INTEGRATION PROJECT
EXPERT PANEL

Closeout Report for Panel Meeting Held October 25 – 27, 2000

Prepared by the Integration Project Expert Panel

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Executive Summary

The main topics addressed at the eighth meeting of the Integration Project Expert Panel (IPEP), held on October 25-27, 2000 included: 1) an update on the Hanford Vision Strategy, 2) a Columbia River Focus session that covered Columbia River Ecology, Water Quality, and Groundwater Remediation along the river corridor, and 3) updates on the Science and Technology (S&T) inventory task and the tank farm vadose zone characterization task.

Hanford Vision Strategy

The IPEP is encouraged by results that are emerging from the effort to create an Accelerated Site Cleanup Plan (Plan) for Hanford. This is an effort of major importance, but it is also critical that stakeholders, Tribal Nations, and regulators support and participate in the process of defining the Plan. We believe that the first two key outcomes that have been defined (i.e., Cleanup and Release the River Corridor, and Transition the Central Plateau to Long-term Waste Management Operations) are sound objectives around which to organize the essence of the Plan. However, important questions and concerns regarding the Plan still need to be addressed.

Thus, DOE-RL must develop the details necessary to support the newly defined Hanford Site Outcomes. The Integration Project (IP) can enhance its credibility by avoiding overly optimistic promises about what accelerated cleanup can achieve. The IPEP strongly recommends that DOE-RL be completely transparent in the assumptions being made and the decision-making that is underway to establish the basis for the Plan.

Columbia River Focus Sessions

Three sessions were organized under the general heading “Columbia River Focus Session.” Including 1) River Ecology: What We Know. What We Need to Know; 2) Water Quality; and 3) Groundwater Remediation along the river corridor.

River Ecology

The range of ecological research at Hanford has long been, and continues to be, very broad. At the same time, IP personnel do not appear to be adequately aware of this diversity of work and its relevance to the IP. The extent to which this information is being integrated and used in the long term planning process for the IP is unclear. Ecological risk factors are not being adequately incorporated into decision-making for environmental restoration at Hanford.

Adoption of cleanup and remediation approaches that are explicitly framed in terms of their biological/ecological context could help to defuse distrust that has arisen on this issue between Hanford management and Tribal Nations, regulators, and diverse stakeholders.

IPEP members emphasize the importance of seeing monitoring and assessment as crucial and complementary activities.

Recommendations – River Ecology

1. The IP should institute a systematic analysis of past ecological work to determine its relevance to current critical IP questions.

2. The design of future research and monitoring programs should be guided by what is known and by what is needed. A central feature of what needs to be known is the effects of contaminants on local and regional living systems.

3. Biological endpoints should become central to the evaluation and validation of the effectiveness of cleanup and restoration programs.

4. The IP should make evaluation of ecological risks associated with contaminants (and with cleanup efforts) a centerpiece, not an afterthought, of the earliest stages of planning and decision making.

5. The IP should use the evolving understanding of the biological/ecological context and consequences of any actions at Hanford, in all its dimensions, to improve communication with all interested constituencies.

River Water Quality

The River Water Quality focus session at the October IPEP meeting was introductory and limited to presentations on: 1) scope of water quality monitoring; 2) case histories of special projects; and 3) challenges and strategies. It is not evident that the IP has developed a long-range plan that includes the water quality monitoring program as a strategic component. Columbia River water quality monitoring appears to be used primarily as a service activity rather than as part of an integrated assessment of contaminant transport and potential human and ecological risks. Columbia River water quality monitoring is essential for determining the success of clean up at Hanford.

Recommendations – River Water Quality

1. The Water Quality Monitoring and Assessment Program needs much more inclusion in the IP planning and strategy.

2. The Columbia River modeling effort should be expanded to include particle tracking of solutes, more realistic boundary conditions, and simulations at other locations.

3. An internally led program review should be conducted to assess the priorities and anticipated demand on program resources over the next five years.

4. An impact analysis for IP review should be prepared with regard to the lack of a baseline for contaminants in sediments, a lack of Columbia River bathymetry, poor

understanding of the mixing zone and its effect on monitoring, and the inability to distinguish Hanford contaminants from non-Hanford sources.

Groundwater Remediation

The groundwater monitoring data presented for hexavalent chromium plumes in the 100 areas H, D, and K did not adequately demonstrate that the pump and treat systems are reducing either the hexavalent chromium in all of the compliance monitoring wells or the mass discharge of hexavalent chromium to the Columbia River. The IPEP also has concerns regarding the ultimate effectiveness and life-cycle costs of the In-Situ Redox Manipulation ("ISRM").

The pump and treat interim remedial system controlling the ^{90}Sr plume in the N area has provided hydraulic control, but has removed only minor amounts of ^{90}Sr from the saturated zone.

The IPEP was encouraged to see that the IP is beginning to assess the implications of the recent National Research Council study on groundwater remediation decisions on the Hanford site.

Recommendations – Groundwater Remediation

1. Compliance and internal reporting should include both the time series data from individual monitoring wells, and an assessment of the change in total mass discharge to the Columbia River on a plume-by-plume basis.

2. An interim performance evaluation report should be prepared on the ISRM technology addressing concerns regarding barrier effectiveness, barrier lifetime, and life-cycle costs.

3. Alternative remedial strategies for the ^{90}Sr plume should be evaluated, including natural attenuation.

4. The IP should prepare a report with a comprehensive assessment of the long-term management needs for the groundwater remediation systems.

S&T Inventory Task Update

The IPEP believes that the issue of inventory definition is an essential tool for the System Assessment Capability (SAC) and must be kept at the forefront of IP and SAC planning. An accelerated effort for inventory definition as input to SAC Rev. 0 appears to have developed over the past few months.

