AN OVERVIEW OF THE WEST VALLEY DEMONSTRATION PROJECT

W. H. Hannum, M. B. Boswell, J. P. Duckworth, T. K. DeBoer
West Valley Nuclear Services Co., Inc.
West Valley, NY 14171-0191

ABSTRACT

This session is titled "DOE Special Waste Management Projects." West Valley and TMI are indeed special projects, in that they represent today's problems. They may well have been the two most visible symbols as to how nuclear wastes can poison the entire civilian nuclear power program. Each in its own way has been perceived as a major threat to the environment and to public health and safety; in both cases this threat has been perceived to be grossly more severe than it has been in fact. It is the Department of Energy's intent that both of these problems be made to disappear. This paper serves to introduce a series of papers describing the status of the West Valley Project. In the West Valley case substantial progress is being made and we believe we are well on the way toward transforming what has been a skeleton along the road to progress into positive and unmistakable evidence that high-level nuclear wastes such as those resulting from reprocessing can be managed, understood, and prepared for disposal by a straightforward adaptation and application of existing technologies. Further, we now have evidence that the costs of doing this are not exorbitant. Subsequent papers will describe waste characterization; the plans and designs for solidification; and the ancillary and supporting programs for handling effluents and wastes, for D and D to utilize existing facilities, and environmental support. In this paper we will describe the history of this plant and the wastes being used in the demonstration; the legislation and intent of the Project; the accomplishments to date; and the projected schedule and costs.

BACKGROUND AND HISTORICAL OVERVIEW

The Western New York Nuclear Service Center is located near the village of West Valley, about thirty miles south of Buffalo. The region is one of rolling hills with frequent deposits of glacial till, covered by mixed hardwoods. This is country characterized by farming, hunting, ridge slope skiing, and persistent underemployment.

The West Valley history began in 1962 when Governor Rockefeller, as part of the redevelopment of Western New York, opened the Western New York Nuclear Service Center to construction of a reprocessing plant. This plant, costing some $30 million, was completed in 1966. During the next six years, it processed some 640 metric tons of spent nuclear fuel. In 1972, the business outlook was bright and the plant was shut down for modifications and enlargement to three times its previous capacity. You may recall that the early '70s were also a period of rethinking of approaches to protection of our environment, rethinking of our nuclear regulatory process, and of rethinking of the implications of uncontrolled commerce in plutonium. As each of these three factors developed and were translated into design implications for the operators of the West Valley reprocessing plant, the costs of the upgrades which would have to be accomplished simultaneously with the enlargement grew astronomically. By 1976, the cost benefit reached the point at which Nuclear Fuel Services decided, on business grounds, to withdraw from the reprocessing business and to turn over the facility to New York State. Between 1976 and 1980, a variety of discussions (mostly at a political level) were held as to how to "take advantage of this opportunity." The final result was the West Valley Demonstration Project Act of 1980 and the takeover of operational responsibility for the plant by the Department of Energy and its prime contractor, West Valley Nuclear Services Company, Inc. (WVNS) in February 1982.

The facilities, in addition to a small office complex, warehouses, etc., consist of the old reprocessing plant, a spent fuel receiving area which incidently contained some 750 spent fuel assemblies (approximately 160 MTU) that we have been temporarily monitoring for the State of New York, high-level waste tanks (containing some 2M liters of high-level wastes, most of which have been neutralized), and various supporting facilities including a low-level liquid waste treatment system and areas for the disposal of solid low-level wastes and for disposal of nonradioactive trash. The inactive former commercial low-level waste disposal area is adjacent to these facilities, but remains under the control and responsibility of the State.

Beginning in February 1982, initial West Valley Demonstration Project efforts focused on site cleanup, planning, environmental characterization, and conceptual design. That phase was largely completed during 1982. More recent efforts have focused on waste characterization and on engineering design of equipment and systems for the actual cleanup and for waste solidification activities. Today we are in the phase of fabrication of equipment and systems, construction of a Component Test Stand and major cleanup of highly contaminated cells. The key milestones and schedules we anticipate are summarized on Fig. 1. You will note that we anticipate beginning of actual solidification

