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Pacific Northwest National Laboratory

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U.S. Department of Energy

# Integrating Pretreatment and Retrieval: Results from the July 1997 Tanks Focus Area Workshop

A 2-Day Workshop
Wednesday, July 16, 1997
Thursday, July 17, 1997
8:15 AM to 4:00 PM
Pacific Time



July 1998



Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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## DISCLAIMER

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# Summary

The U.S. Department of Energy (DOE) is working to clean up millions of gallons of radioactive waste that resides in underground tanks at four key tank waste remediation sites. These sites are

- Idaho National Engineering and Environmental Laboratory: ~1.7 million gallons in 11 tanks
- Hanford Site, Washington State: ~55 million gallons in 177 tanks
- Savannah River Site, South Carolina: ~33 million gallons in 51 tanks[1]
- Oak Ridge Reservation, Tennessee: 0.6 million gallons in 34 tanks.

Plans at the four sites call for the waste to be removed from the tanks and pretreated (note: the specific plans at each site vary). Retrieval processes remove the waste from the tanks and transfers it to another location. Pretreatment activities prepare the retrieved waste for immobilization. Actions taken during retrieval can have a strong impact on pretreatment. By integrating the retrieval and pretreatment activities for remediating the waste in these tanks, the potential exists for reducing costs, improving the design of technologies, and reducing the risks to the environment and workers.

A Retrieval-Pretreatment Integration Meeting was held in Richland, Washington, on July 16 and 17, 1997. Contractors responsible for radioactive tank waste retrieval and pretreatment work, including members of the Tanks Focus Area (TFA) Technical Team, TFA Technology Integration Managers, and key principal investigators at various DOE tank waste sites met to discuss connections between retrieval and pretreatment. The attendees sought to 1) understand the needs of both retrieval and pretreatment processes; 2) gain practical knowledge of the applications, capabilities, and requirements of retrieval and pretreatment technologies being developed and deployed; and 3) focus on identifying and troubleshooting interface issues and problems. By the end of the 2-day meeting, they created a checklist of retrieval and pretreatment considerations when developing new technologies or managing work at the sites in these areas. The meeting was sponsored by the TFA.

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1 In July 1997, the Savannah River Site closed one tank. By December 1997, they closed a second tank.

Since the focus area's inception in 1994, the TFA has significantly assisted DOE's Office of Environmental Management meet its goals and commitments for tank remediation. Managed by DOE's Richland Operations Office and Pacific Northwest National Laboratory,[1] the TFA works to develop solutions to safely and efficiently remediate tank waste at the four key DOE tank waste sites.

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1 Pacific Northwest National Laboratory is operated by Battelle for the U.S. Department of Energy.

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# Tables

# 1.0 Purpose

Retrieving and pretreating the radioactive waste stored in the U.S. Department of Energy's (DOE's) underground tanks are complex, interwoven activities. The composition of the retrieved waste can vary widely depending on the method used to mobilize the waste from the tanks. This varied composition can greatly affect the technologies used to pretreat the waste and the costs of pretreatment. For example, in the gunite tanks at the Oak Ridge Reservation (located in Tennessee), retrieval activities may put small pieces of gunite into the radioactive liquid waste stream. These pieces of concrete could damage pumps and other equipment used to prepare the waste for immobilization. Another example is the shear from retrieval operations; the shear may reduce the efficiency of settling and filtration operations by reducing the size of the waste particles. If scientists and researchers working to solve the tank waste challenges, technical program office managers at the tank sites, and others understand the connection between retrieval and pretreatment activities, more efficient processes and reduced costs can be achieved.

To make this possible, researchers involved in retrieval and pretreatment activities met at the Conference Center in Richland, Washington, on July 16 and 17, 1997, to discuss the connections between these activities. This meeting was sponsored by the Tanks Focus Area (TFA). The TFA manages an integrated program that develops solutions (including technologies and studies) to safely and efficiently remediate tank waste across the DOE complex. The TFA is managed by DOE's Richland Operations Office and Pacific Northwest National Laboratory.[1] The TFA is composed of technical experts from national laboratories, management and operations contractors, management and integration contractors, industry, academia, government organizations, stakeholders, and regulators.