Criteria for selecting the next advances beyond FY01 in development and testing of the model remain vague, although brief mention was made of potential application to tank inventories.

A properly validated model seems likely to reduce the high degree of uncertainty associated with evaluating the risks from leaks, and retrieval losses and residuals.

Tank Farms Vadose Zone Characterization

The proposed phased approach for vadose zone characterization seems reasonable. Every effort should be made to take advantage of existing borehole moisture measurement technology and knowledge before the effort to perform moisture measurements and analysis begins at the SX Farm in FY01, as planned.

Modeling to date has not been sufficiently realistic to demonstrate the practical application of temperature logs for the purpose of identifying large concentrations of heat-producing nuclides in the formation, and the necessary data processing techniques do not yet exist.

Recommendation – Tank Farms Vadose Zone Characterization

The quality and accuracy of the proposed neutron logging method(s) should be demonstrated and documented

IPEP Changes

Several changes in IPEP operations have been implemented in response to the evolving role of the IPEP. Ralph Patt is now Vice Chairman of the IPEP replacing Mike Kavanaugh. The role of Closeout Report Coordinator for each meeting will be assigned on an ad hoc basis to a member of the IPEP. Regarding the number of IPEP meetings each year, the IPEP decided on the full Panel approach with three meetings per year as the best way to continue interacting with the IP.

1 Introduction

1.1 Focus of the Meeting

The eighth meeting of the Integration Project Expert Panel (IPEP) took place on October 25 - 27, 2000. A presentation made by Hanford Site Manager Keith Klein to the IPEP early in 2000 defined the protection of the Columbia River corridor as a primary goal for Hanford cleanup activities. This goal was articulated in more detail in a planning document (Done in a Decade: Restore the River Corridor, Draft*; DOE* 2000a). The river corridor is defined as the "210 square miles beginning at the shores of the Columbia River and extending inland to include nearly all Hanford lands except for the "central Plateau" in the middle of the Hanford site." The plan is, "quite simply, to get on with the work of remediating all sources of radiological and chemical contamination that further threaten the air, groundwater, or Columbia River." Because of the importance of the Columbia River goal to the overall goals for the Hanford Site, the IPEP selected the Columbia River as a central focus for the IPEP October 2000 meeting.

This Closeout Report (Report) presents our observations and recommendations in response to presentation materials provided before or during the October meeting. In addition to presentations on issues related to the river corridor, the IPEP also requested that the Groundwater/Vadose Zone Integration Project (IP) provide an update on the inventory tasks being performed under the Science and Technology program, and on the tank farm vadose zone characterization tasks being performed by the Office of River Protection. An update on the IP was also provided by the IP Project Director, Michael Graham. Finally, Michael Hughes and Wade Ballard presented an update on the Hanford Vision Strategy.

1.2 The IPEP Mission

This Report should be considered in the context of the primary mission of the IPEP as presented in previous IPEP closeout reports and summarized in the recent Detailed Work Plan for the IP (DOE/RL, September 2000b). As noted in that report, the "purpose of the external panel is to provide DOE with technical observations and recommendations regarding the planning, execution, and interpretation of results from the IP." We interpret this statement as a broad mandate for the IPEP to address both management and technical issues related to the implementation of the IP.

Thus, the IPEP continues to address both overarching management issues as well as specific and detailed technical issues which, in the opinion of the IPEP, are crucial to successful completion of the IP mission. That mission, as summarized in the Detailed Work Plan, "focuses on developing a credible, technically-defensible assessment of the cumulative effects of Hanford Site wastes in order to provide risk information to inform and influence cleanup decisions".

1.3 Evolution of the IPEP

As the IP has matured and become more focused on project implementation as opposed to project planning, the IPEP has shifted its focus accordingly to address project-specific issues in contrast to review and evaluation of broad overarching planning issues confronted by the IP at its inception. Several changes in IPEP operations have been implemented in response to the evolving role of the IPEP.

Ralph Patt will be the IPEP Vice Chairman replacing Mike Kavanaugh. The role of Closeout Report Coordinator for each meeting will be assigned on an ad hoc basis to a member of the IPEP. For the October meeting, Mike Kavanaugh is serving in this capacity.

The budget assigned by DOE-RL to the IPEP for FY2001 only allows two full Panel meetings to be held, or one full Panel meeting and three Sub-Panel meetings. The IPEP discussed the merits of these options and decided on the full Panel approach as the best way to continue interacting with the IP. Thus, the first of the two remaining meetings for FY2001 has been scheduled for April 25-27, 2001 with the second tentatively scheduled for a late June-early July 2001 timeframe. The exact dates will be determined following further discussions with the IP. The objective is to hold the meetings when they can be of most value to the IP, given the work that is underway.

The IPEP also reaffirmed that the Panel will support the peer review efforts being planned and conducted by the IP primarily through the assignment of a liaison, as appropriate and desirable. IPEP members will also be able to take part in specific peer reviews where their expertise is essential to the review being carried out[1].

Finally, the IPEP agreed to continue the recent practice of identifying central themes for each Panel meeting and having individual Panel members take the lead in organizing technical sessions in conjunction with an IP staff member. This type of interaction is proving very beneficial in focusing the content of the sessions in directions meaningful to the IP.

[1] On a related note, some confusion exists regarding authorship of two recent reviews. The PITT review was recommended by the IPEP and included one IPEP member on the review panel, but the results of that review have not been considered, nor endorsed, by the IPEP. The SAC Management Review last summer was conducted by three IPEP members but the views expressed in the letter report have not been considered, nor endorsed by the IPEP as a whole.

