TECO
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Glass Plant Engineers & Contractors

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Subject: Comment on FDF Proposed Plan/Feasibility Study for Remedial Actions at Silos 1 and 2

We appreciate the opportunity to comment on the Proposed Plan and Feasibility Study for Remedial Actions at Silos 1 and 2. Although we have concerns about the choice of technology, we have been impressed with the effort to inform your stakeholders and to elicit comment.

We feel that the data and the analysis do not support the decision for Chemical Stabilization as the preferred treatment. Both the strengths of vitrification and the problems with chemical stabilization seem to have been understated. These concerns primarily focus on the following issues:

- The placing of reliance on the disposal container and the disposal site for protection of human health and the environment from the chemically stabilized waste, rather than the properties of the wasteform itself.
- The understating of difficulties experienced with the chemical stabilization technologies under the controlled conditions of the POPT demonstration, yet giving a favorable assessment of chemical stabilization based on extrapolated, undemonstrated, "results".
- The lack of optimization of the container scenario for the VIT 1 technology which reduces the benefit of its inherent volume reduction.
- The favoring of chemical stabilization in the areas of process flexibility and schedule attainment while disregarding the commercial experience in glass furnace design, construction and operation of the VIT1 vendor.
- The favoring of chemical stabilization technologies based on experience on dissimilar waste materials, while disregarding the extensive commercial

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experience in glass furnace design, construction, and operation on non-waste, but more similar, materials by the VIT1 vendor.

1. **Overall Protection of Human Health and the Environment**:

The Feasibility Study places heavy reliance on the packaging of the chemically stabilized wasteform and management of the storage site, especially when the stored waste is considered to require controlled storage for 1000 years. For cases of surface disposal (versus HLW repository disposal where protection is ensured by depth of disposal), long-term management and/or control cannot be guaranteed. The actual waste performance under such conditions should be a significant discriminator between the two technologies. The vitrified product possesses greater long-term durability and radon mitigation (10^6 times better) compared to the cement-stabilized product itself. The potential to provide longer protection to health and the environment seems to have been ignored.

2. **Reduction of Toxicity, Mobility, or Volume through Treatment**:

a) The large volume reduction offered by the VIT1 process should have been given more weight. The packaged disposal volume from VIT1 represented only 24-26% of the volume predicted for the Chemical Stabilization technologies.

In spite of the greatest volume reduction, VIT1 ended up with more shipments than the fritted waste form of VIT2. Had FDF worked with us in optimizing our disposal/shipment package, we likewise would have had the fewest packages shipped. Instead, we continued under the expressed desire by FDF to minimize the wasteform volume. VIT1 should be reconsidered assuming use of the simpler, less expensive fritting.

The VIT 1 technology excelled in this area based on the perceived desire by FDF to minimize the wasteform produced. Based on the success in reducing the volume of treated waste, and the demonstrated performance of the wastes, the vitrification technologies should be 'Strongly Favored'.

b) The amount of secondary waste generated by vitrification technologies is very similar to that from the chemical stabilization. These differences are insignificant in terms of the total waste generated, and do not justify a 'Favorable' rating for the stabilization technologies.

3) Short-term Effectiveness- Worker Risk:

The down rating of VIT1 due to potential risk of electrical shock and from working at heights ignores Toledo Engineering's experience in providing systems to the glass industry with exemplary safety records. Our glassmaking systems are risk-engineered to force personnel safety. While we applaud making your work force a part of your decision-making process, it is important that something not be considered "risky" just because it is not typical of the DOE processes. Certainly the excellent safety record at Fernald while working with the pervasive danger of radioactivity exposure is a testament that potential risk can be controlled and does not necessarily translate into injuries.

4) Short-term Effectiveness – Time to Achieve Protectiveness:

The time to completion assigned by FDF for VIT1 is 3 times that proposed by Envitco and is far too conservative. The length of time to operation start is governed by assets applied and project management; not strictly by complexity of the task or system, and should be the same as for the cement-based system. Toledo Engineering is a commercial design and build firm serving the commercial glass industry and is used to increasingly fast-track projects.