The purpose of the workshop was to help participants 1) gain a better understanding of retrieval and pretreatment process needs and experiences; 2) gain practical knowledge of the applications, capabilities, and requirements of retrieval and pretreatment technologies being developed and deployed; and 3) focus on identifying and troubleshooting interface issues and problems. The end product of this meeting was to create a checklist (Table 1) of retrieval and pretreatment parameters to consider when developing new technologies or managing work at the sites in these areas. For convenience, the information in Table 1 is also organized by pretreatment parameter and retrieval-pretreatment parameter in Section 5.0.

1 The Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle under contact DE-AC06-76RLO.

**Table 1.** Checklist of Parameters to Consider in Tank Waste Processing

| |
|---|
| **Particle Size** |
| What impact will high-shear retrieval and saltcake dissolution processes have on particle size (desired particle sizes between 1 micron and 100 microns for pretreatment)? |
| What are the particle size requirements for solid-liquid separations? Have these requirements been discussed between the retrieval and pretreatment staff? |
| Be aware that some retrieval processes can reduce sludge particles in size to the point that downstream processes lose efficiency. |
| **Water Management** |
| What impact will retrieval techniques have on the waste when it leaves the tank? For example, what impact will air mixed in dilution water have when retrieving waste (i.e., foaming, carbonate formation)? |
| Have steps been taken to ensure that the retrieved waste chemistry will not result in plugged transfer lines? |
| Have steps been taken to ensure that the retrieved waste chemistry will aid in downstream processes or not harm them? |
| Have all reasonable measures been taken to recycle the water used in retrieving the waste? |
| **Safety** |
| What happens to the waste during transfer and lag time? |
| What effect does sludge mobilization have on criticality and flammable gas retention? |
| Will the sludge volume increase from gas retention? |
| **Simulants** |
| Develop simulants that mimic chemical and physical properties of the waste. Use actual waste for laboratory-scale tests. |
| Has caustic been added during retrieval? What impacts will this have on downstream pretreatment processes? |
| **Uniformity** |
| Are the feeds to pretreatment both chemically and physically uniform? |
| Have settling times in lag storage been coordinated with feed requirements for pretreatment? |
| **Temperature Impacts** |
| Have time and temperature gradients from sludge and saltcake during transfer been measured? |
| How will temperature impact waste retrieval and transport? Understand waste temperature issues, such as the heat of solubility with saltcake dissolution (i.e., saltcake gets cold when dissolved). |

**Table 1.** (contd)

| |
|---|
| **Waste Samples** |
| Because retrieval can impact the physical and chemical characteristics of the waste, especially the sludge, have waste samples been provided to the pretreatment staff operating or developing waste processing equipment? |
| Have the physical and chemical characteristics of the waste after retrieval been published in a form available to pretreatment staff? |
| Have the appropriate technology managers been informed of the waste characteristics? |
| **Chemistry Control** |
| Where will chemistry control be done (in the tank being retrieved or the receiving tank)? |
| **Performance Data** |
| Have larger-scale data been provided to validate proposed flowsheets? |
| **pH/Ionic Strength** |
| Have all efforts been made to avoid having a low pH (<10) in the waste stream? Have pH and ionic strength changes that will occur during retrieval been described and made available to others? This impacts both corrosion and waste chemistry. |
| What pH and ionic strength changes will occur during retrieval activities? How will these changes impact tank corrosion and waste chemistry? |
| **Chemical Additions** |
| Ensure impacts of chemical additions on retrieval are fully evaluated. Note: corrosion inhibitors and corrosion products can impact retrieval. |
| Ensure impacts of chemical additions on pretreatment are fully evaluated. Avoid the use of caustic leach, because adding more sodium means making more glass. |
| Consider downstream impacts of adding surfactants or other additives. |
| **Feed Specifications** |
| Define strategy to ensure that feed to crossflow filtration will be acceptable (i.e, monitoring, specifications for retrieval, conditioning step). |
| **Air Addition** |
| What is the impact of carbonates created by the addition of air and carbon dioxide? Carbonates can impact actinide solubility and result in solubilization of transuranics during retrieval. |
| Determine the impact of using air for retrieval on pretreatment processes. Have other alternatives, such as nitrogen sparging instead of air sparging, been considered to avoid pretreatment problems, such as impacts on chromium? |
| **Lag Storage** |
| What are the lag storage needs and considerations? |
| **General** |
| Overlay pretreatment and retrieval processes to ensure optimum water and chemical addition, particle size modification, blending, and lag storage. |