2 Hanford Strategy Update: Site Outcomes - 2012

2.1 Observations

The IPEP applauds the development of an Accelerated Site Cleanup Plan for Hanford. This is an effort of major importance, but it is also critical that stakeholders, Tribal Nations, and regulators support and participate in the process of defining the Plan.

We believe that the first two key outcomes that have been defined (i.e., Cleanup and Release the River Corridor, and Transition the Central Plateau to Long-term Waste Management Operations) are sound objectives around which to organize the essence of the Plan. The articulation of these objectives has focused thinking and discussion on how best to achieve the outcomes. However, it is clear that there are a number of important questions and concerns regarding the Plan that still need to be addressed. Regulators may be open to adjusting current compliance requirements to accommodate new technologies and more logical cleanup approaches, but they are unlikely to agree to any changes without having full confidence in the DOE's new approach.

As was pointed out during the meeting by regulatory representatives, realizing the new Accelerated Site Cleanup Plan requires a 10% increase in the annual cleanup budget to get started. This increase is not assured. It also requires some changes in previously established priorities, as well as changes in the Tri-Party Agreement, in order to establish a new set of milestones. The rationale for the changes that are required do not yet appear to have been clearly delineated to the regulators.

DOE-RL still has a major task in developing the details necessary to support the newly defined Hanford Site outcomes. The "Devil is in the details" as they say, and DOE-RL must convince stakeholders, Tribal Nations and regulators that the newly defined vision can be achieved and is superior to the baseline approach. The key will be to establish and maintain credibility, in spite of historical baggage. This will be a formidable challenge.

A key to maintaining credibility is for DOE to avoid overly optimistic promises about what the accelerated cleanup will accomplish - a trap that has beleaguered Hanford management in the past and has fueled stakeholder and regulator skepticism. As discussed later in this report, presentations during the October meeting concerning accomplishments of pump-and-treat technology and the promise of "In-Situ Redox Manipulation" do not yet confirm the likelihood of successfully completing cleanup to an "end-state" condition. Therefore, it is not yet clear that technologies currently being used or intended for use provide sufficient capability to promise unlimited "release" of the Columbia River corridor.

The IPEP is concerned that the benefits associated with the accelerated plan are not yet sufficiently well articulated, in part because there are still many unknowns. History at Hanford has shown that that cleanup plans developed without sufficient grass-roots support simply do not succeed. Nevertheless, the IPEP is cautiously optimistic about the new plans that have emerged. However, there are clearly major stakeholder and regulatory concerns, and these concerns must be dealt with directly and openly if the new plan to accelerate cleanup at Hanford is to succeed.

2.2 Recommendation

The IPEP believes that this is a time for DOE-RL to be completely transparent regarding the assumptions being made about-accelerated site cleanup, as well as the decision-making that is underway. It is a time to emphasize and explain as clearly as possible to the stakeholders, Tribal Nations, and regulators the trade-offs that exist and the benefits of the decisions that are being made.

3 Integration Project Update

3.1 Observations

In the October 2000 meeting, the IPEP received an update on the overall status of the IP. Significant work is underway and progress is being made on several fronts. There is also growing evidence that the technical staff is engaging in "integrated thinking." However, we also noted that most of the staff associated with the IP use the phrase "GW/VZ" to identify and discuss the Project, while we have adopted the consistent usage of "IP."

While we recognize that the official name is the "Groundwater/Vadose Zone Integration Project," our phraseology emphasizes the integration aspects of the Project, which we feel must remain front and center. Focusing just on "GW/VZ" may have the unfortunate consequence of limiting attention paid to the Columbia River. The Columbia River is not explicitly part of the name of the IP, even though "Protecting the Columbia River" is in the Project's logo.

We point this out merely as a set of observations, not as a conclusion or recommendation for action at this time. Continued success will require strong commitment to integration from DOE-RL and BHI management.

4 River Ecology

4.1 Introduction

Three sessions were organized under the general heading of "Columbia River Focus Session."

- River Ecology: What We Know. What We Need to Know.
- River Water Quality: Contaminant Inputs and Monitoring Strategy
- Groundwater Remediation near the River

IP staff member Roger Dirkes served as the point of contact for the IP and J. Karr, R. Bassett, and M. Kavanaugh served as IPEP points of contact for the three subject areas listed above, respectively.

The Panel would like to raise two issues with respect to the language used in the document "Done in a Decade" (DOE 2000a). First, the Columbia River itself is apparently not included in the river corridor when that corridor is defined as "beginning at the shores of the Columbia River and extending inland." Is that intentional or an oversight? Some clarification of intent seems appropriate, especially in view of the emphasis on the "Columbia River" in the minds of the Tribes, stakeholders, and regulators.

Second, "Done In a Decade" (DOE 2000a) indicates that the plan is to work on remediation of all sources of contamination that further threaten "the air, groundwater, or Columbia River." This language leaves out the vadose zone and the terrestrial environments of both the central Plateau and the river corridor. The Panel has raised the issue of the terrestrial environment on numerous occasions the past two years, and the IP is explicitly supposed to be dealing with contamination and its effects in the vadose zone. Here again, we suggest that some clarification of DOE intent is appropriate.

4.2 River Ecology: What We Know. What We Need to Know.

Soon after the initiation of nuclear research and materials production at Hanford, concerns about the effect of those activities on the Columbia River emerged. These concerns stimulated monitoring and research that continue today, although they have evolved considerably since those early years. Early work emphasized tracking of radionuclides, their presence and effects on the Columbia River water environment, and their acute effects in river organisms. Research and monitoring activities expanded over time to encompass a broad range of terrestrial and aquatic systems, including plants, invertebrates, and vertebrates and range from molecular and cellular phenomena such as pharmokinetics to effects on endangered species and regional ecosystems. More

recently, efforts have been made to understand the status and trends on natural systems as cultural resources.

