CAN THE COMMERCIAL SECTOR FILL THE POTENTIAL TREATMENT GAP FOR DEPARTMENT OF ENERGY'S MIXED LOW-LEVEL WASTE?

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ABSTRACT

New air emissions standards, cost of incinerator operations, integration opportunities, and low projections of future mixed low-level waste (MLLW) volumes requiring incineration prompted a review of the demand for Department of Energy (DOE) incineration and the viability of commercial-sector alternatives.

DOE has three waste treatment incinerators: the Waste Experimental Reduction Facility (WERF) at the Idaho National Engineering and Environmental Laboratory, the Consolidated Incineration Facility (CIF) at the Savannah River Site in South Carolina, and the Toxic Substances Control Act Incinerator (TSCAI) at the Oak Ridge Reservation in Tennessee. Currently only the TSCAI is operating and is scheduled to cease operations end of FY 2003. The WERF ceased incineration operations in November 2000. The CIF temporarily suspended operations in November 2000. A decision for a CIF re-start is scheduled for mid-FY 2002, with a possible re-start about FY 2005-2006.

The commercial sector currently provides treatment for some waste types but has not yet demonstrated capability to broadly treat MLLW wastes requiring incineration or organic destruction. Consequently, an analysis of the complex-wide impact of this planned reduction in DOE treatment capacity was needed. The objectives of the analysisare as follows:

- Document the current demand for incineration and assess the capacity available in the DOE system and in the commercial sector to meet this demand;
- Quantify the amount of waste for which alternatives were not readily identifiable; and
- Identify and recommend path forward to ensure viable treatment.

To facilitate the analysis the Environmental Management Office of Technical Program Integration sponsored a workshop involving DOE staff and contractor representatives from nine field offices and sites. The workshop participants conducted a "bottoms-up" review of their waste treatment plans to determine if an alternative treatment path was possible. The site representatives were assisted in this determination by representatives of the DOE's Transuranic and Mixed Waste Focus Area (TWFA), who provided information on alternative technologies.

The results of the analysis found (1) the estimated lifecycle demand (through 2070) for incineration or an incineration alternative is approximately 46,000 cubic meters; (2) demand for treatment is adequate to justify maintaining operation of the TSCAI at least through 2003; (3) there are potentially near-term capacity shortages, considering DOE and commercial capacity; and (4) while commercial alternatives appear viable for all but a few DOE MLLW streams, approximately 6,100 cubic meters of waste have an unidentified treatment path.

INTRODUCTION

The DOE presently operates one incinerator for treating MLLW: the TSCAI at DOE's Oak Ridge Reservation (ORR) in Tennessee. The CIF at the Savannah River Site (SRS) in South Carolina temporarily suspended operations on November 14, 2000, and the WERF at the Idaho National Engineering and Environmental Laboratory (INEEL) suspended its operations on September 17, 2000. A variety of circumstances, including regulatory changes, internal reviews and recommendations, and budget considerations, have led the DOE's Environmental Management (EM) program to focus attention on its incinerators. The following summarizes the various actions that occurred over the past two years, leading the EM program to critically review its short- and long-term needs for incineration.

The May 1997 "Contractor Integration Report" recommended that the Department "maximize use of existing DOE operating facilities (i.e., incinerators) for MLLW treatment to achieve the best cost efficiencies." Subsequently, EM formed an Incinerator Optimization Working Group to identify options for improving efficiencies. The Working Group issued a draft report recommending continued operation of the CIF, operation of the TSCAI through fiscal year (FY) 2003 (contingent upon the demonstrated success of commercial polychlorinated biphenols [PCB] treatment alternatives), and closure of the WERF at the end of FY 2001. A key assumption of the Working Group was that the CIF would continue its operations until the PUREX solvent waste at the SRS was treated in compliance with the site's Federal Facility Compliance Act Site Treatment Plan (STP).