**Table 1.** (contd)

| |
|---|
| **Blending** |
| Has blending been controlled or limited to prevent negative impacts from potassium, technetium, organic compounds, phosphates, and sodium? |
| Consider waste blending issues. |
| **Waste Transfer** |
| Consider waste transfer issues. For example, continue pumping water after the waste is transferred to avoid waste in the line, heat lines to avoid waste settling in the lines, and provide capability to flush the lines. |
| **Solids Content** |
| Consider possible increase in solids during transfer and storage (i.e., precipitation/crystallization). |
| Consider unwanted precipitations caused by mixing and chemical additions. |

The tanks and waste at the Savannah River Site in South Carolina, Oak Ridge Reservation in Tennessee, and the Hanford Site in Washington are briefly discussed in Section 2.0. An overview of the retrieval and pretreatment needs along with specific concerns mentioned by principal investigators who were attending the meeting are discussed in Section 3.0. Interface issues by key parameter are described in Section 4.0. Parameters that should be considered by both functions are listed in Section 5.0. Suggestions for the future are briefly discussed in Section 6.0. The presentations given on these issues are shown in Appendix A.

# 2.0 Overview of Radioactive Tank Waste

Radioactive waste is stored in underground tanks at several sites across the country. This report focuses on three sites: Hanford Site, Oak Ridge Reservation, and Savannah River Site. Table 2 provides a brief overview of the three sites. For more information, see Appendix A.

**Table 2.** Overview of Tank Waste Sites

| Site | Hanford Site Washington | Savannah River Site, South Carolina | Oak Ridge Reservation, Tennessee |
|---|---|---|---|
| Tanks | 177 | 51[(a)] | 34 |
| Waste (million gallons) | 55 | 33 | 0.6 |
| Radioactivity (curies) | 198 | 534 | 0.2 |
| Waste types | Dissolved salt solution, sludge, slurry | Sludge, saltcake | Sludge, dissolved salt solution |
| Solids (wt%) during transfer | 15 | 10 | 10 |

(a) One tank was closed in July 1997. A second tank was closed in December 1997.

The physical and chemical properties of the waste that must be retrieved and pretreated at each of these sites varies. These differences, summarized in Table 3, must be considered when designing and developing retrieval and pretreatment technologies.

**Table 3.** Summary of Site Perspectives and Experience

| Properties | Hanford Site | Savannah River Site | Oak Ridge Reservation |
|---|---|---|---|
| Chemical additions to waste | Minimum chemical additions within corrosion limits | Inhibited water | Water |
| Sluicing water pH | 12[(a)] | 10[(b)] | ~7 |
| Particle size criteria for waste transfer | Yes[(c)] | No[(d)] | Yes[(e)] |
| Pump system | -- | Would have chosen different pump system based on settling rates and characterization of solids | -- |
| Special concerns | -- | Benzene generation in in-tank precipitation tanks | Strontium-90 is problem constituent |

(a) Hanford sluicing water pH is kept basic because of the high aluminum content in the waste and to avoid plutonium dissolution in the supernate. This is a challenge for equipment because no aluminum parts can be used.
(b) Savannah River Site uses a pH of 10 to avoid precipitation and later to adjust the process.
(c) At the Hanford Site, a controllable recipe for waste conditioning before transfer has not been established.
(d) At the Savannah River Site, particle sizes acceptable for feeds have been processed to date. Equipment can handle particle sizes if lines are flushed.
(e) At the Oak Ridge Reservation, data on breakup of particles is obtained during retrieval. Particle size and percent solids are checked before transfer to ensure limits are met.

# 3.0 Understanding the Needs of Each Function

In the process of waste remediation, retrieval activities remove the waste from the tanks and transfer it to a location where pretreatment occurs. Pretreatment then takes the waste and separates the various components in preparation for immobilization. The actions taken and changes induced in the waste by retrieval can have significant impacts on the pretreatment activities. Thus, this chapter begins by discussing the parameters within which each group works (Table 4). Then, the similarities and differences between the activities are discussed, with more detailed information from the principal investigators following.

