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Evaluation of Groundwater and Vadose Zone Cleanup and Protection Priorities at Hanford

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Project Hanford Management Contractor for the
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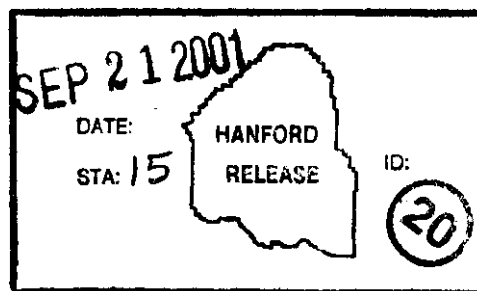
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Executive Summary

This report reassesses the priorities of work related to protection of water resources from Hanford contamination. The U. S. Department of Energy has indicated this work will be reassigned in fiscal year (FY) 2002 to Fluor Hanford's Prime Contract for Hanford Site Management and Integration. Three pieces of work are included: environmental restoration of (a) contaminated soil and (b) groundwater in the Central Plateau and **part** of the 600 Area, and (c) the Groundwater/Vadose Zone Integration Project.

The premises for arriving at the current status of work were examined. The analysis then focused on identifying the fundamental bases for assigning priorities to this work. The Hanford Site Past Practice Strategy, issued in 1992, explicitly states that priorities for Hanford cleanup should emphasize an observational approach that relies on information obtained from actual remediation work. Furthermore, Fluor Hanford's contractual mandate is to apply Fluor commercial practices to ensure consistency of process, quality, and execution of work performed. Those practices require initial detailed identification of project work scope in terms of functions, requirements, and completion specifications. It additionally requires project execution in well defined life-cycle phases.

Priorities were evaluated for three domains of interest: (a) The three work areas noted above compared to all other Hanford projects; (b) relative to one another; and (c) major tasks comprising each of the three work areas. Based on the analysis of all currently identified requirements, assignment of the relative priorities of the work transferring to Fluor Hanford seems clear. Changes from the status quo are recommended.

First priority should be given to contaminated vadose zone soil site characterization and remediation work. Requirements are additionally clear for continued groundwater monitoring and data analysis, and for continued groundwater interim remedial measures. Lowest priority should be accorded to the groundwater/vadose zone integration project because its products are not well defined in terms of requirements-derived specifications, and are not demonstrably needed far in advance of the issuance of a Hanford site-wide cleanup Record of Decision. No near-term requirements exist for the groundwater/vadose zone integration project's highest-priority product, the so-called system assessment capability. Consequently, that work can be deferred until such time as a comprehensive risk analysis in support of the final record of decision is actually needed.

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List of Acronyms

AAMS	Aggregate Area Management Study
AEA	Atomic Energy Act
ARAR	Applicable or Relevant and Appropriate Requirement
BHI	Bechtel Hanford, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DOE/RL	U.S. Department of Energy, Richland Operations Office
DWP	Detailed Work Plan
EPA	Environmental Protection Agency
ERA	Expedited Response Action
ERP	Environmental Restoration Project
FH	Fluor Hanford, Inc.
FY	Fiscal Year
GWNZ IP	Groundwater/Vadose Zone Integration Project
HCP-EIS	Hanford Comprehensive Land-Use Plan Environmental Impact Statement
HSWA	Hazardous and Solid Waste Amendments
HSPPS	Hanford Site Past Practice Strategy
IRM	Interim Remedial Measure
LFI	Limited Field Investigation
LIGO	Laser Interferometer Gravity Observatory
MTCA	Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OU	Operable Unit
PFP	Plutonium Finishing Plant
PUREX	Plutonium/Uranium Extraction
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RFI/CMS	RCRA Facility Investigation/Corrective Measures Study
ROD	Record of Decision
SAC	System Assessment Capability
S&M	Surveillance and Maintenance
TPA	Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order)
TSD	Treatment, Storage, and Disposal
WAC	Washington Administrative Code

BACKGROUND

The purpose of this report is to objectively reassess the high-level priorities of work that will be reassigned in FY 2002 to Fluor Hanford (FH) from Bechtel Hanford, Inc (BHI). That work is the: (1) **200/600 Areas Environmental Restoration Project (200/600 ERP)** for contaminated soil and groundwater; and (2) **Groundwater/Vadose Zone Integration Project (GW/VZ IP)**. Potential contract award fees associated with the work are 7.6% of the total available fee, or about \$12.8 million for the life of the remaining FH contract.

Significant budget reductions (DOE FY 2002 and 2003 Budget Review, April 24, 2001) may accompany transfer of this workscope. Consequently, reexamination of work priorities previously assigned by BHI is appropriate and timely.

Understanding the basis of priorities for cleaning up Hanford's contamination requires focusing on the:

- Regulatory basis of the cleanup work
- Rationale for aggregating contaminated soil sites in the vadose zone into larger operable units with common attributes
- Criteria used to assign priorities for investigation and remediation of the aggregated vadose zone operable units
- Criteria for assigning remediation priorities to specific plumes of groundwater contamination
- Rationale for the current priorities of the GWNZ IP
- Current FY 2002 budget guidance for the 200/600 ERP and the GWNZ IP.

REGULATORY FRAMEWORK

In November 1989 the U.S. Environmental Protection Agency (EPA) included the 200 Areas of Hanford on the National Priorities List (NPL) in implementing the **Comprehensive Environmental Response and Liability Act (CERCLA)** of 1980. CERCLA is carried out via the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40, Part 300 of the Code of Federal Regulations (40 CFR 300).

Under provisions of the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement (TPA)), as currently amended, the 200 Areas NPL Site encompasses the 200 East and 200 West Areas and selected portions of the 600 Area (Ecology et al, 1994). The 200 Areas NPL Site included 800-1000 contaminated sites in 42 operable units

(OUs), 19 of which are in the 200 East Area, 17 in the 200 West Area, 1 in the 200 North Area, and 5 in the 600 Area (32 source OUs, 6 tank farm OUs, and 4 groundwater OUs).

