HANFORD
GROUNDWATER/VADOSE ZONE
EXPERT PANEL

Closeout Report for Quarterly Meeting Held February 1-3, 1999

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Introduction

The eight-member Expert Panel that was formed to provide independent review of the Hanford Groundwater/Vadose Zone Integration Project (hereafter, the Project) met for its third quarterly meeting on February 1-3, 1999, in Richland, WA. During this meeting, the Panel focused on three topics: (1) present status of the Project, (2) review of the current draft of the Project Specification, and (3) review of the Project's Applied Science and Technology Plan. During the meeting, there was a healthy and constructive dialogue between the Panel, Project personnel, and stakeholders.

This report is the Panel's closeout report for the meeting. It provides the Panel members' comments regarding the topics covered. To the extent practical, the report presents the Panel's views on a consensus basis. However, where there are different views among the members, other than on minor points, that fact is noted. Also, individual Panel members have provided additional detailed comments on specific portions of the documents reviewed, and their contributions are included and cited in appendices to this report.

Section 1 of this report presents the Panel's views on the status of the Project based on the information provided to the Panel both before and at the February meeting. This section includes the Panel's recommendations to improve the Project. Sections 2 and 3 of the report provide the Panel's comments and recommendations on the documents reviewed both before and after the meeting. To achieve a level of consistency, the Panel adopted a review framework that addressed the following questions on each document:

1. Is the Objective (i.e., Purpose) of the document clear and appropriate?
2. Is the intended audience for the document clear?
3. Overall, how well did the document achieve its Objective? Are all parts of the document necessary?
4. Major Strengths of the document?
5. Major Weaknesses of the document?
6. How can the document be improved?

In addition, the Panel members were also able to make any other comments on the documents to address any points that were not explicitly covered by these questions.

In conducting our work, the Panel's goal is to offer thoughtful and constructive comments and recommendations designed to assist the Project achieve its objectives. We do not expect our comments to be accepted without question, nor rejected out of hand. Rather, we hope our comments are taken into consideration by Project management and factored into the Project as appropriate. We stand ready to amplify and explain our input on request. In the final analysis, however, the Panel recognizes that it is Project personnel who remain ultimately responsible for timely and cost-effective planning and execution of the Project, as well as for meeting its goals.

Section

1

Status of the Integration Project

The Project Specification indicates that current planning for the Project is based on three documents: (1) the Project Specification (DOE/FIL-98-48, Draft C), (2) the Baseline Cost/Schedule Summary (DOE/FIL-98-89, Draft A); and (3) the Project Long Range Plan (a graphical representation of scope, cost and schedule). Through the February meeting, the Panel had been provided only with the Project Specification (which contains the Applied Science and Technology Plan) and the Long Range Plan to review. Thus, our comments in this report are restricted to these documents.

The Panel's overall conclusions and recommendations on the status of the Project are presented below.

1.1 Conclusions

1. The Project continues to face a very difficult task, and the high pay-off promised by integration remains to be demonstrated.

The Project has the stated intention of wanting to work closely with regulators, other stakeholders, and the Tribal Nations from the start to develop a Project plan that represents something close to a consensus. In addition, the Project must cooperate closely with other existing organizations at the Hanford Site who currently have responsibility for activities that have a major impact on meeting Project objectives. The Panel strongly supports the concept of integration, as well as the inclusive approach to implementing the Project that is being pursued. In addition, we recognize that integration is a difficult concept to implement, especially at Hanford, where there is little history of conducting activities from an integrated perspective. Nevertheless, if integration is successful, it is likely to yield significant efficiencies and economies, as well as avoid some major problems in the future.

But because implementation of the process is so difficult at Hanford, the benefits of integration remain largely theoretical and have not yet been demonstrated. It remains a major challenge and urgent responsibility for Project management to show that integration is more than just a good idea and truly has a high pay-off.

2. The Integration Project is not yet "integrated," a fact that warrants immediate management attention.

On an overall basis, progress on individual components of the Project has varied widely. For instance, efforts to define the Applied Science and Technology (S&T) Plan, which have largely involved National Laboratory personnel, have been very successful. This component is well ahead of other Project components in producing a usable product.

Conversely, efforts to develop the risk assessment component and the System Assessment Capability (SAC), the modeling and data integration effort described as the core activity of the Project, have been very slow. They are far behind where they should be at this time and put the Project at great risk. Although some progress is discernible, the Panel concludes that the Project is not yet internally "integrated" or synchronized. Further, the Panel recommends that this situation receive priority attention from Project management.

3. More effective integration of the Project on-Site is needed. This will likely require active support from upper management at Hanford, as well as DOE-HQ.

The Panel is concerned that if the Project continues on its present course, it is not likely to achieve the level of integration needed to accomplish its goals. The amount of real progress achieved by the Project in integrating its efforts with those of other on-Site organizations who must co-ordinate with the Project (such as TWRS) is not readily apparent to the Panel. The Panel suspects that fulfilling the objectives of the Project at Hanford has not yet become a widely shared vision of all relevant senior managers at the Site. For the Project to have any chance to succeed, this must occur.

The Panel believes that careful consideration should be given to raising the level of integration of remediation work that involves some related tasks now being planned by other Hanford organizations so that they coordinate more closely with Project planning and execution.

A decision to make integration more effective across the Site is probably not controlled by the Project's managers. Rather, it is a decision that would likely have to be made at the Site Manager's level or at DOE-HQ. The Panel believes that to achieve a more effective integration effort on-Site, as well as to increase chances of success, the Project needs higher-level visibility, possibly by reporting to a higher level at RL, or even to DOE-HQ.

4. More realistic and rigorous Project planning is needed.

The Panel understands that the planning documents prepared by the Project to date (for example, the Long Range Plan) have been based on an unrestricted funding scenario. This strikes the Panel as an unrealistic approach, unless the overall planning process also includes a series of other scenarios defining what could be done under more likely circumstances. Unfortunately, the Panel sees very little evidence of this additional type of effort. An undesirable but likely outcome of unrealistic planning is that stakeholders, Tribal Nations, and even other Hanford Site managers will not take the planning documents and activities they define seriously, or stakeholders will become further disillusioned when the final plan falls far short of the early drafts.

The Panel concludes that the Project should conduct its future planning using funding scenarios that are more realistic. Only this type of planning will yield the kind of results that are most useful to effective decision-making. The test of each project element should be: "Is this both necessary and sufficient to achieve our goals?"
The formal planning carried out to date for the Project is visually embodied in the Long Range Plan. This is a bar chart showing activities as a function of time over the planned

duration of the Project. The Panel is concerned about the depth of supporting assumptions and details that underlie the Plan. The sort of schedule planning exercise that is evident to us may be useful and adequate for simple projects, but it is not likely to be adequate in this case. At the same time that Project personnel are soliciting ideas and opinions from interested outsiders, a formal, rigorous, project planning activity should be progressing simultaneously to provide a strong framework; details can be defined over time. For example, critical path analysis and cost-benefit assessments of alternatives are needed. (Note we have avoided the term cost-benefit study. We are not recommending comprehensive, expensive cost-benefit studies with voluminous documentation; rather, more carefully focused efforts to estimate costs and identify benefits are needed to put Project planning on a firmer footing.)

Another vital element of more rigorous planning for the Project is to develop detailed definitions of interfaces between Project tasks and work to be done outside the Project but which are essential for Project success, such as the proposed S&T Plan. Schedules of such outside work must be defined and coordinated with Project needs. After all this time, it is still not clear to the Panel just what the content and relationship of the core projects to the Project really is.

In addition, the Panel is concerned about how existing regulations and agreements (e.g., TPA), as well as those being negotiated outside the Project (e.g., TWRS, privatization, etc.), can affect the degree and effectiveness of the integration effort. It is also not apparent how the Project will enhance the efforts of those who are addressing how to make integration more effective at Hanford.

1.2 Recommendations

1. The Project needs to explain and support the benefits of integration. Project plans, in general, must be explained and defended better.

The Panel believes that a compelling case to support integration and the benefits it will provide has still not yet been made by the Project. This is crucial to securing continuing support for the Project. While the key Site decision points which have been targeted by the Project to support have been identified, they have not been made a highly visible hallmark of the Project with clear links to all supporting activities that need to be carried out.

The Panel recommends that the Project prepare a clear statement that supports the benefits of integration. This statement should then be vetted among those organizations that have some stake in the Project, as a means of having them react to and understand the value of the Project. Such a statement can also be incorporated into an improved Project Specification.

Because Project plans do not include clear and explicit linkages between Project decision points and supporting activities, the Panel perceives that it may be all too easy for important work elements to go astray. For example, the S&T Plan contains a list of sometimes vague Project goals with a rather general description of how Project personnel hope to achieve those goals. There are no clear links to Project decision points consistently evident.

Also, it remains particularly vague to the Panel how the System Assessment Capability (SAC), risk component, and field investigations will be integrated into the schedule and information needs of the Project's key decision points. The Panel believes this lack of linkage could be the source of great inefficiency that leads to wasteful expenditures. The Panel recommends that the appropriate linkages be established explicitly, supportably, and immediately for the SAC, the S&T Plan, and those field investigations which the Project is relying on.

Finally, It is extremely important that the Project be based on concepts and plans that are clear, specific, and understood, as well linked to its goals. The reasoning behind the decisions made by the Project needs to be explained and defended to promote unambiguous communication inside and outside the Project. This should make it easier to improve and implement the Project Plan over time. The Panel recommends that this aspect of Project decisions be given greater attention.