At the same time that the Working Group was drafting its report, the DOE Office of Inspector General conducted audits of each incinerator. Its reports were released between August and December of 1999. Each report documented high operations costs for the volume of waste incinerated. Consequently, they recommended an accelerated closure schedule for WERF and the TSCAI.

Also, in late 1999, the Environmental Protection Agency (EPA) published final standards for hazardous air pollutants released from waste incinerators and kilns. Known as the Maximum Achievable Control Technologies (MACT) rule, these new standards limit emissions of dioxins and furans, toxic metals, hydrochloric acid, chlorine gas, particulate matter, and other toxic compounds. Being subject to these standards, each DOE incinerator site was required to make a draft notification by June 30, 2000, stating its intent to comply with the MACT standards. In June 2000, the Idaho Operations Office (DOE-ID) submitted its notice that WERF would not comply with the MACT regulations. In contrast, the CIF and the TSCAI submitted intent notices of MACT compliance.[a]

In March 2000, the Savannah River Operations Office (DOE-SR) announced its decision to place the CIF in temporary suspension. This decision was made to redirect funding resources from the CIF operations to higher-priority nuclear materials management projects. While the CIF is in temporary suspension, the DOE-SR will evaluate alternative treatment options for its PUREX waste solvents. If none is found, actions may be taken to resume CIF operations. The STP commitment to treat half the legacy PUREX waste solvents by FY 2009 would require restart of the CIF in FY 2006. A restart decision is expected by mid-FY 2002.

In June 2000, DOE-ID submitted to the Idaho Department of Environmental Quality its intent not to comply with the MACT regulations. This decision considered demand for WERF incineration from both on-site and off-site generators, the cost of operations and MACT compliance upgrades, and the availability of alternative treatment technologies, including macroencapsulation and commercial thermal and non-thermal options. After receiving the notice of intent not to comply with MACT, the Idaho Department of Environmental Quality issued a public notice of its intent to deny a permit for the WERF. With the WERF incinerator in cold standby since September 17, 2000, DOE ceased WERF incineration operations on November 20, 2000.

The 1999 draft Working Group report concluded that the complex could adequately treat its MLLW with fewer than three incinerators. However, the Working Group did not anticipate the budget-driven decision for suspension of operations at CIF: nor did it anticipate the State of Idaho's response to the DOE-ID notice of intent not to comply with the MACT rule. The Working Group effort also did not focus on alternatives to DOE incinerators, but rather on how DOE could use its incinerators more efficiently. Consequently, DOE's Office of Integration and Disposition (EM-20) initiated a complex-wide effort to identify and evaluate incinerator and organic destruction capacity requirements and examine possible alternatives to address this capacity.

This paper summarizes the process undertaken to evaluate DOE's volumetric mixed waste treatment demand and capacity for incineration and presents results and recommendations.

Problem Definition and Data Analysis

The purpose of the analysis was to answer two questions: First, should DOE continue with the current planning baseline of closing the TSCAI in FY 2003? Secondly, does the commercial-sector offer viable alternatives for waste streams currently targeted for DOE incineration?

The analysis involved three phases: (1) data compilation of waste targeted for incineration, thermal treatment, oxidation, or organic destruction; (2) technology matching to identify potential alternatives for waste targeted for incineration or incineration-type treatment; and (3) data analysis to determine path-forward recommendations.

The preliminary data set was extracted from the stream disposition data in the FY 2000 Integrated Planning, Accountability, and Budgeting System (IPABS) database and was combined with additional stream data supplied by the site representatives and workshop participants. A total of 63,000 cubic meters of MLLW were identified for analysis. Information extracted from the database included MLLW that generators anticipated sending to incineration, thermal treatment, oxidation, or organic destruction; and waste for which generators had not yet defined a specific treatment method.[b] Obviously, nonincinerable waste such as ground or surface water, and spent nuclear fuel were not extracted from the database for evaluation. The Working Group, including representatives from the DOE sites and the Navy,[c] qualitatively reviewed their waste stream data to determine how much waste fit into the following three categories:

Requires incineration—Waste that requires incineration due to containing an F005 EPA hazardous waste code, specific U, P, and K EPA hazardous waste codes or lab packs under 40 Code of Federal Regulations (CFR) 268.42(c). For this category, incineration is strictly defined as a controlled open flame combustion of waste in a facility that operates very similar to the TSCAI.