The Tri-Party Agreement additionally encompasses 55 Resource Conservation and Recovery Act of 1976 (RCRA) treatment, storage, or disposal (TSD) facilities to be closed or issued operating permits in accordance with Washington Administrative Code 173 Part 303 (Dangerous Waste Regulations, WAC 173-303) and the Hazardous and Solid Waste Amendments Act of 1984 (HSWA). The Dangerous Waste Portion of the Hanford Facility RCRA Permit is administered by The Washington State Department of Ecology (Ecology). The HSWA portion is administered by the EPA. Some of the RCRA TSD units are within the CERCLA operable units. General TSD closure performance standards are specified in WAC 173-303-610(2)(a) and require closure in a manner that minimizes:

- The need for further maintenance
- Post-closure escape of contaminants
- Disturbance of the land.

Specific TSD closure performance standards are specified in WAC 173-303-610 (2)(b) in accordance with the *Model Toxics Control Act (MCTA)* Method B using residential exposure assumptions for clean closure. If dangerous waste constituents are present at the completion of closure at levels above MTCA Method B but below MTCA Method C (WAC 173-340), then a "modified closure" option may be used. Modified closure requires institutional control to restrict access for a minimum of 5 years following closure, periodic closure-effectiveness assessments, and a post-closure permit. When clean closure or modified closure cannot be achieved, the TSD unit can be closed as a landfill following the requirements in WAC 173-303-610. Landfill closure requires a post-closure permit to address maintenance, inspection, monitoring, and corrective actions.

To supplement the Tri-Party Agreement, the EPA, Washington State, and DOE agreed on a Hanford Past Practice Strategy (HSPPS; DOE/RL-9104, 1992). The intent was to streamline and integrate the process of complying with RCRA and CERCLA procedures and requirements. The EPA, Washington State, and DOE agreed (HSPPS, p. 2) that, while paper studies and abstract analyses can be useful in meeting long-term cleanup goals, funding priorities should emphasize an observational approach relying on actual remediation work focused on reducing contaminant toxicity, mobility, or distribution.

Based on concepts outlined in the HSPPS and 8 source-term aggregate area management studies (AAMS) published from 1991 through 1993, DOE/RL issued *The 200 Areas Soil Remediation Strategy* (DOE/RL-96-67, 1996) and the *200 Areas Remedial Investigation/Feasibility Study Implementation Plan* (DOE/RL-98-28, 1999a). The *Hanford- Wide Groundwater Remediation Strategy* (DOE/RL-94-95, 1995) and its supporting technical information (BHI-00464, 1996) were issued separately.

The HSPPS defines the Hanford-specific process for CERCLA remedial investigations/feasibility studies (RI/FS) and RCRA past practice field investigations/corrective measures studies (RFVCMS). The objective of the strategy was to use data from analog sites in lieu of data specifically from each contaminated site, to save time and money. The rationale for this policy was that the approximately 800-1000 contaminated soil sites in the 200 and 600 Areas could be grouped for purposes of investigation and remedy according to the function and design of their associated waste disposal facility, local hydro-geology, and volume or chemistry of the effluent discharged. The goal was to:

- Accelerate decision making by maximizing extrapolation of available data
- Use an observational approach based on concurrent investigation and remediation to lower uncertainties inherent to abstract computer analyses
- Assess risks and the potential for reducing risks by decreasing the toxicity, mobility, or mass of contaminants present
- Provide a basis for setting priorities.

The HSPPS identified three paths for interim decision making. Each path leads ultimately to Records of Decision (ROD) for contaminated site closures:

- Expedited Response Actions (ERA) for health or environmental risks requiring rapid mitigation
- Interim Remedial Measures (IRM) for sites with data sufficient to make defensible short-term corrective-action decisions that lead eventually to an ROD or permit modification
- Limited Field Investigations (LFI) to expedite the CERCLA remedial investigation process by which the minimum additional site data needed for an IRM or ROD can be obtained.

According to the HSPPS, final remedy selection will explicitly depend on information obtained from the three interim-decision paths. The following administrative decisions additionally affect final remedy selection:

- Land-use-related cleanup criteria
- Stipulated points of compliance
- Data adequacy/uncertainty
- Opportunity for use of analog data.

RATIONALE FOR AGGREGATING CONTAMINATED SOIL SITES

The objectives of grouping contaminated soil sites with similar characteristics into a smaller number of larger operable units were straightforward. The objectives were: 1) to dramatically reduce the amount of assessment needed to characterize the 800-1000 sites where liquid wastes containing hazardous chemicals and radionuclides may have spilled or were deliberately discharged to the soil; and 2) facilitate selection of a remedy for each. Planned remedies **for** these sites will be based on results from work plans prepared for only a few large operable units (or waste-site groupings) within nine broad categories (Table 1). The categories and operable units were identified based on the process that generated the waste.

The current baseline calls for only 12 RI/FS work plans for the 23 operable-unit groupings shown in Table 1. Those work plans will focus on characterizing the 12 operable units that are believed to be "typical" or "worst-case" representatives of the 23 operable units. The rationale, process and strategy for why and how the waste streams and contaminated soil sites were aggregated are outlined in *The 200 Areas Soil Remediation Strategy* (DOE/RL-96-67, 1996) and *Waste Site Grouping for 200 Areas Soil Investigations* (DOE/RL-96-81, 1997).

Determinations of the needs for future characterization and remediation activities are predicated on what have been termed "**conceptual models**" of each of the 23 contaminated soil-site groups identified in Table 1 (DOE/RL-96-81, 1997). The conceptual models summarize what is believed to be true about the contaminated soil site groups. The models encompass what is known (or assumed) about the processes affecting migration of contaminants discharged to the vadose zone, including precipitation/dissolution, adsorption/desorption, filtration of colloids and suspended particles, diffusion into mineral grain micropores, and rates of chemical or radioactive decay. Other information comprising the conceptual models includes operational characteristics of the disposal facilities, site-specific physical and chemical properties of the soil column, and chemistry of the discharged effluent.