2. The Project should not promise what probably cannot be delivered. It should emphasize dealing with uncertainty.

The Project must be very careful about promising results that are unlikely to be delivered. For example, in Appendix A, Technical Element Descriptions, of the Project Specification, it is written: *"Sufficient information will be collected to provide (1) an accurate depiction … of contaminant distributions…"* (page A-3 first paragraph). Because it is very unlikely that an "accurate depiction" will ever be obtained in this case, language like this over-promises.

Instead, the Panel recommends that the Project consider and explain how it is going to deal with inevitable uncertainty in the characterization data, for example. How will the Project handle contingencies that arise, for example, when characterization fails to yield needed data or when modeling does not adequately predict subsequent field observations? The Panel recognizes this as a general problem throughout the Project. Defining methods for dealing with uncertainty and sparse data should be emphasized in the Project Plan.

3. The management processes, responsibility, and authority for integrating and coordinating with others, especially outside the Project, should be defined.

The roles and responsibilities of managers inside the Project must be clearly defined, along with formal mechanisms for interacting with other Hanford projects. For example, the danger exists that some S&T products, funded outside the Project, and therefore not under direct Project control, will not be delivered when needed. At the February meeting, Rich Holten (DOE-RL) stated that he accepts responsibility for ensuring this does not happen. This means that progress on S&T developments must be followed closely by Project personnel who must be in a position to take appropriate action if necessary, including possibly providing supplementary funding.

Other similar contingencies should be identified now, while the Project is being planned, in order to avoid serious problems during Project execution. Managers at Hanford outside the Project, who must cooperate with Project managers, must also be assigned and accept

appropriate responsibility and authority for coordinating with the Project. The Panel recommends priority management attention to these issues.

Review of the Project Specification

The current draft of the Project Specification consists of a main body that includes six sections or chapters giving an overview of the Project, along with a number of appendices, some of them quite large, that present background material, supporting documents, and detailed information on aspects of the Project. The Specification includes, among other things, background on the Hanford Site, Project objectives, management strategies (Long Range Plan), Project constraints, and issues raised by various review and stakeholder groups, as well as relatively detailed technical descriptions of proposed projects, particularly in the Applied Science and Technology (S&T) Plan. The number of people involved in defining the Project is quite large and includes DOE staff, several contractors, regulators, stakeholders, Tribal Nations, and interest groups. Close cooperation among these groups is essential for integration of remediation efforts at Hanford to succeed

The Panel's overall conclusions and recommendations regarding the Project Specification are presented in this section, followed by other suggestions for improving the document and a summary of the Panel's views according to the six-question review framework that was adopted. More detailed comments from individual Panel members on the Specification are provided in Appendix A, where contributions are cited by name.

2.1 Overall Conclusions and Recommendations

1. The Project Specification is currently a non-integrated collection of information and plans that is not yet adequate to meet Project needs.

In its present form, the Project Specification is a non-integrated presentation of Project elements that vary considerably in purpose, detail, and clarity. Although it is clear that considerable individual effort went into writing the Specification, no effort is evident to produce an integrated document. The sections and appendices in the Specification differ widely in contributing to the implicit goal of communicating what the Project is and how it is to be implemented. The lack of integration and focus is of general concern to the Panel. We believe that clear communication is essential to having people with different backgrounds and degrees of involvement in the Project understand and participate.

In general, the Panel believes that the Project Specification, in its present form, is not adequate to define the essential features of a project as large, complicated, and potentially unwieldy as the Project. We also think it is likely to have limited usefulness in helping the Project address and resolve many of the key issues it will face. As explained further below, the Panel believes some deficient elements of the Specification are worth improving now.

2. The Project Specification does not make the case for the Integration Project, nor does it define clear, quantifiable goals. Thus, it is not a true specification.

The Panel agrees that the goal of integration at Hanford is conceptually very sound. Presumably, there could be significant savings and benefits from an integrated approach to

Site cleanup. However, the Project Specification does not convincingly communicate to a skeptical public that the project will actually work. The document should convey that sufficient evidence exists that integration is not just a good idea (Section 1.3). It must also convey that it will work at Hanford, that there exists real evidence that it can impact positively risk, schedule, and costs, and that the Project will have the authority to make the changes required for integration. The Project Specification fails to do three things:

- It does not make the case for the benefits of integration by carefully identifying what is to be gained and weighing that against some of the barriers that must be overcome for integration to succeed. The results of such an analysis would be, or should be, a well argued rationale for why the Project is needed and what specific steps must be carried out. The Specification states that a primary objective is to make the Project "science-based." Is science really the limiting factor? Is management (or leadership) the problem? What specifically are the issues that integration will address, and what are the specific obstacles to successful cleanup that integration will overcome? There is a long list of questions like this that beg to be answered.

- It fails to set clear, quantifiable targets against which the Project can be measured. In the private sector, the Project would not be funded until a "return on investment" was justified. Identifying key future decision points when the Project would be expected to provide certain kinds of information regarding tank cleanup is a start. These decision points represent a potential rallying point that can focus all Project-related activities, such as the SAC, the S&T Plan, and field investigations. However, at present, these decision points are buried deeply in the document, whereas they should be easy to find in the first couple of pages

- It fails to justify that the Project will not hinder the advancement of existing core projects that must meet regulatory and contractual commitments, most of which have been, or are being, negotiated at management levels beyond the Project's control. The Project needs to show how the core projects can realize a positive return on investment such that funds committed now out of core projects will provide enhanced performance later on by freeing up money.

Thus, the Panel believes the current Specification is not a true specification, because it does not define what the Project is or establish quantifiable ground rules for its completion. What specific savings or efficiencies are to be achieved? How will these savings and efficiencies provide subsequent benefits to compensate for current and recurring costs of integration? How is the investment in additional science and technology likely to pay dividends in cost savings, risk or schedule reduction, and the like?

3. The Project Specification is not effective in supporting that the structure for integration is really in place or is even feasible.

The Project Specification clearly stresses the need for integration of the technical elements at the entire Hanford Site and that the Project provides a viable approach. This means that Hanford must have a new paradigm in which core projects that represent, in practical terms,

the bulk of the activity at the site, are to be: 1) coordinated, 2) guided by evaluations performed by the SAC, and 3) bolstered by research from the S&T program.

One of the least effective aspects of the Specification is in convincing the reader that the structure to achieve the needed integration is really in place or is even feasible. The reader is not given substantive information about the core projects. There is not sufficient detail to be convinced that any overlap among the projects exists, that existing activities cannot be scheduled to create multipurpose field work satisfying all contractual objectives, or that an authority exists to actually force modifications to current activity. Several times in the document, comments are made such as *"Core projects were evaluated and opportunities for enhancement were identified…."* (p. 1-4), implying that the integration effort will result in economic savings. Unfortunately, this is presented as a vague concept without supporting evidence.

It is still not clear to the Panel what specific activities are envisioned as working together to save resources, and how specific actions in core projects can actually be integrated. For example, integration of field characterization activities by TWRS, remediation projects, inventory groups, etc. could all benefit from the planning to drill boreholes. The truth is that plans for boreholes are developed far in advance, certain tests are not compatible with other activities, some tests are destructive to samples, some are non-invasive, most require subcontracts and scheduling.

Ideally, multiple groups could benefit from combining efforts. Practically, however, to accomplish this in a single project would be difficult enough, but to coordinate multiple-use field sampling among completely different organizational entities, with different objectives and contracts, seems unlikely. In other words, we (and others, we suspect) would like the Project to provide a firm example of how integration could work in practice.

The suspicion that this Project actually cannot be implemented as currently defined is reinforced by the brief and disturbing discussion of the authority structure. It does not appear that there is an authoritative enforcer that can move the Project forward, rather all groups appear to be managing their own projects and integration occurs really by consensus.

The Panel believes that the authority and responsibility of the Project need to be reviewed by DOE-RL management and DOE-HQ to assess whether they are really adequate for the Project to succeed.

4. The System Assessment Capability (SAC) may not be "out of control" but it is not yet "under control." Its lack of progress is undermining the entire Project. Adequate resources and appropriate management attention are urgently needed to bring the SAC to a functional level as soon as possible.

Among the most significant problems affecting implementation of the Project is the central role of the SAC, and its lack of progress to date. The SAC is still in its earliest stages of

development, and the precise role it will play still has not been clearly defined. However, the Project Specification states that the SAC is the "critical path" activity of the Project. If true, and it may well be, the Panel is very concerned that the absence of serious progress on defining and developing the SAC is undermining the entire Project.

The SAC, and associated risk assessment capability, are out of phase with other Project activities; worse, they are not under control, and the Panel has seen little to be confident about with respect to their future success. The mission and goals of the SAC are not tied to overall Project goals or to key decision dates. The Panel believes this is a serious deficiency. Without such a linkage, it will be easy for the SAC to wander from its goal of supporting the Project, and it will be more difficult to keep it focused.

The core programs are designing characterization plans without any feedback from the SAC. Modelers are using models and calibrating models without any feedback from the SAC. The SAC is not developing fast enough to contribute to decisions that must be made soon. The Specification portrays the SAC as central to the Project's mission, but this concept does not reflect current reality. The Panel believes that significantly more resources, as well as better project management, must be available to the SAC to get it to a functional level that might approximate the role given to it in the Specification.

The Specification indicates that the SAC will proceed through several versions over the next few years. How will decisions be made with such a moving target? There is the potential for the Project to flounder because of excessive reliance on the SAC. Is it realistic to think that a computer model or models will unlock the gnarled decision process at Hanford? What credibility does the SAC have now? What credibility can it achieve? How? And could it be too little, too late? These are fundamental questions that need to be addressed.