Requires organic destruction—Waste that requires organic destruction due to the presence of PCB liquids or articles, or waste containing hazardous organic constituents above Resource Conservation and Recovery Act (RCRA) limits. For this category, organic destruction is defined as either an incinerator or an EPA-approved alternative thermal or non-thermal process as provided by several commercial vendors. Options include the Allied Technology Group (ATG) direct current (DC) arc melter or an aqueous-based oxidation system such as direct chemical oxidation. Even though not considered organic destruction, macroencapsulation of organic-based MLLW that is defined as debris would be recognized as an acceptable alternative at most disposal sites

Would benefit from incineration or organic destruction—Waste where incineration or an incineration alternative would provide a benefit to the waste owner or the disposal facility. Examples include waste subject to Washington's Organic Carbonaceous rule,[d] previously negotiated treatments, volume reduction, or the need to sanitize for waste security or classification issues. In this category, destruction or

encapsulation of the organic component is not required to meet RCRA's Land Disposal Restrictions or Department of Transportation requirements.

If the waste stream could not be placed into one of the above categories, it was placed either in the "incineration or organic destruction **not required**," or in the "to be determined (**TBD)**"[e] category. In some instances, the sites did not have enough information to determine the placement of waste into applicable categories; therefore, the waste was not included in the incineration, organic destruction, or ancillary benefit categories, but instead placed into the TBD category. Results of categorizing the 63,000 cubic meters are provided in Figure 1.

The need to potentially treat waste through incineration or an acceptable alternative is based on knowledge of the processes that generated the waste and on assumptions regarding new technologies, environmental restoration (ER) cleanup activities, and deactivation and decommissioning (D&D) activities. These assumptions contain the potential for estimation error in either direction. In addition, it is important to note that the life cycle for existing incinerators is much less than the seventy-year waste generation forecast.

In addition to the TSCAI, treatment options consist of large-scale, fixed commercial facilities potentially available within the next 18 months. Treatment options requiring significant development were not considered. However, for unique applications, specific and potential DOE waste processing options were considered, such as INEEL's future macroencapsulation or stabilization methods.

The analysis process resulted in each waste stream having a preferred and a secondary treatment option based on the known capabilities of the DOE and commercial treatment providers. Table 1 provides the preferred technology option and the waste quantities for each of the MLLW treatment categories.

Table I. Preferred technology alternatives and their identified volume (cubic meters).

Technology	Incineration	Organic destruction	Ancillary benefit	Not required	To be determined	Total
Chemical/physical treatment				27		27
DC arc	1,169	10,043	5,796			17,008
Direct chemical oxidation With and without waste water treatment	3	12,351	280			12,633
Disposal				2,013		2,013
Industrial boiler	23	99	2			124
Macroencapsulation and disposal				4,143		4,143
Molten metal		7	354			361
Molten salt oxidation		29				29
Stabilization and disposal				274		274
Thermal desorption		4,117	20			4,137
To be determined		506	1,436	4,748	6,136	12,827
TSCAI operations	2,350	6,495	297			9,142
WERF*	100	3				103
Waste water treatment				1		1
Total	3,645	33,650	8,185	11,206	6,136	62,822

* At the time of the initial analysis, WERF was still a viable option.

As shown in the "Not required" column of Table I, the analysis identified approximately 11,000 cubic meters of waste that will be treated by non-organic destruction technologies or activities. For example, low-level radioactive waste that is only contaminated with PCBs may be directly disposed of with out treatment because of EPA's rule regarding the disposal of PCBs (referred to as the "Mega" rule). The Mega rule is a TSCA regulation that allows for direct disposal of PCB contaminated waste, as long as it is remediation waste, in any concentration at a RCRA Subtitle C disposal site. Consequently, approximately 2000 cubic meters can be eliminated from consideration for further treatment. However, treatment is undefined for 4,748cubic meters of waste. The impact of this waste volume on commercial treatment capacities is unknown.

