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PUBLIC INVOLVEMENT IN THE HANFORD DOUBLE-SHELL TANK WASTE DISPOSAL PROGRAM

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INTRODUCTION

Hanford's Double-Shell Tank (DST) waste disposal program was redefined following serious challenges to the viability of the previous strategy due to increased regulatory requirements and operating expectations. Redefinition of the DST waste disposal program involved a far-reaching set of decisions and actions. A formal stakeholder involvement process was used to bring the concerns of outside groups into the definition and evaluation of alternative tank waste disposal strategies, broadening the participation and ownership of the revised program.

Hanford's Double-Shell Tank (DST) waste disposal strategy, outlined in the *Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington* (HDW-EIS), calls for using B-Plant to separate the low-level and high-level portions of the DST waste.[1] This separations step would provide feed to the Hanford Waste Vitrification Plant (HWVP), viewed by many as the cornerstone to Site cleanup. The State of Washington strongly opposed using the 47-year-old B-Plant because it was not built to comply with current environmental regulations. Because of this and other challenges to Hanford's tank waste disposal strategy, the Department of Energy (DOE) Richland Field Office (RL) initiated efforts to redefine the strategy. To support this effort, Pacific Northwest Laboratory (PNL),[a] and Westinghouse Hanford Company (WHC)[b] sought input from outside stakeholder groups (stakeholders are those interest groups that are affected by the outcome of the decision and have a strong desire to ensure that their concerns are addressed) through a formal stakeholder involvement and multi-attribute utility (MAU) analysis process. This paper describes that process and its results.

BACKGROUND

The HDW-EIS, published in 1987, was prepared for treating and disposing of the wastes, including tank wastes, stored at the Hanford Site. Under the provisions of the associated record of decision (ROD), DST waste will be pretreated to separate it into a high-level and transuranic (TRU) fraction and a low-level waste (LLW) fraction.[2] The high-level waste (HLW) fraction will be processed into a borosilicate glass waste form in the HWVP and stored onsite until a geologic repository is built. The LLW fraction will be solidified as a cement-based grout and disposed of in near-surface vaults. In the ROD, B-Plant is mentioned as the base for the pretreatment facility. The ROD deferred a decision on the final disposal of single-shell tank (SST) waste pending additional development and evaluation.[2]

When the original decision was made to use B-Plant and other existing Hanford Site facilities to support the waste pretreatment mission, government facilities were not subject to such hazardous waste laws as the *Resource Conservation and Recovery Act (RCRA) of 1976*.[3] Since then, new

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operating and regulatory requirements have caused DOE to rethink the entire tank waste remediation system. Redefining the tank waste disposal strategy involves a far-reaching set of decisions and actions that affect numerous interest groups both within and outside DOE. Parties external to DOE have legally entitled or historically vested interests in Hanford Site activities. The involvement of these stakeholders requires that a dialogue be established and maintained during both the decision-making and execution phases of the program. A critical challenge for the redefinition has been to find and apply effective approaches to integrate stakeholder involvement with the technical analysis of strategy alternatives and with DOE's decision-making process.

TECHNICAL STRATEGY

Public involvement and participation in the DOE decision-making process is not unique; the National Environmental Policy Act (NEPA) of 1969[4] provides for all interested parties to comment on policies and/or decisions that may have environmental impact. However, the NEPA process is typically very mechanistic and formal, with defined protocol. The formality of the NEPA process may be unduly burdensome to some interested parties, and their involvement comes at a time in the decision making when strategy has already been developed, alternatives eliminated, and many decisions already made.

Involving the public throughout the entire decision-making process is a relatively new and unique approach. In the past, public involvement was not sought unless it was required by NEPA. The results of the NEPA process for this effort have been formalized in the HDW-EIS and its associated ROD. After the NEPA process was completed and the final HDW-EIS was issued, DOE sought input from key stakeholder groups regarding the details of enacting the top-level strategy outlined in the HDW-EIS. Keeping the public informed on the issues, tradeoffs, and risks associated with all the decisions that must be addressed in this redefinition will provide a greater appreciation for the difficulty and complexity of managing such a diverse site. This approach is feasible in the more open DOE environment. The approach used in this case combined the formal involvement of multiple stakeholder groups with the more traditional systems analysis and MAU analysis to assess the strategy alternatives and formulate a recommendation to DOE. This approach was developed to ensure that parties having legitimate interests in waste disposal and restoration of the Hanford Site (i.e., stakeholders) were involved during the analysis of alternatives rather than after a decision was made.

