to restrict potential manufacturers.

B. Specific Geosynthetic Transmission Media Properties

1. Geonet properties shall meet or exceed the values specified in the table of required geonet properties contained in this Part of the Specifications.

2. Geotextile properties shall meet or exceed the values specified in the table of required geotextile properties contained in this Part of the Specifications.

3. The geocomposite shall consist of the same geotextile and geonet as selected for use in individual applications. Components of the geocomposite shall meet or exceed the values specified in the tables in this Part of the Specifications.

4. The residual friction angle between the geocomposite and TYPE I geomembrane and between the geocomposite and operations layer material (see Section 02228) shall have a minimum value of 27.5° under a normal load of 400 psf ± 50 psf and a displacement of at least 2 inches. Friction angle shall be determined by direct shear testing under fully saturated conditions.

5. The Manufacturer shall provide test results for all properties listed in these Specifications.

6. The Manufacturer shall certify that the materials supplied meet the requirements of this Part.

7. Geosynthetic transmission media shall retain their structure during handling, placement, and long-term service.

C. Conformance Testing

Upon delivery of the rolls of geotextile, geocomposite, and geonet, the CQA Engineer will obtain samples at a frequency of one per production lot or one per 50,000 square feet of each material type, whichever results in the greater number of tests. The CQA Engineer will test the samples to determine conformance to both the design specifications and the list of certified properties.

As a minimum, the following tests will be performed on geonets:

- Polymer specific gravity (ASTM D792)
- Thickness (ASTM D1777)
- Transmissivity (ASTM D4716)
- Mass per unit area (ASTM D3776)

## REQUIRED GEONET PROPERTIES

| PROPERTY | UNITS | VALUE | TEST |
|---|---|---|---|
| Polymer composition | % | min 95% polyethylene | — |
| Mass per Unit Area | $oz/yd^2$ | 25 | ASTM D3776 |
| Polymer specific gravity Note (1) | | 0.94 | ASTM D792 or D1505 |
| Polymer melt index | g/10 min | 0.1-1.1/10 | ASTM D1238 |
| Carbon black content | % | 2 - 3 | ASTM D4218 |
| Thickness | mils | 198 | ASTM D1777 |
| Nominal Transmissivity(2) | gals/min/ft | 7.2 | ASTM D4716 |

Notes:

(1) The specific gravity of the net polymer shall not exceed that of the geomembrane.

(2) The nominal transmissivity is the transmissivity of a geosynthetic transmission media measured using water at 68°F with a gradient of 0.1, under a compressive stress of 14.5 psi, between two smooth steel plates.

## REQUIRED GEOTEXTILE PROPERTIES

| PROPERTY | UNITS | VALUE TYPE A | VALUE TYPE B | TEST |
|---|---|---|---|---|
| Thickness | mils | 95 | 185 | D1777, 41 psf |
| Mass/Unit Area | $oz/yd^2$ | 7.1 | 16 | ASTM D3776 |
| Apparent Opening Size | mm | 0.210 | 0.149 | ASTM D4751 |
| Grab Strength | lb | 190 | 450 | ASTM D4632 |
| Trapezoidal Tear Strength | lb | 70 | 150 | ASTM D4533 |
| Puncture Strength | lb | 95 | 195 | ASTM D4833 |
| Burst Strength | psi | 345 | 750 | ASTM D3786, Method 4 |
| Permittivity | $sec^{-1}$ | 1.5 | 0.5 | ASTM D4491 |

As a minimum, the following tests will be performed on geotextiles (both TYPES):

- Mass per unit area (ASTM D3776)
- Grab strength (ASTM D4632)
- Tear strength (ASTM D4533)
- Burst strength (ASTM D3786)
- Puncture strength (ASTM D4833)
- Thickness (ASTM D1777)
- Permittivity (ASTM D4491)
- AOS (ASTM D4751)

As a minimum, the following tests will be performed on geocomposites:

- AOS (ASTM D4751)
- Friction Angle with Operations Layer (direct shear method as specified by Design Engineer)
- Friction Angle with TYPE I HDPE (direct shear method as specified by Design Engineer)

D. Transportation, Handling and Storage

Geosynthetic transmission media shall be supplied in rolls wrapped in protective dust-proof covers and marked or tagged with the following information:

- Manufacturer's name;
- product identification;
- lot number;
- roll number; and
- roll dimensions.

Transportation of the geosynthetic transmission media shall be the responsibility of the Manufacturer, Installer, or other party as agreed upon. All handling on site will be the responsibility of the Geosynthetics Installer.

During shipment and storage, the geonet, geocomposite, and geotextile shall be protected from mud, dirt, dust, puncture, cutting, or other damaging or deleterious conditions.

The Installer shall be responsible for the storage of the geosynthetic transmission media on site. The Construction Manager will provide storage space in a location (or several locations) such that on-site transportation and handling are optimized

to the extent possible. Storage space shall be protected from theft, vandalism, passage of vehicles, etc.

PART 3: EXECUTION

3-1 GEOMEMBRANE LINERS

A. General

The primary and secondary geomembrane liners shall be installed at the locations, lines, and grades shown on the drawings. In addition, a geomembrane liner shall be installed in the truck staging area. The geomembrane liners shall be installed in accordance with these Specifications and the CQA Plan.

B. Soil Liner Preparation

The Earthwork Contractor shall be responsible for preparing the surface of the admix liner according to the Specifications. Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects, or debris of any kind. The surface shall provide a firm, unyielding foundation for the membrane with no sudden, sharp, or abrupt changes at break in grade. No standing water or excessive moisture shall be allowed to accumulate on the subgrade prior to geomembrane installation.

The CQA Engineer will confirm that:

- a qualified land surveyor has verified all lines and grades;
- a qualified geotechnical engineer, normally the CQA Engineer, has confirmed that the soil liner meets the density specifications;
- the surface to be lined has been rolled and compacted so as to be free of irregularities, protrusions, loose soil, and abrupt changes in grade;
- the surface of the soil liner does not contain stones which may be damaging to the geomembrane; and
- there is no area excessively softened by high water content or cracked by desiccation.

The Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. The certificate of acceptance shall be given by the Installer to the Construction Manager prior to commencement of geomembrane

installation in the area under consideration. The CQA Engineer shall be given a copy of this certificate by the Construction Manager.

After the soil liner surface has been accepted by the Installer, it shall be the Installer's responsibility to indicate to the Construction Manager any change in the soil liner surface condition that may require repair work. If the CQA Engineer concurs with the Installer, then the Construction Manager shall ensure that the soil liner surface is repaired.

At any time before and during the geomembrane installation, the CQA Engineer shall indicate to the Construction Manager or COTR those locations which may not provide adequate support to the geomembrane.

Special care shall be taken to avoid desiccation cracking of the admix liner. Specifications for allowable desiccation cracking of admix liner and repair measures are outlined in Section 02224.

C. Anchor Trench Excavation and Backfilling

The anchor trench shall be excavated by the Earthwork Contractor (unless otherwise specified) to the lines and widths shown on the design Drawings, prior to geomembrane placement. The CQA Engineer shall confirm that the anchor trench has been constructed according to the design Drawings.

Rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.

Each geosynthetic layer shall be anchored with a minimum 6-inch-thick lift of compacted soil within the anchor trench. The backfill material shall be general fill and shall be compacted by rubber tired equipment.

D. Geomembrane Placement

1. Field Panel Identification

A field panel is the unit area of geomembrane which is to be seamed in the field. Two cases are defined:

- If the geomembrane is fabricated into panels in a factory, a field panel is a factory panel or a portion of factory panel cut in the field.
- If the geomembrane is not fabricated into factory panels, a field panel is a roll or a portion of roll cut in the field.

It will be the responsibility of the CQA Engineer to ensure that each field panel is given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Construction Manger, Installer, and CQA Engineer. This field panel identification codes shall be as simple and logical as possible. (Note that roll numbers assigned in the manufacturing plant are usually cumbersome and are not related to location in the field.)

The CQA Engineer will establish a table or chart showing correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code shall be used for all quality assurance records.

2. Field Panel Placement

a. Location

The CQA Engineer will confirm that field panels are installed at the locations indicated in the Installer's layout plan, as approved or modified.

b. Installation Schedule

Field panels may be installed using either of the following schedules:

- all field panels are placed prior to field seaming (in order to protect the subgrade from erosion by rain). In this case, it is usually beneficial to begin in the sump area and proceed upward and outward with "shingle" overlaps to facilitate drainage in the event of precipitation. It is also usually beneficial to proceed in the direction of prevailing winds.

- field panels are placed one at a time and each field panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels exposed to wind).

An early decision regarding installation scheduling shall be made if and only if weather conditions can be predicted with reasonable certainty. Otherwise, scheduling decisions must be made during installation, in accordance with varying conditions.

The CQA Engineer will evaluate every change in the schedule proposed by the Installer and advise the Construction Manger on the acceptability of that change. The CQA Engineer shall confirm that the condition of the soil liner surface has not changed detrimentally during installation.

The CQA Engineer will record the identification code, location, and date of installation of each field panel.

c. Placement Conditions

Geomembrane placement shall not proceed at an ambient temperature below 40°F or above 104°F unless otherwise authorized. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.

d. Damage

The CQA Engineer will inspect each panel, after placement and prior to seaming, for damage. The CQA Engineer will advise the Construction Manger which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked, and their removal from the work area recorded by the CQA Engineer. Repairs shall be made according to procedures described this Part of the Specifications.

E. Field Seaming

1. Seam Layout

The Installer shall provide the Construction Manger and the CQA Engineer with a seam layout drawing, i.e., a drawing of the facility to be lined showing all expected seams. The CQA Engineer will review the seam layout drawing and confirm that it is consistent with accepted state of practice. No panels shall be seamed in the field without the Construction Manager's approval. In addition, no panels not specifically shown on the seam layout drawing shall be used without the Construction Manager's prior approval.

In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams shall be minimized. On the landfill floor, no horizontal seam shall be less than 5 ft from the toe of the slope, or other area of potential stress concentrations, unless otherwise authorized.

A seam numbering system consistent with the panel numbering system shall be agreed upon at the Pre-Construction Meeting.

2. Requirements of Personnel

All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests similar to those described in this Section. The superintendent and lead welder foreman shall have experience seaming a minimum of 1,000,000 $ft^2$ of polyethylene geomembrane using the same type of seaming apparatus proposed for use on this project. These individuals shall provide direct supervision over less experienced seamers. No field seaming shall take place without one of these individuals being present.

The Installer shall provide the Construction Manager and the CQA Engineer with a list of proposed seaming personnel and their experience records.

3. Seaming Equipment and Products

Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted to the COTR or his representative for approval. Only apparatus which have been specifically approved by make and model shall be used.

The Construction Manager will submit all documentation to the CQA Engineer for his concurrence.

a. Extrusion Process

The extrusion-welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle.

The Installer shall provide documentation regarding the extrudate to the Construction Manager and the CQA Engineer, and shall certify that the extrudate is compatible with the specifications and is comprised of the same resin type as the geomembrane sheeting.

The CQA Engineer will record apparatus temperatures, extrudate temperatures, and ambient temperatures at appropriate intervals.

The Installer shall comply with the following:

- the Installer maintains on-site a sufficient number of spare operable seaming apparatus to ensure continuous operation;
- equipment used for seaming is not likely to damage the geomembrane;

- the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- grinding shall be completed no more than 1 hour prior to seaming;
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
- the geomembrane is protected from damage in heavily trafficked areas.

b. Fusion Process

The fusion-welding apparatus shall be automated vehicular-mounted devices. The fusion-welding apparatus shall be equipped with gauges giving the applicable temperatures and pressures.

The CQA Engineer will record ambient and seaming apparatus temperatures as well as seaming apparatus speed.

The Installer shall comply with the following:

- the Installer maintains on-site a sufficient number of spare operable seaming apparatus to ensure continuous operations;
- equipment used for seaming is not likely to damage the geomembrane;
- for cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage;
- the geomembrane is protected from damage in heavily trafficked areas; and

- a movable protective layer shall be used as directed by the Construction Manager directly below each overlap of geomembrane to be seamed to prevent buildup of moisture between the sheets.

4. Seam Preparation

The Installer shall comply with the following:

- prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- if seam overlap grinding is required, the process shall be completed according to the Geomembrane Manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane; and
- seams shall be aligned with the fewest possible number of wrinkles and "fishmouths."

5. Weather Conditions for Seaming

The allowable weather conditions for seaming are as follows:

- Unless authorized in writing by the COTR, no seaming shall be attempted at ambient temperatures below 40°F or above 104°F.
- Between ambient temperatures of 40°F and 50°F, seaming shall be allowed if the geomembrane is preheated by either sun or hot air device, and if there is no excessive cooling resulting from wind.
- Above an ambient temperature of 50°F, no preheating is required.
- In all cases, the geomembrane shall be dry, protected from wind, and free of dust.

If the Installer wishes to use methods which may allow seaming at ambient temperatures below 40°F or above 104°F, the Installer shall demonstrate and certify in writing that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 40°F and below 104°, and that the overall quality of the geomembrane is not adversely affected. In addition, the Installer shall certify in writing that the seaming procedure does not cause any physical or chemical modification to the geomembrane that will generate any short or long term damage to the geomembrane.

Subsequently, the temperatures in the above procedure shall be modified accordingly.

The CQA Engineer will confirm that these weather conditions are fulfilled and will advise the Construction Manager if they are not. The Construction Manager will then decide if the installation shall be stopped or postponed.

6. Overlapping and Temporary Bonding

The Installer shall comply with the following:

- panels of geomembrane shall have a finished overlap of a minimum of 3 in for extrusion welding and 5 in for fusion welding, but in any event sufficient overlap shall be provided to allow peel and shear tests to be performed on the seam;
- no solvent or adhesive shall be used; and
- the procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

The CQA Engineer will record all appropriate temperatures and conditions, and will report any non-compliances to the Construction Manager.

7. Test Seams

Test seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Such test seams shall be made at the beginning of each seaming period, and at least once each four hours, for each seaming apparatus used that day. Also, each seamer shall make at least one test seam each day. Test seams shall be made under the same conditions as actual seams.

The test seam sample shall be at least 2 ft long by 1 ft wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as indicated in this Part.

Two adjoining specimens, each 1 inch wide, shall be cut from the test seam sample by the Installer. The specimens shall be tested respectively in shear and peel using a field tensiometer, and they shall not fail in the seam. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and

shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall provide the Construction Manager and the CQA Engineer with current calibration certificates.

8. General Seaming Procedure

The general seaming procedure used by the Installer shall be as follows:

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

- If seaming operations are carried out at night, adequate illumination as determined by the Construction Manager and CQA Engineer shall be provided.

- "Fishmouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut "fishmouths" or wrinkles shall be seamed, and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in beyond the cut in all directions.

- When seaming of a large area of the geomembrane liner has been completed and prior to placing overlying materials, the CQA Engineer will observe the geomembrane for wrinkles. The CQA Engineer will indicate to the Construction Manager which wrinkles shall be cut and seamed or otherwise repaired by the Installer. The seam thus produced shall be tested like any other seam.

- Geomembrane in sump areas shall be installed and tested as described in this Part for other areas of the landfill, as practicable. Extreme care shall be taken while welding around appurtenances since neither nondestructive nor destructive testing may be feasible in these areas. The Installer shall ensure that the geomembrane has not been visibly damaged during installation.

9. Nondestructive Seam Continuity Testing

a. Concept

The Installer shall nondestructively test all field seams over their full length using a vacuum test unit, air pressure test (for double fusion seams only), or other approved method. Vacuum testing and air pressure testing are described below. The purpose of the nondestructive test is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be done as the seaming work progresses. Any seams which fail nondestructive testing shall be repaired in accordance with these Specifications. Seams which cannot be non-destructively tested because of seam geometry shall be double welded or capped.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall provide the Construction Manager and the CQA Engineer with current calibration certificates.

b. Vacuum Testing

The equipment shall be comprised of the following:

- a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge;
- a steel vacuum tank and pump assembly equipped with a pressure controller and connections;
- a rubber pressure/vacuum hose with fittings and connections;
- a bucket and wide paint brush;
- a soapy solution.