Results

The analysis responded to the question "Should DOE continue with the current planning baseline of closing the incinerator at Oak Ridge in FY 2003?" It yielded the following results: Treatment capability at the TSCAI is required to treat PCB solids and MLLW containing hazardous organics. The availability of PCB treatment is critical to meeting closure site milestones. Additionally, uncertainty in the volume estimates and characteristics of the waste requiring near-term incineration type treatment may cause a capability shortfall. While commercial PCB treatment technology (e.g. DC arc melter process in Richland, Washington) is anticipated, there currently are no demonstrated alternatives.

The analysis also responded to the question "Are there viable commercial sector alternatives for waste streams currently targeted for DOE incinerators?" It yielded the following results: Of the 63,000 cubic meters of MLLW analyzed, an estimated 57,000 cubic meters could eventually be treated by the commercial sector. The remaining 6,100 cubic meters are being actively worked by site specific action teams and the TMFA. Examples of the remaining waste streams include waste PUREX solvents at SRS,

poorly defined Los Alamos National Laboratory waste streams, high organic sludges, various Rocky Flats streams, and cleanup residues from Energy Technology Engineering Center. Following is a detailed discussion of how these results were derived.

Commercial Alternatives

Determining the capacity for the commercial alternatives required identification of their basic throughput rates (e.g., cubic meters/day, and pounds/hour). These throughput rates were converted into annual capacities using a set of standard assumptions as listed below:

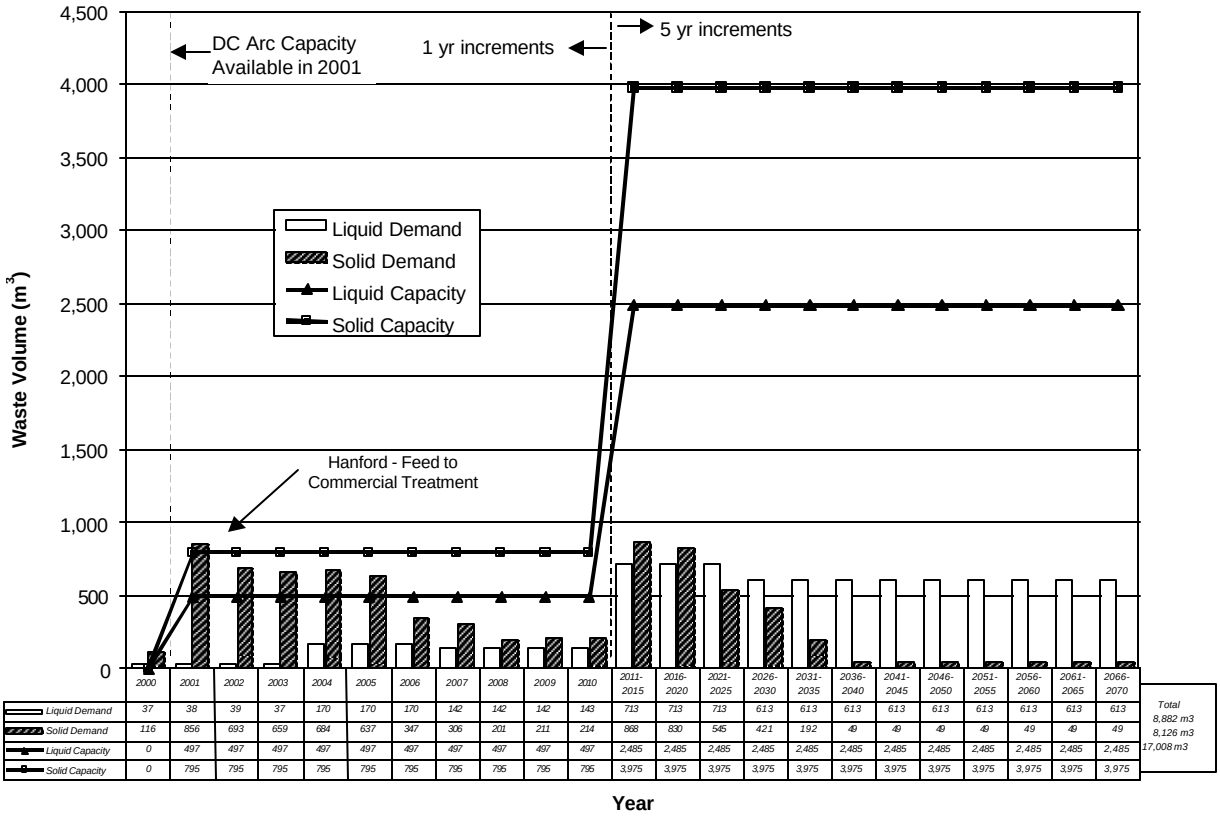
- A solid waste specific gravity of 1.5 yields a density of 93.6 pounds per cubic foot.
- A liquid waste specific gravity of 1.2 yields a density of 74.88 pounds per cubic foot.
- The facility is operational 60 percent of the year. (This is based on current DOE experiences, involving scheduled downtime, campaign preparation, permit restrictions, and equipment failures.)