**Table 4**. Comparison of Retrieval Products and Pretreatment Needs

| Parameter | Retrieval | Pretreatment |
|---|---|---|
| Sodium (molar) | Varies[(a)] | Homogeneous at 5 to 7 molar |
| PH | 10-12 | Greater than 12 |
| Characterization | Before retrieval | After retrieval |
| Particle size | Up to 30% solids (Hanford), 10% solids (Oak Ridge Reservation) | 1 micron - 100 microns |
| Velocity requirements | Velocity requirement with pipeline pressure limitations (6-7 ft/sec for transfer at Hanford) | No specifications |
| (a) Inhibited sluicing water with 0.01 molar sodium is used to retrieve waste in some cases. | | |

At the meeting, similarities and differences in process requirements were compared for important parameters. Looking at similar process requirements, both retrieval and pretreatment staff are concerned about particle size and consider it an important design parameter. Retrieval is concerned about the impacts of waste transfer; pretreatment is concerned about the impacts on settle-decant or filtration activities. Also, both programs are concerned about the impact of the waste chemistry on flow properties. With the waste containing such a variety of chemicals, changes in temperature, pH, or other factors could cause the waste to congeal and plug the lines, a time-consuming and extremely expensive problem. Several differences between the two functions should be noted. In looking at water and chemical additions, pretreatment activities work to minimize this addition because it increases the amount of waste to be processed and the expense of doing it. However, in retrieval, water additions are often needed to make a system more effective. The purpose and use of simulants differ between the two activities. In retrieval, the primary concern for the simulants is that they match the physical properties of the waste. In pretreatment, the concern is that the simulants match the chemical properties of the waste. Another issue is feed uniformity. This is important to pretreatment because of impacts on filtration systems, but control of feed uniformity is a very difficult requirement for retrieval of some waste types.

## 3.1 Retrieval Needs

Only one of the retrieval programs gave a presentation at this conference: the Retrieval Process Development and Enhancements Program (RPD&E). The presentation was given by Jim Lee, Retrieval Technology Integration Manager; Pete Gibbons, Deputy Retrieval Technology Integration Manager, and Mike Rinker, principal investigator. This program is focused on developing robust processes that are capable of handling tank waste with a wide range of properties. The program's goals are efficient removal of salt and sludge without large volumes of water, meeting closure criteria, and effective heel removal.

Key issues identified during the presentation included the following:

- Are results of core sampling being incorporated into simulants? RPD&E is finding it hard to get samples for physical properties. The project depends on users to describe the waste's characteristics so that accurate simulants can be developed.

- How will waste slurries impact the transfer lines? Will the slurries cause plugging?

- A better understanding is needed of the impact of retrieval devices on saltcake dissolution. Saltcake dissolution is most affected by time and temperature, rather than force. It may be difficult to effectively dissolve saltcake in a leaking tank without exacerbating the leaks.

## 3.2 Pretreatment Needs

In looking at the interface between retrieving waste and pre-treating waste, the main need is to understand the specific parameters of the waste feed that the pretreatment technologies will receive from the retrieval activities. One of the parameters that needs to be further understood is uniformity in the feed that will be provided; the blending strategy must avoid unwanted interactions and segregation of problem constituents. An understanding of the waste's constituents will benefit the pretreatment technologies by allowing them to be more focused on specific constituents. More specifically, a better understanding is needed of the chemistry of salt dissolution (i.e., the impact of time and temperature on salt dissolution) and the effect of pH and ionic strength on gel formation and solids precipitation in retrieved waste. A better understanding of the waste's constituents will also benefit the overall remediation of the waste by allowing the retrieval and pretreatment staff to step back from their specific technology and see the broader picture. For example, if adding a chemical to the tank waste in the retrieval process causes a dramatic increase in pretreatment activities, then the larger program needs must be considered and the retrieval and pretreatment staff need to work together to make the entire remediation process more efficient. In focusing on specific issues, the goal is not for pretreatment activities to impose strict feed acceptance criteria. Rather, the goal is to understand the kind of feed the pretreatment technologies will receive.