The primary current program charged with the responsibility in this arena is the Public Safety and Resource Protection Program comprising 6 projects: Hanford Environmental Oversight Project, Meteorological and Climatological Services Project, Surface Environmental Surveillance Project, Ecosystem Monitoring Project, Ecological Compliance Assessment Project, and Cultural Resources Project.

Because of limited time, speakers concentrated on components of the Surface Environmental Surveillance and Ecosystem Monitoring Projects that deal with river and riparian environments. Surface Environmental Surveillance is tasked to (1) establish background levels and trends of environmental contaminants; (2) determine compliance with applicable standards, orders, and regulations; and (3) provide public assurance. The Ecosystem Monitoring Program is tasked to (1) identify impacts of site operations on flora and fauna, (2) define and map significant habitats and species, and (3) provide information for sensitive species protection and natural resources management. In short, environmental surveillance deals with contaminants and their distribution as well as regulatory compliance. Ecosystem monitoring emphasizes the condition of the regional biota, with emphasis on the extent to which it is influenced by contaminants with an origin at Hanford.

Overviews were given of efforts to rank natural resource values across the Hanford complex. Not surprisingly, the highest values were generally associated with the regions removed from most human activity over the past half century. In addition, special emphasis was placed on discussion of federal and state listings of threatened and endangered species and species otherwise considered as rare. Monitoring programs have documented long-term population trends in high visibility species such as bald eagle, Canada goose, salmonid fishes, deer, and great blue heron.

Studies of the effects of reactor operations and releases on the viability and growth of salmonids from eggs to the cross-generation effects of radiation on adult fish have provided much critical information on the effect of contaminants on this key component of the river biota. Additional studies on the production of periphyton or the effects of fish parasites were also cited. Research was not limited to contaminant effects in the Columbia River. One study, for example, examined the effects of water level fluctuations and dewatering caused by water withdrawal on egg, early embryo, and alevin survival in chinook salmon. Still other work concentrated on migration pathways of fish in the Columbia River channel to determine the proximity of migrating fish to the reactors on the west bank of the Columbia River.

The array of research and monitoring programs was noteworthy in several respects. First, they dealt with species and biological contexts with diverse spatial and temporal scales of use of the river and adjacent environments. Second, they represented diverse trophic levels from plants to top carnivores making it possible to improve understanding of the effects of contaminants at virtually all trophic levels. Third, they dealt explicitly with the metabolic and reproductive effects of exposure to environmental contaminants. Several

research programs combined on-site and off-site studies (e.g., contaminant monitoring in deer) to improve understanding of the influence of Hanford contaminants in a larger context. Broad conclusions of these studies were presented, including the point that healthy individuals and populations are present for many species of special interest and contaminant levels in the river biota are generally low.

Similarly, questions raised by IPEP members also spanned a broad range of issues, scales, and contexts. One line of questions explored the need for systematic studies of plants, especially of deep-rooted species or species that might be identified as hyperaccumulators of contaminants. The need for increased understanding of contaminant accumulation in plants versus soil was also discussed briefly. Many of the studies that were discussed emphasized threatened and endangered species or species important as commodities, often due to compliance driven goals.

The IPEP was not able to discern any systematic effort or framework to define an appropriate balance among species and approaches for ongoing monitoring and research efforts. Questions were also raised about the emphasis on certain contaminants while other contaminants have not attracted much research or monitoring attention that could be tied to known or expected ecological effects. No mention was made, for example, of the potential of any Hanford contaminant acting as endocrine disrupters.

Other subjects raised briefly were the apparent lack of systematic work on the effects of burrowing animals and studies documenting the ecological effects of various approaches to restoration. The latter is an especially important requirement for selection of alternate cleanup and restoration approaches. Although these issues were raised in Panel comments and questions, we were not able to determine the extent to which past or ongoing studies adequately address these and other issues because of limited time.

Other important issues that deserved more time for discussion included the need for more systematic planning in the definition of key indicators (biological and ecological) that are appropriate to understand the effects of contaminants and the effectiveness of cleanup and restoration strategies. No information was presented to demonstrate that a systematic effort had been made to identify information needs or that steps had been taken to fill those needs. Limited discussion in the past and limited efforts to connect the specific studies described in the afternoon session to specific needs and IP mandates lead us to believe that more effective communication is needed between SAC and the ecological research team. This communication is essential to ensure that foundation data and understanding of systems dynamics will provide for critical SAC needs.

The need to make the SAC responsive to modeling needs at scales that are relevant to biological and ecological phenomena remains a serious challenge. It is not a foregone conclusion, for example, that modeling scales appropriate for chemical or hydrological dynamics are appropriate for biological dynamics. We also did not receive any information on research designed to monitor and evaluate the effectiveness of cleanup and restoration activities which presumably are important for protecting local and regional ecological health.

A critical strength as well as a weakness of application of past work is illustrated by the Columbia River Comprehensive Impact Assessment (CRCIA). CRCIA models were based narrowly on food-web dynamics in the field but critical parameters for those dynamics were defined based on laboratory work. Moreover, other non-food-web dynamics were not incorporated into the conceptual models as they should have been. Furthermore, the apparent lack of synthesis of past work suggests that much of the cleanup and remediation work may be moving forward before that information can be used to help define the cleanup agenda and approaches to accomplishing that agenda. Because of the sequential movement of ecological considerations into the planning process, many project activities might advance before that ecological knowledge can be used effectively.