The following procedures shall be used:

- energize the vacuum pump and reduce the tank pressure to a minimum of 5 inches of mercury;
- wet a strip of geomembrane approximately 12 inches wide by 48 inches long with the soapy solution;

- place the vacuum box over the test area;
- close the bleed valve and open the vacuum valve;
- ensure that a leak tight seal is created;
- for a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles;
- if no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 in overlap, and repeat the process;
- all areas where soap bubbles appear shall be marked and repaired in accordance with this Part.

c. Air Pressure Testing (For Double Fusion Seams Only)

The following procedures are applicable to those processes which produce a double seam with an enclosed air channel.

The equipment shall be comprised of the following:

- an air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure of 60 to 65 psi;
- a rubber hose with fittings and connections;
- a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be used:

- seal both ends of the seam to be tested;
- insert needle or other approved pressure feed device into the air channel created by the fusion weld;
- energize the air pump to a pressure between 25 and 30 psi for a ½-inch-wide channel, or 55 and 60 psi for a 1-inch-wide channel, close valve, and sustain pressure for approximately 5 minutes;

- if loss of pressure exceeds 2 psi, or does not stabilize, locate faulty area and repair in accordance with this Part;

- remove needle or other approved pressure feed device and seal.

10. Destructive Seam Strength Testing

a. Concept

Destructive seam tests shall be performed at selected locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses. The samples shall meet the requirements of the following table, Seam Properties.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall provide the Construction Manager and the CQA Engineer with current calibration certificates.

b. Location and Frequency

The CQA Engineer will select locations where seam samples will be removed for laboratory testing.

Sampling frequency shall be established as follows:

- A minimum frequency of one sample per 500 ft of seam length (this minimum frequency shall be determined as an average taken from all the panels, including welds for caps), or a minimum of two samples per factory panel, whichever gives the largest number of samples.

- A maximum frequency shall be agreed upon by the Installer and CQA Engineer.

c. Sampling Procedures

Samples shall be cut by the Installer as the seaming progresses in order to provide laboratory test results before completion of installation. The Installer shall assign a number to each sample, mark it accordingly, and record the sample location on the layout drawing.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures. The

continuity of the new seams in the repaired area shall be tested as described in this Part.

d. Size of Samples

The samples shall be 12 inches wide by 42 inches long with the seam centered lengthwise. One 1-inch-wide strip shall be cut from each end of the samples, and these shall be tested in the field as described below. The remaining sample shall be cut into three parts and distributed as follows:

- one portion to the Installer for laboratory testing at his discretion, 12 inch x 12 inch;
- one portion to the COTR for archive storage, 12 inch x 12 inch; and
- one portion to the CQA Engineer for laboratory testing, 12 inch x 16 inch.

e. Testing in the Field

The two 1-inch-wide strips described above shall be tested in the field by hand or tensiometer, for peel and shear, respectively, and shall not fail in the seam. If any test sample fails to pass, then the procedures outlined below (Procedures for Destructive Test Failure) shall be followed.

The CQA Engineer will mark all samples and portions with their number. The CQA Engineer will also record the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail descriptions, and attach a copy to each sample portion.

f. CQA Laboratory Testing

Destructive test samples will be packaged and shipped, if necessary, by the CQA Engineer in a manner which will not damage the test sample.

Testing will include shear strength and peel adhesion and will be performed in accordance with ASTM D4437. The minimum acceptable values for these tests are listed in the table of Seam Properties. At least 5 specimens will be tested for each test type. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear, etc.).

The CQA Laboratory will provide test results no more than 48 hours after they receive the samples. The CQA Engineer will review the laboratory

test results within one day after they become available, and make appropriate recommendations to the Construction Manager.

11. Procedures for Areas Failing Destructive Tests

The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the CQA Laboratory, the Installer's laboratory, or by field tensiometer. The Installer has two options:

- The Installer shall cap the seam between any two passed test locations, or

- The Installer shall trace the seam to two intermediate locations 10 feet minimum from the point of the failed test in each direction and take a small sample for an additional field test at each location. If these additional samples pass the test, then full samples shall be taken for CQA laboratory testing. If these laboratory samples pass the tests, then the seam shall be capped between these locations. If either sample fails, then the sampling and testing process shall be repeated to establish the zone over which the seam shall be capped.

All acceptable capped seams shall be bounded by two locations from which samples passing CQA laboratory destructive tests have been taken. In cases where the length of the capped seam exceeds 150 feet, a sample of the capping seam shall be taken and shall pass destructive testing as described in this Part.

The CQA Engineer will document all actions taken in conjunction with destructive test failures.

12. Repairs

a. General

All repairs shall be conducted in accordance with this Part. Each patch or other type of repair will be numbered and recorded by the CQA Engineer.

All repairs shall be subjected to the nondestructive seam testing procedures described in this Part.

All repair documentation will be prepared by the CQA Engineer.

b. Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Construction Manager, Installer, and CQA Engineer. Potentially acceptable procedures include:

- patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
- grinding and rewelding, used to repair small sections (typically with a maximum length of no more than several inches) of extruded seams;
- spot welding or seaming, used to repair pinholes or other minor, localized flaws;
- capping, used to repair large lengths of failed seams;
- topping, used to repair areas of inadequate seams, which have an exposed edge;
- removing bad seam and replacing with a strip of new material welded into place, used with large lengths of fusion seams.

For all repair methods, the following provisions shall be satisfied as applicable:

- surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
- all surfaces shall be clean and dry at the time of the repair;
- the repair procedures, materials, equipment, and techniques shall be agreed upon in advance of the specific repair by the Construction Manager, CQA Engineer, and Installer;
- patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches; and
- the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

c. Verification of Repairs

Each repair shall be numbered and recorded. Each repair shall be nondestructively tested using the methods described in this Part. Large caps may be of sufficient extent to require destructive test sampling, at the discretion of the CQA Engineer. Repairs that fail nondestructive or destructive tests shall be redone and retested until a passing test is obtained. The CQA Engineer will observe all non-destructive testing of repairs and will record the number of each repair, date, and test results.

F. Materials in Contact with the Geomembrane

The requirements of this Part are intended only to assure that the installation of other materials does not damage the geomembrane. Additional specifications are necessary to assure that systems built with these other materials are constructed in such a way as to provide proper performance.

1. Granular Materials

a. Do not place granular materials on the geomembrane at ambient temperatures below 40°F or above 104°F, unless otherwise specified.

b. Equipment used for placing granular material shall not be driven directly on the geomembrane. A minimum thickness of 1 foot of granular material shall be maintained between placement equipment and the geomembrane. A minimum thickness of 3 ft of granular material shall be maintained between rubber-tired hauling vehicles and the geomembrane.

c. Equipment used for placing granular material shall be a light dozer (such as a wide pad Caterpillar D-3 or lighter) or motor grader (Caterpillar 12G or lighter) or approval equal.

d. Placement equipment shall make no sharp turns on granular material.

G. Lining System Acceptance

The Installer shall retain all ownership of and responsibility for the geosynthetics in the lining system until acceptance by the COTR.

The geosynthetic lining system will be accepted by the COTR when:

- the installation is finished;

- verification of the adequacy of all field seams and repairs, including associated testing, is complete; and

- a written construction report, including "as built" drawings and all other installation documents, has been prepared by the CQA Engineer, sealed by a registered professional engineer, and received by the COTR.

H. Quality Assurance

Quality Assurance procedures for the installation of geomembrane liners are given in the CQA Plan.

## 3-2 GEOSYNTHETIC TRANSMISSION MEDIA

A. General

The geosynthetic media form the leachate collection and removal system and include geotextile and geonet drainage materials on the floor and geocomposite drainage layers on the side slopes of the landfill.

B. Geonets and Geocomposites

1. Handling and Placement

a. The Installer shall handle all geonets and geocomposites in such a manner as to ensure that these materials are not damaged.

b. Clean geomembrane surface prior to placing geonet or geocomposite.

c. On slopes, secure geocomposite and then roll it down slope in a manner to continually keep it in tension. If necessary, position geocomposite by hand after unrolling to minimize wrinkles.

d. Do not slide geocomposite across textured geomembrane in any way that damages the geotextile component or reduces the friction at the geomembrane/geocomposite interface. If necessary, place a clean panel of smooth geomembrane under the geocomposite. Remove this transfer panel when the geocomposite is in place.

e. In the presence of wind, all geonets and geocomposites shall be weighted with sandbags or equivalent. Sandbags shall be installed during geonet or geocomposite placement and shall remain until replaced with cover material.

f. Unless otherwise specified, geonets and geocomposites shall not be welded to geomembranes.

g. Geonets shall only be cut using approved cutting tools.

h. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geonet or geocomposite.

i. During placement of geonets and geocomposites, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt of excessive dust is entrapped in the geonet or geocomposite, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags, to prevent rupture or damage of the sandbag.

j. Tools shall not be left in the geonet or geocomposite.

k. All geonet shall be covered with geotextile on the same day as it is deployed.

l. In geocomposites, tearing the geotextile away from the geonet shall not be allowed.

2. Stacking and Joining

a. Where several layers of geonets are stacked, or at the corners of a landfill, care shall be taken to prevent strands from one layer from penetrating the channels of the next layer, thereby significantly reducing the transmissivity. This will not happen if stacked geonets are placed in the same direction. Stacked or overlapping geonet shall not be laid in a direction perpendicular to the underlying geonet unless otherwise directed by the COTR.

b. Adjacent sections of geonet shall be overlapped by at least 4 inches. Geocomposites shall be overlapped according to manufacturer's directions.

c. Overlaps shall be secured by spot welding or tying. Acceptable tying devices include strings, plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

d. Overlaps shall be secured every 5 feet along slopes and on the floor of the landfill. Overlaps shall be secured every 6 inches in anchor trenches.

Along end-to-end seams, spot weld or tie 2 rows 3 inches apart. Spot weld or tie each row at 6-inch intervals; stagger weld or ties between rows.

e. No horizontal seams shall be allowed on side slopes except at roll ends.

f. If more than one layer of geonet or geocomposite is installed, joints shall be staggered.

3. Repair

a. Geonets

- Any holes or tears in the geonet shall be repaired by placing a patch extending 2 feet beyond edges of the hole or tear.
- Ribs in the patch shall be parallel to the ribs in the existing geonet.
- The patch shall be secured to the original geonet by spot welding or tying every 6 inches as described in this Part.
- If the hole or tear width across the roll is more than 50% the width of the roll, the damaged area shall be cut out and the two portions of the geonet shall be joined as described in this Part.

b. Geocomposites

- Remove the damaged area of geocomposite.
- Cut a piece of geonet satisfying the requirements of Part 2 of this Section to fit into the repair area. Geonet shall fit into repair area to form a flush surface with the geocomposite. Cut geonet so that ribs are in the same orientation as existing geocomposite.
- Remove any dirt or other foreign material which may have entered the geocomposite.
- Place geonet patch into repair area.
- Place geotextile satisfying the requirements of Part 2 of this Section over the geonet patch. Cut geotextile to overlap existing geocomposite at least 6 inches in all directions. Heat seam geotextile to geocomposite around its entire perimeter.

4. Quality Assurance

Quality Assurance procedures for the installation of geonets and geocomposites are presented in the CQA Plan.

C. Geotextiles

1. Handling and Placement

a. The Installer shall handle all geotextiles in such a manner as to ensure that they are not damaged.

b. Place geotextiles in a manner that prevents folds and wrinkles. Folds or wrinkles shall be pulled smooth prior to seaming.

c. In the presence of wind, all geotextiles shall be weighted with sandbags or equivalent. Sandbags shall be installed during placement and shall remain until replaced with cover material.

d. Geotextiles shall be cut using an approved geotextile cutter only. Special care shall be taken to protect underlying geosynthetic materials from damage during cutting.

e. During placement, care shall be taken not to entrap in the geotextile stones, excessive dust, or moisture that could damage the geomembrane, clog drains or filters, or hamper subsequent seaming.

f. An examination of the geotextile over the entire surface, after installation, shall be conducted to ensure that no potentially harmful foreign objects, such as needles, are present. Any foreign objects so encountered shall be removed by the Installer, or the geotextile shall be replaced.

g. If light colored geotextile is used, precautions shall be taken against "snowblindness" of personnel.

2. Seams and Overlaps

a. All geotextiles shall be continuously sewn (i.e., spot sewing is not allowed).

b. Geotextiles shall be overlapped 3 inches prior to seaming.

c. On the landfill floor, no horizontal seam shall be closer than 3 ft to the toe of the slope or other areas of potential stress concentrations unless otherwise authorized.

d. Areas to be seamed shall be clean and free of foreign material.

e. Sewing shall be done using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile.

f. All sewing shall be done using a sewing machine which creates a lock stitch.

3. Repair

Any holes or tears in the geotextile shall be repaired as follows:

a. A patch made from the same geotextile shall be double seamed into place with the seams 1/4 inch to 3/4 inch apart and no closer than 1 inch from any edge.

b. Remove any soil or other material which may have penetrated the torn geotextile.

4. Placement of Soil Materials

The Installer shall place all soil materials located on top of a geotextile in such a manner as to ensure:

- no damage of the geotextile;
- minimal slippage of the geotextile on underlying layers;
- no excess tensile stresses in the geotextile.

5. Quality Assurance

Quality Assurance procedures for the installation of geotextiles are presented in the CQA Plan.

- END -

# SECTION 02511
# TRUCK UNLOADING AREA SURFACING

## PART 1: GENERAL

### 1-1 DESCRIPTION

A. Asphalt concrete paving and surface sealer in the truck unloading area.

B. Aggregate top course.

### 1-2 RELATED SECTIONS

A. Section 02220 - General Excavation and Backfill

### 1-3 REFERENCES

A. MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot Mix Types, The Asphalt Institute.

B. MS-3 - Asphalt Plant Manual, The Asphalt Institute.

C. MS-8 - Asphalt Paving Manual, The Asphalt Institute.

D. MS-19 - Basic Asphalt Emulsion Manual, The Asphalt Institute.

E. ASTM D946 - Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.

F. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.

G. ASTM D1559 - Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.

H. Washington DOT, 1988 Standard Specifications for Road, Bridge, and Municipal Construction.

I. Washington DOT, 1991 Standard Specifications for Road, Bridge, and Municipal Construction.

1-4 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt concrete when surface temperature of top course is less than 40°F or when surface is wet.

B. Do not apply primer or seal coats when surface temperature is less than 60°F. Apply in dry weather only.

PART 2: PRODUCTS

2-1 ASPHALT CONCRETE

In accordance with Washington DOT 1991 Specifications, Section 5-04 and other Sections referenced therein, Class B.

2-2 PRIMER

Homogeneous, medium curing, liquid asphalt MC-70 or approved alternate conforming to Washington DOT 1991 Specifications, Section 9-02.1(2) and other Sections referenced therein.

2-3 SEAL COAT

Coal tar pitch emulsion seal coat conforming to Washington DOT 1988 Specifications, Section 5-03 and other Sections referenced therein, 5 pounds of sand per gallon of undiluted emulsion.

2-4 TOP COURSE

Crushed aggregate surfacing conforming to Washington DOT 1991 Specifications, Section 9-03.9(3) and other Sections referenced therein.

PART 3: EXECUTION

3-1 TOP COURSE

Place top course to thickness and limits shown on the Drawings. Compact top course using a vibratory steel drum roller to 95% of modified Proctor density (ASTM D1557).

3-2 PRIMER

A. Prepare surface of top course in accordance with Section 5-02.3(2)A of Washington DOT 1991 Specifications and other Sections referenced therein.

B. Apply primer to top course surface at uniform rate of 0.5 gal/sq yd in accordance with Section 5-02 of Washington DOT 1991 Specifications and other Sections referenced therein.

C. Use clean sand to blot excess primer.

3-3 ASPHALT PAVEMENT

A. Place asphalt concrete in accordance with Washington DOT 1991 Specifications, Section 5-04.3 and other Sections referenced therein, as applicable.