CRITERIA TO ASSIGN PRIORITIES TO CONTAMINATED SOIL SITES

The TPA (Ecology et al., 1994) specified that the following are important considerations for determining priorities for investigation and remediation of contaminated sites:

- Volume of wastes or hazardous substances
- Need for hazardous substances identification and classification
- Relative toxicity or health effects of the hazardous substances
- Potential for contaminant migration to receptors via environmental pathways
- Availability of technology to investigate/remediate the operable unit
- Operational considerations (e.g., timing of related facility decommissioning)

- Considerations for RCRA TSD closure.

The process and criteria described in the 200 *Areas Soil Remediation Strategy* (DOE/RL 96-67, 1996) were originally used to rank the 23 contaminated soil-site groups with respect to: 1) priority for characterization work; and 2) priority for remediation work. The following technical and administrative criteria were used.

Table 1. Contaminated Soil Site Categories And Associated Groups.

<u>1. Process Condensate/Process Waste Category</u>
1. Uranium-Rich Process Condensate/Process Waste Group
2. Plutonium Process Condensate/Process Waste Group
3. Plutonium/Organic-Rich Process Condensate/Process Waste Group
4. Organic-Rich Process Condensate/Process Waste Group
5. Fission-Product-Rich Process Condensate/Process Waste Group
6. General Process Condensate/Process Waste Group
<u>2. Steam Condensate/Cooling Water/Chemical Sewer Group</u>
7. Steam Condensate Group
8. Chemical Sewer Group
9. U Pond/Z-Ditches Cooling Water Group
10. Gable Mountain/B-Pond and Ditches Cooling Water Group
11. 200 North Pond and Trenches Cooling Water Group
12. S Pond and Ditches Cooling Water Group
13. T Pond and Ditches Cooling Water Group
<u>3. Chemical Waste Category</u>
14. 200 Areas Chemical Laboratory Waste Group
15. 300 Areas Chemical Laboratory Waste Group
<u>4. Miscellaneous Waste Category</u>
16. Miscellaneous Waste Group
<u>5. Tank/Scavenged Waste Group</u>
17. Unplanned Releases Group
18. Scavenged Waste Group
<u>6. Tanks/Lines/Pits/Diversion Boxes Category</u>
19. Tanks/Lines/Pits/Diversion Boxes Group
<u>7. Unplanned Releases Category (Non-Facility Specific)</u>
20. Unplanned Releases Group
<u>8. Septic Tank and Drain Fields Category</u>
21. Septic Tank and Drain Fields Group
<u>9. Radioactive Landfills and Dumps Category</u>
22. Radioactive Landfills and Dumps Group
23. Non-Radioactive Landfills and Dumps Group

Characterization Priority. Contaminated soil-site groups that ranked technically high in priority for remedial investigation were those judged likely to cause **new** aquifer contamination in the immediate future (5-10 years) or to have high potential to eventually affect groundwater because of the mobility of their contaminants. Contaminated soil-site groups that ranked high administratively were those judged relatively simple to characterize or remediate or, compared to other groups, to be adequately represented by a relatively small number of sites (DOE/RL 96-67, 1996).

Groups ranked technically intermediate in priority were those **currently** contaminating groundwater. Contaminated soil-site groups ranked administratively intermediate in priority were those lacking characterization data, located outside the 200 Areas fence, exhibiting low levels of contamination over a broad area, or suitable for testing promising treatment technologies.

Contaminated soil-site groups ranked technically low in priority were those that adversely affected groundwater in the **past** but are believed no longer to be contaminating groundwater (i.e., because of the lack of infiltrating water to flush the contaminants downward, or absence of residual mobile contaminants in the vadose zone.) Groups ranked administratively low in priority were judged to be too complicated to readily characterize or remediate, or not to be adequately represented by just one or two sites.

Remediation Priority. The primary criteria for remedial action priorities were identified as follow (DOE/RL 96-67, 1996):

- Sites at which contaminants are currently spreading or which have high risk of future spreading were ranked as high priority
- Sites that are near facilities or infrastructure that will be remediated in the near future had priority over sites in proximity to facilities that will not be remediated in the near future
- Sites that can easily and rapidly be cleaned up to demonstrate progress had priority over sites that could not
- Sites where contaminant removal is the preferred alternative were given higher priority than sites where contaminants will be left in place under intrusion barriers and infiltration caps.

Secondary criteria for remedial action priorities were as follow:

- Need to synchronize remedial action schedules to maximize the availability and efficient use of specialized worker skills
- Need to synchronize remedial action schedules with schedule requirements of construction and operation projects

- Preference to begin remediation work outside or within the 200 Areas buffer zone and work toward the waste management facilities of the 200 Areas
- Preference for completing all environmental restoration work in a specific geographic location at one time, rather than in a piecemeal fashion.

STRATEGY FOR GROUNDWATER REMEDIATION

More than 220 km² (85 mi²) of Hanford's groundwater are contaminated by hazardous and radioactive **waste** to levels above federal drinking water standards (40 Code of Federal Regulations [CFR] 141) and Washington State groundwater quality criteria (Washington Administrative Code [WAC] 173-200). Monitoring of groundwater quality at Hanford is conducted using networks mandated by the Atomic Energy Act (AEA), RCRA, CERCLA, and by WAC-173-216 operating permits. These networks evaluate the movement of contaminant plumes, provide early notification of increasing contamination, assess compliance, and evaluate the effectiveness of remedial actions.

The groundwater remediation strategy for Hanford (DOE/RL-94-95, 1995a) preceded, and was developed independently of, the strategy for remediating contaminated vadose zone soil sites (DOEEL-98-28, 1999). However, in many instances, vadose zone contamination continues to contribute to the groundwater contamination. Consequently, Ecology and the EPA have repeatedly stated that no groundwater operable unit will be considered remediated until the corresponding source(s) that caused or are contributing to the groundwater contamination have been satisfactorily remediated and closed.