Key issues identified during the presentation included the following:

- Do we have the skills to deal with the problem constituents that are being removed and going to the low-activity waste glass? The volume of low-activity waste is often ignored.

- The effects of dilution on sludge chemistry should be understood. In particular, dilution affects the pH.

- Are there constituents in the waste, such as fluoride, that affect the solubility of aluminum?

- Severe pH and temperature gradients may occur during retrieval, transfer, and pretreatment. These gradients may result in unwanted precipitation.

- Will in-tank or out-of-tank processes be used? Some of the in-tank retrieval tools could be used for in-tank processes.

- Is there a correlation between hard and soft sludge and aluminum content?

- Adding chemicals during retrieval and sludge washing may cause problems in downstream pretreatment. It destroys the validity of waste characterization data. Even water dilution changes pH, solubility, ionic strength.

- Coagulation during sludge washing will affect downstream transfer and pretreatment. When sludge is mixed with caustic, we start to see sinkers, floaters, and foam. Retrieval will have this same phenomena occurring.

- Sluicing, waterjet cutting, and pulsed air are examples of technologies that could cause problems. When air and water are introduced into the waste, a lot of unwanted oxidation of waste constituents could occur.

- To perform crossflow filtration, uniform feed is needed in terms of viscosity and insoluble solids concentration.

- Studies may be needed for settling rate versus ionic strength.

- In some cases, settling may be cheaper than filtration because filtration is so sensitive to feed stream permutations.

- An analysis software must consider that the users may not know if the input to the system is reasonable.

# 4.0 Interface Issues

This section provides a more detailed discussion of important interface parameters and how sites are dealing with these parameters. Implications across the DOE complex are identified, if applicable.

## 4.1 Particle Size

The key issue is to determine to what degree particle sizes need to be controlled. In general, pretreatment requires particle sizes between 1 micron and 100 microns. Yet, sites such as the Savannah River Site do not have feed specifications from retrieval for particle size. At the Savannah River Site, the pretreatment equipment is able to handle the particle sizes that are being delivered. Transfer lines are the most affected by the lack of a specification. At the Oak Ridge Reservation, the major concern with particle size is as the waste moves through transfer lines. The site plans to monitor particle size following Gunite and Associated Tanks (GAATs) retrieval to see where waste conditioning will be useful. At the Hanford Site, work is being done to develop specifications for waste transfer; however, the specification is for the velocity and percent solids to the transfer lines and not for particle size. Use of the Retrieval Analysis Tool (now known as the Retrieval Technology Guide) may provide some insight into whether a particle size specification is warranted.

The drivers for particle size specifications include what is needed to mobilize waste, avoid plugging of transfer lines, leach aluminum, chromium, and phosphorus during enhanced sludge washing, and facilitate solid-liquid separations. (Note: Some participants felt the driver on particle size should be solely what is needed to mobilize the waste. The waste can be conditioned for transfer, and the particle size can be adjusted before separation.)

## 4.2 Homogeneity

There are two aspects to controlling homogeneity: chemical and physical. Physical homogeneity, which depends on waste type, is increased by in-tank size reduction, agitation, blending, and feed staging strategies. Currently, holding tanks at the Savannah River Site do not have agitation, and material tends to build up at the inlet to the tank. Agitating holding tank waste would help maintain physical homogeneity.

## 4.3 Dilution of Supernate

Supernate may be diluted by retrieval operations. The importance of water management to the overall treatment process is not well understood. In pretreatment activities, water could be considered a chemical additive. For example, adding water may result in re-dissolving salts and in unwanted partitioning of aluminum. Such effects must be balanced against the other benefits of water addition.

## 4.4 Chemistry Control

The goal of sludge processing is to reduce the volume of high-level waste by removing diluents (e.g., sodium, aluminum) or sludge-limiting constituents that cause immobilization problems (e.g., chromium, phosphorus, sulfur, iron). To do this, pretreatment uses chemical methods such as oxidation to remove chromium and iron. This oxidation must be balanced to limit the solubilization of radionuclides such as plutonium. The chemistry of retrieval also impacts the oxidation state. Understanding the chemistry of retrieval is necessary to prevent unwanted consequences for pretreatment.