Based upon available data, commercial treatment capacity information is summarized in Table II.

Table II. Alternative incineration technologies

Technology	Vendor	Availability	Waste Form	Estimated Capacity (cu.meters/yr^r)
DC-ARC	ATG	2001	Solids	795
			Liquids	497
Direct Chemical Oxidation (DCO) with/without Waste Water Treatment	ATG	2004	Liquids	Unknown
	M&EC	2001	Liquids	497
	Perma-Fix	2001	Liquids	248
Industrial Boiler	DSSI	2000	Liquids	Unknown
Mercury Retort	NSSI	2000	Solids	1,026
Microwave Melter	NSSI	2000	Solids	46
Molten Salt Oxidation (MSO)	ATG	2004	Solids or Liquids	Unknown
Oxidation/Neutralization	NSSI	2000	Liquids	622
Thermal Desorption	M&EC	2001	Solids	986
	Perma-Fix	2000	Solids	131

Out of the six technologies considered, capacity estimates could be made for only three; DC arc, direct chemical oxidation, and thermal desorption. For those three technologies, the capacity exceeds the estimated demand by 13,000 cubic meters through FY 2006. This excess could be used to address the 5,300 cubic meters treatment capacity shortfall shown in Figure 5. Beyond FY 2006, no reliable estimates of the commercial sector's ability to treat the identified commercial demand are available, since capacity data for many of the vendors are unknown.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2015	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	2051-2055	2056-2060	2061-2065	2066-2070	Total
Liquid Demand	37	38	39	37	170	170	170	142	142	142	143	713	713	713	613	613	613	613	613	613	613	613	613	8,882 m3
Solid Demand	116	856	693	659	684	637	347	306	201	211	214	868	830	545	421	192	49	49	49	49	49	49	49	8,126 m3
Liquid Capacity	0	497	497	497	497	497	497	497	497	497	497	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	17,008 m3
Solid Capacity	0	795	795	795	795	795	795	795	795	795	795	3,975	3,975	3,975	3,975	3,975	3,975	3,975	3,975	3,975	3,975	3,975	3,975	

Fig. 1. Estimated MLLW demand for treatment via DC Arc technology versus its estimated capacity for FY 2000-2070. Total of 17,000 cubic meters.