B. Compact pavement by rolling to 93% of ASTM D1559. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

C. Place asphalt concrete in single course, 4 inches thick after compaction, or as otherwise shown on the Drawings.

3-4 SEAL COAT

Apply two seal coats in accordance with Section 5-03.3 of Washington DOT 1988 Specifications and other Sections referenced therein, as applicable.

3-5 TOLERANCES

A. Flatness: Maximum variation of 0.25 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 0.25 inch.

C. Variation from True Elevation: Within 0.5 inch.

3-6 PROTECTION

Protect pavement from mechanical injury and exclude traffic from area for two days after completion of seal coating. A longer time period for protection may be directed by the Construction Manager.

- END -

# SECTION 02720
# DRAINAGE FACILITIES

## PART 1: GENERAL

### 1-1 DESCRIPTION

Contractor shall construct the drainage facilities including drainage ditches as shown on the Drawings.

### 1-2 SUBMITTALS

Submit a description of the methods to be used for excavation and finishing of drainage ditches as part of the overall excavation plan. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

**not used**

## PART 3: EXECUTION

The perimeter drainage ditch is incorporated into the perimeter road design as shown on the Drawings.

- END -

# SECTION 02725
# HDPE PIPE AND FLATSTOCK

## PART 1: GENERAL

### 1-1 DESCRIPTION

A. This section includes all High Density Polyethylene (HDPE) Pipe used in the landfill construction including but not limited to:

1. Leachate collection piping on floor and cleanout access pipes on the slopes of the landfill.
2. Side-slope riser pipes containing submersible sump pumps.
3. Sump pump discharge piping.
4. Level sensor piping.
5. Leachate collection well pipe at base of vertical riser.
6. Prefabricated HDPE boots to be placed around all pipe protrusions through the HDPE liner.
7. Secondary containment piping on riser pad at slope crest and elsewhere as shown on the Drawings.

B. This section includes HDPE flatstock installed in sumps.

### 1-2 RELATED SECTIONS

A. Section 15060 Pipe and Pipe Fittings

B. Section 15066 Pipe and Conduit Support Systems

C. Section 02222 Trenching and Backfilling

D. Section 02275 Geosynthetics

### 1-3 SUBMITTALS

A. Prior to shipment, the HDPE pipe Manufacturer shall submit a quality control certificate for each lot/batch of HDPE pipe provided. The quality control certificate

shall be signed by a responsible party employed by the HDPE pipe Manufacturer, such as the Production Manager. The quality control certificate shall include:

1. lot/batch numbers and identification, and

2. sampling procedures and results of quality control tests.

B. Prior to construction, Contractor shall submit fabrication drawings for pipe which describe connecting methods; fittings; type, size, and spacing of perforations; and penetrations

C. Submit in accordance with Section 01300.

1-4 REFERENCES

A. American Society for Testing and Materials (ASTM) most current versions:

1. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.

2. ASTM D2513 - Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.

3. ASTM D2657 - Practice for Heat Joining of Polyolefin Pipe and Fittings.

4. ASTM D2683 - Specification for Socket-Type Polyethylene Fittings for Outside-Diameter Controlled Polyethylene Pipe and Tubing.

5. ASTM D3350 - Specification for Polyethylene Plastics Pipe and Fitting Materials.

B. Code of Federal Regulations (CFR):

1. 49 CFR 192.285 - Plastic pipe; qualifying persons to make joints.

PART 2: PRODUCTS

2-1 HDPE MATERIALS

All HDPE pipe and flatstock shall meet the following requirements:

A. Specific Gravity, as determined by ASTM D792 or D1505:

0.94 minimum.

B. Carbon Black Content, as determined by ASTM D1603:

2.0% minimum.

C. Resistance to Soil Burial, as determined by ASTM D3083, as modified by NSF Standard 54 Appendix A, Part 3:

At least 90% strength retained.

D. Melt Index, as determined by ASTM D1238 Condition 190.2.16:

0.1 to 1.1 g per 10 min

2-2 HDPE PIPE

A. HDPE pipe shall be manufactured from first quality polyethylene resin containing no more than 2% clean recycled polymer by weight. Resin shall be Type III, Category 5, Class C, Grade 34 per ASTM D1248. The cell classification shall be 345434C per ASTM D3350.

B. The pipe shall meet the requirements for specific gravity, carbon black content, and melt index described above.

C. The pipe shall have uniform wall thickness and shall be uniform in color, opacity, density, and other physical properties. Pipe shall be homogeneous throughout and free of visible cracks, holes, blisters, bubbles, undispersed raw materials, or any contamination by foreign matter. Any pipe with nicks, scrapes, or gouges deeper than 5 percent of the nominal wall thickness shall be rejected.

D. Pipe may be supplied in a continuous extruded seamless piece or in sections.

2-3 PERFORATIONS AND PENETRATIONS

A. Leachate Collection Piping: Leachate collection piping on the floor of the landfill, on the access ramp, and under the truck unloading area shall be perforated. Perforations shall be as shown on the Drawings. Alternatively, slotted (sawn) pipe may be used; submit evidence of equivalent flow capacity. Cleanout access pipes shall not be perforated.

B. Submersible Pump Piping: The lower portion of the side slope riser pipes surrounding the primary and secondary submersible leachate pumps shall be perforated with ¼-inch-diameter holes as shown on the Drawings.

C. Level Sensor Piping: The lower portions of the pipes containing the transducer level sensors shall be perforated with ¼-inch-diameter holes as shown on the Drawings. This applies to both the primary and secondary systems.

D. Leachate Collection Well: The 30-inch-diameter HDPE leachate collection well shall be perforated using ¾-inch-diameter holes as shown on the Drawings. In addition, holes shall be cut in leachate collection well to accommodate primary leachate collection pipes, primary slope riser pipe, and primary level sensor pipes, as shown on the Drawings.

## 2-4 SCHEDULE

HDPE pipe nominal diameter and wall thickness shall be as follows:

| | |
|---|---|
| Submersible pump discharge piping | 1½" diam. SDR 13.5 |
| Self-priming pump discharge piping | 3" diam. SDR 11 |
| Slope riser pipes (casing) | 8" diam. SDR 11 |
| Secondary containment pipes | 6" diam. SDR 13.5 |
| Perforated leachate collection | 4" diam. SDR 11 |
| Cleanout access pipes | 4" diam. SDR 11 |
| Level sensor pipes | 2" diam. SDR 11 |
| Leachate collection well | 30" diam. SDR 13.5 |

## 2-5 COUPLINGS

A. Couplings for socket fusion shall satisfy the specifications listed above for HDPE pipe, except that other cell classifications are acceptable provided that they are compatible with the HDPE pipe and provide equivalent performance to class 345434C. Couplings shall satisfy the requirements of ASTM D2513 and shall be manufactured in compliance with ASTM D2683.

B. Where pipes or fittings of different materials are connected, the coupling shall be a flanged connection. The flanges shall be ANSI 150 pound class flanges. The flange joints shall use steel bolts. Gaskets shall be required when jointing to nonpolyethylene materials.

## 2-6 FLATSTOCK

A. Flatstock shall be series 1000 or 8600 HDPE. Flatstock shall be manufactured from first quality polyethylene resin containing no more than 2% clean recycled polymer by weight.

B. The flatstock shall meet the requirements for specific gravity, carbon black content, and melt index described in Part 2-1.

C. The flatstock used for the leachate collection well base shall have a nominal thickness of one inch. The edges of the flatstock shall have a 0.25-inch bevel.

## PART 3: EXECUTION

### 3-1 GENERAL

A. Pipe shall be handled and stored in such a manner as to ensure a sound, undamaged condition.

B. Pipe shall be cut in a neat, workmanlike manner using an approved mechanical cutter that will not damage the pipe.

C. Joining of HDPE pipe to HDPE pipe shall be accomplished by thermal butt or socket fusion; no solvent or adhesive welding shall be allowed. Pipe shall be joined per ASTM D2657 and manufacturer's recommendations. Installation personnel who join HDPE pipe shall be experienced and certified in accordance with 49 CFR 192.285. The Contractor shall provide the Construction Manager and CQA Engineer with a list of proposed joining personnel and their qualifications.

D. During installation, the pipe shall not be pulled across sharp projections that could cause gouges, kinks, or other types of damage.

E. The pipe shall not be dropped into the trench. The full length of the pipe shall be firmly bedded on the trench bottom. The pipe shall be bedded in such a way as to maintain grade with a tolerance of -0.0%, +0.5%.

F. Temporarily close pipe ends as required to avoid introducing dirt or other foreign material into the pipe.

G. Trenching and backfilling operations shall be conducted in accordance with the requirements of Section 02222. Backfilling operations shall ensure that no voids are present under or at the sides of the pipe. Backfill shall initially be placed to the top of the pipe, then hand compacted. The remainder of the trench shall then be backfilled and compacted by hand or with a power tamper only.

H. Where flanged joints are used, the bolts shall be evenly torqued using a crossing pattern to gradually tighten the lug nuts. Flanged joins shall be retorqued after one hour or more has passed.

### 3-2 SLOPE RISER PIPES

Install slope riser pipes to the lines and grades shown on the Drawings to produce a smooth interior surface with a minimum curvature. Curvature may be produced by factory

prefabrication, heating, or field placement of sand bags; finished pipe must not be kinked or out of round.

## 3-3 LEVEL SENSOR PIPES

Install level sensor pipes adjacent to slope riser pipe using the same methods. Minimize the curvature of the pipes.

## 3-4 ACCEPTANCE TESTING

The Contractor shall perform acceptance testing of all HDPE piping and receive approval by the Construction Manager prior to burying the pipe or covering the pipe with liner. Acceptance tests shall be as follows:

A. Slope Riser Pipes: With pipe in permanent location, insert submersible pump, discharge piping, and wiring to check pump location and to demonstrate that pipe is free from obstructions.

B. Level Sensor Pipes: With pipe in final location, insert transducers to final location as shown on the Drawings to demonstrate that pipe is free from obstructions.

C. Self Priming Pump Discharge Piping: Pressure test to 50 psi.

D. Leachate Collection Pipes and Well: Field inspection by CQA Engineer.

## 3-5 BOOTS

A. Contractor shall supply prefabricated HDPE boots conforming to the requirements for TYPE III geomembrane presented in Section 02275 for all penetrations of HDPE pipe through the geomembrane liner.

B. Boots shall be welded to the surrounding liner and the HDPE pipe using methods described in Section 02275 as applicable.

- END -

# SECTION 02727
# VERTICAL RISER PIPE

## PART 1: GENERAL

### 1-1 DESCRIPTION

This section describes the precast concrete vertical riser pipe for the primary sump.

### 1-2 SUBMITTALS

A. Submit manufacturer's information and literature on precast concrete pipe, including wall thickness, reinforcement, joint details, and other pertinent information.

B. Submit in conformance with Section 01300.

## PART 2: PRODUCTS

### 2-1 PRECAST CONCRETE PIPE

A. VERTICAL RISER PIPE: shall consist of reinforced concrete 48-inch manhole extensions conforming to ASTM C478. Joints shall conform to ASTM C443, except that joints need not be watertight.

B. COATING: The coating for all surfaces of the riser pipe, except joint gaskets, shall be in conformance with Painting Coating system A-2 described in Section 09900.

C. COVER: See Section 05500, Metal Fabrications.

### 2-2 PRECAST CONCRETE FOUNDATION SLAB

A. CONCRETE: Concrete for the riser pipe foundation shall conform to ACI standards with $f_c' = 3{,}000$ psi minimum.

B. COATING: The coating for all sides of the foundation slab shall be in conformance with Painting Coating system A-2 described in Section 09900.

## PART 3: EXECUTION

### 3-1 GENERAL

A. For any construction method, the Contractor shall be responsible for providing all temporary guys, bracing, and other supports as needed to safely resist all temporary loads.

B. When installation has been completed, the riser pipe shall be plumb to within 1 inch of vertical between top and bottom.

- END -

# SECTION 03100
# CONCRETE FORMWORK

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

### 1-2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 03310 - Structural Concrete: Supply of concrete accessories for placement by this Section.

B. Section 05500 - Metal Fabrications: Supply of metal fabrications for placement by this Section.

### 1-3 RELATED SECTIONS

A. Section 03210 - Concrete Reinforcing Steel

B. Section 03310 - Structural Concrete

### 1-4 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ACI 347 - Recommended Practice For Concrete Formwork.

D. ANSI/ASME A17.1 - Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks

E. PS 1 - Construction and Industrial Plywood.

PART 2: PRODUCTS

2-1 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

2-2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2-3 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Corners: Chamfer, wood strip type; 1 x 1 inch size; maximum possible lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Waterstops: See Section 03310

PART 3: EXECUTION

3-1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

3-2 EARTH FORMS

A. Earth forms require prior approval.

## 3-3 ERECTION - FORMWORK

A. Erect formwork, shoring, and bracing to achieve design requirements in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over stressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not indicated on Drawings.

F. Provide chamfer strips on external corners of all walls and equipment pads.

G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

## 3-4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive protective paint which is effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

## 3-5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate with work of other Sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3-6 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3-7 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

3-8 FIELD QUALITY CONTROL

A. The CQA Engineer shall observe erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

3-9 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

- END -

# SECTION 03210
# REINFORCING STEEL

## PART 1: GENERAL

### 1-1 DESCRIPTION

The Contractor shall furnish, bend, cut, and place steel reinforcement required for concrete construction.

### 1-2 SUBMITTALS

A. Steel: The Contractor shall furnish a certificate by the reinforcement supplier(s) stating the reinforcement meets the requirements of this Specification.

B. Shop Drawings: Submit drawing(s) showing bar schedules, shapes, lengths and proposed bar placement in conformance with Section 01300.

## PART 2: PRODUCTS

### 2-1 GENERAL

The cleaning, placing, spacing, bending, and splicing of reinforcement shall conform to the applicable provisions of ACI 318 and the CRSI Manual of Standard Practice, unless otherwise shown on the Drawings.

### 2-2 REINFORCING BARS

All reinforcing bars shall be new, and shall be deformed bars conforming to ASTM A615, Grade 60, epoxy coated in accordance with ASTM D3963.

### 2-3 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A185, epoxy coated in accordance with ASTM D3963. Where the size, mesh and weight of the fabric are not indicated or specified otherwise, use 6 by 6 - W2.9 fabric weighing approximately 42 lbs/100ft$^2$.

## PART 3: EXECUTION

### 3-1 FABRICATION AND CLEANING

Before the reinforcement is embedded in concrete, all loose rust, scale, and other objectional material likely to be found on reinforcing bars, such as paint, oil, grease, dried mud, and

dried mortar, shall be removed by wire brushing, sand-blasting, wiping with burlap, or other effective means.

Reinforcement shall be accurately formed to the dimensions indicated on the Drawings. All bars shall be bent cold. Reinforcement shall not be straightened or rebent. Bars with kinks or bends not shown on the Drawings shall not be used. Heating or welding of the reinforcement shall not be permitted, except bars may be flame cut to length.

## 3-2 PLACING

Reinforcement shall be accurately positioned and secured against displacement by using annealed iron wire ties (16 gage or heavier) or suitable clips at intersections. Reinforcement shall be supported by concrete or metal supports, spacers, or hangers. In all cases, sufficient supports for horizontal reinforcement shall be used so that there will be no sagging of the bars. In slabs-on-grade, reinforcement shall be supported by means of precast mortar blocks. The blocks shall have a horizontal surface approximately 3 inches by 4 inches. The reinforcement in all other slabs and in beams shall be supported by means of metal chairs. Other details of reinforcement placement are shown on the Drawings.

- END -

# SECTION 03310
# STRUCTURAL CONCRETE

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

The Contractor shall furnish plant, labor, and materials and perform all operations necessary to furnish, place, and install concrete and appurtenances necessary for construction of the cast-in-place and pre-cast concrete (except vertical riser pipe) as shown on the Drawings.

### 1-2 SUBMITTALS

A. Contractor shall submit a certificate from an approved laboratory attesting that the admixture to be used exceeds the physical requirements of ASTM C494, Type A, water reducing and normal setting admixture and, when used, of ASTM C494, Type D, water reducing and set retarding admixture.