Retrieval operations can assist downstream pretreatment operations. For example, the dissolution of minerals — formed by the long-term aging of wastes — is driven by kinetics and is very slow. By adding leach chemicals during retrieval, the time required for pretreatment operations can be reduced.

Retrieval activities can greatly influence the chemistry of the waste. These influences need to be understood. One example is inhibitor water — there is very little pH control on inhibitor water additions to the tanks. The control is on the water added and not on the waste in the tank. Similarly, chemical control during retrieval will be on the receiver tank and not on the waste being retrieved. The potential impact of the chemistries not being tightly controlled is the creation of safety issues from precipitates during storage and transfer.

Waste blending will also represent problems for chemistry control. There are negative downstream impacts from high concentrations of potassium, technetium, organic compounds, and sodium in a blending tank.

## 4.5 Monitoring

Monitoring strategies are needed to gain knowledge of waste feed to pretreatment technologies and control the leaching process. Strategies should use monitoring to watch the process and remedial actions to control parameters being monitored. At the Savannah River Site, radiation monitoring is used to estimate the percent solids in the waste before entering the transfer lines. The Hanford Site will need to deliver the second batch of waste to vendors within 60 days of the vendor request. It will be challenging to retrieve the waste and meet the analytical requirements for feed characterization within such a short time period.

## 4.6 Simulants

Currently, simulants used for retrieval process development differ from those required for pre-treatment process development. Retrieval's simulants emphasize the physical properties of the waste. Pretreatment requires definitive representation of both the physical and the chemical properties. It may be that both retrieval and pretreatment processes need to work with actual wastes on a small scale to better understand unwanted chemical interactions, rather than to rely on simulants; however, the challenge is to get a representative sample.

## 4.7 Closure

Closure requirements should be integrated with the retrieval strategy. If a tank is not going to be reused, the retrieval strategy can be relaxed. Conditioning and cleaning agents should not be used if the volume of residual radionuclides is small to nonexistent; this is subject to closure agreements on the amount of radionuclides that can be left in the tank.

## 4.8 Temperature Impacts

Variations in temperature induce changes in the feed. Saltcake dissolution is endothermic and results in waste cooling. Cooling may impact solution solubility and result in unwanted precipitations and gels that impact the effectiveness of separation processes. Higher temperatures increase kinetics and solubilities of silicon, aluminum, and phosphates. Pretreatment prefers that the sludge processing be done at as high a temperature as practical. Conversely, supernate temperature management is critical for success. If retrieval can assist in increasing and maintaining a constant temperature during sludge removal, pretreatment is enhanced.

## 4.9 Chemical Addition to Dislodge Waste

Chemical additions may reduce the need for high-pressure water additions to dislodge hard-to-remove wastes. Salt dissolution may require chemical additions to retrieve saltcake in a timely manner. Chemical additions must be evaluated for impacts to both pretreatment and immobilization activities. Chemical additions could cause foaming in the melter and unwanted offgas problems during vitrification. It may be possible to add chemicals in the retrieval step that would be added anyway at a later stage or that may assist in the pretreatment process.

# 5.0 Opportunities Pretreatment and Retrieval Should Consider

Retrieval is the first opportunity to implement processing options that are optimized across the entire flowsheet. A number of opportunities exist for retrieval to facilitate this optimization. Pretreatment is a major cost and risk reduction step in tank waste remediation. A number of opportunities exist for pretreatment to work with retrieval to better achieve this goal. These opportunities are listed in the form of recommended parameters in Table 5.