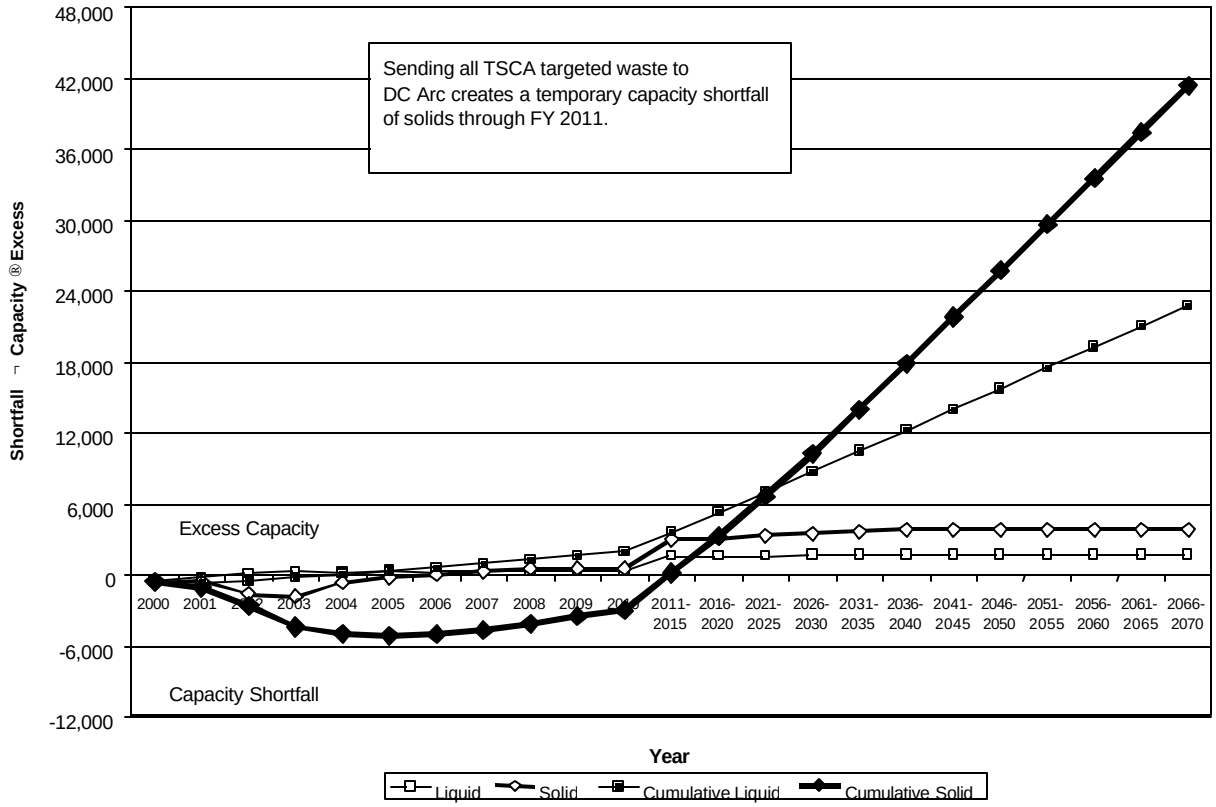


Fig. 2. Annual and cumulative demand versus capacity of the DC arc system, assuming closure of the TSCAI

Figure 1 illustrates the DC arc estimated capacity and its identified annual demand from DOE for both solid and liquid waste. Because the DC arc system is not expected to be available until FY 2001, there is a small shortage of capacity in that year, as indicated by Figure 6. In the first year of operation, there is a potential capacity shortfall. In the years FY 2002 – 2005 the DC arc system has approximately 100 cubic meters of excess capacity, assuming the waste currently targeted for treatment at the TSCAI is not available for the DC arc system. Beyond FY 2005 the excess solids capacity ranges from hundreds of cubic meters to thousands in the out years, based on current projections. These estimates do not take into consideration the demand for this treatment by non-DOE sources.

Figure 2 illustrates the potential impact to DC arc operations if the TSCAI was no longer available. The chart illustrates annual and cumulative demand for solid and liquid MLLW treatment. As shown by the line illustrating cumulative solids, there would be a capacity shortage until FY 2011, after the capacity rapidly exceeds the demand.