Double Shell Tank Waste Disposal Redefinition Evaluation Process

An integrated systems approach was used to evaluate facility and process alternatives for disposal of Hanford Site tank wastes. The evaluation process included the following steps, which are interconnected as shown in Figure 1:

- Stakeholder Involvement. This step ensured that issues of concern to the stakeholders were included in assessing tank waste disposal alternatives. The stakeholders' values and concerns were translated into objectives hierarchies and then into measurable attributes that defined the dimensions along which the alternatives were evaluated. Each attribute was weighted to indicate its relative importance to each stakeholder group.

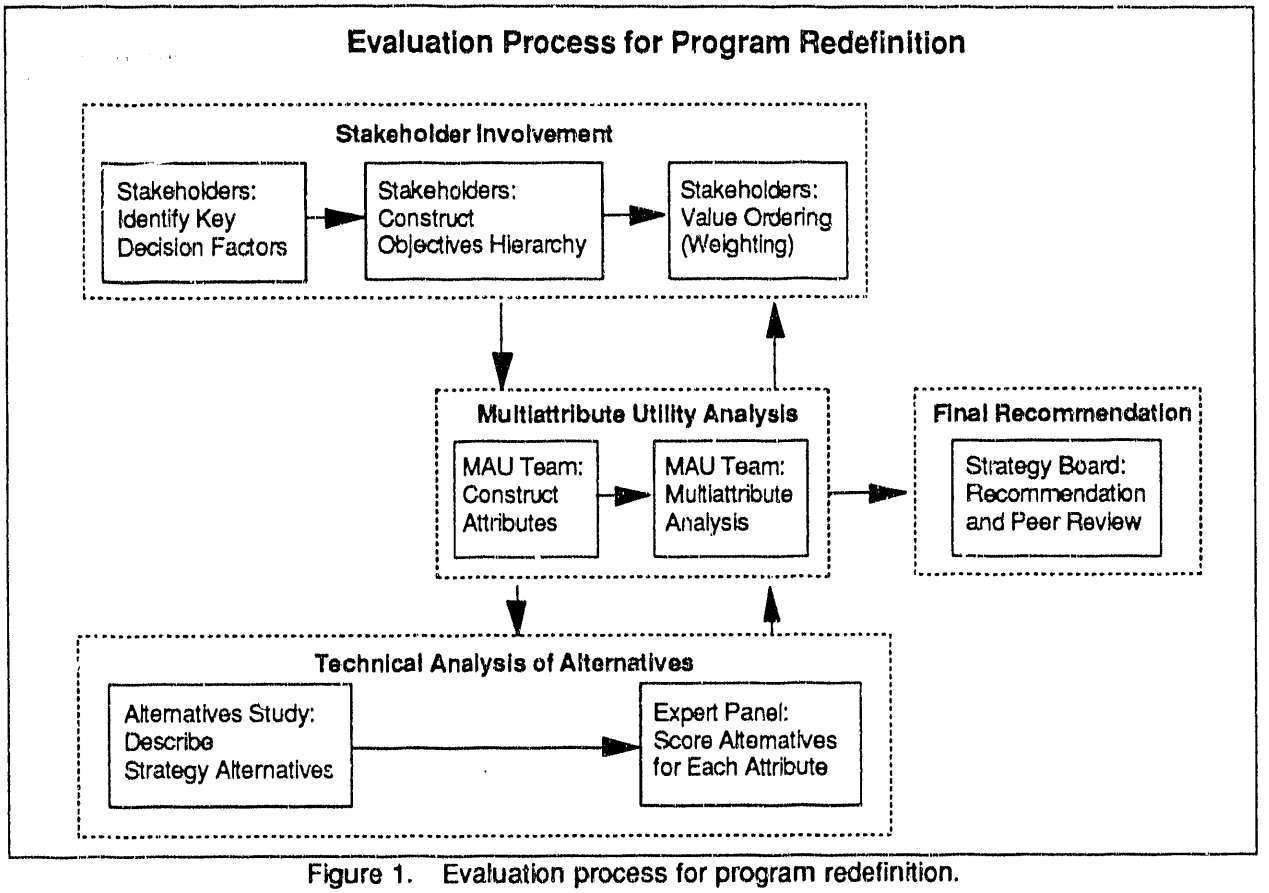

Figure 1. Evaluation process for program redefinition.

- Technical Analysis of Alternatives. This series of steps provided a technically consistent and credible basis for comparing strategy alternatives. It provided uniform definitions and assessed the merits of the alternatives for each attribute derived from the stakeholder values.

- Multiattribute Utility (MAU) Analysis. MAU analysis provided a formal mechanism for linking stakeholder values with technical performance measures of the strategy alternatives. Specific attributes were derived from the stakeholders' objectives hierarchies; they defined the dimensions along which the alternatives were to be compared and the information that was needed to make the comparisons. Attribute scores and weights were combined to yield an overall ranking of the alternatives. A sensitivity analysis was also performed in this step by varying the weights of the attributes to determine those ranges over which various alternatives were dominant.

- Final Recommendation. From the preceding evaluations, a recommendation was formulated. This decision and its attendant action plan were then reviewed by an independent peer review panel made up of national and international experts in radioactive waste management. Their comments and concerns were included in the conclusions and recommendations.

ASSESSMENT OF STAKEHOLDER VALUES

A unique aspect of this redefinition process was the involvement of some stakeholders who are not in the immediate DOE community. This involvement was deemed prudent because of the Tri-Party Agreement,[5] the increased awareness of and concerns about DOE activities around the country, and increased public involvement in Hanford Site activities. The intent of the stakeholder involvement process was to ensure that the tank waste disposal alternatives were assessed relative to the factors of greatest concern to the stakeholders.