**Table 5.** Recommended Parameters to Consider

| **Recommended Retrieval Activities and Parameters for Consideration** | |
|---|---|
| | **To Do** |
| Particle size | Understand effect of high-shear retrieval and saltcake dissolution processes on particle size. Provide particle sizes between 1 micron and 100 microns. |
| Physical properties | Maintain control of blending to prevent negative impacts from unwanted concentrations of sodium, technetium, organic compounds, phosphates, and sodium. |
| Water management | Understand impact of foaming, i.e., air in dilution water coming out when mixed with waste. |
| Waste conditioning | Understand what conditions need to be enhanced. The purpose of waste conditioning is to avoid pipe plugging and to aid in downstream processes. |
| Safety | What happens in transfer and lag time? Understand the effect of sludge mobilization on criticality and flammable gas retention. Consider potential for sludge volume increase due to gas retention. If caustic is to be used, it must be part of the safety basis for the tank. |
| Uniformity | Provide uniform feed for a given batch both chemically and physically. Coordinate settling times in lag storage with feed requirements for pretreatment. |
| Temperature impacts | Provide time and temperature gradient from sludge and saltcake during transfer. |
| Characterization | Better characterization of pretreatment feed. Need samples after retrieval to physically and chemically characterize the sludge. Define what retrieval technologies will do to the waste, so that pretreatment staff can understand how to work with actual tank samples. |
| Chemistry control | Will chemistry control be in the tank being retrieved or the receiving tank? |
| Performance data | Provide larger-scale data from real waste. |

**Table 5.** (contd)

| | **To Avoid** |
|---|---|
| pH/Ionic strength | Avoid low pH (<10). Better characterize pH and ionic strength changes that will occur during retrieval. This impacts both corrosion and waste chemistry. |
| Chemical additions | Make sure downstream impacts of chemical addition are fully evaluated. |
| | Avoid adding surfactant or any additive without consideration for downstream impacts. |
| Tank cleaning | Avoid loosening or removing corrosion from walls. Retrieval inherits corrosion products and chemical additions from addition of corrosion inhibitors during storage. |
| Temperature | Avoid waste cooling in pipes from heat of solubility of saltcake dissolution. |
| Physical | Avoid grinding in retrieval operations as sludge particles can be reduced in size to the point that downstream processes lose efficiency. |
| **Recommended Pretreatment Activities and Parameters for Consideration** | |
| Particle size | Provide better definition of particle size requirements for solid-liquid separations. Separations should handle particle size specifications rather than retrieval. Retrieval can overcome particle size limitations if it is clear what pretreatment activities need. |
| Feed specifications | Define strategy to ensure that feed to crossflow filtration will be acceptable (i.e., monitoring, specifications for retrieval, conditioning step). |
| Air addition | Determine if carbonates from the addition of air and carbon dioxide will be a problem. Carbonates can impact actinide solubility and result in solubilization of transuranics during retrieval. Air may also impact chromium. Determine if retrieval requires nitrogen for sparging. |
| **Both functions should work together** | |
| Lag storage | Address lag storage needs and considerations |
| General | Pretreatment and retrieval processes should be overlaid to ensure optimum water and chemical addition, particle size modification, blending, and lag storage. |
| Blending | Blending may require cooperation from both programs. |
| Waste transfer | Stop waste transfer before pumping is finished to avoid waste in the line. Keep everything hot to avoid settling in the lines. Provide capability to flush the lines. |
| Simulants | Develop simulants that mimic chemical and physical properties of the waste. Use actual waste for laboratory-scale tests. |

# 6.0 Next Actions

A number of critical interface issues exist for retrieval and pretreatment. Many of these issues can be resolved within the programs. Many are best addressed jointly. Specific actions recommended by the group for TFA's consideration include the following:

- Obtain samples from GAAT and Hanford Tank 241-C-106 to determine changes in both physical and chemical characteristics from retrieval. Provide samples of retrieved waste for solid-liquid separations studies.

- Investigate the impact of chemical additions to the waste to avoid "showstoppers" later.

- Continue interaction between the retrieval and pretreatment functions and expand these interactions to include safety and closure.

# Appendix A

# Site Perspectives

# Appendix A

# Site Perspectives

## A.1 Savannah River Site (SRS) Status — Eloy Salvidar and Walt Tamositis

The presentation discussed in-tank precipitation (ITP) feed retrieval and pretreatment; Tank 20, 19, and 17 closure activities; Defense Waste Processing Facility (DWPF) melter pouring problems; and retrieval effects on the DWPF flowsheet. Key issues are as follows:

- Unexpected levels of benzene were generated in the ITP supernate Batch 1.

- Tank 20 will be closed in FY97. The technetium, mercury, and chromium in the residual waste of Tank 20 has been stabilized with reducing grout. No problems were encountered. Performance assessment and closure criteria drive the extent of retrieval, characterization, and encapsulation of residual waste.

- DWPF pour spout problems have been eliminated with the installation of an insert.