Several Panel members question the wisdom of using such potentially contentious, cumbersome, and non-transparent modeling efforts as the primary basis for key decision making. The case has not been made that the limiting factor at Hanford is more and better models. Rather, key issues are likely to be: 1) high degree of uncertainty with regard to key characterization issues, and 2) very limited remediation options for some of the major contamination areas. There is a potential here for a significant contribution toward better decision making. The process should involve applying the risk paradigm to identify priority contamination problems, specify the level of uncertainty in key variables, and determine, based on existing modeling capabilities, the most urgently needed data. Perhaps the assistance of experts in the field of decision-making in the face of great uncertainty could be sought.

5. The contribution to the Project by the so-called core projects is not evident in the Project Specification.

The core projects are intended to supply much of the data needed by the Project. Unless core project personnel have a strong commitment to the idea of expending significant effort to make integration happen, then this effort will be an empty programmatic shell. Contracted core project activities must be modified and investigators must be given incentives to change their research or technical activities to cause integration. The Panel

believes that the Project Specification must state examples of how this can be done. Clear examples of needed integration brought forward by core project groups would be a strong endorsement that core projects are supportive of the integration effort.

The Panel is concerned that there is no evident contribution in the Specification by the core projects. There is no visible evidence that any thinking is underway to create improved data flow and to integrate efforts. It appears that all projects are still pursuing their own objectives. This is especially obvious from other documents and from on-site presentations pertaining to the fieldwork that TWRS is pursuing this fiscal year, and to the vadose zone modeling that TWRS is presently doing. Integration bridges should already be evident. Planning for fieldwork should include input from the SAC, inventory groups, risk and remediation, vadose and groundwater modelers, etc. This represents current activity, and there is no discussion in the document of such activity as an example.

The Panel is left to conclude that the other groups do not see the proposed integration structure as having sufficient detail to be helpful regarding how to do this, nor do sufficient drivers exist to cause anything to happen. These deficiencies need to be addressed for the sake of the Project's survival. Upper level Site management, or DOE-HQ, may need to intervene to expedite this process.

6. Some parts of the current Project Specification are worth improving now, and it would be valuable to do so.

The assortment of information and variety of levels of detail in the Project Specification give evidence that the Project has not yet adequately defined and/or communicated its essential purpose. The Panel believes the Project Specification should become a more useful document to the Project. Eventually, a more rigorous specification for the Project should be prepared. However, for the time being, the Panel believes there is value in improving certain parts of the document. In this regard, the Panel recommends that the Project focus further on topics such as:

- Defining the Project's strategic goals and objectives;
- Defining the linkage of all work elements to currently defined decision points;
- Explaining the benefits of integration;
- Describing how integration will be used to support key groundwater/vadose zone-related decisions on Site;
- Indicating how work priorities will be set and managed;
- Explaining how interfaces and communications will be managed on Site, especially with personnel associated with core projects; and
- Indicating how uncertainty and contingencies will be handled.

In addition, use of a technical editor with the document would be worthwhile (see further below). While the Panel believes it would be beneficial for the Project to address the above topics and improve the current Specification, we emphasize it is not necessary to delay all technical work to do this.

7. Preparing a good Project Specification will demonstrate the ability of Project staff to integrate important issues.

The Panel concludes that the Project Specification merits being improved by Project management, not for its own sake, but in order to prepare the Project to successfully meet the challenges it will inevitably face. Project staff must be capable of demonstrating that it can "integrate" diverse and seemingly conflicting interests. If this can not be demonstrated in a document like the Project Specification, then the Panel doubts that the staff can deal successfully with the fundamental integration issues that are essential to Project success.

The challenge is straightforward. The Project must clearly demonstrate in the Project Specification its ability to integrate issues. If it does not do this, what confidence is there that more difficult integration issues, which are sure to arise, will be successfully resolved in the future?

8. Progress in addressing the recommendations of the previous Vadose Zone Panel, as gleaned from the Project Specification, is very slow.

A measure of success of the Project's progress is to compare the planning documents and corresponding actions against ten recommendations put forward by the Vadose Zone (VZ) Expert Panel in its March 18, 1998, letter report to DOE Undersecretary Moniz. That report was based on Dr. Moniz's request for the Panel's evaluation of a February 1998 Draft A management plan for the Project (note that this Panel is reviewing Draft C). A major concern of Dr. Moniz at that time, and subsequently of the VZ Panel, was the slow progress of the developers of the plan. DOE-RL and Bechtel Hanford have been tasked with planning an integration effort since November 1998. Thus, while some progress has been made in the year since, it still appears to be very slow.

The ten recommendations in the March 18, 1998, letter report are summarized as follows:

1. Identify technical and regulatory requirements;

2. Be responsive to the need for timeliness, technical detail and concerns of affected parties and regulators;

3. Develop an efficient management structure;

4. Incorporate the concepts and technical details of CRCIA analysis modules 1 through 4;

5. Provide a combination of sensitivity and uncertainty analysis for setting priorities;

6. Set priorities based on risk;

7. Bring in specialists from the National Laboratories , Nevada Test Site and Yucca Mountain as active participants in planning and performing work;

8. Maintain impartial independent peer reviews;

9. Provide a mechanism for conflict resolution; and

10. Maintain a review panel as a troubleshooting team to communicate with Hanford technical specialists.

The perceived status of response by the Project to these recommendations, as gleaned from the Project Specification, is as follows (numbers correspond to above):

1. Section 3 and Appendix F adequately define regulatory requirements, but Section 3 and Appendix A fail to account for the uncertainties to be experienced and appear to be overly optimistic in the expectations they convey;

2. Progress to date does not reflect a responsiveness to "timelines" or "technical details," especially regarding TWRS (now Office of River Protection, ORP), while a strong effort appears to be unfolding on concerns of affected parties;

3. Management efficiency must still be demonstrated;

4. CRCIA modules are in the process of being incorporated, even beyond those considered by the VZ Panel;

5. The System Assessment Capability (SAC) will necessarily include both sensitivity and uncertainty analysis. However, while the SAC is described as the critical path activity for the Project, little progress has been made. To reduce costs and expedite this work, the Project should consider adapting other existing assessment methods available at Hanford. For example, the assessment methodology developed by Jacobs Engineering for the Retrieval Performance Evaluation (RPE) should be carefully considered;

6. As above, risk based prioritization appears unlikely in the near term from the SAC, but may already be available elsewhere at Hanford, such as in the work of Jacobs Engineering;

7. Specialists from the National Laboratories and other DOE organizations have been brought in to develop the S&T Plan, and the product seems reasonably successful. However, project awards and successful integration of S&T projects into Hanford needs must still be shown;

8. The issue of impartial independent peer reviews was targeted largely at the Hanford contractual practice which awards site contracts to "Alliance

Contractors." This recommendation appears to have been violated in the SAC effort, wherein the parties that the VZ Panel found unresponsive to Site needs (April 1997 VZ Panel Report) appear to be the principals despite a recommendation that other modelers be brought in;

9. The concept of conflict resolution regarding risk-based prioritization does not appear to have been addressed; and

10. Although an expanded Expert Panel has been constituted, it has, so far, focused on document, rather than technical, review.

The Panel is concerned that the overall success of the Project is being impacted by the slow rate of responding to recommendations and subsequent progress.

2.2 Other Suggestions

1. The Mission statement for the Project is basically good. However, the Vision statement should expanded.

The Mission statement for the Project is comprehensive and good, although some terms need to be better defined (see Appendix A of this report). However, the Vision statement is not consistent with it and may be too limiting by indicating only the protection of "water resources." This appears to exclude ecosystems that depend on the Columbia River, as well as users of river resources, both concepts of which are covered in the Mission statement. Protecting water resources does not necessarily include protecting river ecosystems or river resource users.

The Panel believes the Project should consider extending the Vision statement by adding to it *"… river-dependent life, and users of river resources."*

2. The strategic objectives defined for the Project are really tactics, not goals. Consider re-thinking these to define true "strategic objectives."

Five strategic objectives were defined for the Project in the Synopsis of the Specification, and re-stated differently in the Introduction as activities to be performed. These are really not strategic objectives but rather tactical steps that will be taken by the Project. "Integrate ongoing projects and planning" is a tactic, not a strategic objective. "Determine the cumulative impacts" is also a tactic. "Apply sound science and technology" is again a tactic, not a goal.

In Table 5.1, the objectives for integration are summarized. It states, *"Establish a consistent and integrated approach…leading to an understanding of…processes."* Again, this is not an objective but rather a tactic. Isn't the goal of integration to improve the remediation process? Understanding processes may be necessary to achieve this goal, but it is not, in

itself, the objective. This is another example of language used in the Specification that does not clarify to the issues.

The Panel believes it would be worthwhile for the Project to re-define its objectives in a strategic fashion.

3. The role of the Expert Panel is not properly nor consistently defined in the Project Specification. It is important that the Panel's role be understood by the Project.

The Panel's role with respect to the Project is not consistently nor accurately defined in the Specification. At various points, the Panel is described as providing technical peer review (page 5-12), as providing oversight of the Project (Synopsis), or as providing technical recommendations to the Project (Synopsis and page 5-12).

In fact, we believe the Panel's major purpose is to provide programmatic, as well as technical, observations and recommendations regarding the Project from an independent perspective. The purpose of the Panel is not to provide oversight (Synopsis), nor do we focus on just problem resolution and technical reviews (page 5-12). Through sub-Panels, members participate in technical peer reviews of specific topics, however.

4. The Long Range Plan should be replaced by a critical path analysis.

The Long Range Plan (LRP) is touted as one of the three documents, in addition to the Specification, that form the baseline for the Project. However, the LRP is not a plan at all but rather a chart containing activities and a schedule. The Panel is concerned that the explanation of the LRP is not well done in the Specification and likely to be intelligible only to those individuals who were intimately involved in its preparation. If left in its present form, the Panel believes that the Project should take steps to provide a more descriptive explanation of its content. However, what is really required is a plan that contains a critical path analysis and accompanying explanation of its work elements.