In summary, we conclude that the range of ecological research at Hanford has long been, and continues to be, very broad. Much of this work is no doubt directly related to IP goals and mandates, as evidenced by the major contributions that derive from the CRCIA synthesis of some of that work. The synthesis represented by CRCIA was a major first step in both using a long history of Hanford research and in defining new research and monitoring data needs. At the same time, IPEP members felt that IP personnel were not adequately aware of this diversity of work and its relevance to the IP. We are not able to tell at this point the extent to which that information is being integrated and used in the long term planning process for the IP.

Finally, IPEP members believe that ecological risk factors are not being adequately incorporated into decision making for environmental restoration at Hanford. The interactions of Department of Energy, Hanford management and Tribal Nations, regulators, and diverse stakeholders in recent decades has generated a climate of distrust. A central underpinning of that distrust has been a failure to explicitly incorporate the ecological dimension of risk and consequences in terms that are widely understood, technically defensible, and comprehensive. Adoption of cleanup and remediation approaches that are explicitly framed in terms of their biological/ecological context could help to defuse that distrust as well as focus decision making on critical yet often ignored endpoints.

In the past, attainment of policy goals and enforcement of environmental regulations were often assessed in terms of bureaucratic endpoints (number of permits issued, reduction in contaminated effluent; (e.g., see Yoder and Rankin 1998). Often, agency or institutional activity (effluent released or cleaned up) was used to define the “ambient condition” of a water body, rather than tracking the biological condition of the system being protected (Karr, 2000).

Effective use of biological endpoints in monitoring and assessment programs can be instrumental in avoiding two problems that waste either fiscal or ecological resources. First, cleanup beyond a threshold needed to provide protection to human and ecological health wastes money. Second, cleanup that does not protect human and ecological health because chemical standards are not adequately connected to biological results damages ecological health. In short, biological monitoring and assessment focuses on biological endpoints as the most integrative measures of ecological health.

Because living systems, human and nonhuman, are the endpoint of interest in virtually all environmental legislation and regulation, it is crucial that the health of those systems as measured by carefully designed biological assessments be a central component of any effort to evaluate program success. Hanford is no different from other places in North America in this respect. IPEP members emphasize the importance of seeing monitoring and assessment as crucial and complementary activities. For too long, monitoring has been approached as an effort to accumulate data. The fundamental reason for monitoring is to make the assessment step possible.

4.3 Recommendations

4.3.1 Recommendation 1

The IP should institute a systematic analysis of past ecological work to determine its relevance to current critical IP questions. By bringing together past work (from knowledge of data sets to the lessons of those data sets), biological monitoring, system assessment, research, and modeling projects can be strengthened scientifically and made more relevant to IP needs.

4.3.2 Recommendation 2

The design of future research and monitoring agendas in this arena should be guided by what is known and what is needed, and a central feature of what needs to be known is the effects of contaminants on local and regional living systems.

4.3.3 Recommendation 3

Biological endpoints should become central to the evaluation and validation of the effectiveness of cleanup and restoration programs.

4.3.4 Recommendation 4

The IP should make evaluation of ecological risks associated with contaminants (and with cleanup efforts) a centerpiece, not an afterthought, of the earliest stages of planning and decision making.

4.3.5 Recommendation 5

The IP should use the evolving understanding of the biological/ecological context and consequences of any actions at Hanford, in all its dimensions, to improve communication with all interested constituencies.

5 River Water Quality

5.1 Introduction

Columbia River water quality monitoring has been a continuous and well-documented part of the Hanford Program since the mid-1940's. With the closure of the last single pass reactor, the mission changed from effluent based to contaminant source based with an expanded list of contaminants. At present the river monitoring activities have been expanded to a broad and complex program with competing obligations: 1) compliance monitoring, 2) IP data collection, and 3) special projects.

The River Water Quality focus session at the October IPEP meeting was introductory and limited to discussing:

- The scope of monitoring
- Case histories of special projects
- Challenges and strategies

Key issues not yet addressed include the following; 1) How will the Columbia River Monitoring Program be coordinated with the Ground Water Monitoring Program, two programs that are administratively separate but which must have data streams that connect?, 2) How do the groundwater-modeling program and the SAC use the data from the monitoring program, data that are needed both for history matching and calibration at the Columbia River's edge?, 3) Are the Columbia River sampling locations adequate?, 4) Is the Columbia River sampling program monitoring for contaminants whose fates are being predicted in the flow and transport modeling?, and 5) What are the likely effects of these contaminants on the river biota?

5.2 River Monitoring Program

5.2.1 Observations

The focus of water quality sampling over the years has changed, and the task has become more difficult. In addition to the legacy sampling points along the Columbia River for compliance, and specially funded projects, the program must monitor for point sources, e.g. springs and seeps with ill-defined entry points to the Columbia River; non-Hanford sources from both upstream and across the Columbia River; and possible yet undetected sources reaching the Columbia River from past operations using a network of sampling points along the river.

The IP has increasing needs for comprehensive monitoring of the Columbia River to answer questions about risk, especially at the Columbia River boundary. Unfortunately the

IP funds only a small part of the water quality monitoring activities and the demands by other groups are high. Limited staff must allocate time for special projects funded by organizations such as the hydropower industry, other agencies, core projects, etc., and maintain the network of routine monitoring stations.

The IP already has specific water quality monitoring requirements ranging from baseline and background data needs at the ground water/river boundary to monitoring points that will need to be correctly placed for early detection of leading edges of plumes. For example, the remediation efforts for chromium and chlorinated solvents must be monitored at locations compatible with the best prediction of arrival points at the Columbia River, and monitored at the appropriate detection limits. Currently, sampling points are located at compliance points, at regularly spaced intervals along the Columbia River, at specific points where discharges are known to occur and in locations of specific research investigations.