There are approximately 8,100 cubic meters of MLLW whose treatment path is not defined. Of these 8,100 cubic meters, 1,900 cubic meters may require organic destruction or involve organic destruction for an ancillary benefit, but due to lack of information, participants in the workshop could not identify a specific treatment. This includes approximately 1400 cubic meters of PUREX solvents from the Savannah River Site and approximately 400 cubic meters of high organic sludges from Lawrence Livermore.

Conclusions and Recommendations

Near-term analysis shows DOE and commercial treatment capacity to treat MLLW and PCB waste in the next few years is very limited, even with the TSCAI remaining in operation through the current baseline shutdown year of FY 2003. The commercial sector, which is expected to gain operational experience in the next few years, now offers little incineration or organic destruction capacity for DOE mixed waste. In addition, changes to treatment schedules may disrupt current planning and force the treatment of additional waste volumes after the FY 2003 shutdown date for the TSCAI. Furthermore, the capacity analysis performed and discussed in Section 3 suggests commercial organic destruction capacity coupled with the TSCAI may still be inadequate in the years FY 2001 through FY 2006
.
Based upon the results of this study, DOE evaluated two options for a path forward. The first option is to execute the baseline as planned, identifying closure of the TSCAI at the end of FY 2003. This plan would be reflected in the FY 2003 budget. This plan has the least impact on the Oak Ridge planning baseline; it follows the plan already shared with Tennessee stakeholders; and it may foster accelerated development of treatment capacity in the commercial sector. However, this decision may lead to a forecast shortfall for treatment capacity; it could negatively impact schedules at closure sites currently planning to use the incinerator; and it would result in DOE's complete dependence on commercial sector for treatment of DOE PCB-contaminated waste.

An alternative option is to defer the TSCAI closure decision until the March 2002 preparation of the FY 2004 budget. The FY 2003 budget would reflect continued operations of the incinerator. The TSCAI would remain in operation until the commercial sector alternatives are fully on line and demonstrate capability. This option ensures closure sites have an outlet for waste treatment by providing schedule float. It also provides backup to commercial sector capabilities. However, this decision would require planning changes at Oak Ridge, and ORR stakeholders, who had been expecting a FY 2003 closure, may view this action negatively.

Bearing in mind the above issues, delaying any decision to shutdown the TSCAI is prudent until adequate capacity exists for the legacy and forecasted MLLW and PCB waste. The commercial sector may provide the required capacity in the future; however, at this point, it has not demonstrated operational reliability.

The recommended option is to defer the TSCAI closure decision until preparation of the FY 2004 budget. This option provides assurance the closure sites will have treatment alternatives for the waste quantities now known to need treatment. This recommendation also provides backup in case generators identify new waste streams during the closure process.

ENDNOTES

a. Notices of intent to comply with MACT were submitted to the state of Tennessee Department of Environment and Conservation for the TSCAI and to the South Carolina Department of Health and Environment for CIF.

b. The FY 2000 IPABS User Guidance suggested that the user designate waste stream treatment or disposition as "to be determined" (TBD) if the treatment or disposition was uncertain. Treatment or disposition capacity may exist, but if the site was uncertain of its plans, then the waste stream was designated TBD. By including these waste streams in the data set, the analysis could assist the sites in choosing a treatment path for these wastes.

c. The Navy waste referred to in this report was generated by the Naval Nuclear Propulsion Program, which is an integrated program carried out by two organizational units. One is the Department of Energy; the other is the Department of the Navy, as described in 42 USC 7158, which provides that under the Atomic Energy Act, radioactivity is regulated by the DOE, including such radioactivity present in mixed waste.

d. Even though RCRA allows the macroencapsulation of debris waste containing limited amounts of organics, the Hanford disposal site does not accept carbon material, thus requiring an organic destruction step. This also applies to non-hazardous organics.

e. This TBD should not be confused with the TBD nomenclature used in the IPABS data call; the TBD here means that the waste stream could not be categorized using the process described above.

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