B. Submit in accordance with Section 01300.

### 1-3 RELATED SECTIONS

A. Section 03210 - Reinforcing Steel

B. Section 03100 - Concrete Formwork.

### 1-4 REJECTED CONCRETE

In the event that concrete construction fails to conform to the requirements of this Specification, the Contractor may be required to repair or remove and replace said concrete in a manner satisfactory to the COTR. Such repair or removal and replacement shall be performed by the Contractor at no additional expense to the Owner. When the COTR rules that such repair or removal and replacement is required, he will notify the Contractor in writing, stating the extent of the repair or replacement to be made.

## PART 2: PRODUCTS

### 2-1 AGGREGATE

All aggregate shall be stone aggregate conforming to ASTM C33. Maximum size shall be 3/4-inch. Blast furnace slag shall not be used or permitted as coarse aggregate.

## 2-2 CEMENT

Cement, except as otherwise specified herein, shall be Portland Cement approved by the Construction Manager, conforming to ASTM C150 and shall be Type I or Type II. Only one brand of cement shall be used throughout the duration of this work.

## 2-3 WATER

Water used for mixing concrete shall be potable conforming to ACI 301.

## 2-4 WATERSTOPS

Resilient re-extruded virgin polyvinyl chloride, minimum tensile strength 1,900 psi, ultimate elongation 375 percent in accordance with ASTM D412. Six-inch flat, or corrugated with formed center rib or bulb, thickness no less than 3/8-inch tapering to not less than ¼ inch at edge. Use W.R. Meadows No. 6380, Burke No. RB 38-6, Sonneborn No. 6380, or approved equal. Heat seal joints.

## 2-5 ANCHOR BOLTS

Anchor bolts shall be either drilled or cast-in-place as shown on the Drawings.

A. Drilled anchor bolts shall be either resin adhesive, 316 stainless steel, Hilti Type HVA or wedge type expansion anchor, 316 stainless steel, Hilti Type HKB, or equal.

B. Drilled drop-in type female expansion anchors shall be 303 stainless steel, Hilti Type HDI or equal.

C. Adjustable anchors for equipment shall be floating nut type which will allow at least 1/2-inch movement of the fastening stud. The fastening stud shall be 316 stainless steel. Adjustable anchors shall be DECO Manufacturing Co., Decatur, Illinois, Standard Anchor or equal.

# PART 3: EXECUTION

## 3-1 BATCHING

Concrete shall be transit-mixed, supplied by a reputable local ready-mix company, or mixed on site. Concrete shall be proportioned to provide a 28-day compressive strength of at least 3,000 psi. Amount of water used shall be that just required to produce a workable consistency. Slump shall be 4 inches or less. Increase cement content by 20 percent if aggregate is batched by volume instead of weight unless calibrated containers are used in a manner to assure that proper weights of aggregates are used.

When stationary mixers are used, the Contractor shall maintain records of the amounts of the various materials entering each batch and the time of batching. When truck mixers are used, the Contractor shall submit a certified delivery ticket with each mixer load. The ticket shall show the quantities of the various ingredients contained in the batch and the time of batching. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94, subject to the provisions of this Specification.

## 3-2 MIXING

Concrete mixers may be stationary mixers or truck mixers, of a design acceptable to the Construction Manager. The mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. Mixing time shall be that necessary to completely and uniformly combine the ingredients to produce concrete without lumps or pockets of ingredients and without segregation of mixed ingredients. In no case shall mixing time be less than 1 minute after all ingredients (cement, aggregates, admixtures, and water) have been placed in the mixer.

## 3-3 PLACEMENT

A. PREPARATION - Before placing the concrete, the Contractor shall remove all dirt, sawdust, loose tie wire, debris, ice, snow, and water from forms, trenches, existing concrete surfaces, and excavations. Earth surfaces upon which concrete is to be placed shall be clean, damp surfaces, free from frost, ice, and standing or running water. Concrete shall not be placed upon soft mud, dried porous earth, or upon fill that has not been subject to approved rolling and tamping until specified compaction has been obtained.

   No concrete shall be placed until the Construction Manager has given his approval, by issuing a written pour slip, of the subgrade, forms, clean-up, and reinforcing steel in place.

B. CONVEYING AND PLACING - Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation or loss of ingredients. No addition of water to the concrete to facilitate conveying, placing, or finishing shall be permitted after discharge from the mixer.

C. CONSOLIDATION - During and immediately after placing, concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the materials to segregate. The Contractor shall provide a sufficient number of vibrators so that consolidation can be started immediately after the concrete has been deposited in the forms. Concrete shall be deposited as close as possible to its final position in the forms. The depositing of concrete shall be regulated so the concrete may be effectively compacted with a minimum of lateral movement. Concrete shall be consolidated with the aid of

mechanical vibrating equipment supplemented by hand spreading and tamping. Vibrators shall not be used as a means of moving concrete to a desired placement area; this action shall be accomplished by correct initial placement augmented by the use of hand shovels. Vibrating equipment shall be of the high-frequency internal type and shall at all times be adequate to properly consolidate all concrete. Vibration shall be applied at the point of deposit and uniformly throughout the freshly placed concrete.

## 3-4 FINISHING

All unformed surfaces shall receive a float finish. Floating shall be accomplished by either wood or metal floats or by a finishing machine. After the concrete has been properly placed, vibrated, and roughly leveled, it shall be screeded off to the proper elevation. All coarse aggregate shall be pushed below the surface. After screeding and tamping of coarse aggregate, the surface shall be made uniform by means of bull floats operated with a horizontal motion. After floating, the surface shall be tested for uniformity by use of a straightedge. Use of neat cement to absorb excessive surface water is prohibited. No hard trowel or broom finishes will be required. Finished surfaces shall conform to the lines and grades shown on the Drawings within the following tolerances:

1/8 inch for abrupt irregularities
1/4 inch in any 10 feet
3/8 inch in any 20 feet
3/4 inch in any 40 feet or more.

The Contractor shall be held responsible for fully protecting all finished concrete surfaces from any damage which will leave such finished surface in a condition unsuitable for its intended use, as determined by the COTR.

## 3-5 CURING AND PROTECTION

A. GENERAL - "Curing" of concrete shall mean keeping the concrete moist and, if necessary, warm so that hydration of the cement can proceed. Concrete surfaces shall be adequately protected against early evaporation of water, injurious action by the sun, rain, flowing water, frost, freezing, and mechanical injury.

B. METHODS OF CURING - One or more of the following methods shall be used unless otherwise directed:

1. MOIST CURING: Unformed surfaces shall be covered with burlap, cotton, or other approved fabric mats kept in intimate contact with the surface, or with sand, and shall be kept continually wet for the period specified below. Where formed surfaces are cured in the forms, the forms shall be kept continuously wet. If the forms are removed before the end of the curing period, curing

shall be continued as on unformed surfaces using suitable materials. Burlap shall be in two layers, if used.

2. MEMBRANE CURING: Pressure spray tinted curing compounds shall conform to ASTM C309, Type I. Wax resin or wax base curing compounds shall not be used. Unless otherwise specified, the compound shall be the clear or translucent type and shall contain a fugitive dye to assist in securing uniform coverage. The dye shall have a color strength sufficient to render the film distinctly visible on the concrete surface for a period of at least four hours after application. The compound shall be of such a character that it will harden within thirty (30) minutes. The use of any membrane material which will impart a slippery surface to the concrete or alter its natural color shall not be permitted.

   All curing compound shall be delivered to the site of the work in the original sealed container bearing the name of the manufacturer, the brand name, and the manufacturer's batch number. The compound shall be stored so as to prevent damage to the containers, and water-emulsion types shall be protected from freezing.

   The curing compound shall be used as described below:

   The compound shall be applied according to the manufacturer's recommendations and shall be applied immediately after finishing operations are completed and forms are removed. The quantity shall be sufficient to provide the formation of a continuous unbroken film. The curing compound shall be applied to the entire area of the exposed surface. It shall be applied in two separate applications, each of which shall be by an even sweeping motion of the nozzle with sufficient overlap to provide uniform and complete coverage. The second application shall follow five to thirty minutes after the first application and shall be so applied as to cross the sweep of the first application. After final application of the compound, surfaces shall be protected from traffic and other damage to the membrane for the period of curing as specified below.

   No curing compound shall be permitted on surfaces where future painting or bonding with concrete is indicated. Such surfaces shall be cured by the moist process as described previously.

C. MINIMUM CURING PERIODS - Following are the minimum curing periods for curing concrete.

| | | |
|---|---|---|
| Ambient temperature or temperature in curing enclosure: | 50°F - 70°F | 70°F - 100°F |
| Duration of curing concrete : | 7 days | 5 days |

D. PROTECTION

1. GENERAL: Either dry heat or steam heat will be an acceptable means of maintaining temperature control. Open type, or oil pot salamanders, are prohibited for temporary heating purposes. Heaters shall not be placed directly upon green concrete. The Contractor shall protect concrete structures from damage throughout the duration of the project. Any damage to structures occurring before final acceptance of the work shall be repaired by, and at the expense of, the Contractor to the satisfaction of the COTR. In no case shall concrete structures be subjected to dead or live-loads, or construction loads (including backfilling around structures), until completion of the specified curing operation.

2. COLD WEATHER CONCRETING: Placement of concrete in cold weather shall be in accordance with ACI 306 and the requirements of this Specification. Provisions shall be made by the Contractor so that adequate equipment is available for protecting the concrete during freezing or near-freezing weather.

   Concrete shall not be mixed or placed when the daily minimum atmospheric temperature is less than 40°F, unless facilities are provided to ensure adequate protection of the concrete. The temperature of all aggregates and mixing water shall be not more than 100°F when introduced into the mixer. During conveyance of the concrete from the mixer to the pour location, the concrete shall be protected by means of insulated or heated containers as necessary to maintain the temperature of the concrete at not less than 50°F. At time of placement, the temperature of the concrete and reinforcement, forms, and fillers shall be not less than 50°F or more than 90°F. The ground upon or against which the concrete is to be placed shall be maintained at or above 40°F for at least 12 hours before concrete is deposited.

   When the daily minimum temperature is less than 40°F, the structures shall be insulated or housed and heated for the duration of the placement and curing period. Proper ventilation shall be provided in all heated areas to prevent carbonization of concrete surfaces. Air surrounding concrete and concrete

surfaces in contact with forms shall be maintained at or above 50°F for the duration of the curing period. Care shall be used to avoid hot spots and provide uniform heating. When dry heat is used to protect curing concrete, means of maintaining ambient humidity shall be provided. Salts or other chemicals shall not be used for the prevention of freezing. In no case shall concrete be exposed to freezing temperatures for a period of 14 days after placement.

3. HOT WEATHER CONCRETING

Placement of concrete in hot weather shall be done in conformance with ACI 305.

E. INSPECTION AND TESTING - The CQA Engineer shall perform observation and testing to confirm suitability of materials, determine quality of delivered concrete, and to confirm proper placement and curing in accordance with these Specifications. Material suppliers shall submit written certification that the cement aggregates and concrete conform to the requirements of this Specification.

A set of three cylinders shall be taken per every 50 cubic yards of concrete placed or a minimum of one set per day concrete during which is placed. One cylinder shall be tested at 7 days, the remaining two at 28 days to confirm $f'_c$.

The slump and air content shall be tested on every truckload delivered to the site.

Rejected concrete shall be wasted in an area designated by the Construction Manager.

- END -

# SECTION 05500
# METAL FABRICATIONS

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

Structural steel components include, but are not limited to, the riser pipe miscellaneous metal support system for self-priming leachate removal pump, angle mounting brackets, pipe penetrations, control panel mounting system, vertical riser pipe cover, and various support members, as shown on the Drawings.

### 1-2 SUBMITTALS

Prior to fabrication, shop drawings shall be prepared and submitted for approval in accordance with Section 01300. These drawings shall show complete dimensions and details of fabrication, including an erection diagram if not manually placed. Materials shall be clearly specified on the drawings. The Contractor shall have welder certification and conformance test results available at the job site for review by CQA Engineer.

## PART 2: PRODUCTS

### 2-1 STRUCTURAL STEEL

All structural steel shall conform to ASTM A36. All welding of structural steel shall conform to the 1979 edition of the American Welding Society's Structural Welding Code for Steel (AWS D 1.1-1983).

### 2-2 PAINT AND COATINGS

All paint and coatings shall be done in accordance with the Drawings and Section 09900, Paint Coating Systems.

### 2-3 STAINLESS STEEL

Unless otherwise specified or approved, all miscellaneous metal parts, including anchor bolts, which are labelled stainless steel shall be Type 316 stainless steel.

### 2-4 GRATING

Grating shall be capable of supporting all anticipated live and dead loads with an adequate factor of safety. Loss of capacity due to cut-outs shall be considered in the design. Grating shall be fabricated from material that is corrosion-resistant in the expected environment. Grating shall be non-skid.

## PART 3: EXECUTION

### 3-1 FABRICATION AND INSTALLATION

The Contractor shall fabricate, paint, and install all miscellaneous metal work as shown on the Drawings and the submittals.

- END -

# SECTION 08100
# METAL DOORS AND FRAMES

## PART 1: GENERAL

### 1-1 DESCRIPTION OF WORK

Hollow metal doors and frames and hollow metal relights for control building (see Section 13120).

### 1-2 SUBMITTALS

A. Submit manufacturer's technical information showing each type of door and frame, anchorage details, louver types, and glass lite moulding details.

B. Submit in accordance with Section 01300.

## PART 2: MATERIALS

### 2-1 MANUFACTURER

CECO - Republic or approved equal.

### 2-2 BASIC MATERIALS

A. Standard Materials:

Frames: Hot rolled, prime quality carbon steel.
Doors: Cold rolled, stretcher level sheet steel.

B. Galvanized Materials: 100 percent iron-zinc alloy hot-dipped sheet.

### 2-3 DOORS

A. Type: Flush, seamless, with top edges closed flush, 1-3/4-inch thick, seams continuously welded.

B. Face Sheets: 18-gauge minimum.

C. Internal Stiffeners: Formed steel, 22-gauge, vertical stiffeners at 6-inch o.c. maximum, welded to each face of door at 5-inch intervals.

D. Sound Deadeners: Coat inner surfaces with synthetic resin.

E. Fillers: Kraft honeycomb and foam fillers not allowed.

F. Louvers: Standard with manufacturer, galvanize where door scheduled to be galvanized.

G. Glass Lite Mouldings: Standard with manufacturer, vandal proof at exterior, galvanized in galvanized doors.

H. Weather Seals: Standard with manufacturer, adequate to prevent entry of precipitation or blowing dust.

2-4 FRAMES

A. Type: Mitered and welded steel frames. Door frames of 14-gauge steel. Relight frames of 16-gauge steel. Provide standard profiled frames as detailed.

B. Anchors:

1. Type: As appropriate for adjacent construction.

2. Jambs: Not less than 4 each side and spaced not more than 30 inches apart.

3. At concrete walls: Use 3/8-inch round countersunk flat head screws set in lead anchors. Provide 2 additional anchors at head for pair of doors.

4. Floor: Not lighter than 12-gauge, minimum 2 fasteners at each jamb.

5. Stops and Trim: Profiles indicated, 18-gauge.

2-5 PRIMER

Material standard with manufacturer and compatible with galvanized finish where provided.

PART 3: EXECUTION

3-1 FABRICATION

Execute in strict accordance with best steel cabinet craftsmanship. Cut, punch, form, miter, and weld to hairline measurements. Re-roll, hammer level, and straighten steel for flat surfaces. Make exposed joints accurately fitted, hairline in width, and inconspicuous. Use welding where possible, grind exposed joints smooth and invisible. Finish surface smooth and true, free from waves, buckles, dimples, and roughness. Surface imperfections shall be adequate justification for rejection. Use no exposed screws unless mechanically necessary.

Where exposed screws are used, fill recess with body putty and grind smooth. All doors and frames shall be ship primed after fabrication.