5. A good technical editor could improve the Project Specification considerably and should be used.

It is clear that considerable effort went into writing the Specification and that it contains the work of many authors. The primary readers of this document are likely to be the interested public, and though the Hanford public has become increasingly informed, the document is not yet written in appropriate language for them. In many places, the writing is quite technical and complex. This could be greatly improved by a good technical editor, something that would greatly benefit the public not working at the Site on a daily basis. There also seems to be some duplication of material, which by deleting would make the document shorter and easier to read.

Clearly, the Project Specification should be written in general lay vocabulary where possible, because it provides an overview. The document can be significantly improved by editing the text to eliminate: jargon (..*effects assessment*..), noun phrases (..*purpose of the S&M*

function for contaminated surplus facilities awaiting decommissioning..) narrow technical terms (..*pedogenically altered sediment, ..paleosols*..), and by defining vague terms (..*conceptual model, credible, defensible*..). In some sections, many sentences are ambiguously worded or simply incomprehensible and the text is sometimes loaded with bureaucratic jargon that impedes communication and will be discouraging to stakeholders (see Appendix A of this report for examples).

By contrast, the appendices necessarily contain the scientific detail and terminology required to communicate the supporting technical information. The technical vocabulary used there is appropriate.

In the face of ambiguous text, many readers will provide their own interpretation, potentially leading to misunderstandings that could prove embarrassing or expensive for the Project over time. At a minimum, the Panel feels this document needs the attention of a good technical editor, a practice that should be standard for all documents to be circulated outside the Project.

6. Consider breaking the Project Specification into several volumes to improve user friendliness.

The Project Specification has grown so voluminous that many Panel members were concerned that it was cumbersome and confusing to work with. While the supporting material is useful, Project personnel should consider breaking the Project Specification into volumes or otherwise reducing the bulk.

2.3 Review Framework Summary

This section summarizes the Panel's views on the Project Specification with respect to the six-question review framework provided in the Introduction of this report and used by the Panel in the document review process.

Question 1 -- Is the Objective of the document clear and appropriate?

The Project Specification does not include a clear and unambiguous statement as to its purpose. Therefore, each Panel member was left to interpret the document's objective(s) for himself. This is not an optimum situation, as general readers will be put into the same situation. Some Panel members perceived the purpose to be encouraging greater cooperation and coordination among the various programs working on remediation of the soil, groundwater and the Columbia River, and to avoid duplication of work, such as data gathering. Most others were concerned that the lack of a clearly stated objective for the document was a large part of the reason for its abstruse quality and inability to really "specify" what the Project is. The overall concern was that this lack of a clear document objective could stem from poorly defined Project objectives.

Question 2 -- Is the intended audience of the document clear?

Again, the intended audience for the Project Specification is not clearly stated, leaving it open to interpretation by the Panel members and other readers. It is clear that the Project involves Tribal Nations, regulators, state of Oregon, and other stakeholders, as indicted on page 1-1, but are these the audience for the document? What about others like Project staff and management, DOE staff and management, and other contractors? On page 1-9, it is stated that, "*The document is designed for a wide community of individuals who wish to understand the Integration Project."* This may have been the intent, but the complexity, lack of integration, and extensive use of confusing language, will likely make this document not very clear to the public.

Question 3 -- Overall, how well did the document achieve its objectives? Are all the parts of the document necessary?

The Specification has a primary objective of describing the Project in sufficient detail that the readership is informed. Another significant but unstated objective is describing to the Project team in one place how their work efforts fit into the future plans at the Hanford Site. An objective that is essential but generally assumed is that the document will clearly communicate to the audience and be convincing. Presenting a convincing case is needed to demonstrate the Project really is viable and represents a new way of working at Hanford.

Because the Specification contains so much information, albeit not optimally integrated or organized, a diligent reader could learn a great deal about the Project from the document, in spite of its shortcomings. Thus, to a greater or lesser extent, the objective of "informing" the readership has been achieved, at least partially. However, as previously discussed in greater detail, the objective of communicating the viability and likelihood of success of the Project has not. If the objective is to show the public, Tribes, and stakeholders that DOE has the desire and ability to achieve the stated Mission and Vision for the Project, that has not been successful. Stakeholders and Tribes understand that project success comes only with commitment of a dedicated, adequate project budget, and they will remain skeptical until that happens.

All parts of the document may be necessary to the Project, but they surely are not necessary as part of a single document. As discussed earlier in this report, the document could be made more user-friendly by breaking it up into more than one volume. Stand-alone documents could be created on important but distinct topics, such as the state of knowledge of the Site and the S&T Plan.

Question 4 -- Major strengths of the document?

The Specification gives a good general overview of Hanford history, Site knowledge, technical problems, and scope of the Project. In addition, preparation of the document forced the Project to accumulate and organize a substantial amount of information, especially about the current state of technical knowledge and "knowledge gaps." Clearly this is only a first step, but in reality, it is a very positive step. If the Project follows through with strong support and Site leadership, the document would be a major accomplishment.

Section 3

The Project has the potential to change the culture of site remediation at Hanford, not only as far as the DOE-RL and contractors are concerned, but also with regard to the heavy influence of RCRA and CERCLA on the regulatory framework. A comprehensive, integrated risk assessment capability, with defined uncertainty specifications, would be a valuable tool for decision making -- on remediation requirements, methods and endpoints. But, this addresses potential strengths of the Project, not of the document.

Question 5 -- Major Weaknesses of the document?

Without re-stating all the points discussed more fully earlier in this report, major weakness of the Project Specification are summarized as follows:

- Objective (i.e., purpose) of the document is not clearly stated.
- Document is loaded with technical and "Hanford" jargon.
- Organization is weak, not integrated, and not intuitive. There is duplication and excessive volume of peripheral material (some in text, some in the appendices).

Question 6 -- How can the document be improved?

- Address weaknesses identified in this report, especially crafting of an "objectives" statement for the document. Also, technical and Site-specific language needs to be edited for clarity and to make it easier for the non technical public to understand.
- Improve the organization, shorten the document, avoid duplication, and create several volumes, if necessary.
- Document needs to acknowledge the present lack of a funding commitment to achieve the Project's goals, other than the existing Hanford budget.

Review of Applied Science and Technology Plan

The Science and Technology (S&T) Plan and associated roadmap include a great deal of well thought-out material that was developed by a systematic process of involving subject matter experts from Hanford and the National Laboratories, together with stakeholders. The Plan is easily the most cohesive and well written document produced so far by the Project. For reasons elaborated below, the Panel is pleased to see this kind of effort bear fruit. However, we are concerned that implementation of the Plan will not yield the

anticipated results under current Project circumstances in which budgets and priorities are not well enough defined to support but a fraction of the work most needed by the Project.

The Panel's overall conclusions and recommendations regarding the S&T Plan are given below. More detailed comments on the Plan from individual Panel members are provided in Appendix B, where contributions are cited by name.

3.1 Overall Conclusions and Recommendations

1. The S&T Plan needs to be linked better with the Project's overall management and planning approach.

It is important that the S&T Plan be managed under a flexible management structure so adjustments in scope, goals, and funding can be made as the details emerge and priorities change. A management approach must be developed that avoids the common deficiencies of "Big Science" projects, including ponderous and inflexible bureaucratic structure, infrequent, mass show-and-tell reviews, and communication barriers between the end-user and the personnel performing the work. It is essential that Project managers have unambiguous responsibility and authority at least for all technology developments that lie on or near the Integration Project critical path(s).

Although the S&T Plan does make an attempt to link its projected outputs to key Project decision points, it still contains budget projections which may not be realized. Another pass is needed at the Plan to make its priorities more rigorous and better integrated with the Project as a whole. Because the rest of the Project lags behind the S&T Plan, this pass should be restricted to identifying those S&T projects which need to be started in the very near future, leaving to a future time the remaining activities.

One of the Panel's recommendations for the Project as a whole is to formalize the planning process, including cost-benefit assessments and a critical path analysis. S&T planning should be integrated more closely with overall Project planning.

2. The reasoning behind each activity in the S&T Plan needs to be explained and defended in terms of the value of the information it will provide to the Project.

Too much of the S&T Plan still sounds like a wish-list of activities that would be "nice to do." The S&T Plan should clearly indicate the rationale for conducting each activity in terms of what value the information will be to the Project. This approach enforces discipline in planning and allows others to understand clearly and provide meaningful constructive criticism if appropriate. When the reasoning behind decisions is not explained and justified, others are left to wonder why this choice was made above all others, thus diminishing confidence in the process and increasing the likelihood of miscommunication.

3. The Project's S&T needs should be described in terms of their value to the Project.

While needs were no doubt identified during the S&T planning process, they are not always explicitly described in the S&T Plan. Instead, recommended technologies are sometimes listed without identifying the underlying needs. The Panel recommends a needs-driven approach that discusses in detail the technological needs of the Project followed by recommended solutions or the process by which such solutions will be identified.

4. S&T tasks should be prioritized, and those that are not absolutely required by the Project should be eliminated.

Some prioritization has been done already but the prioritization process and its results are generally not explained in the S&T Plan document. The S&T Roadmap gives a general indication when the various S&T products are to be delivered, but the order in which S&T products are required is not necessarily synonymous with their priorities. The Panel recommends a more thorough exercise to prioritize the S&T project list within the context of the Project and document the reasoning behind the prioritization.

After prioritizing, we recommend distinguishing between specific S&T needs that must be met if the Project is to succeed and the more general investigations being recommended. Funding will be extremely tight even for vital S&T work. Research and development projects not absolutely required to meet Project objectives should only be funded outside the Project, in the context of broader DOE-complex needs and programs.