The groundwater remediation strategy (DOE/RL-94-95, 1995a) follows CERCLA principles and practices to: 1) define the extent of the contamination; 2) identify and control continuing sources of contamination; and 3) implement methods to contain/ remediate the contaminant plumes. Under CERCLA, remedial alternatives are evaluated with respect to the following explicitly identified criteria:

- Overall protection of human health and the environment
- Compliance with *ARARs*
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- cost
- State acceptance
- Community acceptance

The broad objectives of the strategy announced in DOE/RL-94-95 (1995a) are to implement a phased process of expedited, interim, and final actions to:

- Contain and reduce the mass of contaminants in the Central Plateau
- Restore, where possible, groundwater adjacent to the Columbia River for unrestricted beneficial use
- Prevent further degradation of groundwater quality at Hanford beyond the boundaries of the Central Plateau
- Achieve the applicable or relevant and appropriate requirements (ARARs) for groundwater resources.

In addition to these objectives, the strategy defines the priorities and technical approaches for cleanup or containment of contaminated groundwater at Hanford. Key elements of the strategy are defined in *The Hanford Site Groundwater Protection Management Plan* (DOE/RL-89-12, 1995b) as:

- Act to protect the Columbia River
- Reduce contamination entering groundwater from vadose zone sources
- Control the migration of contaminant plumes beyond the Central Plateau
- Employ the HSPPS strategy to accelerate remedial actions
- Balance the sequencing and scale of actions to efficiently use resources
- Utilize available treatment and disposal infrastructure
- Coordinate and integrate CERCLA- and RCRA-related actions.

Consistent with the nine land-use designations for the five geographic areas identified in the ROD for the *Hanford Comprehensive Land-use Plan Environmental Impact Statement* (DOE/HQ, HCP-EIS, 1999), the goal of the groundwater remediation strategy (DOE/RL-94-95, 1995) is two-fold. The goal is to contain and restrict access to contaminated groundwater in the Central Plateau and achieve beneficial use of groundwater in all other areas of Hanford consistent with the HCP-EIS land-use designations for those areas. Appropriate groundwater uses and restrictions are defined using the following HCP-EIS land-use designations:

- Industrial-Exclusive (waste management and disposal; i.e., 200 Areas)
- Industrial (reserved for general industrial activities)
- Agricultural (reserved for growing crops and raising livestock)
- Research and Development (reserved for basic or applied research facilities)
- High-Intensity Recreation (allocated to visitor-serving facilities)
- Low-Intensity Recreation (primitive visitor facilities)
- Conservation (limited and managed mining and grazing allowed)
- Conservation (limited and managed mining allowed)
- Preservation (managed to preserve natural resources).

CURRENT SOIL-SITE PRIORITIES

After the initial priority ranking of the contaminated soil sites (DOE/RL-96-67, 1996), a more formal priority ranking system was instituted. Each criterion was given a weighted numerical score ranging from low to high; low scored 1 point and high scored 5 points. Zero was awarded if the criterion was not applicable. The assigned scores were summed to establish a numerical ranking for the 23 waste site groups (DOE/RL-96-81, 1997).

In the fourth quarter of FY 2000, more administrative criteria were added that related to determination of contaminant plume sources, data integration needs, and RCRA assessment milestones. Priorities of the previously published objectives were restated as follow and provided with numeric weights for purposes of ranking:

- Stabilize waste and support cleanup decisions (High = 5)
- Monitor contamination (Medium = 3)
- Remediate contaminated sites (Low = 1).

To date, the results of that re-ranking have not been published by BHI or DOE/RL and exist only as an internal "working file". The content of that working file is summarized in Table 2.

Table 2. Current Priorities for 200/600 Area Contaminated Soil Sites.

OU Group No.	Description	Priority Ranking
200 - PW - 1	Plutonium/Organic-Rich Process Waste	1
200 - TW - 2	Scavenged Waste Group	2
200 - TW - 1	Tank Waste Group	3
200 - CW - 1	Gable/B-Pond & Ditch Cooling Water	4
200 - C S - 1	Chemical Sewer Group	5
200 - CW - 5	U-Pond/Z-Ditches Cooling Water	6
200 - PW - 2	Uranium-Rich Process Waste	7
200 - PW - 3	Organic-Rich Process Waste	8
200 - LW - 1	300 Area Chemical Laboratory Waste	9
200 - CW - 4	T-Ponds/Ditches Cooling Water	10

CURRENT GROUNDWATER PRIORITIES

DOE/RL originally committed to eight interim remedial and expedited response actions for groundwater contamination. These commitments were made to obtain key information on the feasibility of using groundwater pump-and-treat systems at Hanford. Four of the eight systems are in the 100 Areas. The remaining four are in the 200 East and 200 West Areas. The current groundwater remediation approaches and priorities for

the 200 and 600 Areas are summarized in Table 3. The groundwater remediation strategy for the Central Plateau gives priority to:

Table 3. Current 200/600 Area Contaminated Groundwater Priorities.

Contaminants	Facility	Location	Cleanup Approach	Priority
U, Tc-99	UO ₃ Plant	200 West Area	Containment & Mass Reduction	Intermediate
CCl ₄ , TCE, CrCl	PFP	200 West Area	Containment & Mass Reduction	High
Pu, Cs-137, Sr-90	B Plant, B-5 Reverse Well	200 East Area	No Action	Low
Tc-99, Co-60	B Plant, BY Cribs	200 East Area	No Action	Low
Tritium	618-10, -11 Burial Ground	600 Area	Source Removal	Undetermined

- Containing and reducing the mass of organic chemical contamination (CCl₄) associated with the Plutonium Finishing Plant (PFP) (200-ZP-1 Operable Unit)
- The combined Tc-99 and U plumes associated with the Uranium Trioxide (UO₃) Plant (200-Up-1 Operable Unit)
- Reducing or eliminating the leakage or deliberate discharge of operations-derived effluent to the soil.