## 3-2 PROVISIONS FOR FINISH HARDWARE

Work to templates provided by hardware supplier. Include cut-outs and sinkages. Coordinate with doors. Accurate alignment and clearance shall be provided to avoid field cutting of hardware. Provide reinforcing for both surface and concealed items. Drill and tap as required. Reinforcing shall be adequate for secure, permanent attachment and shall prevent warping or buckling of surfaces.

- END -

# SECTION 09900
# PAINT COATING SYSTEMS

## PART 1: GENERAL

### 1-1 DESCRIPTION OF WORK

This Section describes surface preparation and shop and field application of paint coatings. Prefinishing or factory coating is specified in other Sections.

### 1-2 DEFINITIONS

A. Shop Applied: Shop applied coating is the application of specified materials under controlled conditions at the fabrication facility following fabrication and surface preparation.

B. Field Applied: Field applied coating is the application of specified materials after erection or installation at the project site.

### 1-3 EXCLUSIONS

Do not coat aluminum, stainless steel, brass, or bronze surfaces, except as noted. Do not apply coatings over equipment labels, decals, or nameplates. Other exclusions are specified in Part 3-4.

### 1-4 FACTORY FINISH

Do not coat factory finished surfaces unless specified in Part 3-4. Factory finishes which have been scratched or damaged, regardless of the reason, shall be sanded, feathered, and touched up with materials which match the material and color of the original factory coating.

### 1-5 QUALITY ASSURANCE

A. References: This Section references the Steel Structures Painting Council Specifications (SSPC), 1973. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of SSPC, the requirements of this Section shall prevail.

B. Standardization: Materials, supplies, and articles provided shall be the standard products of the listed manufacturers. Paints in a particular coating system shall be the products of a single manufacturer.

## 1-6 SUBMITTALS

A. Submit the following product data:

1. Coatings systems list keyed to the manufacturer's products.
2. Manufacturer's specifications for each coating system.
3. Samples and color charts of materials which require a color or finish selection.
4. 8-1/2 x 11 color brushout samples, if requested.

B. Submit in accordance with Section 01300.

## 1-7 DELIVERY AND STORAGE

Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name brand, batch number, date of manufacture, storage life, instructions for reducing where applicable, and special directions.

Paints shall be stored in enclosed structures and shall be protected from weather and excessive heat or temperatures below 50°F. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

## 1-8 SPARE PAINT SUPPLIES

The Contractor shall provide one unopened gallon container of each color and type of coating, solvent, and thinner required for the project. Store as directed by the Construction Manager.

## 1-9 PRE-COATING CONFERENCE

Prior to application of shop or field coatings, a conference shall be held. Attendees shall include representatives of the COTR, Construction Manager, Contractor, CQA Engineer, paint subcontractor, and coatings manufacturer. Agenda items shall include, but not be limited to: surface preparations, application conditions, quality of work, and remedy of defective work.

1-10 TEST PANELS

Subsequent to the pre-coating conference and prior to any surface preparation, the Contractor shall prepare a test panel for each coating system. The test panel shall have separate sections for each step involved, including surface preparation, prime coat, and finish coat. After review by the CQA Engineer and acceptance by the COTR, the test panels shall become the project standard for the applicable coating system.

PART 2: PRODUCTS

2-1 MANUFACTURERS

Products of specific manufacturers (except as noted) are listed for reference only. Comparable products of other manufacturers may be submitted for approval by the COTR. Products of other manufacturers shall be of the same general type and intended for industrial applications. Submit information in accordance with Section 01300.

2-2 COATING SYSTEM SPECIFICATIONS

Following are the coating systems for this project. The systems are separated into generic type and the surface to receive the coating.

SYSTEM A-1:

| | |
|---|---|
| Coating Material: | Amine cured epoxy |
| Surfaces: | Metal |
| Surface Preparation: | SSPC SP-5 (White Blast Cleaning) |
| Application: | Shop or Field |
| Primer: | One coat (8 mils DFT) Tnemec Series 61-5002 Teneme-Liner; or,<br>One Coat (3 mils DFT) Sigma Coating's Colturiet Phenguard primer #7409 |
| Finish Coating: | One coat (8 mils DFT) Tnemec Series 61-5001 Teneme-Liner; or,<br>One Coat (5 mils DFT) Sigma Coating's Colturiet Phenguard coating #7435; and, one coat (4 mils DFT) Sigma Coating's Colturiet Phenguard finish #7436. |
| Total System Thickness: | Per manufacturer's recommendations |

SYSTEM A-2:

| | |
|---|---|
| Coating Material: | Amine cured epoxy |
| Surfaces: | Concrete |
| Surface Preparation: | Concrete: Light sweep blast or acid etch. |
| Application: | Shop or Field |
| Primer: | One coat (8 mils DFT) Tnemec Series 61-5002 Teneme-Liner; or,<br>One Coat (3 mils DFT) Sigma Coating's Colturiet Phenguard primer #7409 |
| Finish Coating: | One coat (8 mils DFT) Tnemec Series 61-5001 Teneme-Liner; or,<br>One Coat (5 mils DFT) Sigma Coating's Colturiet Phenguard coating #7435; and, one coat (4 mils DFT) Sigma Coating's Colturiet Phenguard finish #7436. |
| Total System Thickness: | Per manufacturer's recommendations |

SYSTEM B-1:

| | |
|---|---|
| Coating Material: | Polyamide-epoxy/aliphatic polyurethane |
| Surfaces: | Metal |
| Surface Preparation: | 1. Bare ferrous metal surfaces shall be prepared in accordance with SSPC-SP5 (White Blast Cleaning).<br>2. Interior ferrous metal with bleeding surfaces shall be cleaned in accordance with SSPC-SP1 (Solvent Cleaning) and sealed with two coats Koppers Inertol Tar Stop, or as otherwise recommended by coating manufacturer, applied to a thickness of 1.5 mil DFT per coat prior to application of the coating system. |

3. Shop primed surfaces shall be prepared in the field by cleaning all surfaces in accordance with SSPC-SP1 (solvent cleaning) and SSPC-SP2 (Hand Tool Cleaning).

4. Galvanized or nonferrous surfaces shall be treated with a passivator and vinyl wash primer as recommended by the coating system manufacturer.

5. If smoothing of rough metalwork is necessary, a smoothing cement acceptable to the paint system material manufacturer shall be used.

| | |
|---|---|
| Application: | Shop or Field |
| Primer: | One coat (4 to 6 mils DFT) Tnemec Series 61-5002 Teneme-Liner. |
| Finish Coating: | One coat (4 to 6 mils DFT) Tnemec Series 61-5001 Teneme-Liner. |
| Total System Thickness: | Per manufacturer's recommendations |

PART 3: EXECUTION

3-1 PREPARATION

A. General: Surfaces to be coated shall be clean. Before applying coating or surface treatments, oil, grease, dirt, rust, loose millscale, old weathered coatings, and other foreign substances shall be removed except as specified. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded, and free of contaminants which might interfere with the adhesion of the coatings.

Clean cloths and clean fluids shall be used in solvent cleaning. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process will not fall on wet, newly painted surfaces, hardware, electrical fixtures, or surfaces which are not to be coated.

Contractor shall demonstrate that field coating is compatible with factory coating by applying small test patches of specified coating over shop coating.

B. Metallic Surfaces: Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC). Specific applicable standards are specified in each coating system. The solvent in solvent cleaning operations shall be as recommended by the manufacturer.

Preparation of metallic surfaces shall be based upon comparison with SSPC-Vis-1-67T (ASTM D220), and as described herein. To facilitate inspection, the Contractor shall prepare test panels in accordance with Paragraph 1-10.

Except as noted, surface preparation for galvanized metal, aluminum, copper, and brass shall be in accordance with SSPC SP-1 (solvent cleaning) and passivated in accordance with the coating manufacturer's written instructions.

C. Preparation of Concrete, Masonry and Plaster Surfaces: Loose concrete and latency shall be removed by sandblasting and chipping. Voids and cracks shall be repaired by removing loose material and patching with neat cement, mortar, plaster, or other approved material similar in composition to the base material. Patches shall conform to the adjacent surface geometry and texture so as to be indistinguishable after coating. Patching materials shall be allowed to cure as recommended by the manufacturer or in conformance with the requirements of Section 03310.

Unless otherwise specified, surfaces which are to be coated shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the coating manufacturer. Moisture content shall be tested by the Contractor with a Delmhorst Instrument Company moisture detector, or equal. In addition, the surfaces shall be brush treated with a 10 percent muriatic acid solution and thoroughly flushed with water after 10 minutes. (Ten percent acid solution is commercial solution; 30 percent is diluted 2 water to 1 acid.)

Surfaces shall be cleaned by washing and scrubbing with clear water to remove foreign and deleterious substances.

## 3-2 APPLICATION

A. Workmanship: Coated surfaces shall be free from runs, drops, ridges, waves, laps, and brush marks. Coats shall be applied so as to produce an even film of uniform thickness completely coating corners and crevices. Painting shall be done in accordance with the requirements of SSPC Paint Application Guide.

Each coat of paint shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.

B. Paint Properties, Mixing, and Thinning: After application, paint shall provide a satisfactory film and smooth even surface. Flossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Paints shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the manufacturer's instructions. Where necessary to suit the conditions of the surface, temperature, weather, and method of application, the paint may be thinned immediately prior to use by the addition of not more than one pint of the proper thinner per gallon. Unless otherwise specified, paint shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.

C. Atmospheric Conditions: Unless otherwise specified or required for certain water-thinned paints, paints shall be applied only to surfaces that are dry, and only under such combinations of humidity and temperature of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. Paint shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10°F of the dew point, the surfaces shall be heated to prevent moisture condensation thereon. Bare metal surfaces, except those which may be warped by heat, may be dried by flame-heating devices immediately prior to paint application. During painting, and for a period of at least 8 hours after the paint has been applied, the temperature of the surfaces to be painted, the painted surfaces, and the atmosphere in contact shall be maintained at or above 40°F and 10°F above the dew point. During application, paint shall be approximately the same temperature as that of the surface on which it is applied. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are severe.

D. Shop Preparation and Priming: Where specified, components may be shop primed. Surface preparation and priming shall be in accordance with the applicable coating specification. Shop primer shall be of the type specified and from the same manufacturer as the subsequent field applied coatings.

E. Method of Paint Application: Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead or any lead compound which may be destroyed or affected by hydrogen sulfide or any gas likely to be found in wastewater treatment plants.

Electrical and mechanical equipment, on which the manufacturer's coating is acceptable, shall be touch-up primed and painted with two coats of the specified coating system to match the color scheduled. This does not apply to electrical and instrumentation equipment specified in Divisions 11, 13, and 16.

Paint shall not be applied to a surface until it has been prepared as specified. Unless otherwise specified, the primer or first coat shall be applied by brush to ferrous surfaces, except subsequent coats for blast-cleaned ferrous surfaces, which may be either brush or spray applied. Unless otherwise specified, prime and finish coats shall be applied at the rate recommended by the manufacturer for the service involved. After the prime coat is dry, suction spots shall be touched up before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed or rolled.

Unless otherwise specified, finish coats shall not be applied until other work in the area is complete, and until the prime and intermediate coats have been inspected.

F. Film Thickness and Continuity: Coating system thickness is the total thickness of primer and finish coats and does not include passivators or sealers.

The surface area covered per gallon of paint for various types of surfaces shall not exceed that recommended by the manufacturer. The first coat on metal surfaces refers to the first full paint coat and not to conditioning or other pretreatment applications. Unless otherwise specified, the average total thickness (dry) of any completed protective coating system on exposed metal surfaces shall not be less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.

G. Special Requirements: Hangers and supports shall be coated, except for the final coat, prior to installation. Except for those to be filled with grout, the underside of ungalvanized equipment bases and supports shall be coated with at least two coats of rust inhibiting primer prior to setting the equipment in place. Bolt and bolt holes in flanges (such as those used with couplings or wafer type valves where holes and bolts as finally installed will be exposed to weather or moisture) shall be painted prior to assembly to prevent rusting of the unprotected metal.

## 3-3 CLEANUP

Upon completion of painting, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other paint-related damage.

## 3-4 COATING SYSTEMS SCHEDULE

In the following schedule, coating system letters conform to those listed in Part 2-2 of this Specification.

Unless shown otherwise, surface coatings shall be semigloss, except that ceilings shall be coated with flat coatings to match wall areas.

Surfaces to be coated and coating systems to be used are described below. The final coat shall be applied only after all other work, including punch list items, has been completed.

In the following table, the coating system letter (A, B, C, ...) denotes the generic type of coating; the number (1, 2, 3, ...) denotes the surface; the second number (-1-1, -1-2, etc.), if used, denotes a special condition such as inside, different mil thickness, and so forth.

| Surface | Coating System |
|---|---|
| A. GENERAL: | |
| 1. Metal work: | |
| Equipment, including metal base and guards; sluice gates; conduits; piping; appurtenances, including grilles and louvers; electrical, pneumatic, and instrumentation control panels and stations, including supports; precast concrete for anchors. Refer to equipment specifications for exceptions. | |
| a. Submerged iron or steel in all tanks and channels (except stainless and nonferrous). | A-1 |
| b. Iron and steel, including nonferrous, except stainless, exposed to moisture or atmosphere. | B-1 |
| c. Iron and steel, including nonferrous, except stainless, interior. | B-1 |
| d. Roof mounted equipment items including ventilation equipment, louvers, pipes, stacks not otherwise specified, except aluminum. Includes all ferrous surfaces and motors inside ventilation equipment | B-1 |

| | |
|---|---|
| enclosures. Air blower intake/filters, silencer and attachments. | |
| e. Piping and conduit, including supports. | B-1 |
| 2. Concrete, grout, masonry and plaster: | |
| a. All concrete within landfill. | A-2 |
| b. Other. | Unpainted |
| 3. Other materials: | |
| a. Aluminum jacketing on insulated piping systems. | Unpainted |
| b. Ductwork not exposed to view. | Unpainted |
| B. BUILDINGS: | |
| 1. Interior | |
| a. Concrete and masonry walls, plaster and gypsum board walls. | Unpainted |
| b. Metal surfaces, including doors and door frames, except for aluminum, stainless steel and anodized finish surfaces. Exceptions are metal items specified with factory finish. | B-1 |
| 2. Exterior | |
| a. Metal surfaces, such as doors and door frames, except for aluminum and stainless steel surfaces, except exposed portions of aluminum cap flashing shall be painted. | B-1 |

- END -

# SECTION 11210
# LEACHATE PUMPS

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

A. The submersible pump in the Primary Leachate Collection System. This will be the principal pump used to remove leachate from the landfill.

B. The self-priming sump pump in the vertical riser of the Primary Leachate Collection System. This higher capacity pump will be used to remove storm water from the primary sump.

C. The submersible pump in the Secondary Leachate Collection System. This pump will be used to remove leachate from the secondary collection system which will capture any leachate that leaks through the primary system.

D. The transfer pump used to move stored leachate from the leachate temporary storage tank to highway tank trucks.

### 1-2 SUBMITTALS

A. Submit detailed information on proposed pumps, motors, materials, connections, and electrical requirements

B. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 SUBMERSIBLE PUMPS

The submersible pumps for both primary and secondary leachate collection systems shall be identical. The pumps shall be rated approximately as follows:

| | |
|---|---|
| RATED CAPACITY | 10 gpm |
| TOTAL DYNAMIC HEAD | 50 feet |

The pump shall be constructed such that all wetted parts are type 316 stainless steel, or other highly corrosion resistent materials. The pump and motor shall have bearings which permit the pump to be operated in continuous or intermittent service in the horizontal position. The external portions of the case shall be free of sharp edges or burrs which would damage the HDPE slope riser pipes, or which might prevent the free sliding of the pump along the enclosing pipe. The motors shall be wired to run on single phase 240 volt (3

wire) service. The submersible pumps shall be GRUNDFOS Model 7S03-8, or approved equal.

2-2 SELF-PRIMING SUMP PUMP

The large capacity sump pump installed in the vertical riser shall be a self-priming type, capable of drawing water 10 ft or more at sea level. The pumps shall be rated approximately as follows:

| | |
|---|---|
| RATED CAPACITY | 150 gpm |
| TOTAL DYNAMIC HEAD | 50 feet |

The pump shall be a Gorman-Rupp Model 92B9B, or approved equal. The pump shall have all internal wetted parts constructed of type 316 stainless steel.