5. It is still not clear how the S&T Plan will be implemented.

Although planning for the S&T program is ahead of most other components of the Project, it is still not evident to the Panel how this S&T effort will, in fact, be funded and realized.

There is no discussion of funding mechanisms, or a process to assure that relevant and meritorious proposals link with the identified priority "data gaps." There is no discussion of this need or process in the document, and the first funding cycle is already underway.

6. The S&T program for the Project will have to be closely managed.

The S&T program defined for the Project does not accurately reflect the reality of its function. The need for science and technology associated with the Project's characterization and remediation efforts is not in dispute. The fact is that the contribution will likely be very small unless the Project pays close attention to the management of this program. For example, a great deal of effort has been spent in identifying "data gaps" and defining the needs of the cleanup effort at the Hanford Site. These needs will certainly not all be fundable through the EM Science Program. In fact, it is likely that only a small percentage of the "needed" projects will be funded.

Given that this is the realistic scenario, the Project must establish clear objectives, driven by key decisions, such that the research needs can be specifically prioritized in terms of

importance as well as schedule priority. The Project Specification document does not lead one to conclude that this process is in place. Priorities are in place for general research areas in an unconstrained budget scenario, with only the most general descriptions of needs. Further, the priorities presented in the Plan are apparently in terms of schedule, not importance to the mission, which is the critical ranking needed if resources are as limited as they are. Careful management of the Plan will be required to assure that it can assist the Project to any significant degree.

7. The S&T Plan fails to promote "data discovery and data mining" from existing sources.

Because there is such a need for characterization and inventory information, and because drilling and sampling is such a slow and expensive process, the Panel believes other potentially productive efforts should be pursued simultaneously. The effort missing from the S&T Plan is a strong promotion for continued "data discovery and data mining" from existing documents. The information in Appendix G regarding the state of knowledge is a significant start, but it is clear from many sources that much additional data are available. Much can be gained by using the knowledge base of former employees, contractors, and obviously the still classified documents.

The Panel believes the Project Specification document should have a discussion of this valuable source of continuing data discovery. A web site, information room, and even subcontracts to former employees to produce historical information should be vigorously pursued. This kind of information has been valuable at other sites and should greatly assist the inventory and characterization effort.

8. The Project should not promise what it probably cannot deliver. It should emphasize dealing with uncertainty.

Although the S&T Plan is a significant product, in reality, the funding for this program is quite small and will actually fill only a few of the basic needs of the Project. The Plan does not reflect this reality by using the unconstrained budget and brainstorming approach to resolving the "data gaps" and technical issues at Hanford. Reading the Plan and roadmap creates the expectation of a much larger program. This is just not anywhere near an approximation of reality.

In addition, at several locations in the S&T Plan, goals are identified that are unlikely to be achieved. For example, on page H-8, two major scientific thrusts are listed for the vadose zone work. The first is: *"Establishment of the existing distribution of chemical and radioactive contaminants and their sources and causes, the chemical/mineralogical/physical state in which they exist, and their potential for future migration."* Such a statement is unrealistic (if you disagree, please describe specifically how this will all be achieved) and raises false expectations that will eventually cause trouble for the Project. Replacing the word "Establishment" in the statement with the words "Reduce uncertainty" would make the thrust more realistic and not raise false expectations.

It is essential that the Project deal explicitly with (and document) the constraints that will be imposed by sparse data and imperfect modeling. S&T thrusts need to be developed to deal with the uncertainty that these constraints will impose. The Panel recommends that the Project place the S&T Plan on a more realistic footing that does not raise false expectations.

3.2 Review Framework Summary

This section summarizes the Panel's views on the S&T Plan with respect to the six-question review framework provided in the Introduction of this report and used by the Panel in the document review process.

Question 1 -- Is the Objective of the document clear and appropriate?

Although objectives are provided for the individual technical elements, the S&T Plan does not set out objectives for itself. The Panel believes setting such objectives would be very beneficial. The S&T Plan should be produced as a stand-alone document separate from the Specification that can be referenced.

Then, thought should be given to establishing Goals, Mission and/or Vision statements for the S&T Program, on its own but as a part of the Project. The needed Objectives statements for the Plan should then become apparent, and the overall Plan will have more utility to the Project.

Question 2 -- Is the intended audience of the document clear?

The Plan makes no attempt to define an audience. The Plan is good from the standpoint of technical merit and quality of ideas. However, the only audience for whom it would be fully intelligible would be other Hanford scientific and technical staff. The document is filled with references to undefined sites, chemicals, geologic features, and other local jargon. It would be useful for the Plan to define its audience.

Question 3 -- Overall, how well did the document achieve its objectives? Are all the parts of the document necessary?

Since the document did not have stated objectives for itself, the Panel cannot address this question directly. However, the perceived objective of creating an initial, cohesive S&T plan to address some of the Project's technical issues was clearly achieved.

For practical purposes, all parts of the document are necessary. However, there is great opportunity to reduce the volume of redundant material.

Question 4 -- Major strengths of the document?

The document has exceptionally well-developed definitions of data gaps, S&T needs, and technical elements. It is well-documented and technically sound. Presentations of technical

issues are reasonably clear, except during those times (and they are many) when the authors use local jargon and nomenclature.

Question 5 -- Major Weaknesses of the document?

As an appendix to the Project Specification, the document loses impact and definition. It also suffers from lack of Vision and Mission statements, and Goals and/or Objectives statements. Further, it has no Table of Contents, Glossary, or Summary. It is redundant in places and over-uses local jargon and nomenclature.

Question 6 -- How can the document be improved?

- Address the weaknesses identified in this report.
- For a stand-alone document, add sections on: Vision, Mission, Goals, Objectives for the document, Table of Contents, Glossary, Summary page(s), list of authors, etc.
- Use a thorough technical editor to restructure and rewrite the plan in clear English, taking special care to define the locally-derived jargon, etc.

Appendix

A

Detailed Comments on the Project Specification

This appendix provides other, more detailed comments from identified Panel members on the Project Specification.

A.1 Comments by Prof. Bassett

SYNOPSIS

p. i, line 14. "Science based" is not **defined** and may be misleading. This entire project is much more about engineering, design, and technology, and much less about science. Even the S&T Plan is dominated by engineering. Does Moniz mean Science and Engineering based? If not, we are spending money improperly. Please clarify.

p. ii, line 1. Peer review as it is normally defined is not underway, and likely will not be, unless the document is implying that this is the Panel's work. I do not think this refers to the Panel however because under the 5th bullet on this page the Panel is described and peer review is not listed. Conversely, oversight is listed which has never been the role of the Panel.

p. ii, Second bullet. The "Cost and Schedule Baseline," one of the 3 key documents, was not available in time for this review.

p.ii, Third bullet. To realize value from the participation of National Labs in defining research topics, it will be necessary for the project to clearly identify and prioritize research needs. The EM-50 program and the S&T research administrators must first request the appropriate work, and subsequently reviewers who will evaluate the proposals based on relevance to Hanford must clearly know the Hanford needs. This must all be done more than a year ahead of time, and the project has already missed the initial proposal deadline.

ACRONYMS -- This is a useful table. The document could also benefit form a glossary that defines the intended meaning of several important words that are easily misunderstood, and are further noted in the review.

p. 1-1, Second paragraph. The concept of "protection of water resources" should not be read as just general protection from degradation but specifically from contamination originating from Hanford.

p. 1-1, Second bullet. Better to use the term "determine or measure current" not "predict current…" Also, you will not predict what is predicted to be, you may predict what has a probability of being released, etc. The last sentence states that the stakeholders, Tribal Nations, etc. are involved in the decision making. I do not see any evidence in section 1.4 in the discussion on authority that these groups have any authority. It is more realistic to state that advice is sought.

p. 1-2. The **Mission** statement must use defined words. The terms “defensible,” and the phrase “ consistency and maintain mutual compatibility,” are ambiguous. The latter is clearly not true at present. Unless there is evidence that the core projects are contributing to the Integration Project by moving significantly toward these ideals, integration will not happen. Similarly, the terms “credible” and “technical defensibility” require an explanation. Who determines this? Is it based on some criteria, is this a consensus action, or is it based on some accepted standard? Note that the work is not to be done just by national laboratories (last line of **Mission** statement) but will involve universities and probably other institutions as well as national labs.