The highest priority for contaminated groundwater in the Central Plateau is for the CCl₄ plume associated with the PFP in the 200 West Area. This high priority was assigned because the concentration of CCl₄ in this plume is many times the permissible state drinking water standard, the contaminant plume is very large, and it is expanding and migrating toward the river. Pump-and-treat and vapor-extraction methods currently are being applied as an interim remedial measure. Additional remedial investigation of this groundwater plume and its apparent continuing source in the vadose zone is in progress. Approximately two-thirds of the CCl₄ discharged at this site still has not been located or accounted for.

The U and Tc-99 contaminant plume associated with the UO₃ Plant in the 200 West Area has been subjected to interim pump-and-treat remediation in an effort to contain its eastward spread and reduce the highest contaminant concentrations. The system has been

operated intermittently to evaluate diminution and rebound of concentrations as a function of pumping rates and durations.

In the 200 East Area, plumes of Pu, Cs-137 and Sr-90 associated with the B-5 reverse well near B Plant (200-B-5 Operable Unit) are believed not to be actively spreading and, hence, not to be an immediate risk to human health. The results of treatability tests conducted at this location have not been encouraging. Despite contaminant concentrations in excess of regulatory standards, these plumes currently are not being actively investigated or remediated because of the assumed immobility of Pu and the relatively short half-life of Sr-90 and Cs-137.

Similarly, cleanup of the technetium-99 and Co-60 in groundwater contaminated by the BY Cribs in the 200 East Area (200-B-5 Operable Unit) is considered not to be high priority because the aquifer in this vicinity has a very low pumping capacity and is not readily treated by current technology. The effluents discharged at this location were dense brines that may have sunk to the bottom of local declivities on the bottom surface of the aquifer. Consequently, detection of the current location of the contaminants is somewhat problematic.

Very high concentrations of tritium in groundwater associated with the 618-10 and 618-11 burial ground in the 600 Area immediately north of the Energy Northwest power generation facility are currently being evaluated. The evaluation results may elevate this site's priority for expedited response action.

Contaminant plumes associated with facilities in the 100, 300 and 1100 Areas are outside the scope of work being transferred from BHI to FH. Needs to remediate groundwater contaminant plumes with essentially site-wide extents (consisting of tritium, 1-129, and nitrate) will be assessed based on the following two criteria (DOE/RL-89-12, 1995) in addition to regulatory and legal agreements:

- Can be shown to pose a demonstrably adverse impact to the Columbia River or an ecosystem, or to compromise a current or potential use of the river
- Remediation would reduce or eliminate the spread of contamination to uncontaminated parts of the groundwater system.

CURRENT GWNZ IP PRIORITIES

DOE/RL established the GWNZ IP in late 1997 via a letter of direction to BHI (Appendix B, DOE/RL-98-48, 1998). No formal set of project requirements and/or criteria that could be used to assign project priorities were part of that letter or were subsequently issued. Hence, a documented rationale for project priorities is not currently available.

However, **Ad hoc** priorities can be surmised from the *Detailed WorkPlan: Groundwater/Vadose Zone Integration Project*; Vol. 3, (DOE/RL-97-44, 2000). In addition, the *Groundwater/Vadose Zone Integration Project Specification* (DOE/RL-98-48, 1998) states that the purpose of the project is to lead to "an overall defensible end state for the Hanford Site" and address the "credibility concerns of the public." Performance criteria and measures for whether or how well these objectives are achieved were not provided.

According to DOE/RL-98-48 (1998), the project's criteria for establishing work priorities are the following:

- Minimum Safe Operations. No remediation, stabilization or disposal activities which are not necessary for safe operations will occur
- Essential Services/Activities. Actions required to support other planned work
- Mitigate Urgent Risks. Actions with the specific purpose of reducing levels of public, worker, and environmental risk
- Compliance. Necessary to comply with laws, orders, federal facility agreements, consent orders, and Defense Nuclear Facility Safety Board recommendations.

Examination of the *Detailed WorkPlan* (DWP) (DOE/RL-97-44, Vol. 3, 2000, p. 1-2) reveals only one self-imposed milestone objective that could drive priorities of GWNZ IP work for FY 2002: "*Complete the operational groundwater model*". The action plan for FY 2002 provided by the same report (p. 1-33) intimates that this milestone could be either to "revise site conceptual model" or "complete the conceptual and numerical models of groundwater/river interaction to estimate groundwater discharge to the river's ecosystem."

There are no TPA milestones for FY 2002 tied to any work breakdown structure number for the GWNZ IP. TPA milestones for FY 2002 relate only to monitoring and remediation work for 200 Areas groundwater contaminant plumes and contaminated soil sites. That work is part of the 2001600 ERP, rather than the GWNZ IP.

CURRENT BUDGET GUIDANCE

In April 2000, DOE/RL presented budget requests to DOE/HQ for FY 2002-2003. For FY 2002, DOE/RL requested ~\$689 million (M) at the target level and \$823 M at the TPA compliance level. For FY 2002, the President's budget request for RL is \$585 M, a decrease of \$117 M in FY 2002 compared to the FY 2001 appropriation (Table 4).

DOE/RL priorities for the FY 2002 budget request emphasize continued progress on the spent nuclear fuel and plutonium stabilization projects, river corridor cleanup, and 200 Areas materials and waste management. Consequently, the budget requests of projects

Table 4. President's FY 2002 Budget Request for DOE/RL.