The following stakeholder groups were involved in the process:

- The States of Washington and Oregon
- The U.S. Environmental Protection Agency
- The Yakima Indian Nation
- Westinghouse Hanford Company and Pacific Northwest Laboratory
- The U. S. Department of Energy-Headquarters (DOE-HQ)
- The U. S. Department of Energy-Richland Field Office (RL)

While not an exhaustive representation of all regional entities that have an interest in Hanford Site activities, this group represented such a diversity of interests that their values would encompass a significant fraction of the region's interests. It is anticipated that future activities will involve a significantly expanded group of stakeholders.

Stakeholder Elicitation Process

Stakeholder groups met separately on at least two different occasions. The initial interaction was defined to elicit their objectives for the strategy under consideration. The second interaction was defined to determine the priority or ranked value associated with each of the attributes that were defined to represent the objectives of all stakeholder groups. The interactions consisted of interactive meetings followed up by written summations. All participants were given the opportunity to review and comment on the results and interpretation of the meetings.

It was recognized that there may be widely varying objectives and areas of interest among stakeholder groups. It was important that all objectives were verbalized in a comfortable atmosphere to avoid any suppression of ideas, and that each individual was free to express his/her opinions without fear of confrontation or judgement. To aid in achieving that atmosphere, each of the stakeholder groups was met with separately.

It was acknowledged that there might appear to be a conflict of interest between the WHC/PNL team that was making the decision as well as eliciting input from the stakeholders. This conflict was eliminated by having national experts with no interest in the outcome perform the actual

elicitation interviews. Staff from WHC and PNL were assisted throughout this process by Dr. Detlof von Winterfeldt and Dr. Ralph Keeney from the University of Southern California and Dr. Robin Gregory from Decision Research.

Elicitation of Stakeholder Values

The initial stakeholder meetings generated a set of objectives and criteria for assessing the relative merits of the facility and process alternatives. These objectives were elicited from each of the participants and were clarified through discussions. An initial objectives hierarchy was developed that represented the structure of the groups' objectives. Participants were given an opportunity to review and revise the initial hierarchy.