Treatment time could reduced by increasing the melter size and such an increase would have minimal effect on the total project cost. However, this approach was proposed to FDF, who refused any efforts to provide added capacity to shorten the treatment time. In the end, the perceived 'lack' of capacity and ability to accelerate schedule was considered a deficiency for VIT1.

5) Long-term Effectiveness:

The Feasibility Study places heavy dependence on the packaging of the chemically stabilized wasteform and management/maintenance of the storage to accomplish the long-term effectiveness. This should not be a acceptable basis for control, considering the long-term risks associated with the wasteform (long half-life radionuclides, long-term dose, continued radon emanation). Control of the storage site was stated by FDF as required for 1000 years. This seems quite unlikely to be possible.

The vitrified wasteform possesses much greater long-term durability and radon mitigation 10^5 to 10^6 times better than the actual cement-stabilized product.

6) Implementability:

Judgement of the VIT1 implementability should be based on the in-depth commercial experience of Toledo Engineering in addition to hazardous and radioactive glass experience. Use of high-level radio active waste vitrification examples should not be compared as analogous to low-level grout examples. Worldwide, hundreds of production glass furnaces run 24 hours/day, 7 days/week for 5 to 15 years without a shutdown. Evaluation of VIT implementability based on high-level waste demonstrations, versus evaluation of grout implementability for low level and hazardous waste demonstrations is unfair, and biases the evaluation to down-rate vitrification. The inappropriateness of the argument as presented is best exemplified at the Hanford DOE site, where grout stabilization was canceled and replaced with vitrification, due to confidence in the process and wasteform.

Operability and controllability of the melter were questioned since some of the important properties of the glasses were not measured directly during operation. The model for glass composition and melter performance developed during initial operation and refined during operation allows accurate prediction of all properties and operating variables. This has been demonstrated very effectively at Savannah River and at the West Valley Demonstration Project.

7) Process Robustness/Reliability:

Cement stabilization was shown to have a narrow window for acceptability without significant sacrifice in waste loading, as demonstrated by the failure of 11 of 12 formulations tested. These failures were both in leaching and compression strength. These factors are critical to process implementation, and these failures have been understated in evaluation of the process robustness, implementability, rework quantities, long-term protection, process control, and numerous other areas throughout the Feasibility Study.

Product Rework was taken to be 1% of the product produced for all four technologies. This is not a valid assumption based on the actual 1/12 acceptable formulations of the Cement-Stabilization POPT demonstration. This low level of rework was not demonstrated, and it is doubtful that it can be achieved.

The results of the Chemical Stabilization –Cement tests (page G 3-16, Line 20-25) show an increase in the cement content from 8.42 wt% to 12.11 wt.% increased the TCLP leaching from 0.0144 ppm to 301 ppm lead. Based on this, the Stabilization-Cement process should not be deemed capable, considering expected variation in the waste, the water content, the analytical methods, and in the weighing of material additions.

The robustness of the VIT1 process, even at 90% waste loading, was demonstrated by the number and breadth of glass formulations that were developed and still met the TCLP requirements. Significant variations in waste, or in process variation, could be accepted by the VIT process without significantly affecting product performance.

8) Process Control:

Process control for vitrification is based on qualification of the waste prior to melting, and verification of performance. These activities are in-process hold points, or near-process feedback points. Off-spec product is unlikely, and can be corrected quickly. None was produced during the extended POPT demonstration of VIT1.

With the grout, determination of defective product cannot be made for a minimum of a week due to curing. Detection of process deviation or performance problems cannot be detected until the wasteform is fully cured, during which time numerous batches have been processed. This raises the question of whether the chemical stabilization process can operate within the very small-required working region, both in terms of chemical durability and processability.