Responsible Entity	Workscope	Target Budget (\$Million)
BHI		
CP01	200 Area Remediation	10,795
RC01	100 Area River Corridor Clean Up	42,958
RC02	300 Area Clean Up	8,155
RC04	Central Core (600 Area) Clean Up	355
RC05	River Corridor Waste Management	13,056
RS01	South Hanford Industrial Area Clean Up	750
SC01	Near-Term Stewardship	353
SS03	Groundwater Management & Monitoring	17,947
SS04	Groundwater/Vadose Zone Integration	7,000
Transfer Impacted		37,200
Total BHI		101,370
Fluor		
CP01	200 Area Remediation	2,205
CP02	200 Area Materials & Waste Management	67,607
CP03	Plutonium Finishing Plant	73,844
RC02	300 Area Clean Up	845
RC03	Advanced Reactor Transition	1,485
RC05	River Corridor Waste Management	1,944
RC06	300 Area Facility Transition	30,000
RS03	Spent Nuclear Fuel	163,135
SC01	Near-Term Stewardship	788
SS01	Site Integration	18,959
SS02	Landlord & Site Services	85,000
SS05	HAMMER	1,000
Total FH		446,811
PNNL		
SC01	Near-Term Stewardship	6,491
SS01	Site Integration	11,219
Total PNNL		17,710
RL DIRECTED		
SS01	Site Integration	19,822
Total RL Directed		19,822
	Total RL DIRECTED FOR FY 2002	585,713

and programs other than these would likely provide the \$104 M difference between DOE/RL's request to the President and the President's request to Congress. Among those projects and programs are the 2001600 ERP and the GW/VZ IP.

The breakdown of the President's budget request for RL, in terms of the responsible contractor and program breakdown structure, is summarized in Table 4 (Klein, Correspondence #01-AMI-013, April 30, 2001). Work being transferred in accordance with Section C.8 of Fluor's prime contract, and related work currently being performed by FH are highlighted in the table (unshaded) and are summarized in the text that follows.

CPOI - 200 Area Remediation

The current BHI portion of CPOI that is transferring to FH in FY 2002 includes characterization, soil and groundwater remediation, and selected facility surveillance and maintenance (S&M) or decontamination and decommissioning (D&D).

- Budgeted Work = 200 Area S&M
- Challenged (unbudgeted) Work =
 - ✓ 200-UP-1 pump-and-treat
 - ✓ Canyon disposition
 - ✓ 200 Area assessment and barrier monitoring
 - ✓ 200-P-1 CCl₄ pump-and-treat and vapor extraction
 - ✓ 233-S D&D.

Fluor's current portion of CPOI includes minimum-safe-condition maintenance and repair of 9 nuclear/radiological/industrial buildings and replacement of the roofs of B-Plant and PUREX.

- Budgeted Work = Minimum-safe maintenance of 9 nuclear/radiological/industrial buildings
- Challenged (unbudgeted) Work =
 - ✓ Characterization of 224-T and 231-Z facilities contamination
 - ✓ Replacement of B-Plant and PUREX roofs
 - ✓ 10 CFR 830 compliance.

RC04 - Central Core Cleanup (600 Area)

This project covers cleanup of the 600 Area, with the exception of the buffer zone around the 200 Area that is north of the Energy Northwest Site and LIGO.

- Budgeted Work = Maintain safe operations.

RS01 - South Hanford Industrial Cleanup

The portion of this work that is transferring from BHI to FH includes remediation of the 618-10 and 618-11 burial grounds immediately northwest of Energy Northwest's electric generating facilities.

- Budgeted Work = Maintain safe operations in the 400 Area and parts of the 600 Area
- Challenged Work = Initiate 618-10 and 618-11 burial grounds remedial action design.

SC01 - Near-Term Stewardship

This project includes S&M of remediated sites, including long-term and post-remediation S&M and inspection.

- Budgeted Work =
 - ✓ S&M of remediated sites in 200 and 600 Areas (transferring from BHI)
 - ✓ Support to HCP-EIS.

SS03 - Groundwater Management & Monitoring

This work currently consists of a BHI services contract with PNNL. The contract provides groundwater management and monitoring services for Hanford.

- Budgeted Work =
 - ✓ Maintain RCRA/AEA/CERCLA groundwater monitoring
 - ✓ Groundwater data analysis and modeling
 - ✓ RCRA groundwater monitoring well installation
- Challenged Work = vadose zone characterization

SS04 - Groundwater/Vadose Zone Integration

This work includes integration of on-going groundwater monitoring and treatment projects, and vadose zone investigations. One means developed for integration is yet another computer model (the System Assessment Capability, or **SAC**), in addition to several previously developed computer models, that predictively simulates groundwater flow and contaminant transport, and resultant risk to human health and the environment.

- Budgeted Work = SAC model maintenance and data interpretation/management

- Challenged Work =
 - ✓ Remaining current scope of GW/VZ IP activities
 - ✓ Science and Technology development activities
 - ✓ Expert panel support
 - ✓ Public involvement support.

ANALYSIS OF PRIORITIES

As noted at the beginning of this report, the three new work areas transferring from BHI to FH in FY 2002 are:

- CERCLA RI/FS for 2001600 Areas contaminated vadose zone soil sites
- CERCLA RI/FS for 2001600 Areas contaminated groundwater
- The GWNZ IP.

The objective of both RCRA and CERCLA processes, and the GW/VZ IP is remediation and closure of contaminated sites in a manner that protects public health and safety, and the environment. To accomplish this, DOE M 435.1-1, the **Radioactive Waste Management Manual** for DOE Order 435.1 (DOE/HQ, 1999a), requires facility and site closure plans to identify a strategy for allocating performance objectives to each contaminated facility from the site closure-performance standard. A strategy of that type necessitates setting priorities.

Project priorities typically are derived from a critical-path analysis of the **work** and schedule needed to execute the identified site closure strategy. Because a site closure standard has yet to be established and a critical-path analysis has not yet been performed for the three work areas transferring to FH in FY 2002, the analysis provided here is necessarily based on three things: 1) legally binding requirements and agreements of the TPA; 2) scopes and schedules of work currently identified as needed for compliance with #1; and 3) the budget currently proposed for FY 2002. Relative priorities can be compared for three domains of interest:

- Priorities of the three work areas relative to all other Hanford projects
- Priorities of the three **work** areas relative to one another
- Priorities of the major tasks comprising each work area

Site-Wide Context

The highest priority claims on Hanford's budget reflect major, legally enforceable TPA commitments made by DOE to the EPA and Ecology. These commitments mirror current perceptions of relative risk to human health and the environment. Hence, Hanford's highest priority projects are to: 1) remove and/or immobilize high-level radioactive and chemical waste stored in Hanford's tank farms; 2) remove radioactive spent nuclear fuel, sludge, debris and water from the K Basins at the edge of the Columbia River; and 3) stabilize plutonium stored at the Plutonium Finishing Plant. Each facility has demonstrably large inventories of high-activity, mobile radionuclides and/or hazardous chemicals that are potential sources of additional vadose zone and groundwater contamination. Hence, the three projects transferring to FH are widely acknowledged to have lower funding priorities than these major-facilities projects.