I do not see the point of the paragraph that follows the **Vision** statement. It is really not adding anything and does not belong as part of the **Mission** and **Vision**.

p. 1-4. The Figure 1-1 does not only display technical elements.

p. 1-4, line 7. Key deficiencies were identified only in the most general and generic fashion. Until the key decisions are identified how will the key deficiencies be identified? Most of the key deficiencies are generic issues that were faced on the Yucca Mountain Project and other sites around the nation. In order to actually initiate most of the work described here, or to issue a request for proposal, much more detail will be needed about key deficiencies. The end of the paragraph implies that the S&T program will rectify the key deficiencies. It is important to state that much of the deficiency can be dealt with by collecting data as part of the core programs using available technology. It just needs to begin and be coordinated to avoid duplication and take advantage of the integration possibilities. S&T will help, but the budget for S&T is small and will answer but a few of the key questions.

p. 1-4, line 12. If core projects have been evaluated and opportunities for enhancements identified then this information is quite valuable and should be summarized or available, section 5 of the LRP does not do this. In this regard, a summary of Core Project activities should be available; an integration Project must have this if it is to plan and evaluate the progress of integration. The reviewer is left completely out of this process and not given any assurance that this has been done.

p. 1-5, line 4. Who is doing this and where is this ongoing assessment? Who does the evaluation?

p. 1-5, First Bullet. Here again we need a definition of “technically defensible,” and can the document site any examples of efforts to integrate the sampling? It is unclear where the authority resides to eliminate duplication; who will be forced to give up their existing activity and schedule and reorient toward an integrated effort? The described authority and decision making structure over the core projects does not seem workable.

p. 1-5, Third Bullet. Here and in many other places the term “conceptual model” is used. Conceptual models already exist. What is the advancement here? Conceptual models are different among those who create them and cannot be goals. How can you optimize and maintain a conceptual model? Mathematical models will be needed to evaluate travel times and risk. Why so much ambiguous discussion about conceptual models? Unless they can be evaluated with criteria, assume that they are always being considered and are nothing more than the beginning of mathematical models.

p. 1-6. How are decisions made? This procedure is vague and appears to work by consensus; it is improbable. Last paragraph. What are “..numerical tools for effects assessments..”?

p. 1-8. Section 1.6 is really a table of contents and is not needed.

p. 2-16. Last paragraph must be a misplaced piece from another section, it does not fit with the discussion and is not relevant. It has the appearance of patronizing the stakeholders.

p. 3-2, Figure 3-1. This figure does not show how priority is determined, nor does the accompanying text. How does this work? What are the criteria for priority? This figure is just a list of items.

p. 3-4. The heading states "Vadose Zone" but the discussion is generic and does not address the vadose zone. In fact, some of the items might apply to the groundwater. Why is this specific section called out as vadose zone?

p. 3-8, Paragraph two. The safety discussion seems too sanitary. We are not just worried about potential large leaks, we have a major leak problem already and it affects safety and should be discussed here and perhaps even in the Waste Retrieval Section below. Tanks are leaking and may continue to leak, this is one reason for the urgency of the project and for consideration of the safety issues, as well as for the recent focus on vadose zone science and technology.

p. 4-1. Paragraph 1 is self-congratulatory and not needed. Later, on the same page, the terms credible and defensible are again used, and are not useful without clear definition.

p. 4-5. First bulleted item, include the vadose modeling effort of TWRS.

p. 5-14, Section 5.5. Clearly the SAC is to play a central role. Who develops the candidate sets (CRCIA based?) and how will the models be selected. This methodology should be clear; modeling will begin early on and model selection and evaluation will be an early need. Modeling is already being done in the core projects; how will the evaluation consider these activities? Will the SAC conduct objective third party studies, or will it rely on the current users to decide? How will objectivity be insured? Model comparison is a slow and arduous task. The SAC will need criteria for several modeling scales, interfaces, and applications. Is the SAC adequately staffed and funded to accomplish these stated needs? If the SAC does not move quickly into the evaluation, then core projects will decide the modeling choices, and the SAC will never catch up.

p. 5-15. Define a "minimum credible model."

p. 5-18, Line 12. Not evident that the authority exists to "redirect" existing work in core projects if it does not meet Integration Project needs.

p. 6-1, SAC. Same comments as before; the SAC is behind on these goals even from the start.

p. 6-2 to 6-3. What of this is really important? The goals and key decisions are not defined, this work may be very low priority, and priority identifies which decisions need to be made first. Some of these activities are busywork and ambiguous words. Where do the urgencies and real needs become recognized?

A.2 Comments by Dr. Conaway

Section 3 -- An introductory paragraph is needed that explains the title of this section and leads into the rest of the material.

Section 4 -- This section is called "The Need for Integration" but it is mostly a list of concerns of the public, regulators, and the Indian Nations. It fails to make a good case for integration other than listing stakeholder concerns, and even that material lacks focus. Other important advantages of integration identified by Project personnel receive little attention, including improved efficiency, reduction of redundancy, and resulting improved cost-effectiveness. These factors are important and should be discussed; even if the stakeholders were indifferent to the concept of integration it would still be a good idea.

Section 4.1, page 4-1, paragraph 3: *"… contaminants may, at some point in the future, reach the Columbia River …"* Essentially, this states that contaminants have not reached the Columbia River and may never do so. Is that your intent?

Section 5 -- Parts of this section are unclear and ambiguous. It is almost as if much of the text were thrown together to serve as a placeholder for later, clearer text. In a document of this importance, clear writing or professional editing is vital.

Table 5-1 (Page 5-4): The cell at the intersection of "Science and Technology" and "Planning Concepts" says, *"Predictions of transport and effects of Hanford Site contaminants require an applied science and technology effort to bring credibility to the decisions that are supported by the predictions."* Bringing credibility is a side-effect of implementing an effective S&T effort, not the main goal. If the work done under the auspices of the Integration Project satisfies the professional standards of the many fine technical people involved, then credibility and public acceptance should follow.

The text goes on to say, *"Numerical, laboratory, and field scale experiments are needed to demonstrate the level of understanding (and credibility) in the predictive tools used to estimate effects."* Again, this comment hints at a fixation on public perception as an end in itself and implies that improved understanding and credibility are not really required.

The final sentence says, *"Improved characterization and monitoring methods are needed to sufficiently characterize baseline conditions, and to demonstrate a basic understanding of transport phenomena."* This implies that improved characterization and monitoring methods are not needed to improve understanding of transport phenomena but simply to demonstrate a basic understanding. Perhaps you mean *achieve* a basic understanding.

Table 5-1 (Page 5-4): The row entitled "Peer Review" seems to provide only one level of peer review, by outside experts. Reviews by outside experts should provide only the highest level of a robust peer review system that is mostly internal. A well designed internal peer review system will save time and money. The challenge is to make the internal review system effective and self-correcting, yet at the same time minimally intrusive. The outside experts will only have the resources to review the in-house peer review system and spot check a few parts of the work.

Section 5.3.2.1. (Page 5-8): This section is titled *"Major Milestones and Decisions"* and says, *"…There are three near-term critical decisions that need to be made,"* followed by three bulleted

statements the first of which is *"The initial decision for the integration of ongoing assessment activities, which is based on the objectives of the Integration Project…."* But what is the decision that needs to be made? This does not specify a decision but rather seems to be shorthand that project insiders might be expected to understand. Similarly, the second and third bullets are vague and do not clearly state what decisions are to be made.

Section 5.3.2.2 (Page 5-8): This section is titled *"Operations/Interim Actions"* and says, *"… This effort is included to track/highlight two activities,"* followed by two numbered paragraphs, the first of which says *"The tank farm interim corrective measures, which are the subject of the current Tri-Party Agreement negotiations, and which will contribute to define assessment and S&T needs for the tank farms."* This sentence appears to be garbled. The second numbered paragraph says, *"…While significant progress has been made in the integration of groundwater monitoring…"* which is ambiguous. Does this mean "integration of various groundwater monitoring activities that were formerly separate" or "integration of groundwater monitoring with (certain other activities)" or something else?

Section 5.3.2.3 (bottom of page 5-8 and top of page 5-9): *"(2) the ILAW assessment, which is driven by a planned procurement in FY 2000."* Procurement of what?

5.3.2.4, SAC (page 5-9*) states, "The critical path activity for the Integration Project is the SAC."* This absolute statement implies that a formal critical path analysis has been done but this is not the case. The statement implies that developing the ability to perform analyses based on data to be gathered is more of a time constraint than, for example, gathering the data. You may be underestimating the difficulty of getting even a modest set of representative characterization data for the vadose zone, among other things.

Lower on the page, the second bullet says, *"Develop and document criteria that allow candidate and study sets of capabilities to be determined. An important element of this approach is to be as complete as possible, and document what determines completeness (i.e., candidate sets). Approximately 12 candidate sets of capabilities are likely to be needed in the design. Criteria will be developed to progress from candidate sets to the smaller study sets."* This is unclear unless the reader is already familiar with the CRCIA document. Define these terms. Why approximately 12 sets?

5.3.2.4, SAC (page 5-10), second bullet on this page: *"Document and review the planning results in a 'Software Requirements Document,' and the design in a 'Software Design Document.'"* This implies that the SAC is a set of computer programs; in other locations, the description of the SAC appears to differ from this. During the February 1999 Expert Panel meeting, we learned that the SAC is poorly defined at present. In any case, it seems premature to produce two software specifications before producing a more general document defining the SAC.

> ***Third bullet:*** *"Build the initial model for use in the SAC, and conduct a risk/effects assessment."* By model do you mean computer simulation program? There are many definitions of the word model – what kind of model is the initial model likely to be? Assessment of what? If you don't know, say so and explain the process for filling in the missing parts of the plan.
>
> ***Fourth bullet:*** *"Improve the basis for the assessment and incorporate site planning changes."* What does this mean? Does it mean deficiencies identified by the simulation

results will be used to guide further data collection and adjust the sampling and analysis plans?

5.3.2.4, SAC (page 5-11, first paragraph): *"This more detailed information…"* What more detailed information?

Page 5-11, first bullet: *"The decision to proceed with remediation…"* is ambiguous. Does this mean the decision whether or not to proceed, the decision when to proceed, or something else?

5.3.2.5 (page 5-11, second paragraph of section): *"S&T products will be delivered to the SAC…"* What does this mean? How do you deliver a product to a capability? Does it mean that some of the deliverables from the S&T effort are intended to result in improvements in the SAC?

5.3.2.6 (page 5-12), first bullet: *"The waste sites summarize the initiation and completion of 200 Area remediation."* What does this mean?

5.3.2.7, Project Management (page 5-13 first paragraph): In your list of areas of greatest importance for reviews, tasks or projects that are particularly costly should be listed.

5.5, last paragraph (page 5-15): *"Revision 2 of the SAC is envisioned as the "minimum credible model," that is capable of supporting assessments for key site decisions."* What is the fallback if the SAC fails to demonstrate reliable predictive capabilities at the Rev 2 level?