The hierarchies from each stakeholder group were combined into a single hierarchy to capture in one place the objectives and values that are relevant to the problem. At this stage, the objectives were not assigned different levels of importance. The hierarchy, which served as a guide to developing attributes, has three basic elements: 1) long-term cleanup objectives, 2) pretreatment objectives, and 3) process and management objectives. Long-term cleanup objectives were separated from the shorter term (30-year) pretreatment objectives because it was believed that the pretreatment alternatives would not differ significantly along these dimensions. The process and management objectives were also treated separately from the shorter term (30-year) pretreatment because they were believed to apply to all pretreatment alternatives and could be viewed as critical success factors affecting the implementation of the alternatives. Neither the long term cleanup objectives nor the process and management objectives is discussed further in this paper.

The pretreatment objectives represented the primary values that were relevant to evaluating the strategy alternatives. Figure 2 illustrates the complete hierarchy of these objectives. These objectives were matched to the following categories of specific, measurable attributes:

- HEALTH. Radiological and nonradiological risks were estimated, including risks from construction, routine operation, and accident situations for both the public and Hanford Site workers.

- ENVIRONMENT. The potential for contaminating soil, surface water, and groundwater were measured through proxies such as the amount of solid waste generation and the number of grout vaults and glass canisters.

- COMMUNITY. This attribute addressed the regional and local economic impacts from the development and operation of the pretreatment system, especially the impact from variations in employment levels.

- SCHEDULE. The desire to start the job and complete it in a reasonable time frame was expressed; specifically, start of feed to HWVP, completion of DST mission, completion of SST mission. Also, compliance with Tri-Party Agreement and other regulations was assessed.

- MISSIONS. These attributes reflected the desire to provide benefits to other missions in addition to the DST mission, especially SST remediation and tank safety.

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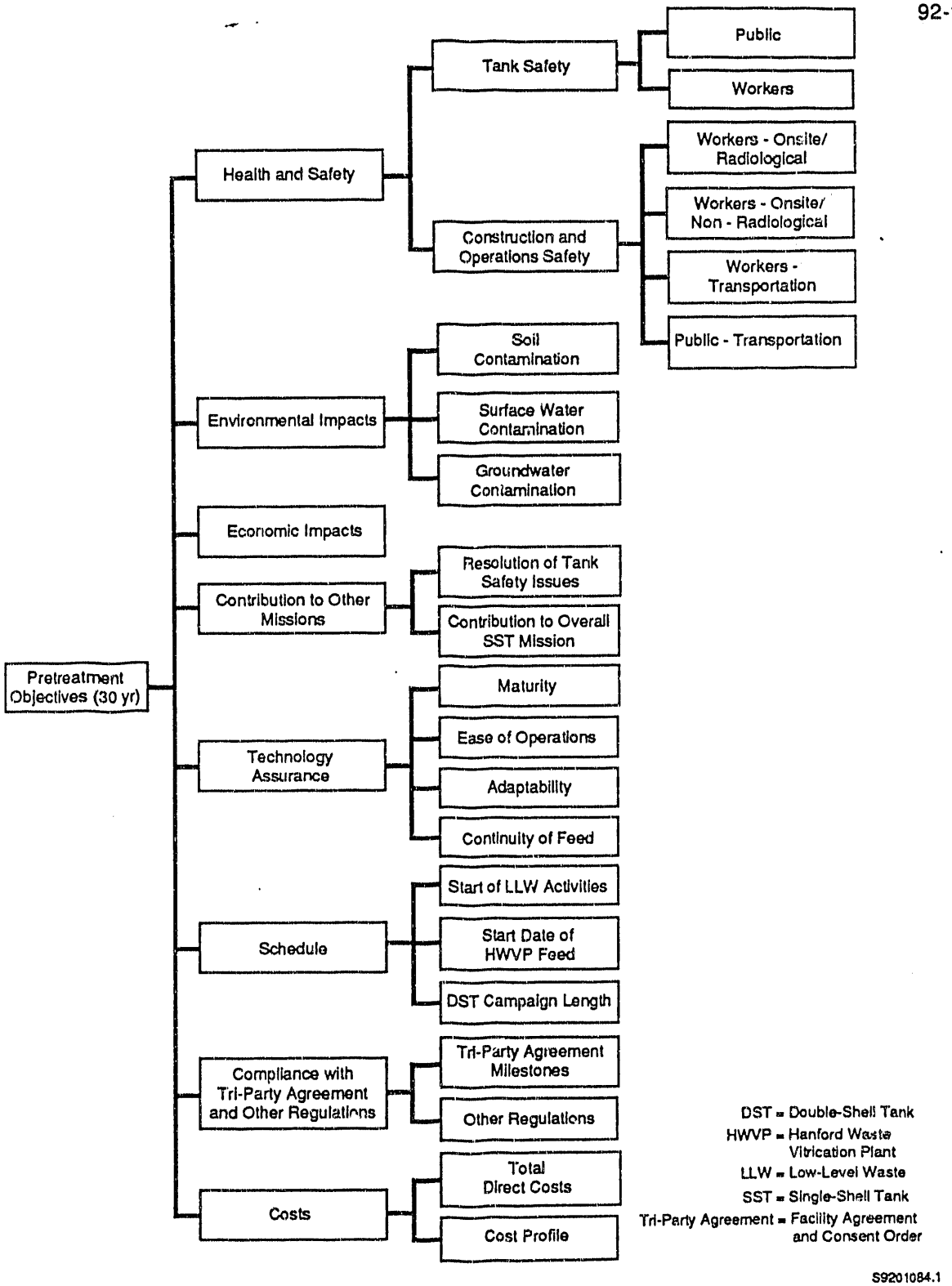