Their lower priorities reflect a common-sense perception that groundwater contamination cannot in many instances effectively be remedied until its actual or potential sources in the vadose zone are remedied. In turn, many contaminated soil sites in the vadose zone cannot effectively be remedied until major potential sources of contamination in associated engineered surface or near-surface facilities are removed or immobilized (e.g., in Hanford's 149 single-shell and 28 double-shell tanks, and in the two K-Basins).

3-Project Context

Priorities of the three areas of work transferring to FH in FY 2002 can also be analyzed in terms of their importance relative to one another.

The term "*project*" normally is defined as a series of tasks that are conceived, organized, and completed to provide well-defined products and/or services in accordance with requirements-based specifications and schedules. Projects have a well defined life cycle consisting of a beginning, a period of progression, and an end. In contrast, the term "*program*" normally is defined as a management structure employed to disburse funds to implement a policy or to further a broadly defined goal. Compared to projects, programs do not have well-defined life cycles predicated on the delivery of specific products or services in accordance with explicit specifications and schedules.

In the context of these standard definitions, the 200/600 ERPs for contaminated soil and groundwater are being managed as projects. In contrast, the GWNZ IP is currently being managed as a program. Although the GWNZ IP has been in existence for more than four years, its functional requirements, completion performance criteria, a clear process for identifying and making the needed decisions it purportedly will affect, and a discernable project life cycle have yet to be identified. Nor are there TPA milestones or other regulatory commitments that require any product or service from the GW/VZ IP in the near future.

As previously noted, Ecology and the EPA have repeatedly and publicly stated that no groundwater operable unit will be considered remediated until the corresponding "upstream" sources of the contamination have been satisfactorily identified and remedied. The immediately upstream source of contaminants entering Hanford's *groundwater* is the overlying vadose zone. In turn, the upstream source of additional contaminants entering the *vadose zone* are engineered surface and near-surface facilities such as the tank farms, K-basins, burial grounds, and contaminated buildings.

Levels of funding for the three areas of work being transferred to FH should therefore reflect a work sequence that logically diminishes the potential for additional contamination from upstream sources, or for recontamination of already remediated downstream areas in the river corridor. Consequently, the sequence of RI/FS work should generally reflect a progression from: 1) removal or immobilization of contamination in engineered surface or near-surface facilities, to 2) removal or immobilization of contamination in the vadose zone, to 3) removal or immobilization of contamination in the groundwater, to 4) eventual analysis of the overall results through monitoring observations and predictive simulations which foster confidence that the objectives have been achieved.

Contaminated Soils Tasks

The approach used to aggregate the 800-1000 contaminated sites in the 200 and 600 Areas was born both of necessity and common sense. The rationale for aggregating the sites into larger operable units with common characteristics and for assigning priorities to those larger operable units is well documented in publicly issued documents. The results of the aggregation and priority assignments reflect at least a modicum of consensus with Federal and State regulators. Top current priorities of this project were identified in Table 2.

Characterization and remediation work for the 200/600 Areas contaminated soils ERP currently is being carried out in accordance with TPA milestones. The process and criteria used to assign priorities are consistent with the regulatory framework, the HSPPS, and EPA guidance. Nevertheless, funding for ERAs, IRMs, and LFIs, has been severely limited because of the low priority and budget currently assigned to this project relative to the GWNZ IP.

Groundwater Tasks

The groundwater remediation strategy (DOE/RL-94-95, November 1995) and groundwater protection management plan (DOE/RL-89-12, July 1995) also demonstrably follow CERCLA principles and practices. Action priorities for tasks comprising this project (Table 3) have been identified based on broadly defined criteria. High-priority actions currently are being carried out in consensus with State and Federal regulators, and in accordance with **TPA** milestones. However, end-state goals for these actions are not clearly defined in accordance with the ROD for the HCP-EIS (DOE/HQ, 1999).

Furthermore, the cost/benefit values of the current treatment methods are in some cases questionable.

GW/VZ ZP Tasks

According to the GW/VZ IP's *Detailed Work Plan* (DOE/RL-97-44, September 2000), this program's top priority is development of a system assessment capability (SAC) to predict future groundwater flow, contaminant transport, and resultant risk to public health and the environment. The project's budget disbursements to date and its future projections (Klein, April 2002) reflect that priority.

A partly overlapping, sister project, termed the *200 Areas Composite Analysis*, is also being conducted by the same Hanford subcontractor. Unlike the composite analysis, the SAC is not required by any Federal or State requirements, the TPA, nor the HSPPS. Consequently, additional performance specifications for the SAC, as distinct from other, previously developed groundwater flow, contaminant transport, and risk-prediction software used at Hanford, cannot rigorously be tied to any regulatory requirements or DOE Orders.