Page 5-18: This page is a good example of the bureaucratic jargon that clouds much of this document. Parts of it are incomprehensible; we urge you to use plain, clear English to improve communication and avoid antagonizing the stakeholders.

Page 5-18, first paragraph: *"The deficiencies assessment is designed to systematically review and evaluate the work scope, technical capabilities, and the technical knowledge base, by sorting, based on technical elements."* By sorting what against what criteria?

Page 5-18, second paragraph: *"Identified gaps, inefficiencies, and overlaps are compared to ongoing work activities that may provide data to resolve deficiencies."* If you compare a gap to a work activity, what do you conclude?

Page 6-1, first bullet "Integration": *"The Integration Project … is coordinating this work to the fullest extent possible."* This is not a reasonable statement.

Pages 6-3,4: At the end of *Section 6, Path Forward*, four questions are raised that will play a large part in determining the ultimate success or failure of the Integration Project. These are:

> *"Can the Integration Project efficiently and effectively execute its mission over the longer term, within the context of current management systems?*
>
> *"Can the Integration Project maintain its schedule with current levels of project participation and apparent funding constraints?*
>
> *"Can a consistent set of regulatory requirements be established within an overall framework to guide the assessment and cleanup activities at the Hanford Site?*

"Can the Integration Project successfully manage in the face of diverse interests and reach a consensus among various interested parties regarding the project's direction, content, and decision making processes?"

These are vital issues and we commend the authors for raising them. We recommend that this practice be expanded so potential problem areas in other parts of the Project plan are identified in other sections of the document.

Conversely, we note in passing that section *G.1.1, Inventory*, is reproduced nearly verbatim from the earlier draft of that document but the last section, *Key Deficiencies*, seems to have been removed. It is important that Project documents describe deficiencies and explain the planning processes that are expected to provide solutions.

Appendix A, Technical Element Descriptions, general comment: You should consider making Appendix A part of the main body of the Project Specification. The information presented here is needed to understand some of the concepts in the main body. If you want to keep the main part of the document short, make *Section 2, Hanford Site Setting,* an appendix. This type of background material seems to appear as a chapter in virtually every document that comes out of the Integration Project and could easily be placed in an appendix or separate document.

Appendix A, Section A.1, page A-1, paragraph 1: *"The scope of the system assessment technical element includes designing, developing, and applying assessment methods that meet the objectives of the Integration Project."* This is ambiguous; either "the scope of the system assessment is to design, develop and apply…" or "the scope of the system assessment includes designing, developing, and applying assessment methods that meet the objectives of the Integration Project, among other things."

Page A-1, paragraph 2, sentence 1: unnecessarily obscure and awkward wording.

Page A-2, Section A.3, first paragraph: *"(1) underly liquid waste disposal sites"* Does this include the tanks? By the way, the word is "underlie."

Page A-3, first paragraph: *"Sufficient information will be collected to provide (1) an accurate depiction … of contaminant distributions …"* This seems unlikely. Do your statistical sampling experts agree with this statement? You should discuss reasonable, achievable characterization objectives along with methods of proceeding in the face of large uncertainties, not claim you will have an accurate depiction of contaminant distributions.

Page A-3, Section A.5, first paragraph: *"Technical scope … extends from … upstream of the Hanford Site to downstream …"* Isn't this geographical or spatial scope rather than technical?

Page A-5, first paragraph of section A.7: *"The risk technical element receives information from the other technical elements to address stakeholder questions relating to the risks posed by Hanford Site contaminants."* The clear implication is that Project personnel have no interest in investigating risk other than to address stakeholder questions. If the stakeholders had no questions, would you ignore risk?

Page A-5, bottom of last paragraph: *"Once offsite, stakeholder concerns shift to include effects on salmon migration, …"* The meaning is obscure – this says, "Once the stakeholder concerns are offsite…"

Page A-7, second paragraph: *"Of particular interest for assessing ecological risk are locations where sensitive habitat and contaminants coexist…"* This seems to be a euphemism meaning "where sensitive habitat has become contaminated."

Page A-7, second paragraph continues: *"A critical location is one where the entry of contaminants into an exposure pathway and/or the food chain is likely to occur."* "entry of contaminants into an exposure pathway" does not convey a clear message. How about something like "…where organisms are likely to be exposed to contaminants, including through the food chain."

Page A-8, third paragraph: *"Regulatory requirements specifically applicable to an activity will be identified to ensure consistency of application."* What are you saying?

Page A-8, second last paragraph: *"Remediation alternatives … include the following: no action …"* No action is an alternative to remediation, not a remediation alternative. Calling no action a remediation alternative is the sort of thing that hurts your credibility with the stakeholders.

Page A-10, first complete paragraph: *"Natural attenuation is a passive rather than active treatment."* Natural attenuation includes various natural processes but is not a treatment of any sort.

A.3 Comment by Dr. Matuszek

Page 3.5: Ce is not TRU.

A.4 Comments by Mr. Patt

The Vision statement states that DOE will "assure existing and future generation are protected from unacceptable levels of contaminants." At the present time, there are widely different viewpoints among Stakeholders, regulators, and especially Tribal Nations on what is meant by "unacceptable levels of contaminants." Because at the present time there is no real knowledge of what the future "risk" is to the River and its human and ecological receptors, the characterization efforts are vital to developing a credible science based knowledge of the "risk." Only through an adequately funded characterization program with data collection sufficient to determine future risks, will stakeholders believe the vision of this Integration Project and support a reasonable balance between cost driven cleanup and "risk." The public does not trust modeling efforts that lack the necessary data to make them credible.

Page 1-1, Bullet 2 should be deleted or revised to state that it is a goal to predict current and future impacts. The text states that the Integration Project will predict current and future impacts. That will depend on the adequacy of funding and technology development to meet that goal.

Pages 1-6, 1-7, 1-8 and 3-2 describe responsibility for development of required data (characterization data and scientific information). This clearly shows the process that puts the budget for characterization in competition with all other items on the Integrated Priority List (IPL) for the yearly allocated funding for the Hanford Site. If the Integration Project does not have the strong support (allocation of funds) of the Hanford Manager, it will have no chance of achieving its goals.

Chapter 2, Hanford Site Setting is well done, short and concise.

Chapter 3, Where We Have Focused is well done, short and concise.

Chapter 4, The Need for Integration is well done, short and concise.

Chapter 5, Strategic Approach is somewhat difficult to follow and needs editing. Bullet 3 on page 5-6 states SAC is on the critical path for Hanford Site cleanup and closure decisions. This needs clarification.

Chapter 6, Path Forward is well done, short and concise.

Appendix A, Technical Element Descriptions is well done, short and concise.

Appendix B, Direction of Project Authority is short and concise.

Appendix C, Management Plan Requirements is difficult to follow but reasonably well done.

Appendix D, Operational History of Hanford is well done, could be edited to shorten.

Appendix E, Pertinent Regulatory Laws and Regulations is well done, short and concise. I'm not sure if it is necessary in this document.

Appendix F, Requirements and Guidelines is well done, but needs editing to shorten.

Appendix G, Current State of Technical Knowledge needs serious editing to shorten, and clarify. If this can't be done it should be in a separate document.

A.5 Comments by Dr. Wierenga

Page 1-8, par. 2. The IPL ranks projects and their funding. In the past, this seems to have caused funding based on a variety of criteria. This resulted in a great deal of discontinuity of research projects, as well as dissatisfaction among scientists. How is the Integration Project going to improve on this? It is not good to start a major field research project and turn the funding off after only one or two years of study.

Page 4-5, par. 2. What is meant by "a detailed characterization plan"? Has this been defined? How detailed is such a detailed plan? Why develop it? The philosophy expressed in this paragraph is OK. However, if, for example, we are dealing with a very small area with highly contaminated soil, common sense might say that the best way to clean it up is by digging it up and bringing it to a disposal area. Why then would one have to follow the procedure described in this paragraph, i.e., conceptual model, scoping investigations, more data collection, further modeling, and than a detailed characterization model?

Page 5-10. Although there is a groundwater discharge to river model, there is no vadose zone to groundwater modeling effort. This area is not well investigated, and the present modeling practice to move what comes from the vadose zone, into the upper layer of the groundwater (independent of its thickness) is not based on field observations.

Page 5-12, par. 2, line 5. There appears to be a typo in FY 43?

Page 5-12, Bullet #4. Development of an integrated regulatory framework seems very necessary and important. The proposed discussions should start as soon as possible.

Page 6-2, par. 2. It states that an expert panel has been established to provide direction to and oversight of the Integration Project. This statement is quite unrealistic. The panel cannot, and probably should not provide direction to the Integration Project. This is the role of DOE, Bechtel Corporation, or some other group located permanently at Hanford.

Page 6-3, last paragraph, and page 6-4, first three bullets. This list of primary areas of vulnerability is excellent.

Appendix
B

Detailed Comments on the Science and Technology Plan

This appendix provides other, more detailed comments from identified Panel members on the Applied Science and Technology (S&T) Plan.