Figure 2. Pretreatment objectives hierarchy.

- TECHNOLOGY. Technology assurance shows the desire to implement appropriate technology in the pretreatment strategy. Appropriate would include, mature (well-developed and demonstrated), reliable, and adaptable (able to accommodate changes in requirements or improvements in technological capabilities).

- COST. This attribute measures the total direct or life-cycle cost and was estimated for both the DST and the combined DST and SST missions.

- COST PROFILES. These attributes represented the difficulty of obtaining funding for several large capital projects, technology development, and continued operation of facilities.

Stakeholder Weights.

Weight Elicitation. The attributes listed above varied in importance, or weight, among the stakeholders. To determine the relative importance that should be placed on each, a process was used to elicit separate sets of weights from each stakeholder group. The weights were used to determine the impact on the relative ranking of the alternatives caused by variations in the values expressed by each stakeholder group.

Attribute weights were obtained from four separate stakeholder groups: Hanford Site contractor management staff (WHC and PNL), RL, the Washington State Department of Ecology, and the Yakima Indian Nation. Weights were elicited in separate sessions with representatives from each organization. The technique used to estimate weights for the attributes is known as "swing" weighting, which calibrates the relative importance to the stakeholder of the expected swings or ranges in the attributes. For example, should a swing of $1 billion between two alternatives be considered more important than a swing of five years in the expected start date of HWVP?

Comparisons were made with each stakeholder group, first within a group of similar attributes (e.g., technology attributes), then, once these initial importance comparisons were done, across groups of attributes. Comparisons were expressed in terms of ratios of importance. Weights were computed for each attribute so that the weights totaled 1.0, and the ratio of any two weights was consistent with the ratios expressed by the stakeholders.

Stakeholder Group Weight Elicitation Results. Figure 3 summarizes the weights for each category of attribute and each stakeholder group that were derived from the initial stakeholder meetings. While a wide range of variation in some attribute weights was apparent, there were also some important commonalities. The importance of schedule is clear. The stakeholders showed a strong consensus that the decision must be made and a final and complete solution developed. Also, there appeared to be consensus on the importance of technology assurance. All the stakeholders recognized the key role that technology plays in accomplishing this mission. Contributing to the SST mission was also highly weighted for all stakeholder groups. There was clearly a strong signal from the stakeholders to adopt a strategy that is capable of accomplishing the entire mission.