It is not evident that the IP has developed a long-range plan that includes the monitoring program as a strategic component; and this integration will be essential. The IP will likely need a monitoring program that is versatile in time and space depending on which contaminants are being tracked. Further, SAC will need baseline and background data for history matching and model calibration as well as scheduled future sampling for verification. The SAC needs are complex, because the scales of modeling of flow and transport grid sizes are apparently not well suited for the sampling point distribution.

Because of limited resources, SAC personnel must ensure that the water quality-monitoring group and management understand their needs. The IPEP clearly heard that there is a problem regarding the SAC needs at the Columbia River interface and the monitoring program limitations; this in our view is a high priority.

The monitoring program is too large and inter-related with other activities at the site to examine in detail quickly. It was accepted by the IPEP prior to the our October meeting that some important Columbia River related issues could not be addressed in the focus sessions because of time and schedule. Thus, several related issues will be addressed at future IPEP meetings.

5.2.2 Recommendation

The Monitoring Program needs much more inclusion in the IP planning and strategy. Although the Columbia River is at the end of the flow line at the Hanford Site the planning for monitoring should begin early. This is essential in order to build a reliable baseline of background data. Columbia River monitoring should be closely integrated with groundwater monitoring, SAC, groundwater remediation, and other site-wide modeling of contaminants from the tank farms.

There should be evidence that these programs are influencing the strategic planning of the Columbia River Monitoring Program.

5.3 Special Projects

5.3.1 Observations

The only case study we had time to pursue at the October 2000 meeting was the investigation of mixing in the zones adjacent to the Columbia River. Well-placed monitoring lysimeters are needed to define the contaminant distribution, and hydrologic parameters must also be obtained, e.g. water levels, hydraulic conductivities, and Columbia River stage with respect to time. The data obtained for this study were quite good and the computer simulation of the mixing process was a significant first step. This work will influence how sampling programs are designed and how near Columbia River contaminant concentrations are viewed. The modeling was instructive and can be a valuable tool when the boundary conditions are more precisely defined and when the particle tracking includes solute transport.

5.3.2 Recommendation

The near-Columbia River modeling should be expanded to include particle tracking of solutes, more realistic boundary conditions, and extend the simulations to include other locations.

5.4 Challenges and Strategy

5.4.1 Observations

This was a session the IPEP requested because it offered an opportunity for dialogue about the challenges ahead in optimizing the Columbia River monitoring program and the strategy required for the monitoring program to be an effective component of the IP.

Roger Dirkes, as the Columbia River Monitoring Lead presented the complexities and competing interests. In an effort to coordinate with emerging client demands as well as to improve the program generally, his group has taken the initiative in several ways. First, to have direct input into SAC planning and to identify needs Dirkes is a lead in the Columbia River interface part of the SAC modeling. Second, the group has participated in S&T workshops that include monitoring issues. Third, internal evaluation now includes annual reviews of the Columbia River Monitoring Program aimed at using available resources more efficiently.

From the IPEP point of view however, Columbia River monitoring is being used as more of a service acitivity than as a part of the integrated approach to understanding contaminant transport and risk. Columbia River monitoring has not been incorporated into any of our discussions held to date with the IP, yet in our view it is essential in determining the success of clean up at the site. Although the river is certainly a component of the Ground Water/Vadose Zone Integration Project, in our view the river monitoring is not thoroughly integrated into the IP.

Monitoring at the Columbia River interface can be thought of as one of several important compliance checkpoints. The interface is defined by wells and sampling points along the Columbia River, and sampling locations within the river from which monitoring produces a snapshot of contaminant first arrival, contaminant concentration variations, as well as an inference about near-river remediation effectiveness over time. Many variables of sampling times, locations, depths and contaminant list must be considered early and evaluated often to optimize the detection network and provide a baseline for the long-term view.

The water quality monitoring program is essential not only to the IP but to multiple clients at Hanford, and consequently the mission is diffuse. Further, the IP is one of the smaller clients in terms of FTEs and budget; this will continue to constrain the effectiveness of the monitoring program in meeting the IP needs

We encourage the IP staff to define carefully and explicitly the criteria used to judge whether specific components of the monitoring and assessment program (both water quality monitoring and river biota monitoring) should be continued or ended. Similar documentation should be produced to support decisions to add new monitoring and assessment programs. A peer review of documents produced by this effort may also be warranted.

5.4.2 Recommendation 1

An internally led program review should be conducted, including outside experts on the committee, to assess the priorities and anticipated demand on program resources over the next 5 years. Consider especially whether the current mix of routine compliance monitoring, special research projects, and IP data collection will be appropriate for the site clean-up goals.

5.4.3 Recommendation 2

Several key obstacles were identified and briefly discussed at the IPEP meeting, and some are time sensitive. We recommend drafting an impact analysis for IP review with regard to the key issues, including among others the lack of baseline for contaminants on sediment, Columbia River bathymetry, poor understanding of the mixing zone and its effect on monitoring, and the inability to distinguish Hanford contaminants from non-Hanford sources.

6 Groundwater Remediation

6.1 Introduction

A final topic in the focus session on the Columbia River was groundwater remediation at the Hanford Site along the Columbia River corridor. Active groundwater remediation systems have been in operation for several years controlling various contaminant plumes emanating from the 100 area.

This session was organized by Greg Mitchem and Virginia Rohay in consultation with the IPEP. Key issues discussed were 1) update on status of remediation projects in the Columbia River corridor, 2) tritium investigation at 618-11, and 3) long-term stewardship as it relates to groundwater remediation.