2-3 TRANSFER PUMP

The transfer pump shall be a horizontally mounted centrifugal type pump. The pump shall be rated approximately as follows:

| | |
|---|---|
| RATED CAPACITY | 500 gpm |
| TOTAL DYNAMIC HEAD | 50 feet |

All the wetted parts of the pump including the interior of the pump case and the impeller shall be epoxy coated to prevent corrosion. Motor shall be TEFC, 3 phase 230/460 Volt, 10 horsepower minimum. Pump shall be a PACO 4095-7, or approved equal.

2-4 PUMP SCHEDULE

| Pump No. | Description |
|---|---|
| W5P1 | Primary Sump, Submersible |
| W5P2 | Secondary Sump, Submersible |
| W5P3 | Primary Sump, Self Priming |
| W5P4 | Transfer Pump |

2-5 PUMP MARKING

Pumps shall have stainless steel (SS) indented marker plates marked with the pump number, Panduit Corporation, Catalog No. MMP350-C or approved equal, held in place with SS ties, Panduit Corporation, Catalog No. MLT4S-CP or approved equal. Characters shall be 3/16" in height minimum, indented with indenter marker press, Panduit Corporation, Catalog No. IMP187, or approved equal.

## PART 3: EXECUTION

### 3-1 PUMPS

Contractor shall install all pumps and motors in accordance with manufacturers' instructions, as shown on the Drawings. Installation shall include all piping, safety cables, and wiring.

### 3-2 ACCEPTANCE TESTING

Contractor shall test pumps in-place to demonstrate their ability to operate at the design flow rate and dynamic head.

### 3-3 SPARES

Contractor shall furnish one spare submersible pump, one spare self-priming pump, and one spare transfer pump. Spare pumps shall be acceptance tested as above.

- END -

# SECTION 13120
# CONTROL BUILDING

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

A. Control building to house electrical equipment and control panel for leachate collection system pumps and ancillary equipment.

### 1-2 RELATED SECTIONS

A. Section 16100 - Basic Materials and Methods

B. Section 08100 - Metal Doors and Frames

### 1-3 SUBMITTALS

A. Submit shop drawings and other manufacturers' information showing the details of the proposed control building, hardware, and foundation.

B. Submit manufacturers information supporting the ability of the proposed building system to support the design loads.

C. Submit in accordance with Section 01300.

### 1-4 DESIGN LOADS

The building shall be capable of supporting a snow load of 20 psf and a wind velocity of 80 mph. The building shall support live loads, if any, associated with the interior lighting and electrical and control equipment.

## PART 2: PRODUCTS

### 2-1 PRE-MANUFACTURED METAL BUILDING

A. General: The control building shall be a pre-manufactured metal building with minimum dimensions as shown on the Drawings.

B. Performance: The metal building shall have a leak free roof and shall be assembled in a neat and workmanlike manner so as to eliminate unsightly gaps and fitment problems. The building need not be insulated. However, closures are required at top and bottom of walls to minimize dust entering the building.

C. Finish: The building finish shall be corrosion resistant; galvanized steel or aluminum or approved equal.

2-2 HARDWARE

A. Door shall be in conformance with Section 08100, Metal Doors and Frames.

B. Lock and latch mechanism shall consistent with existing Hanford master key system. Provide 6 keys. Manufactured by Stanley or approved equal.

PART 3: EXECUTION

3-1 GENERAL

Erect building and install hardware in conformance with manufacturer's recommendations.

- END -

# SECTION 13205
# LEACHATE TEMPORARY STORAGE TANK

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

Steel tank which will be used for the temporary storage of leachate.

### 1-2 RELATED SECTIONS

A. Section 09900 - Paint Coating Systems

### 1-3 SUBMITTALS

A. The Contractor shall submit fabrication drawing(s) for the tank showing the details of the proposed construction. The tank drawing shall also define the proposed coating system, lifting points, tank support anchor bolt locations, mechanical level indicator, insulation, heat tracing, float switch assembly, and other details.

B. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 TANK

Tank Data:

| Item | Number Required | Description |
|---|---|---|
| Diameter | - | 8 ft |
| Sideshell | - | 25 ft |
| Capacity | - | 10,000 gal |
| Rating | - | 25 psi ASME stamped |
| Tank Material | - | Carbon Steel, Type A36 |
| Inspection Ports | 2 | 14 x 18 inches |
| Flanged Nozzles | | |
| (125 lb American Standard) | 2 | 4 inch (tank fill and drain ports) |
| | 1 | 6 inch (high level float) |
| | 1 | 8 inch (float cable) |
| Tank Coatings | | |
| Interior: | - | A-1 |
| Exterior: | - | B-1 |

Tank shall be A36 steel with dimensions shown on the approved fabrication drawing(s). Tank shall be ASME code stamped, rated for the pressure shown above.

2-2 COATINGS

Apply coatings to the exterior and interior of the tank in accordance with Section 09900, Paint Coating Systems. The interior of the tank shall receive a SYSTEM A-1 coating; the exterior shall receive a SYSTEM B-1 coating.

2-3 LEVEL INDICATOR ASSEMBLY

Provide a mechanical level indicator assembly consisting of:

A. A corrosion resistant float, Type 316 Stainless Steel

B. A stainless steel cable passing through corrosion resistant sheaves.

C. A stationary vertical bar graduated in hundredths of a foot (alternating black and white), extending over the full depth of the tank, numbered at 0.2 ft intervals or better.

D. A pointer fabricated of corrosion resistant material which clearly indicates the depth of leachate in the tank.

E. A framework to support the indicator.

PART 3: EXECUTION

3-1 GENERAL

Furnish and install the leachate temporary storage tank as shown on the approved submittal drawings. All welding to tank wall shall be completed prior to sandblasting for coating.

3-2 INSPECTION

ASME Code pressure test to be arranged and paid for by tank Fabricator and Contractor. All welding of tank including connections and details for electrical or pipe supports, insulation, and cladding shall be completed prior to ASME pressure test. Contractor shall notify CQA Engineer following coating to allow inspection by CQA Engineer. Tank shall not be insulated until coating is approved by COTR.

- END -

# SECTION 13340
# PUMP CONTROLS

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

A. Controls for leachate collection system pumps, alarms, timers, float switches, level indicators, and related equipment.

### 1-2 RELATED SECTIONS

A. Section 16100 - Basic Materials and Methods (Electrical).

### 1-3 GENERAL REQUIREMENTS

A. The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment.

B. Locate and install all equipment so that it is easily accessible for operation and maintenance.

C. The Contractor shall coordinate the work specified in this Section so that a complete instrumentation and control system for the facility will be provided and will be supported by accurate shop and record drawings.

### 1-4 FUNCTIONAL OBJECTIVES

During normal operation, the control of the pumps is done automatically by the control panel. The low capacity primary submersible pump is normally switched on when a rising leachate level is sensed by the transducer and current sensitive relay; it is switched off when a low level is sensed. The secondary submersible pump control is similar. These on/off levels are adjustable at the control panel through adjustment of the current sensitive relay controlled by current from the level transducer. The high capacity self-priming primary pump has independent high and low on/off levels controlled by mercury float switches in the vertical riser pipe. The levels are adjusted by physically moving the position of the float switches. Each of the transducer/level sensor systems will have an LCD indicator on the front of the panel indicating the depth of water, in inches. All sump leachate pumps will be equipped with hand-off-auto switches. In the auto position, all pumps will be shut off by either a high tank level or a low water level. The sump leachate pumps will have panel mounted failure and run lights. The transfer pump will have an ON/OFF switch and motor starter located at the pump, without automatic shutoff (except thermal). The control

building will be provided with a rotating beacon on the roof, to be activated by either a pump failure or a high tank level.

Leachate flow will be monitored by an accumulating turbine meter on the discharge line.

## 1-5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The equipment, materials, installation, and other work shall conform to all applicable regulations, standards, specifications, and codes which are current as of the date of the final inspection for this work. Such documents include, but not limited to, those which are established by the following sources:

1. Instrument Society of America (ISA).
2. American Petroleum Institute (API).
3. National Electrical Manufacturers Association (NEMA).
4. Occupational Safety and Health Administration (OSHA).
5. American National Standards Institute (ANSI).
6. Military Standards (MIL Standards).
7. National Fire Protection Association (NFPA).
8. Scientific Apparatus Makers Association (SAMA).
9. Institute of Electrical and Electronic Engineers (IEEE).
10. National Electrical Code (NEC).
11. Insulated Cables Engineers Associates (ICEA).
12. Local Power and Telephone Companies.
13. Local Authorities having jurisdiction over the work.

## 1-6 SUBMITTALS

A. Submit detailed drawings and detailed manufacturers' information describing the proposed control panel and associated devices. The design shall be consistent with the logic presented on the Drawings, which is included in order to show the intended control logic and not as a specific wiring diagram. Interface between

instruments, motor starters, control valves, flow meters, and other equipment related to the instrumentation and control system shall be included in the shop drawing submittal.

B. Submit details of the electrical system and pump controls to support Acceptance Test Procedure WHC-SD-W025-ATP-001.

C. Prepare and submit record drawings, spare parts lists, and O&M manuals in accordance with Sections 16010 and 01300.

D. Submit in accordance with Section 01300.

PART 2: PRODUCTS

2-1 GENERAL

A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

B. All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from one manufacturer.

C. All instrumentation shall be suitable for operation in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges. The Contractor shall furnish and install all power wiring for these devices (e.g., heaters, fans, etc.). NEMA rated enclosures suitable for the environment shall be furnished.

D. Analog measurements and control signals shall be electrical as indicated herein, and shall vary in direct linear proportions to the measured variable, except as noted. Electrical signals outside of control panel(s) shall be 4 to 20 milliamperes dc except as noted. Signals within enclosures shall be 1-5 volts dc. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.

E. All power supplies shall have an excess rated capacity of 40 percent.

F. The power source or branch supply to each control and analog loop shall be individually fused and disconnectable.

G. Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the COTR. Any changes associated with a proposed alternative shall be at no additional cost to the Owner. The required approval shall be obtained in accordance with Section 01300, Submittals.

## 2-2 GENERAL INSTRUMENTATION ENCLOSURE COMPONENTS

A. Signal Isolators, Converters, and Power Supplies: Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to ensure adjacent component impedance match, or where feedback paths may be generated, or to ensure system integrity thereby allowing any signal receiving component to be removed without disabling the entire loop. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to ensure sufficient power to each loop component.

B. General Purpose Relays: General purpose relays in the control panel(s) shall be plug-in type with contacts rated 10 amperes at 120 volts ac. Quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover with an LED indication of relay actuation. Sockets for relays shall have screw type terminals. Relays shall be IDEC, Potter and Brumfield Type KRP or KUP, Square D Type K, or equal.

C. Time Delay Relays: Time delay relays shall be pneumatic on-delay or off-delay type with contacts rated 10 amperes at 120 volts ac. Units shall include adjustable dial with graduated scale covering the time range in each case. Time delay relays shall be IDEC, Agastat Series 7000, Omron Type ATSS, or equal.

D. Slave Relays: Additional relays (slave relays) shall be installed and wired when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.

E. Selector Switches: Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations, and other features shall be as shown. Devices shall be IDEC, Cutler-Hammer Type E-24, General Electric Type CR104, or equal.

F. Pushbuttons and Indicating Lights: Pushbuttons and indicating lights shall be round configuration. Indicating lights shall be push-to-test. Details including colors, engraving, contacts, and other features shall be as shown on the submittal. Devices shall be IDEC, Cutler-Hammer Type, General Electric Type, or equal.

G. Circuit Breakers: Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.

H. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box-clamp terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided, and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be General Electric Type CR 151A1 with mounting rack, equivalent by Cinch-Jones, or equal.

I. Signal and Control Circuit Wiring:

1. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire; these shall be UL listed Type MTW and shall be rated 600 volts. Wires for instrument signal circuits and alarm input circuit shall be No. 18 AWG. All other wires, including shielded cables, shall be No. 16 AWG minimum.

2. Wire Insulation Colors: Conductors supplying 120 volts ac power on the line side of a disconnecting switch shall have black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt ac control circuit conductors shall be red. All wires energized by a voltage source external to the control panel(s) shall have yellow insulation. Insulation for all dc conductors shall be blue.

3. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, Brady Type B-500, Thomas and Betts "E-Z Code", or equal or shall be permanently marked heat-shrink plastic.

## 2-3 ALARM BEACON

Provide an amber strobe light suitable for outdoor installation, Graingers 4A966 or approved equal conforming to the requirements of Hanford Site Standards.

## 2-4 ENCLOSURE

The control panel shall be enclosed in a NEMA TYPE 4X steel cabinet, 14 gauge steel construction, similar to Hoffman A-36H30BLP or approved equal. The size of the enclosure shall be sufficient to contain all the necessary controls.

## 2-5 PANEL MOUNTED DEVICES

The lights and switches mounted on the panel front (the door) shall be 1 1/8 inch diameter IDEC, Telemechanique, or approved equal. Each panel mounted device shall have a label

permanently affixed to the panel front which describes the device function or meaning. These labels shall be engraved laminated plastic or metal with cushioned adhesive backs.

## 2-6 SUB-PANEL LABELS

All devices mounted on the subpanel shall be labelled using embossed tape or other semi-permanent material. The labels shall be consistent with the labelling system used in the shop drawings and wiring diagrams.

## 2-7 FLOAT SWITCHES

Float switches used in the primary sump and in the leachate temporary storage tank shall be sealed mercury switches with all non-metallic wetted parts, NOHKEN FG88 point switch combination (Zi-Tech Instrument Corp.), or approved equal.

## 2-8 TRANSDUCERS AND METER/CONTROLLERS

The level sensing transducers shall be constructed of 316 stainless steel with maximum diameter of 1.5 inches. The operating range shall be 0 to 6 psi with an accuracy not less than ±0.5% of full scale. Each transducer shall be mounted in an external flush-joint semi-ridged plastic pipe (PVC threaded flush joint well pipe or equal) for insertion into the level sensor pipe.

The meter/controller shall have outputs from two relays, one adjustable to the "pump start" level and the second adjustable to the "pump stop" level. Relays shall be adjustable over the full range of current. The meter/controller shall display the water level in inches; the indicator shall be mounted on the face of the control panel.

The transducer shall be AMETEK Model 57SP and the meter/controller shall be AMETEK Model 572, or approved equal.

## 2-9 PROGRAMMABLE LOGIC CONTROLLER (PLC)

The Contractor may substitute a PLC in place of the relays, timers, and other control devices shown on the control Drawing. The PLC shall be supplied with a hand-held field programmer and memory modules such that the system can be monitored and reprogrammed in the field. PLCs shall be IDEC, Gould/Modicon, or approved equal.

## 2-10 TIMER

The 24-hour interval timer shall be a single channel digital time switch with LCD display for mounting inside the control panel, MaxiRex BD1 by Grenmont Controls, Inc., or approved equal.

# PART 3: EXECUTION

## 3-1 FABRICATION AND INSTALLATION

Following the receipt of an approved submittal in accordance with Section 01300, the Contractor shall fabricate the control system as shown on the approved drawings. The Contractor shall install the controls and perform all necessary field electrical work to connect the local and remote control devices.

## 3-2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation:

1. All wires shall be run in plastic wireways except field wiring, wiring run between mating blocks in adjacent sections, wiring run from components on a swing-out panel to components on a part of the fixed structure, and wiring run to panel-mounted components.

2. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

3. Wiring run to control devices on the front panels shall be tied together at short intervals (6 inches maximum) with nylon wire ties and secured to the inside face of the panel using adhesive mounts.

4. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in approximately the same plane as the rear of the instruments.

5. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings.

B. Wire Marking:

1. Instrument signal circuit conductors shall be tagged with unique multiple digit numbers, consistent with Section 16100 Part 3-8.

2. Black and white wires from the circuit breaker panelboard shall be tagged including the 1- or 2-digit number of the branch circuit breaker.