One of the main variations among stakeholder groups appeared in the environment attribute category. This result from the stakeholder weight elicitation process showed the impact of the stakeholder groups' widely differing concerns over the suitability of onsite disposal of low-level waste.

This concern, and the associated high weight placed on the number of grout vaults for one stakeholder group, highlighted the need to develop processing steps that will further reduce the mobile constituents in grout (the onsite low-level waste disposal option). For example, a process in the final strategy that would further reduce the mobile constituents in grout would reduce the differences seen in stakeholder preferences for that attribute.

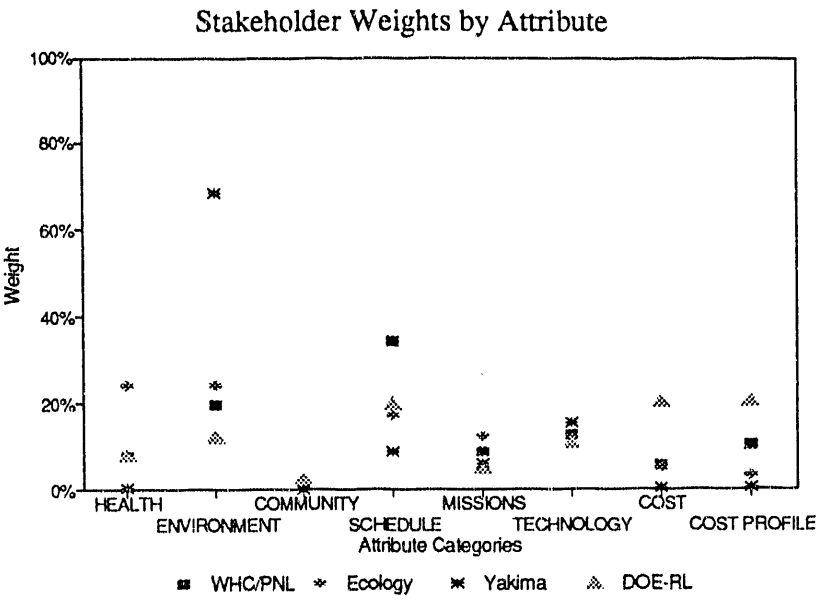

Figure 3. Stakeholder weights by attribute category.

STRATEGY ALTERNATIVES

Sixteen facility and process alternatives were considered for pretreating and disposing of Hanford tank waste. The 16 alternatives, listed in Table 1, ranged from the original planning case, using B-Plant for the pretreatment process (alternative 1), to delaying all cleanup activity until a completely new pretreatment facility (NPF) is available to house the total treatment capability (alternative 16). Various combinations of new and existing facilities and in-tank processing alternatives were considered for the comparative analysis and decision formulation.

COMPARATIVE ANALYSIS OF ALTERNATIVES

An MAU analysis model was constructed to provide an overall measure of the relative value of the alternatives and to indicate the attributes most critical to the results. Attribute scores were combined with stakeholder weights to yield a composite measure of the relative utility, or value, of each option.

Composite Results

Figure 4 shows the weighted scores for the alternatives using the weights derived from the Hanford Site contractors (WHC and PNL management staff). The total score for each option shows its relative value and provides a measure of the strength of preference that the stakeholder group might have for it. Alternatives 4, 5, 11, 13, and 14 are grouped closely together at the top. The MAU analysis results show very little differentiation among these alternatives. They seem to show a clearly preferred set of alternatives for the weights that were applied. All of these alternatives used an NPF with the TRUEX process to accomplish the bulk of the DST waste processing and to provide the

capability to process retrieved SST waste. In addition, these alternatives used in-tank sludge washing to get early feed to HWVP before the NPF comes online.

All alternatives that use an NPF without TRUEX (alternatives 3, 6, 7, 9, 10, 12, and 15) scored low. These alternatives produced many more canisters of vitrified waste and were not able to process SST waste. The remaining alternatives with TRUEX capability (alternatives 1, 2, and 8) also scored low; each of these uses the TRUEX process in an existing facility, either PUREX Plant or B-Plant.