Several other problems were identified with the Chemical Stabilization processes in Section G.3. This was particularly prevalent with the cement-based stabilization, including flow characteristics, curing/hardening time and unbound water in the product. All of these indicate poor process control, giving unacceptable product. Based on the POPT data presented, the stabilization-cement technology did not demonstrate process capability and should be significantly down-rated.

Further difficulties were experienced with the chemical stabilization technologies (particularly cement) with meeting the TCLP leaching requirements. The FS suggested that the mix could be 'tuned' to match the TCLP No. 2 leachant, i.e. so the pH of the TCLP tests will approach the minimum solubility of lead. This approach is a severe circumvention of the intent of the TCLP testing process. These conditions are not likely in the NTS disposal cell and the waste may be exposed to lower or higher pH conditions that result in rapid degradation and/or leaching of the wasteform. Such "tuning" does not serve the long-term protection of the environment.

9) Transportation-Shielding Optimization:

The VIT1 evaluation should be reassessed to include an optimized container and associated changes such as fritting as favored by the optimization. The VIT 1 design approach submitted by Envitco relied on a qualified container design by SEG as described in the POPT report. This container design was utilized at the suggestion of FDF, and Envitco understood that all technology providers would utilize this container.

However, as reported in the Feasibility Study, the shipping and disposal containers for the other three technologies were specified following a container optimization exercise by FDF. The container design for VIT1 was not optimized, and provided approximately 155% the shielding that is required. The difference is significant in terms of waste per container, number of containers required, and ultimately a significantly increased number of shipments. This approach unfairly skews the transport costs, since the volume transported is 270% of the actual glass volume (i.e. packaging ~170% of vitrified waste volume, 153% of the vitrified waste mass).

The SEG container used by VIT1 was a qualified container meeting drop test requirements while the containers selected after optimization for the remaining three technologies were unqualified. If unqualified packaging is acceptable at this phase of the study, then FDF should re-assess the packaging for the VIT 1 wasteform. This would include optimization of the wall thickness to meet the 70 mrem/hr requirement, and re-assessing the transport volume, costs and risks. It is not equitable to assess one technology based on an unoptimized, yet qualified container, while the other technologies utilize unqualified, though dimensionally optimized containers.

10) Cost:

The cost data appearing in the FS for VIT1 was significantly different than that presented in the Public Workshop in November 1999. VIT 1 costs increased by over 25%, primarily due to cost of money and O&M costs. This magnitude of change did not appear in the cost assessments for the other technologies. It was not obvious to us why this would differ for the different technologies.

VIT1 should be evaluated on the basis of at least 85-90% on-line time. The vitrification technologies were penalized for 24 hr/day, 7 day/week schedules, although this is not critical to the operation of either technology. This has, however, been identified as an increased risk, increased cost, inability to recover schedule, inability to accelerate schedule, and various other negatives in the assessment. The vitrification technologies focused on 70% utilization, a utilization rate that is significantly lower than commercial glassmaking processes. It would be more accurate to consider the higher demonstrated utilization of the vitrification processes based on commercial history.

VIT1 should be evaluated on the basis of supplying an initial 30 ton/day melter. The size of the Joule-heated melter presented in the conceptual design was based on requirements set in the contract by FDF, which called for a three-year treatment schedule, and a 70% maximum utilization. An advantage was awarded to Chemical Stabilization due to their ability to add capacity. This award does not seem justifiable. The VIT1 evaluation should be adjusted to include construction of a larger melter. There is no constraint on the size of the melter—the VIT 1 team has built commercial Joule-heated melters as large as 250 TPD. Construction of a 30 TPD melter to allow accelerated cleanup or allows for "catch up" can be done without a proportional increase in cost. There is no justification in requiring a second melter when assessing the need for additional capacity. A second melter is not required for additional capacity. A single 30 TPD melter could be designed and constructed at the start of operations and provide the same flexibility, reduced operating manpower, and accelerated treatment flexibility as has been deemed an advantage for the Chemical Stabilization technologies.

We appreciate your consideration of our concerns.

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