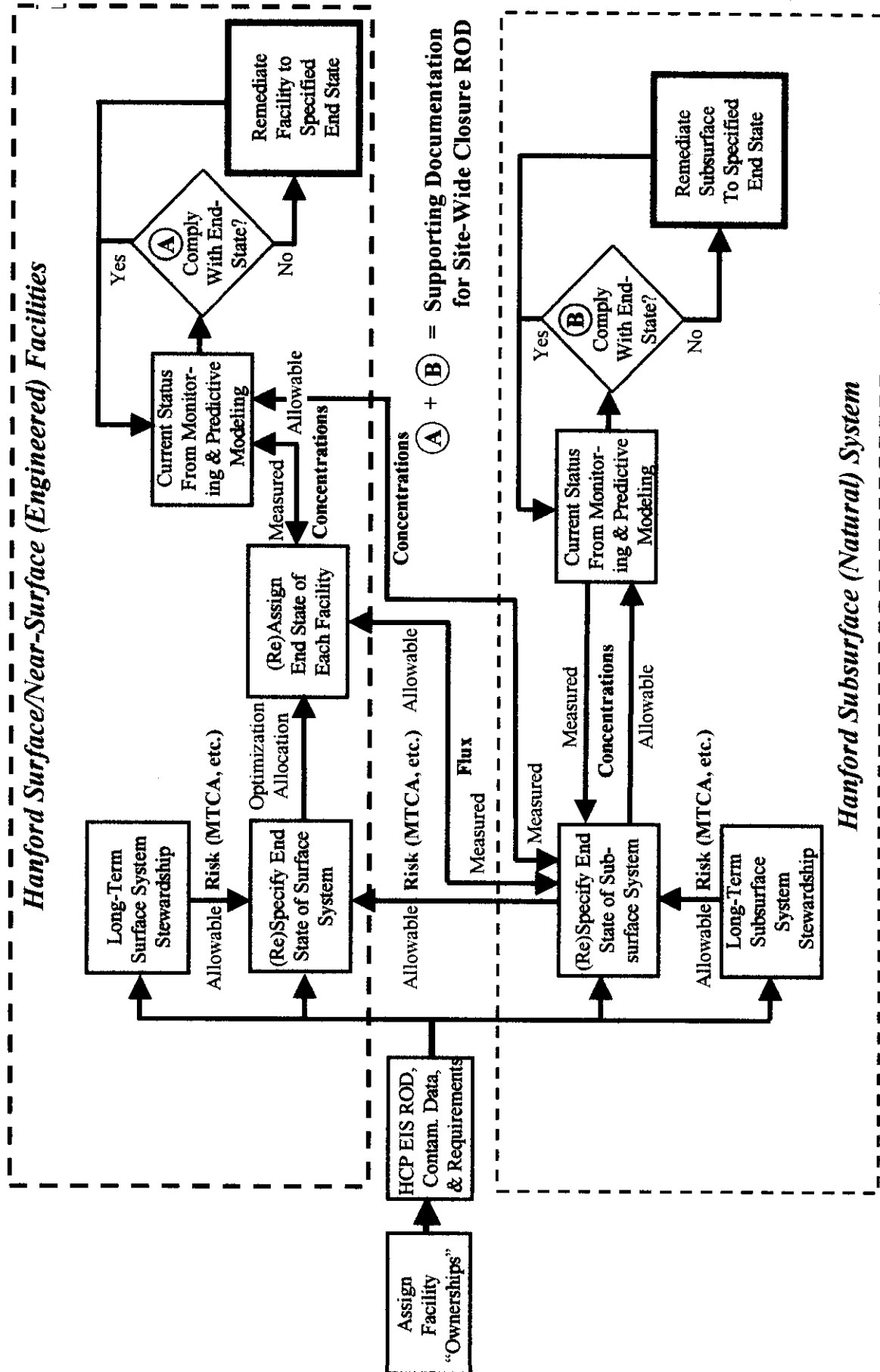
RECOMMENDATIONS

The Hanford strategy for remediating contaminated past-practice sites regulated under CERCLA (HSPPS, DOE/RL, 1992, p. 2) explicitly states that funding priorities for Hanford cleanup should emphasize an observational approach. In accordance with HSPPS guidance, that approach should rely on actual RI/FS remediation work focused on reducing contaminant toxicity, mobility, or distribution. Furthermore, FH's mandate from DOE/RL, as stated in its FY 2001-2006 contract extension signed in January 2001, is to apply Fluor commercial practices at Hanford through a Project Operations Center (POC) that includes a Central Engineering function. The objective of this mandate is to ensure application of best commercial practices, and consistency of process, quality, and execution of work performed.

Fluor commercial practices (Fluor, 2000) require: 1) initial detailed identification of project work scope in terms of the project's functions, requirements and completion-performance specifications, and 2) project execution in well defined phases, using a standardized time- and practice-proven approach. Consequently, GW/VZ IP work transferring to FH in FY 2002 will require definition of scope and product specifications in terms that are explicitly derived from requirements. The 200/600 ERP for contaminated soils and groundwater does not appear to share this deficiency.

In many instances, products will be required from the three work areas that can be defined in terms of operable-unit end-state specifications. Figure 1 depicts the general process flow recommended for the work transferring to FH. The process depicted is based on what is needed to obtain operable unit end-state specifications that are based on

Figure 1. Process-Flow Logic for Protection of Water Resources from Hanford Contamination.



identified requirements, in accordance with Fluor standard engineering and project management practices.

Based on all currently identified requirements, assignment of the relative priorities of the three areas of work transferring to FH seems clear. For the reasons previously stated in the **Analysis** section of this report, first priority should be given to contaminated vadose zone soil site characterization and remediation work.

The rationale for the previously established rankings of priority for the 23 aggregations of contaminated soil sites is well documented and generally accepted by regulatory agencies. Similarly, requirements are clear for continued groundwater monitoring and data analysis, and for the continuance of existing groundwater IRMs, provided the methods and design of the current work can be shown to be cost-effective. Lowest funding priority should be accorded the GWNZ IP because its products are not well defined in terms of requirements-derived specifications, and are not demonstrably needed far in advance of the issuance of a Hanford closure ROD.

No near-term requirements exist for the GW/VZ IP's highest priority product, the SAC. The current FY "proof-of-principal" analysis using the SAC software is due to be completed in September. A near-term need for another analysis or for continued software development work based on DOE Orders, regulatory requirements, or TPA commitments has not been demonstrated. Other integration tasks of the GWNZ IP fall within the integrative functions of FH's POC organization and are not sufficiently extensive to require their continuance as a separate "project".

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