Table I. Hanford tank waste facility and process alternatives.

Facility and Process Alternatives	
Alternative	Description
1	Original baseline program using B-Plant for all processes including TRUEX
2	Option 1 with limited in-tank processing (sludge washing) to accelerate preparation of feed to HWVP
3	Same as option 2 except without TRUEX capability
4	Initial in-tank processing until later availability of an NPF with TRUEX capability
5	Same as 4 with intermediate (additional) in-tank processing
6	Same as 4 except without TRUEX capability in the NPF
7	Same as 6 but with intermediate processing
8	Initial in-tank processing with follow-on processing in the PUREX Plant using TRUEX
9	Same as 8 but without TRUEX
10	Initial in-tank processing with additional processing in the HWVP Plant not using TRUEX
11	Initial in-tank processing and in B-Plant with follow-on processing in an NPF using TRUEX
12	Same as 11 but without TRUEX in the new plant
13	Initial processing in a combination of DST's and the HWVP Plant with follow-on processing in a new facility using TRUEX
14	Same as 13 but with intermediate processing added
15	Same as 13 but without TRUEX
16	All pretreatment in a new pretreatment facility using TRUEX

Sensitivity Analysis Results

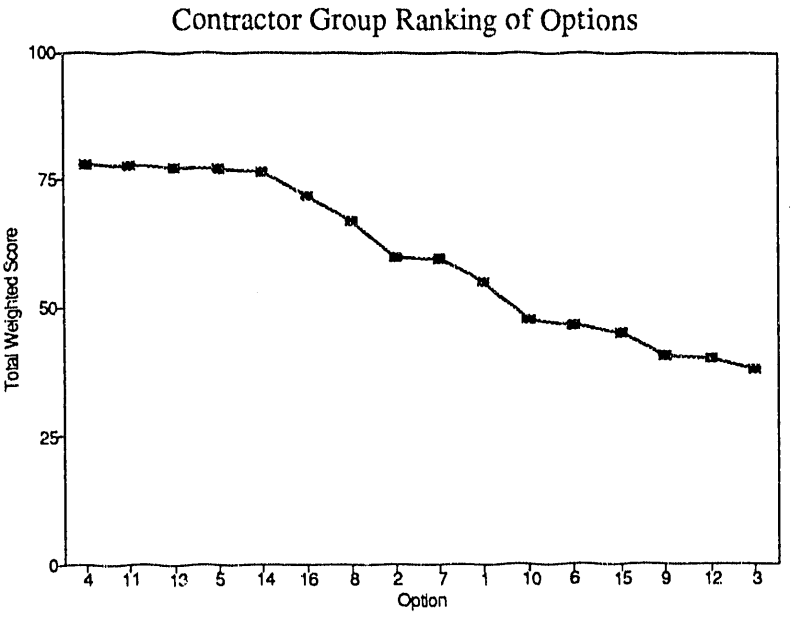

Figure 4. Hanford Site contractors ranking of options.

The effects of varying attribute weights and scores can be examined easily with MAU analysis. Sensitivity analyses help clarify real differences among the alternatives and show how variations in stakeholder values change the relative performance of the alternatives. These analyses examined how the relative merits of and preferences for alternatives changed as either the attribute weights or scores changed, and indicated the stability of the final results and their sensitivity to variations in stakeholder values or uncertain performance measures. For this paper, the sensitivity of the final ranking to variations in the four stakeholder group weights is shown in Figure 5. More detailed results and additional sensitivity analyses are reported in *Hanford Tank Waste Disposal Program Redefinition.*[6]

Separate sets of weights were obtained from the four stakeholder groups. The variation in weights across these groups provided a set of sensitivity results. Figure 5 shows the final weighted score obtained for each option using each of the stakeholders' weights. The ordering of the alternatives along the x-axis was based on the average of the total scores for the four groups. This average was computed to simplify displaying the data and was not intended to represent a preferred ranking of alternatives.