## 3-3 INSTALLATION, CALIBRATION, TESTING, START-UP, AND INSTRUCTION

A. General: All systems specified in the applicable Sections of Division 13 shall be installed, connected, calibrated, and tested by the Contractor as described below.

B. Installation and Connection: The installation personnel shall be provided with a final reviewed copy of the shop drawings and data. All external wiring shall be installed in conformance with Section 16100, Basic Materials and Methods.

1. The instrument process sensing lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section 16100. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.

2. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe and/or tubing entries.

3. The Contractor shall have a technical field representative instruct these installation personnel on any and all installation requirements. Thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.

4. After all installation and connection work has been completed, the technical field representative shall check it for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all other similar details. The technical field representative shall certify in writing to the Contractor that for each loop or system checked out, all discrepancies have been corrected by the installation personnel.

5. The Contractor shall bear all costs and provide all personnel, equipment, and materials necessary to implement all activities specified herein.

## 3-4 FLOAT SWITCHES

Install the "pump off" float switch in the leachate collection well at a level such that the switch opens when the leachate level is 6 inches deep. Install the "pump on" switch 24 inches above the "pump off" switch. Install the "tank high level" switch in the leachate temporary collection tank to close when the leachate level is 12 inches from the top of the tank. Switch levels may be modified as directed by the COTR.

When installing float switches in the leachate collection well, provide at least 24 inches of wire coiled in housing so switches may be lowered if required.

## 3-5 ACCEPTANCE TESTING

Perform acceptance testing of leachate pumps and control system in accordance with Acceptance Test Procedure WHC-SD-W025-ATP-001.

- END -

# SECTION 15060
# PIPING AND PIPE FITTINGS

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

All HDPE, stainless steel, and other piping included in the leachate collection and removal system.

### 1-2 REFERENCES

All pipe materials and methods shall conform to applicable requirements of documents listed below. In case of conflict between this Section and the listed documents, the requirements of this Section shall prevail.

| | |
|---|---|
| ANSI A13.1 | Piping and Piping Systems |
| ANSI A74 | Cast Iron Soil Pipe and Fittings |
| API 1104 | Welding of Pipeline and Related Facilities |
| ASME | Boiler Code (Class I) |
| ASME B2.1 | Pipe Threads (except Dryseal) |
| ASME B16.1 | Cast Iron Pipe Flanges and Flanged Fittings |
| ASME B31.1 | Power Piping |
| ASME B31.3 | Chemical Plant and Petroleum Refinery Piping |
| ASTM A53 | Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless |
| ASTM A312 | Seamless and Welded Austenitic Stainless Steel Pipe |
| ASTM A403 | Wrought Austenitic Stainless Steel Piping Fittings |
| ASTM D2683 | Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing |
| ASTM D3261 | Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM F477 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| AWWA C101 | Standard for Thickness Design of Cast Iron Pipe |
| AWWA C110 | Standard for Gray Iron and Ductile Iron Fittings, 2-inch through 48-inch, for Water and Other Liquids |
| AWWA C111 | Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings |
| AWWA C115 | Standard for Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges |
| AWWA C151 | Standard for Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for water and Other Liquids |
| AWWA C200 | Standard for Steel Water Pipe, Six Inches and Larger |

| | |
|---|---|
| AWWA C203 | Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied |
| AWWA C206 | Standard for Field Welding of Steel Water Pipe |
| AWWA C207 | Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4-inch through 144-inch |
| AWWA C606 | Standard for Grooved and Shouldered-type Joints |
| AWWA M11 | Steel Pipe / A Guide for Design and Installation |
| CISDI 301 | Standard for Cast Iron Soil Pipe |
| UPC (1985) | Uniform Plumbing Code |

1-3 RELATED SECTIONS

A. Section 16859 - Electrical Heat Trace.

B. Section 15250 - Tank and Piping Insulation.

C. Section 02725 - HDPE Pipe and Flatstock.

1-4 SUBMITTALS

A. Submit shop drawing(s) showing discharge piping from leachate temporary storage tank through transfer pump to final discharge fitting.

B. Submit shop drawing(s) for the HDPE piping and valves between crest wall and leachate temporary storage tank. Drawing shall include flanged connections for each HDPE pipe on tank side of wall to accommodate pipe disconnection for pump retrieval.

C. Submit manufacturer's material certification for stainless steel pipe.

D. Submit in accordance with Section 01300.

PART 2: PRODUCTS

2-1 PIPE

A. HDPE Pipe - See Section 02725, HDPE Pipe and Flatstock.

B. Stainless Steel Pipe - All pipe identified on the Drawings as stainless steel shall be Schedule 40 Type 316 Stainless Steel, conforming to ASTM A312 and ASTM A403.

1. General

Pipe shall be handled and installed in accordance with AWWA M11, Chapter 16. Welded joints shall be in accordance with AWWA C206 and the manufacturer's recommendations.

2. Pipe Welding

Pipe shall be welded by ASME Section 9-certified welders using shielded metal arc, gas shielded arc, or submerged arc welding methods. Each welder's certificate shall be provided to the Construction Manager prior to that welder working on the job. Welds shall be in accordance with the requirements of ASME Boiler Code (Class I) and API 1104.

## 2-2 INSULATION

Conform to Section 15250 - Tank and Piping Insulation.

## 2-3 ELECTRICAL HEAT TRACE

Conform to Section 16859 - Electrical Heat Trace.

## 2-4 FITTINGS

All wetted surfaces of fittings shall be HDPE or Type 316 stainless steel, or other approved corrosion resistant material.

Standard fittings and special fittings shall be manufactured from the same class of material as the associated pipe and shall be fully compatible.

Fittings shall be manufactured in accordance with ASTM D2683 or ASTM D3261. Fabricated fittings shall be pressure rated to match the system piping.

## 2-5 FLANGE GASKETS

When connecting flanges requiring gaskets, 1/8" thick neoprene or approved equal shall be used.

## 2-6 COUPLINGS

A. HDPE Pipe: Joining of HDPE pipe to HDPE pipe or fittings shall be done in accordance with Specification 02725. Couplings of HDPE pipe to pipes or fittings shall be flanged, using flanged coupling adapters and ANSI backup rings rated equal to or greater than the system design pressure for the piping.

B. Stainless Steel Pipe: Joining of stainless steel pipe to stainless steel pipe or fittings shall be done by welding or by flanged connections. Flanges shall be rated for a working pressure equal to or greater than the system design pressure.

C. Dissimilar Pipe Materials: Where pipes, nozzles, or fittings of different materials are connected, the coupling shall be a flanged connection.

D. Flanged Bolts: Flanged joints shall use grade 2 or higher steel bolts. Gaskets shall be required when joining to non-polyethylene materials. In all cases, the bolts shall be evenly torqued using a crossing pattern to gradually tighten lug nuts. Flanged joints shall be retorqued after one hour or more has passed.

2-7 DISCHARGE FITTING

The discharge end of the transfer pump discharge piping shall be equipped with a KAMVALOK quick disconnect fitting. Size and model number are shown on the Drawings.

PART 3: EXECUTION

3-1 ACCEPTANCE

A. Pipe Testing: Contractor shall perform all tests specified. Provide all test equipment including test pumps, gauges, volumetric measuring equipment, and other equipment required. Pressure gauges used shall be graduated in increments not greater than 5 psi and shall have range of approximately twice test pressure. Use only calibrated gauges and instruments. Provide evidence that calibration was performed within one year of date of use.

Where testing is specified, completed installation shall comply with designated requirements. Provide replacement materials as may be required to accomplish this compliance. Specific pipe test schedule is as follows:

PIPE TEST SCHEDULE

| Piping | Test Pressure | Test Duration |
|---|---|---|
| HDPE Sump Discharge Piping From Crest Pad to Tank | 33 psi | 1 hr |
| HDPE Leachate Collection (drain pipe) | 0, visual only | |
| Stainless Steel Piping - all | 33 psi | 1 hr |

General procedures shall be as follows:

1. General

During testing, remove from systems all equipment which would be damaged by test pressure. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, any previously tested portion shall become a part of any later test of composite system. Where new pipe connects to existing piping, the joint between the two pipes shall be tested. Correct leaks by remaking joints with new material; makeshift remedies will not be permitted. Test time will be accrued only while full test pressure is applied to system.

The Contractor shall be responsible for providing all temporary fittings, plugs, and thrust blocking for all testing at the specified pressure.

Perform all testing before backfilling, concealing, insulating, or painting.

2. Liquid Systems

Leakage shall be zero for the exposed piping at the specified test pressure throughout the specified duration. Leakage from buried liquid piping systems shall be less than 0.05 gallon per hour per inch diameter per 100 feet of buried piping.

Makeup water will be permitted to maintain test pressure as appropriate. The volume of makeup water shall be accurately measured and recorded.

B. Valve testing:

1. Test valve bonnets for tightness. Test operate valves from closed to open to closed position while valve is under piping pressure.

2. Test automatic valves by actuating from fully open to fully closed position.

3-2 CLEANING

A. Clean equipment and materials. Remove foreign materials including dirt, grease, and other matter.

B. Clean, by flushing, interior of water piping prior to pressure testing. Upon completion of flushing, completely drain systems at all low points. Remove, clean, and replace all strainer baskets and refill systems, if appropriate.

## 3-3 DIMENSIONS

Piping dimensions shown on the Drawings are approximate. It is the Contractor's responsibility to furnish and install piping of the proper dimensions, which will properly fit with the connecting elements, pipes, fittings, tank, pumps, etc.

- END -

# SECTION 15066
# PIPE AND CONDUIT SUPPORT SYSTEMS

## PART 1: GENERAL

### 1-1 DESCRIPTION OF WORK

This Section describes pipe and conduit hangers, brackets, and supports. Pipe and conduit support system shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, structural attachments, and other accessories as shown on the Drawings and as specified herein.

### 1-2 SUBMITTALS

A. Manufacturer's technical data for all hangers, brackets, supports.

B. Computations demonstrating that the support system is adequate to meet the test pressure (33 psi) and dead loads.

C. Fabrication drawings showing location of pipe and conduit supports, including type of structural and pipe attachments.

D. Submit in accordance with Section 01300.

### 1-3 REFERENCES

All pipe and conduit support materials and methods shall conform to the most current versions of applicable requirements in documents listed below. In case of conflict between this Section and the listed documents, the requirements of this Section shall prevail.

| Reference | Title |
|---|---|
| ANSI A13.1 | Piping and Piping System |
| ANSI B31.1 | Power Piping |
| ASME | Boiler and Pressure Vessel Code |
| ANSI/MSS SP-58 | Pipe Hangers and Supports - Materials, Design and Manufacturer |
| ANSI/MSS SP-69 | Pipe Hanger and Supports - Selection and Application |
| UPC | Uniform Plumbing Code |
| ANSI C2 | National Electrical Safety Code |
| C84.1 | Electric Power System and Equipment |
| C136 | Roadway Lighting |
| NFPA 70 | National Electrical Code |

PART 2: PRODUCTS

2-1 GENERAL

The Contractor shall design, provide, and install pipe and conduit support systems which include hangers, brackets, supports, anchors, expansion joints, and structural attachments. The support system shall be pipe rack, trapeze pipe hangers, or individual pipe clamps, hangers, and supports as specified herein. The support system shall be designed in conjunction with the pipe and conduit to be supported.

Pipe supports, anchors, and expansion joints have generally not been indicated on the Drawings. It shall be the Contractor's responsibility to provide a complete system of pipe and conduit supports.

Where pipe transitions are required from one elevation to another, the Contractor shall field verify and adjust the pipe, conduit, and associated support system to provide a complete, safe, and satisfactory installation.

2-2 PIPE RACKS AND TRAPEZE HANGERS

Pipe and conduit racks and trapeze hangers shall be constructed of galvanized steel channels, rods, posts, post base, clamps, brackets, fittings, and accessories for supporting pipes in equipment area as shown. All components for pipe and conduit rack and trapeze shall be Unistrut or approved equal.

2-3 PIPE CLAMPS AND HANGERS

In area where pipe racks and trapezes are not used, pipe shall be supported with clamp hanger and stanchion saddle support system. The clamps and hangers shall be fastened to threaded rods hanging from structural attachments. Pipe supports shall be selected for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. All pipe clamps and hangers shall be hot dip galvanized steel.

Pipe and conduit clamps and hangers shall be as manufactured by ITT Grinnell or equal and shall be as follows:

| Type | Pipe Size - Inches | Pipe Material | Grinnell Figure |
|---|---|---|---|
| Split ring | 3/4 to 6 | all type | 104 |
| Split clamp | 1/2 to 3 | all type | 138R |
| Adjustable ring | 1/2 to 6 | all type | 97 |
| Adjustable ring | 3/4 to 4 | copper | CT-269 |
| Adjustable ring | 3/4 to 6 | all type | 269 |
| Adjustable clevis | 4 to 30 | all type | 260 |
| Adjustable clevis | 3/4 to 12 | all type with insulation | 300 |
| Pipe clamp | 3 to 30 | all type | 216 |
| Socket clamp | 4 to 24 | cast iron | 590 |
| Stanchion saddle | 4 to 12 | all type | 259 |
| Adjustable saddle support | 3 to 24 | all type | 264 |
| Riser clamp | 2 to 8 | all type | 40 |

## 2-4 STRUCTURAL ATTACHMENTS

Structural attachments shall be concrete insert channels or individual inserts for new concrete; surface mounted channel or individual inserts for existing concrete; or where applicable, steel roof-plate-supported attachments, complete with all accessories required. All structural attachments including all accessories shall be hot dip galvanized steel and shall be provided by a single manufacturer. Structural attachments shall be as manufactured by Unistrut Corporation or equal.

## 2-5 PROTECTION SADDLES

Protection saddles shall be used for protecting pipe insulation against damage at pipe supports. The nominal thickness of covering shall be the same as that of pipe insulation. The protection saddles shall be curved carbon steel plate and shall be ITT Grinnell Figure 160 through Figure 162 or equal.

# PART 3: EXECUTION

## 3-1 DESIGN

Pipe or conduit support system shall be designed in accordance with applicable reference standards listed in Part 1-3. Pipe and conduit supports shall be designed and selected to withstand seismic loads for UBC Zone 2, and shall adhere to the following:

A. Weight balance calculations shall be made to determine the required supporting force at each pipe support location and the pipe weight at each equipment location. Design loads for inserts, clamps, and other support items shall not exceed the manufacturer's recommended loads.

B. Pipe supports shall be able to support the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment. Allow clearances for pipe expansion and contraction.

C. Wherever possible, pipe attachments for horizontal piping shall be pipe clamps. Horizontal or vertical pipes shall be supported at locations of least vertical movement as practicable.

D. All pipe supports shall provide a means of vertical adjustment after erection.

E. Where practical, riser pipe shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamps.

## 3-2 INSTALLATION

Pipe support system shall be installed strictly in accordance with standards and codes referenced in Part 1-3, piping support system manufacturer's recommendations, and piping manufacturer's recommendations.

In addition, all piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper-plated. Those portions of pipe supports which contact other dissimilar metals shall be rubber or vinyl coated.

Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

Pipe supports and expansion joints are not required in buried piping, but concrete thrust blocking or other approved anchorage shall be provided as required.

- END -

# SECTION 15100
# VALVES

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

All valves used for control of water and air; manual, electric, hydraulic, and pneumatic operators; epoxy coating; control units; and appurtenant work. Butterfly valves are covered separately under Section 15104.

### 1-2 RELATED SECTIONS

A. Section 15104 - Butterfly Valves

### 1-3 SUBMITTALS

A. Submit detailed manufacturer's information on all valves proposed for use.

B. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 VACUUM RELEASE VALVES

Provide vacuum release valves on discharge line of submersible pumps and the transfer pump discharge line at locations shown on the Drawings. Connect to HDPE piping using service saddles. Connect to stainless steel pipe by direct tapping or other method approved by the COTR. Valves shall be constructed of corrosion resistant wetted parts.