- The retrieval process must be designed to include blending to meet flowsheet requirements. All chemical additions added during retrieval are flowsheet evaluated.

The staff at SRS recognize that retrieval impacts pretreatment processes in a number of ways. The products of corrosion and concrete erosion impact filter performance. Rocks, clunkers, and chunks can be dredged up that impact pumps, filtration, etc. Retrieval may affect particle size and reduce the efficiency of settling and filtration. A list of retrieval-pretreatment parameters to be considered is provided in the presentation. A large number of retrieval-closure considerations were also discussed.

### A.1.1 SRS Tank Closure Project — Eloy Salvidar

The work at SRS in closing Tanks 20, 17, and 19 was summarized as follows:

- Technetium-99 and selenium-79 were the limiting constituents that drove the need for reducing grout. The selected point of compliance was the seep line for groundwater entering Four Mile Creek, about 1 km away.

- Reducing grout volume is assumed to be the concentration averaged to meet 10 CFR 61 Class C requirement. Waste is processed to remove radiation to the extent technically and economically feasible. The solid physical form is less than Class C and managed in accordance with the AEA.

- Tank 20 residual waste volume was estimated from in-tank photography and ½-inch-high plates on the tank bottom.

- New risers were installed on the tank top for slurry pumps between $10K and $50K. This is a sharp contrast to Hanford's estimate of $4M (concrete-domed at a cost of single-shell tanks).

- Reducing grout to encapsulate sludge was tested outside the tank and then verified inside the tank during emplacement using photography.

## A.2 Oak Ridge Reservation (ORR) Overview — Sharon Robinson

A key issue at ORR is sludge grouting–looking at the difference between waste volumes from 1) creating optimum formulations for each tank form, or 2) creating a single robust grout formulation. Questions exist about mixing wastes from several sources in the Melton Valley Storage Tanks.

- Old Hydrofracture Tank and Gunite and Associated Tank wastes are fairly well characterized.

- Bethel Valley Evaporator Service Tanks and Melton Valley Storage Tanks have one access point and require multiple samples to be taken.

The staff at ORR expect layering of sludge in the Melton Valley Storage Tanks and are leaving the decision of how to retrieve and treat these sludges up to privatization bidders. A debate exists about the point of designation of transuranic (TRU) waste (composition in tank or grouted sludge TRU concentration). For grouting of residual solids in tanks, the problem constituent is strontium-90.

## A.3 Hanford Site — Randy Kirkbride

Retrieval operations are focused on providing feed envelopes to privatization. Feeds for phase 1 will have varying combinations of supernatant, soluble sodium salts, and insoluble solids (sludge). Issues exist surrounding the amount and composition of liquid used for retrieval. An added function of processing sludge wash liquor as low-activity waste will be included in phase 2.

The Project Hanford Management Contractor sees their role as reducing the uncertainty of privatization scope to facilitate fixed price contracting (reduce contingency). To fulfill this role, retrieval needs information as a basis to develop specifications for the phase 2 privatization request for proposal.

### A.3.1 Hanford Retrieval Projects — Tom May

The first major retrieval effort is Project W320 for waste retrieval from Tank 241-C-106. Retrieval parameters are as follows:

- 40-hp adjustable level pump with 250-hp booster in pit.

- sluicer - 350 gal/min feed in a 4-inch line to give 100-mph sluicer speed.

- 30 wt% insoluble solids maximum allowed for transfer.

Some solids transfer/settling testing was done with simulants but exact data was not presented. Pacific Northwest National Laboratory did settle-decant testing in FY96–estimated settling rates were 1-2 cm/min. Experience at SRS was ~3 ft/min; a very fast settling rate that can cause plugging problems.

For hard heel retrieval, a pump recirculating loop will be operated at 350 gal/min–and confined or enhanced sluicers will utilize a 60 gal/min slip stream and inject waste into the loop going to Tank 241-AY-102. Specification limit for waste is ¼-inch maximum particle size.

# Appendix B

## Pretreatment and Retrieval Workshop Attendance Sheet
## July 16 and 17, 1997

# Appendix B

## Pretreatment and Retrieval Workshop Attendance Sheet
## July 16 and 17, 1997

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