Figure 5 shows that all four stakeholder groups ranked the same alternatives in the top six. While the order of preference differed with each group, the preferred set included alternatives 4, 5, 11, 13, 14, and 16. As shown by the flat slope of the solid line in Figure 5, the average total scores for these six alternatives were fairly close. There was fairly good agreement on the top alternatives, but a wide range of disagreement on the lower-ranked alternatives.

Interpretation of Results

The results of the MAU analyses showed that the stakeholders place high value on proceeding in a timely manner and being environmentally sound, safe, cost-effective, technically correct, and compliant with all applicable laws and regulations. In general, the stakeholder weights drove the preference for options to a set with the following features in common: early in-tank sludge washing and an NPF containing the TRUEX process. These features are common to alternatives options 4, 5,

11, 13, and 14. Early in-tank washing contributes significantly by supporting the earliest possible startup of HWVP, supporting the Tri-Party Agreement milestone[5] and the need to establish real progress. This combination of characteristics also performs the bulk of the waste processing in newly constructed facilities, avoiding potential environmental compliance problems that can arise with attempting to use existing facilities.

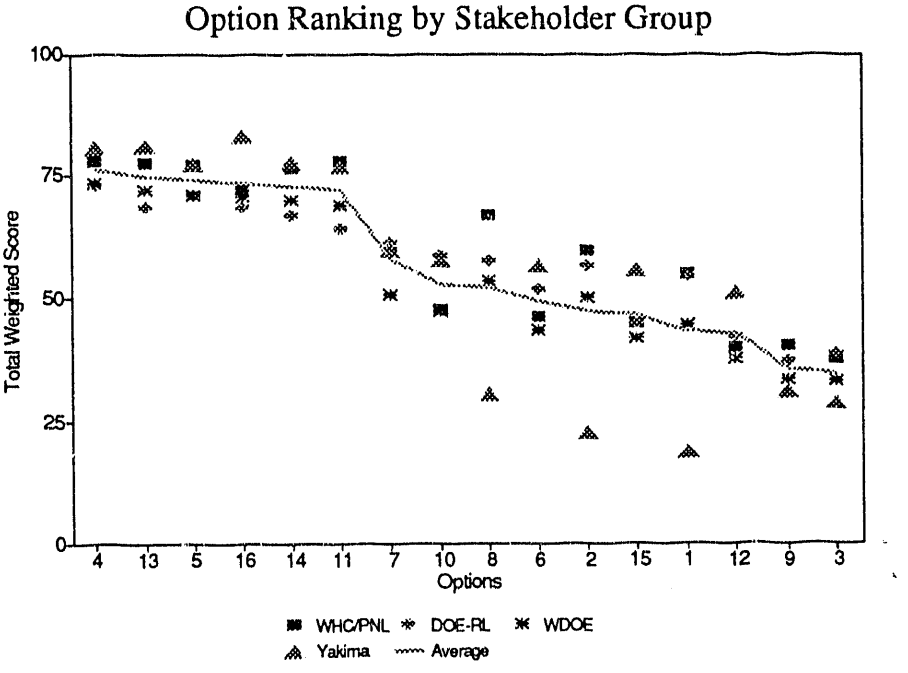

Figure 5. Stakeholder group ranking of options.

All stakeholder groups placed a high value on accomplishing the entire tank waste (DST and SST) disposal mission, which TRUEX-based options can do.

CONCLUSIONS

The stakeholder involvement process was an effective mechanism for obtaining input from a diverse set of interest groups. Without this process, several important attributes would not have been evaluated. The early identification of these stakeholder values and concerns provided a useful focus for assessing the relative merits of the strategy alternatives. The stakeholder groups showed strong agreement on many critical aspects of the problem, which was not obvious at the beginning. Similarly, the process highlights the critical value differences across the stakeholder groups. These differences have helped to focus efforts on finding ways to improve the overall disposal strategy to make it more acceptable to all parties. The MAU analysis process also forced some stakeholders to grapple with difficult value tradeoffs, which increased the understanding of all parties about the fundamental choices required in reaching a decision.

All participants realize that DOE's cleanup decisions will continue to require effective participation from outside groups. Processes such as the one described in this paper must be applied to an even broader set of cleanup issues and should include additional stakeholder groups.

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