### 2-2 SOLENOID DRAIN VALVE AND PIPING

Furnish and install an electric solenoid-operated valve for back-draining of leachate to prevent freezing. Enclosure shall be NEMA-4. Wetted parts shall be stainless or thermoplastic. Orifice size 3/8" minimum, 115 VAC coil; use ASCO solenoid valve or approved equal. Tap HDPE pipe using type 101S saddle, available from Industrial Plastics, Inc., Washougal, WA or approved equal. All connecting piping shall be HDPE or type 316 stainless steel; all fittings shall be type 316 stainless steel. Drain piping shall be insulated but not heat traced.

## 2-3 SAMPLE COCKS

Furnish and install ¼" NPT sample cocks, fabricated of type 316 stainless steel, on tank discharge piping at the location(s) shown on the Drawings. Sample cocks shall be heat traced.

## 2-4 CHECK VALVES

Furnish and install three check valves, one on each of the leachate sump pump discharge pipes, as shown on the Drawings. Wetted parts shall be type 316 stainless steel, rubber, thermoplastic, or other approved corrosion-resistent material.

## 2-5 DRAIN DOWN VALVES AND PIPING

Provide stainless steel or thermoplastic spring-actuated valve which will close against pump pressure, and open against gravity pressure allowing the piping to drain back into the sump. Connecting pipe and fittings shall be stainless steel. Valve pipe size shall be ¼" minimum.

## 2-6 VALVE SCHEDULE

| Valve No. | Description |
|---|---|
| W51 | 1½" primary check valve |
| W52 | 1½" secondary check valve |
| W53 | 3" primary check valve |
| W54 | solenoid drain down valve |
| W55 | spring release, drain down valve, ¼" min. |
| W56 | spring release, drain down valve, ¼" min. |
| W57 | Transfer pump isolation valve, 4" manually operated BF valve, lever actuator (see Section 15104) |
| W58 | Vacuum release valve, primary leachate discharge line |
| W59 | Vacuum release valve, secondary leachate discharge line |
| W60 | Vacuum release valve, transfer pump discharge line |

## 2-7 VALVE MARKING

Valves shall have stainless steel (SS) indented marker plates marked with the valve number, Panduit Corporation, Catalog No. MMP350-C or approved equal, held in place with SS ties, Panduit Corporation, Catalog No. MLT4S-CP or approved equal. Characters shall be 3/16" in height minimum, indented with indenter marker press, Panduit Corporation, Catalog No. IMP187, or approved equal.

## PART 3: EXECUTION

### 3-1 GENERAL

All valves shall be installed in accordance with AWWA Standards and manufacturer's recommendations.

### 3-2 SOLENOID DRAIN VALVE AND PIPING

Install solenoid drain valve and piping around 3" diameter check valve such that low spots are minimized. Locate solenoid and piping taps at an elevation about ½" above invert of 3" piping.

- END -

# SECTION 15104
# BUTTERFLY VALVES

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

Furnishing and installing one manually-operated butterfly valve (W57) including epoxy coating, appurtenances, operators, and accessories, for use as the transfer pump isolation valve.

### 1-2 SUBMITTALS

A. Submit detailed manufacturer's information on valve proposed for use.

B. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 BUTTERFLY VALVES

A. General: The butterfly valve shall be 4 inches, manually operated, with a lever actuator. Butterfly valves shall conform to ANSI/AWWA C504 subject to the following requirements. Flanged valves shall have 125-lb American Standard flanges and unless otherwise shown, may be either short-bodied or long-bodied. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not deviate from the nominal diameter by more than one inch, nor shall it have any obstructions or stops.

B. Coating: All corrosive ferrous surfaces of valves, 4-inch and larger, which will be in contact with leachate, exclusive of flange faces, shall be epoxy-coated with System A-1 as specified in Section 09900.

C. Manual Operators: Operators shall conform to ANSI/AWWA C504, subject to the following requirements. Unless otherwise shown, all manually-operated butterfly valves shall be equipped with a handwheel and 2-inch square operating nut and position indicator.

D. Suppliers, or Equal:

1. Allis Chalmers
2. De Zurik Corporation
3. Henry Pratt Company

4. Center Line

E. Valve Marking: Mark valves in conformance with Section 15100.

PART 3: EXECUTION

3-1 INSTALLATION

All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator.

- END -

# SECTION 15150
# TURBINE METER

## PART 1: GENERAL

### 1-1 SECTION INCLUDES

Furnishing and installing one turbine meter for monitoring the accumulated leachate discharged to the leachate temporary storage tank.

### 1-2 SUBMITTALS

A. Submit product information showing conformance with specifications contained herein.

B. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 PERFORMANCE

The turbine meter shall be capable of measuring the accumulated flow through the meter with an accuracy of ± 1.5% at flow rates from 5 gpm to 160 gpm. A flow rate indicator is not required. End connections shall be flanged. Provide reducers and/or adapters as necessary to mate with adjacent pipe.

### 2-2 MANUFACTURERS

Hersey or Rockwell, or approved equal.

## PART 3: EXECUTION

Install turbine meter in accordance with manufacturers' recommendations.

-END -

# SECTION 15250
# TANK AND PIPING INSULATION

## PART 1: GENERAL

### 1-1 DESCRIPTION OF WORK

Contractor to furnish and install insulation on leachate storage tanks, metallic discharge piping, and transfer pump.

### 1-2 STANDARDS

Premolded fiberglass insulation shall conform to the requirements of FEDSPEC HH-1-558 and ASTM C335.

### 1-3 SUBMITTALS

A. Submit manufacturer's product data and technical information.

B. Submit evidence or certification of compliance with the above standards.

C. Submit in accordance with Section 01300.

## PART 2: PRODUCTS

### 2-1 GENERAL

Piping insulation shall be tubular and prepared for simple installation. Insulation for vessels and appurtenances shall be in a form suitable for installation directly onto the equipment. Insulation shall include insulating material, protective jackets, flashing, and other materials as required for a complete and vaporproof system.

### 2-2 INSULATION

A. Pipe Insulation: The pipe insulation shall be premolded fiberglass type in accordance with the required specifications. Minimum thickness shall be 2 inches.

B. Tank Insulation: Premolded fiberglass 3 inches thick, 3# board.

### 2-3 PROTECTIVE JACKET

A. General: A protective jacket shall be provided to prevent damage to the vapor barrier. Protective jackets shall be fabricated from aluminum or polyvinyl chloride (PVC) materials as specified.

B. Aluminum Jacket: Aluminum jackets shall be fabricated from plain finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier.

Jackets shall be 0.016 inch thick. Jackets shall be designed to provide a positive weatherproof seal along the entire length of the jacket.

Jackets for valves, fittings, pipeline appurtenances, and vessels shall be fabricated of 0.20-inch thick sheets for insulation O.D. 12.75 inches and smaller, and 0.24-inch thick sheets for insulation O.D. larger than 12.75 inches.

Sheet metal screws shall be 6062-T6 aluminum, anodized 2024 aluminum, or Type 300 or 400 series stainless steel of adequate strength. For outdoor service, all screws shall be pan-head and furnished with neoprene washers attached.

Strap fasteners for securing jacketing shall be made from aluminum or stainless steel and installed over outside diameters as follows:

1. Pipe jackets - 0.16 by 2-inch aluminum alloy snap strap with 0.015 by 1/2-inch type 302 stainless steel band.

2. Fabricated jackets 12.75 inches and less - 0.020 by 1/2-inch bands.

3. Fabricated jackets 14 inches to 36 inches - 0.020 by 3/4 inch bands.

4. Fabricated tank jacket - 0.020 by 3/4-inch stainless steel expansion-type bands.

C. Polyvinyl Chloride Jacket: The minimum jacket thickness shall be 60 mils. All PVC shall conform to ASTM D1784, Class 12454-B. Joint tape shall be vinyl, 10 mils thick. Fittings, valves, flanges, and other similar items shall be jacketed with 15 mils thick premolded PVC. PVC jacketing and tape shall be spray-coated to match PVC jacket color.

D. Shields: Shields for the protection of insulation at hangers and supports shall be 16-gage aluminum sheet, 9 inches long and formed into a half cylinder.

## 2-4 FLASHING

Flashing shall include aluminum caps, sealant, and reinforcing as required. Aluminum caps shall be 0.020 inch thick and shall be cut to completely cover the insulation. Sealants for insulation shall consist of manufacturer's adhesive.

Reinforcement, if required, shall be wire mesh or as recommended by the insulation manufacturer.

PART 3: EXECUTION

3-1 INSTALLATION

Insulation shall be installed in accordance with the manufacturer's recommendations and the above referenced standards. Insulation shall be applied over clean, dry surfaces with all joints butted firmly together. Aluminum jacket used for pipe exposed to weather shall be completely sealed so as to be leak proof.

Insulation shall be provided with metal shields at each pipe support. Shield inside faces shall be coated with insulation adhesives to prevent movement. No strapping will be required.

- END -

# SECTION 16010
# GENERAL PROVISIONS

## PART 1: GENERAL

### 1-1 GENERAL

All work in Division 16 and related work in other Divisions shall conform to these General Provisions.

### 1-2 SCOPE OF WORK

It is the intent of this Division of the Specifications and the accompanying Drawings to describe and provide for furnishing, installing, testing, and placing in satisfactory and fully operational condition all equipment, materials, devices, and necessary appurtenances to provide a complete electrical system, together with such other miscellaneous installations and equipment specified below and/or shown on the Drawings. The work shall also include all materials, appliances, and apparatus not specifically mentioned in the Specifications or shown on the Drawings, but which are necessary to make a complete, fully operational installation of all electrical systems. Equipment and devices furnished and installed under other Divisions of this Specification shall be connected under this Division. The Drawings and Specifications are complementary and what is called for in either is binding as if called for in both.

### 1-3 WORK IN OTHER DIVISIONS

See all other Divisions of these Specifications for other work required for Division 16.

### 1-4 CODES AND REGULATIONS

A. If any conflict occurs between government adopted code rules and this Specification, the codes are to govern. Nothing in the Drawings and Specifications shall be construed to permit work not conforming to the governing codes. This limitation shall not be construed as relieving the Contractor from complying with any requirements of the Drawings or Specifications which may be in excess of requirements of the above mentioned governing codes and rules and not contrary to same.

B. The electrical systems shall be installed based on the most current versions of the following Standards:

All applicable Hanford Plant Standards

NFPA 70 National Electrical Code as adopted and amended by the State of Washington or Local Jurisdiction

ANSI C2 National Electrical Safety Code.

The Contractor shall familiarize himself with the detailed requirements of these standards and any local codes and ordinances as they affect the installation of specific electrical systems.

## 1-5 COORDINATION

A. The Contractor responsible for accomplishing Division 16 work shall coordinate his work with that of the other Contractors and/or other trades doing work on the project and shall examine all Drawings and Specifications of other trades for construction details and necessary coordination.

B. Obtain submittals and shop drawings of all equipment with electrical connections furnished under other Divisions of the Specifications. Provide all wiring in accordance with requirements indicated. Advise the Construction Manager of any changes which may affect the contract price.

C. Special attention is called to the following items, and all conflicts shall be resolved prior to installation:

1. Recessing and concealing electrical materials in concrete construction, precast construction, or similar construction.

2. Electrical characteristics (HP, KVA, voltage, phase) of actual equipment furnished under other Divisions being different from that shown on the electrical Drawings.

D. The Contractor will not be paid for relocation of work, cutting, patching, and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

## 1-6 CONTRACT DRAWINGS

A. Raceways, boxes, and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways. The Contractor shall furnish, install and place in satisfactory condition all raceways, boxes, conductors, connections, and all other materials required for

the electrical systems shown or noted in the contract documents to be complete, fully operational, and fully tested upon completion of the project.

B. The Drawings do not show all requirements of the Specifications.

C. The horsepower of motors and apparatus wattages shown on the Drawings are estimated requirements of equipment furnished under other Divisions of this contract and bid shall be based on these sizes. Overload elements shall be provided to suit actual equipment nameplate current.

## 1-7 RECORD DRAWINGS

In conformance with Section 01300, continually record the actual electrical system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs. At the completion of the work, Contractor shall furnish a set of reproducible record drawings (xerox type) and the set of mark-ups. Final payment to the Contractor will not be authorized until these prints have been submitted to and accepted by the COTR.

## 1-8 ABBREVIATIONS AND DEFINITIONS

When the following abbreviations and definitions are used in relation to the work for Division 16, they shall have the following meanings:

| Item | Meaning |
|---|---|
| Accepted | Reviewed with no exceptions taken to submittal material. See "Submittal" below. |
| ANSI | American National Standards Institute. |
| Approved | Inspected and accepted by the Construction Manager or COTR. |
| ASTM | American Society for Testing and Materials. |
| Boxes | Outlet, Junction, or Pull Boxes. |
| Code | All codes currently enforced at project location. |
| Compression | Compressed using a leverage powered (hydraulic or equivalent) crimping tool. |

| | |
|---|---|
| Connection | All materials and labor required for equipment to be fully operational. |
| EMT | Electrical Metallic Tubing. |
| Exterior Location | Outside of or penetrating the outer surfaces of the building weather protective membrane. |
| Fully Operational | Tested and approved and operating to the satisfaction of the Construction Manager or COTR, manufacturer, and contract documents. |
| Furnish | Deliver to the jobsite. |
| Install | To enter permanently into the project and make fully operational. |
| Mfr. | Manufacturer. |
| NEC | National Electrical Code, National Fire Protection Association Publication #70 (latest adopted edition with amendments). |
| NEMA | National Electrical Manufacturers Association. |
| NFPA | National Fire Protection Association. |
| Noted | Shown or specified in the contract documents. |
| PVC | Polyvinyl Chloride. |
| Provide | Furnish and install. |
| RGS | Rigid Galvanized Steel. |
| Required | As required by code, the COTR, or contract documents for the particular installation to be fully operational. |
| Shop Drawing | Document prepared by Contractor, supplier, fabricator, or similar party which fully illustrates details the equipment and intended installation relative to this specified project. |
| Shown | As indicated on the Drawings or details. |

| | |
|---|---|
| Submittal | Material for Construction Manager's or COTR's review which may contain catalog cuts, shop drawings, wiring diagrams, etc., of the actual material being furnished. |
| UL | Underwriters' Laboratories, Inc. |
| Wiring | Raceway, conductors, and connections. |

PART 2: PRODUCTS

*** NOT USED ***

PART 3: EXECUTION

*** NOT USED ***

- END -

# SECTION 16100
# BASIC MATERIALS AND METHODS

## PART 1: GENERAL

### 1-1 DESCRIPTION

This Section contains the general requirements for materials and installation methods which apply to all sections of Division 16.

## PART 2: PRODUCTS

### 2-1 GENERAL

A. All materials shall be new, free from defects, and not less than the quality herein specified. Materials shall be designed to ensure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.

B. Each type of material furnished shall be of the same make, be the standard product of a manufacturer regularly engaged in production of such materials, and be the manufacturer's latest standard design.

C. All materials and equipment installed, including lighting fixtures, shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled.

### 2-2 SUBSTITUTION OF MATERIALS

See Section 01300.

### 2-3 COMPLETE SYSTEMS

All systems specified in Division 16 and shown on the Drawings shall be complete in every detail and fully operational upon completion of the project unless specifically noted otherwise. Mention of certain materials in these Specifications shall not be construed as releasing the Contractor from furnishing such additional materials and performing all labor required to provide complete and fully operational systems.

## 2-4 SUBMITTALS AND SHOP DRAWINGS

A. Product Information submittals are required for:

Raceways
Wire and Cables
Connectors and Terminations
Motor Controllers
Power Service Equipment
Transformers
Panelboards
Lighting Fixtures and Ballasts
Wood Poles
Open Fuse Cutouts
Surge Arresters
Pushbutton Stations
Pullbox
Heat Trace

B. Shop Drawings are required for:

Panelboards

C. Submit in accordance with Section 01300.

## 2-5 NAMEPLATES

Provide permanently attached nameplates constructed of plastic laminated material engraved through white surface material to black sublayer. Nameplates shall indicate the equipment designation, voltage, number of phases, and the name of the piece of equipment that provides the source of power.

A. Panelboard Nameplates: Refer to Section 16471.

B. Motor Starter Nameplates: Refer to Section 16160.

C. As shown on the Drawings and details.