6.2 Remediation Update

Groundwater monitoring results were presented for hexavalent chromium plumes in areas H, D, and K. The data did not adequately demonstrate to the IPEP that the pump and treat systems are reducing the hexavalent chromium concentrations in the leading edges of the plumes. Some of the sampling results collected since 1998 from the compliance wells appeared to show an increasing trend in hexavalent chromium levels. In those compliance wells where a decreasing trend was reported, the data exhibited a high degree of variability. Whether or not the rate of mass discharge of hexavalent chromium to the Columbia River has decreased since 1998 is uncertain. Additional data would need to be reviewed to assess that question.

Thus, the IPEP concluded that additional analysis is needed to provide clear and comprehensible documentation of the effectiveness of the pump and treat systems. Uncertainties in the quantities of hexavalent chromium in the release areas and in the plumes, coupled with a high degree of variability in monitoring results raise doubts about IP predictions of the time required to achieve compliance. Current estimates range from 2 to 10 years.

The In-Situ Redox Manipulation (“ISRM”) technology is considered by PNNL to be an innovative technology for groundwater remediation, with projected savings in life-cycle costs for remediation of the hexavalent chromium plumes along the River corridor. This technology is one of several examples of Hanford technology initiatives designed to meet remediation targets established within the new accelerated cleanup strategy for Hanford. While the results of this technology demonstration are encouraging, the IPEP has some concerns that the ultimate cost of this technology may not be as favorable as originally predicted. This appears to be due to increased demands for quantities of process chemicals, and a shorter lifetime for the chemical barrier compared to original predictions of 30 years. Dr. Fruchter of PNNL stated at the October 2000 IPEP meeting that, in fact, the ISRM barrier may have a lifetime of less than 20 years.

Pump and treat results were also presented for the control of the ^{90}Sr plume in the N area These data clearly demonstrate that the pump and treat system in the N area has not been effective at removing significant amounts of ^{90}Sr from the groundwater, although the system has been effective at hydraulic containment. The IPEP understands that this system was installed as an interim remedy for control of the ^{90}Sr plume. However, after five years of pumping, and the extraction and processing of over 490 million liters of water, only 0.8 curies have been recovered. Furthermore, the mass discharge of ^{90}Sr to the River does not appear to pose any unacceptable ecological or human health risks. Given that annual costs to operate this system are running at about $800,000 per year, a reassessment of the need for this system seems appropriate.

6.2.1 Recommendation 1

Compliance and internal reporting should include both the time series data from individual monitoring wells, and an assessment of the change in total mass discharge to the river on a plume by plume basis. This type of reporting will provide a more transparent and defensible basis for demonstrating compliance.

6.2.2 Recommendation 2

The IPEP supports continued scientific and optimization studies of the ISRM technology but urges the IP to evaluate process effectiveness carefully. An interim performance evaluation report should be prepared on this technology addressing concerns regarding barrier effectiveness, barrier lifetime, and life-cycle costs.

6.2.3 Recommendation 3

Alternative remedial strategies for the ^{90}Sr plume should be evaluated, including natural attenuation. The necessary documentation should be prepared to demonstrate whether an alternative strategy is protective of human health and the ecological health of the river, with the potential for significant life-cycle savings.

6.3 Tritium Investigation Near 618-11 Burial Ground

Jane Borghese provided a comprehensive overview of the tritium investigation near the 618-11 Burial Ground. This project represented a major challenge to the IP following the unexpected discovery of very high (>1,000,000 pCi/L) tritium levels in a small area approximately 4 miles from the Columbia River. A phased approach to site characterization was employed, and a new soil gas technique was used for rapid site characterization.

The IPEP commends the IP for rapid response to this problem and for use of innovative investigative approaches to associated site characterization. The proposed method to define the extent of the tritium in the vicinity of the “hot spot” by extracting and analyzing helium gas from the vadose zone is interesting. However, care should be taken to maximize the accuracy of this method. If possible, core samples should be collected at selected points, to verify the helium method by comparison with directly measured tritium

concentrations in the pore water. Improvement in the analytical sensitivity of tritium measurements performed at Hanford could also provide more definitive data concerning the mechanisms of tritium migration (gas-phase versus liquid) in Hanford soils at this and other locations. It should also be noted here that tritium may be a precursor of other more problematic contaminants moving from the disposal site into the groundwater. This makes the precise location of the tritium plume even more important.

6.4 Long-Term Institutional Controls

The IPEP asked the IP to consider the issue of long-term institutional controls related to the groundwater remediation systems. The recent National Research Council ("NRC") study of this topic (NRC, 2000) explicitly stated that all barrier technologies employed at DOE facilities are likely to fail over a finite lifetime, and the implications of these failures have not been adequately considered in DOE's management strategy at these sites. The NRC findings seem particularly relevant to Hanford groundwater remediation projects because of current and proposed uses of barrier technologies for several plumes along the Columbia River corridor, as well as the likely need for long-term management of plumes in the 200 Areas. Along the Columbia River corridor, the contamination issues that are likely to require long-term management include the hexavalent chromium plumes, the ^{90}Sr plume, and the disposition of the nuclear reactors and fuel storage basins.

6.4.1 Observation

The IPEP was encouraged to see that the IP is beginning to assess the implications of the recent NRC study on groundwater remediation decisions along the Columbia River, as well as at other locations at Hanford. The accelerated cleanup strategy presented at the October 2000 meeting appears to be based on optimistic expectations for successful technology applications that will reduce or eliminate the need for, and cost of, long-term institutional management at some groundwater remediation sites. Information to support these assumptions has not yet been provided to the IPEP.

6.4.2 Recommendation

We recommend that the IP prepare a report with a comprehensive assessment of the long-term management needs for the groundwater remediation systems. This report would assess the effectiveness of barrier technologies, and explicitly account for the effects of radioactive decay and chemical reactions on risk reduction relative to groundwater exposure scenarios. Finally, this report would address the likelihood of meeting the cleanup goals and timetables presented in the accelerated cleanup strategy.