B.1 Comments by Dr. Conaway

Much of the information presented in the S&T Plan is obscured by its organization and presentation. There is much unnecessary repetition; further, not all of this repetition is internally consistent. For example, on *page H-12, section H.2.3.1.3 – S&T Activities,* the proposed activities are listed three times in the space of half a page, seemingly with internal inconsistencies:

> *First:* "**Two primary activities** are envisioned: 1) reviewing and remodeling the databases for several … waste disposal sites and 2) studying and analyzing core materials from representative contaminated sites …"
>
> *Second:* "**Some of the activities** identified to date are:
>
> - Collaboration with the TWRS Program in their planned coring of the vadose zone
> - Evaluation and supplementation of the existing 200-BP- 1 data set for … more sophisticated reactive transport models.
> - Quantification of the variations in recharge rates … and assessment of the impact of these variations on contaminant migration rates.
> - Selective, high-impact collaborations with other site characterization efforts …"
>
> *Third:* "**Activities to be conducted** range from compilation, review, and evaluation of existing site data to generation of supplementary information. New data or insights should be obtained by re-analyses of inventoried materials, collection of additional samples, and/or geostatistical correlations; performance of new down-hole physical or chemical measurements; collection of soil and/or porewater samples for chemical/mineralogical speciation analyses or process-level laboratory studies; and three-dimensional mapping/visualization of the site."

This section does not convey a clear plan, perhaps because no one has tried to edit this for external readers. Such editing is necessary, however, not only for the benefit of stakeholders and others outside the Project, but also for existing and new Project personnel. This plan must be clearly understood by all interested parties – tens of millions of dollars are likely to be spent according to this

plan. The activities described in this section should be listed only once in enough detail to define the plan, or otherwise clarified.

Another example of redundancy that clouds the issues is the "five major areas of research" identified for the vadose zone. These are first listed in point form on *pages H-4 and H-5*, then presented in a table with somewhat more detail on *pages H-8 and H-9 (Table H-1)*, and finally discussed in still more detail on *pages H-11 through H-25*. If the table were redundant but illuminating, it might be useful, but this table is redundant and confusing. The idea of a summary (such as this table is intended to be) is a good one because this is a complicated plan, but this particular table presents just enough cryptic comments to be confusing. Perhaps a large fold-out table with enough material to be helpful would achieve the authors' purpose.

H.3, Groundwater (pages H-27 through H-49): This section is laudable because the reasoning behind decisions is explained in several places. For example, on page H-28 beneath the 6 bullets is a section explaining the conceptual model for contaminant movement from the vadose zone into and through the groundwater. Also, uncertainty, which does not seem to have been sufficiently considered in much of the Project planning, is explicitly discussed at the bottom of page H-31, albeit briefly. The authors should consider expanding the discussion of uncertainty, including recommendations for S&T efforts to develop methods for dealing with uncertainty in the data and modeling.

Appendix I, Applied Science and Technology Roadmap: In this section, some of the material presented in *Appendix H* is reiterated in condensed form. A better use of this space would be a written, guided tour of the large color printout of the *Applied S&T Roadmap,* explaining and interpreting that chart line by line. The Roadmap chart is presumably intended to tie in with this appendix, since they have the same name, but the two should be better integrated. A guided tour of the *Roadmap* chart would be much more helpful than having the same material that is presented earlier in *Appendix H* repeated here (yet again).

The large *S&T Roadmap chart* needs more accompanying explanatory material. The legend should be expanded to explain orange and blue lines and diamond-shaped, square, and hexagonal symbols. Some of these can be puzzled out, perhaps, but that should not be required. Even with that information, this chart is not at all clear, nor is *Appendix I* much help. If *Appendix I* were revised so that it explains the chart in detail, then that explanation could be summarized and added to the chart itself so the chart stands alone. A text box running down the right hand side of the chart with explanatory material summarized from *Appendix I* would be helpful. The chart can then be printed with the text box for a general audience or without the text box for Project insiders.

Overall budgets are given in ***Appendix I, Applied Science and Technology Roadmap***, but these figures are presumably educated guesses since you cannot develop a reliable budget without knowing who is going to do the work and how they will proceed, and identifying uncertainties in the process. Although the budget must necessarily be uncertain at this stage, this fact and the lack of rigorous support for the budget figures are not clearly explained in *Appendix I*. You may think this information is implicit in this document but it is not; this should be clarified on the first page of this appendix.

Appendix I, page I-5, first paragraph: *"Past knowledge has not always been sufficient to forecast the quantity, location, and movement of contaminants in the vadose zone."* This implies that past knowledge has sometimes been sufficient to forecast these things, which is not true. Has past knowledge *ever* been sufficient to forecast these things?

Next sentence: *"The cost has been high …"* Cost of what?

B.2 Comments by Dr. Matuszek

A major editing effort by a technical writer/editor is necessary if the S&T Plan is going to have an impact on an audience outside of Hanford, especially one at DOE HQ. Beside the recommendations made in Section 3 of this report, the following specific suggestions (by page) are provided:

- **H-12.** Mention is made of collaboration with TWRS, but the extent of collaboration and the issues being discussed with TWRS are not described;
- **H-12.** "Forensic studies" are not defined;
- **H-15.** Mobilization of Cs-137 should be considered to the same degree as is fixation;
- **H-17.** Frequency of preferential flowpaths is important, especially at cribs and other large domains, but alignment relative to leak location (at a tank) may be as/more important;
- **H-18.** How representative will a controlled site be of tank farms (reaction zones, caliche layer, clastic dikes, dome-enhanced recharge zones, etc.)?
- **H-22.** Again, explain coordination with TWRS?
- **H-23.** Significance of "AVERAGE' (emphasis added) field-scale properties - in tank farms, cribs, etc?
- **H-25.** Again, explain TWRS collaboration;
- **H-30.** Mention is made of S&T-related data gaps - useful to list as an appendix those data gaps that were identified, but are NOT S&T related;
- **H-54 to 60.** River technical elements appear to ignore relationship to SAC needs;
- **H-57.** Add epidemiological risk analyst to multidisciplinary team;
- **H-58.** First mention of DQO approach to S&T work (other elements, also?);
- **H-60.** Objectives buried in "Products and Benefits" should be part of "Scope" on previous page;
- **H-61.** GW/VZ Interface shows bias toward "attenuation processes", but mobilization processes will also affect and effect temporal changes;
- **H-74, 75.** List is a prime example of the need for a Glossary and some appendices to explain many of the jargon items;
- **H-75.** Unlikely to be such a clear partition between volatile and non-volatile organic compounds, because partition functions are so distinctly discontinuous;

- **H-77.** Explanation of why Tc-99, I-129 and HTO require special models for tank inventories should be earlier to relieve confusion at all those points where the issue is first discussed;

- **H-77.** Assumption that I-129 scrubbers were "extremely effective" is likely to be untrue based on past studies showing high environmental concentrations around the site and at West Valley (NY) where similar scrubbers were used for reprocessing Hanford fuel elements;

- **H-77.** Does disposal of Hg scrubbers pose a toxic hazard from Hg, as well as from the disposed I-129?

- **H-77.** Are prioritization criteria weighted?

- **H-83.** TBD on "Activities" and on "Products and Benefits";

B.3 Comments by Mr. Patt

Appendix H, Applied Science and Technology Plan, is very technical. It needs serious editing to shorten and clarify. If this can't be done, it should be in a separate document.

Appendix I, Applied Science and Technology Roadmap, is well done, important to understanding the goals and objectives of the Project. However, many of these goals, as stated in Section 3 of this report, may not be achievable, even under optimal funding, and this is not spelled out.

B.4 Comments by Dr. Wierenga

General. Numbers in triangles/circles are not very clear. It is stated that the numbers are reference for the products described. After careful analysis, this becomes clear, but it is certainly not obvious.

1. A major problem with the S&T Plan could be that it is not clear how to add new programs or new S&T investigations. As new knowledge is obtained and new deficiencies are found, how is the program adjusted?

2. As it is unlikely that all S&T proposals/needs will be funded, who makes the decision as to what is funded and what is not?

3. It is unclear how the vadose zone and groundwater models will be connected. Who is going to do the modeling where vadose zone leakage enters the groundwater. This effort and need appear to be missing. There are plans to do depth discrete sampling, but who is doing the modeling?

4. There seem to be no plans for long term vadose zone monitoring. There is extensive groundwater monitoring, but except for gamma, and spectral gamma monitoring, no vadose zone monitoring of soil moisture, nor of specific nuclides or tracers.

5. There seems to be a lot of emphasis on understanding chemical and physical processes (i.e., waste/sediment lab experiments and process models, see S&T Plan page H-4, H-13 to H-16). However, vadose zone monitoring, to see how things move over a period of several years, is missing.

6. It is not clear that priorities for actions are properly placed. It appears that all programs start in 1999 or 2000.

7. The vadose zone plan has a great deal of emphasis on physical and chemical interaction but little on fluxes. How can one predict downward rates if one does not know the flux rates (see also p. H-8 of the S&T Plan). On page H-8, it is explained that one needs to know how water and contaminants move but not how fast. This is an omission. In order to make reasonable predictions, one needs to know how fast on average contaminants move to the groundwater.

8. The main driving force for transport of contaminants to the groundwater is water flow. In this report, there is a lack of emphasis on determining flux rates to the groundwater. Yet these flux rates drive the contaminants down and should be known in any modeling effort. There is no effort to determine the flux rates at a particular site (i.e., the 200 area) or the variability in flux rate over the Hanford Site as a whole.

9. The inventory technical element was written in such a way that one gets the impression that most of the information about inventory is somewhat known. Several holes in our knowledge about the inventory at Hanford were discussed, but few details on how to go about filling these holes in our knowledge base were proposed. In fact, this section of the S&T Plan appears to be the least specific as to what to do and how to go about it.

10. In terms of new methodologies, there is much emphasis on geophysical methods. However, such methods have not always proven to work and one should be very careful in determining which geophysical method might work under certain conditions. Where large differences in soil electrical conductivity are present, it may be that cross-hole geophysics would work fine. Under other conditions, the methods may not work.

11. Research plans for the river technical element are lacking. This part of the S&T Plan needs improvement.

12. Overall, the plans for the vadose zone technical element seem to be the most complete.