7 S&T Inventory Task Update

7.1 Observations

Only a brief period of time was allotted to this subject during the October IPEP meeting, because the primary focus of the meeting was on the Columbia River. The presentation by Rob Corbin, and the subsequent discussion of key points by Corbin and by Bruce Simpson, were well received.

The IPEP is pleased that significant progress appears to have been made in model development. The brief session further strengthened the belief of the IPEP that the issue of inventory definition is an essential tool for SAC and must be kept at the forefront of IP and SAC planning. To that end, the IPEP intends to devote a more extensive discussion of the subject of inventory definition and input to the SAC model via a session at the next IPEP meeting loosely titled at this time as "Inventory/VZ Interface".

A significant impediment toward evaluating scope, technical development and validation of the inventory program was that the pre-meeting material provided to the IPEP had little in the way of tangible documentation, consisting primarily of recently prepared overheads - some apparently used for a SAC presentation to the NAS/NRC Panel in September. The judgments above are based primarily on the overheads presented at the October 2000 meeting and the investigators' comments during the discussion that followed.

This remark is not an indictment of the investigators' work, however, because we realize that the scope of the inventory program is still evolving, as judged from other documents provided for the October meeting (such as the GW/VZ Detailed Work Plan). Much of the developmental work is so new that the investigators have not had sufficient time to interpret and report the details of their work. During the discussion period, the IPEP was informed that a report was being prepared, with delivery for review on November 1, 2000. We hope that the progress report will be available well prior to the next meeting of the IPEP.

It appears that an accelerated effort for inventory definition as input to SAC Rev. 0 has developed over the past few months, especially during the period since the May 2000 meeting of the IPEP. Currently, the investigators' effort seems to be focused on the 200 areas, but plans were announced for defining inventories in other areas. Examples of uranium release to the B-farm cribs and estimates of inadvertent radionuclide and chemical releases through leaks from the TY-103 and BX-102 tanks were provided to describe model functions. Plans for FY01 call for calculations to be performed for more sites and waste streams, for adding noble metals and other fission products (73 analytes and radionuclides currently in the model), and for considering other tank leaks and releases.

Criteria for selecting the next steps beyond FY01 in development and testing of the model remain vague, although brief mention was made at this meeting of potential application to

tank inventories. Some amplification of this potential application can be derived from the overheads from the NAS/NRC meeting, wherein the Inventory/RPP interface describes estimating current, past and future (residual) tank inventories. Because the model accounts for phase separation of tank constituents over time in order to estimate leak content, it could prove a valuable tool for defining retrieval and treatment options, as well as permissible residuals on a tank-by-tank basis.

A properly validated model seems likely to reduce the high degree of uncertainty associated with evaluating the risks from leaks, retrieval losses, and residuals, an uncertainty value that approached seven orders of magnitude over long time periods for a single tank farm [DOE 1999]. These potential applications and plans for extension to other sites will be discussed at the next IPEP meeting.

8 Tank Farms Vadose Zone Characterization

8.1 Observations

In this session, the IPEP was told by Tony Knepp that their strategy is to perform initial characterization of each set of tank farms as part of a phased, nominally four-year cycle. For example, the plan for T, TX and TY farms is to prepare the DQO in FY01, collect data in FY02, perform a Risk Assessment in FY03, and complete the Field Investigation Report in FY04. In response to a question from the IPEP, Tony Knepp stated that they are finished characterizing S/SX Farm (in terms of new boreholes) "in this time period," leaving open the question of drilling additional borehole(s) in the future.

While only a modest amount of characterization has been accomplished in S/SX to date, particularly in the deep vadose zone, the phased approach seems reasonable because it allows time to develop an objective set of criteria to determine how much sampling will be required in the various tank farms, in terms of both accuracy and level of detail, to satisfy retrieval and closure needs and establish a baseline for long-term monitoring.

This approach also allows time for data analysis and interpretation, which will be needed for guiding any future characterization, and allows time for maturation of relevant S&T developments which may make characterization more effective and/or less costly.

A new analysis of the neutron moisture data from the slant hole below SX-108, completed the day before the IPEP meeting, produced a log with little character and minimal correlation with laboratory water content estimates based on borehole samples, in contrast with an earlier analysis of the same data that had seemed more promising. It is premature to assess this work, which is still evolving, but it is worth noting that getting good neutron logs in the vadose zone is a challenge that DOE has invested millions of dollars into addressing at other DOE sites (e.g., Hearst and Carlson, 1994; Hearst, 1995).

Every effort should be made to take advantage of existing technology and knowledge (if necessary) before the effort to perform moisture measurements and analysis begins at SX Farm in FY01, as planned. The quality and accuracy of the proposed neutron logging method should be demonstrated and documented, as was previously done quite well for the high-resolution spectral gamma logging system at Hanford, as soon as feasible, preferably before routine logging and monitoring begin.

A temperature log was obtained in the slant borehole beneath SX-108 using an infrared sensor. Borehole temperature data have the theoretical potential to identify large concentrations of heat-producing nuclides in the formation, including ^{137}Cs and ^{90}Sr. This idea was suggested by the earlier Vadose Zone Expert Panel and its theoretical feasibility was subsequently supported by computer modeling (e.g. Piepho, 1999). However, we

need to keep in mind the fact that the modeling to date has not been sufficiently realistic to demonstrate the practical application of temperature logs for this purpose, and the necessary data processing techniques do not yet exist.

8.2 Recommendation

The quality and accuracy of the proposed neutron logging method(s) should be demonstrated and documented.

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