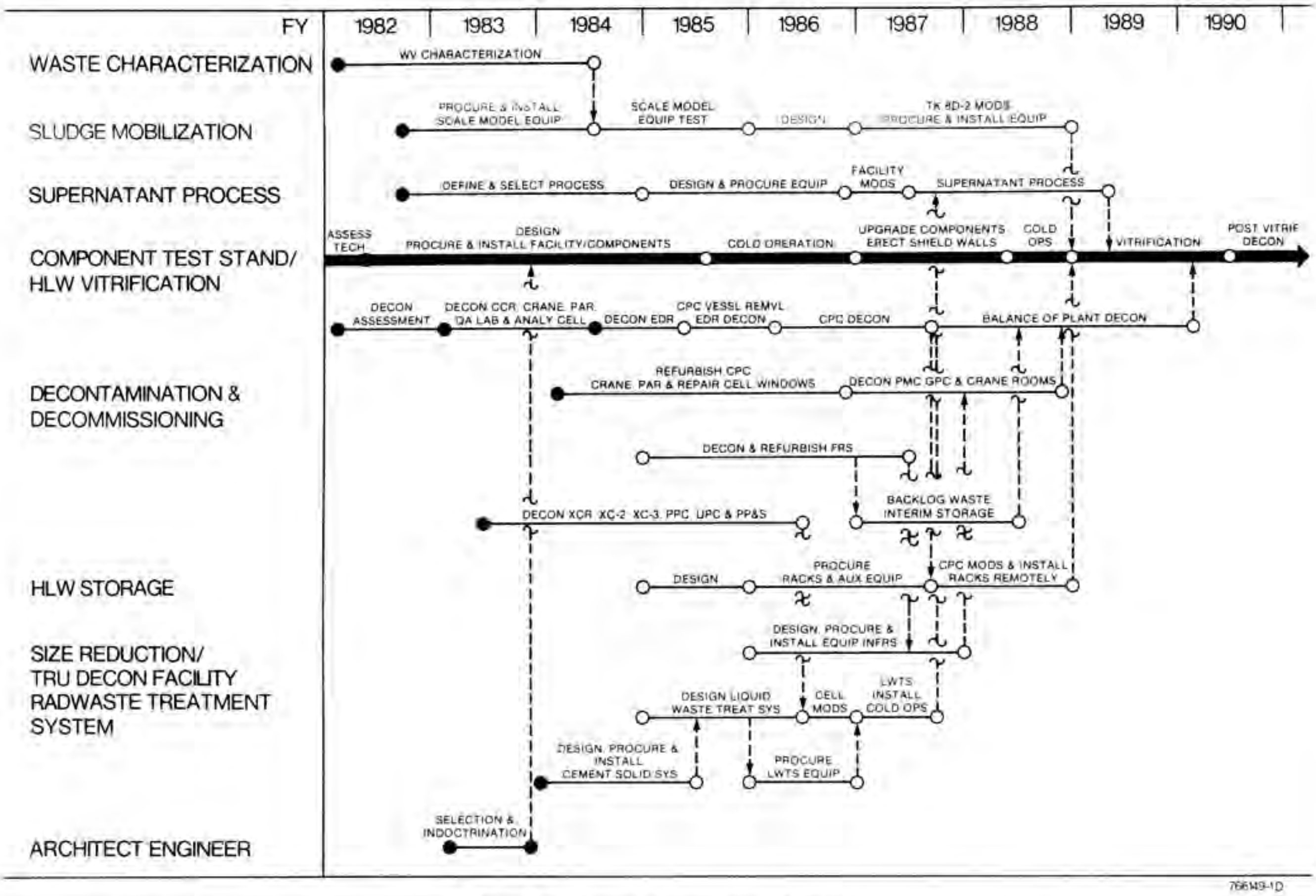

Fig. 1. Key Schedule activities.

of high-level wastes in late 1988, concluding early in 1990. The recently approved total project cost estimate through completion of solidification is $382 million 1984 dollars or $470 million with allowance for escalation. This compares with our working estimates of a year ago, based on solidification during 1990 through 1993 at a total cost of approximately $500 million 1983 dollars. For orientation, at the time of project authorization in 1980, it was projected that costs would likely be in the $300 million to $500 million 1980 dollar level. At this stage, we are still showing a less than originally projected cost to complete.

Let me walk quickly through the status of the Project. We are well along in characterizing the high-level wastes. As noted, these wastes were neutralized and this has led to a heavy precipitation, leaving a sodium salt liquid (supernatant) on top of a heavy sludge layer. For practical purposes, the only major radionuclide in the supernatant is cesium. The sludge contains little cesium, but essentially all of the other fission product and residual transuranic nuclides. In this particular instance, there are two reasonably distinct layers in the sludge: a bottom layer, some 15 cm thick with extremely high shear strength; and an upper 15 to 30 cm layer which is more loosely compacted.

We have taken many samples of the supernatant and its chemistry is now well characterized. I might note that its chemistry is unique. The next paper will discuss this in more detail. To illustrate the differences, we have found that the potassium and cesium, for example, are ten times that in the supernatant typically found in the Savannah River Plant wastes. The implications of the uniqueness of the detailed chemistry are that the precise separation and solidification processes must be adapted to our particular wastes.

The first sludge samples have been taken and are now in the laboratory for physical and chemical examination. Physical tests--in place--of depth, profiles, and shear strength have already been performed.

In addition to the chemistry, one of the particular challenges is that of mobilizing (i.e., extracting) the sludge from the storage tank. The engineering design of this tank is such that there is a large amount of internal structure at the bottom and extremely limited access through the top. A 1/6 scale mock-up of the tank has been constructed for testing and qualifying various pumps, lances, and other sluicing techniques.

To solidify the high-level wastes, the procedure will be to first extract (decant) the supernatant and to strip the cesium and minor constituent radionuclides (strontium, plutonium, technicium) as necessary, for inclusion in the final waste form. The precise method of stripping the cesium from the supernatant is currently under review but is expected to be done with a Zeolite ion exchange column. This would then be eluted and the cesium with its nitric acid eluent used as one of the feeds to the solidification system. The residual salt solution will be incorporated in cement in a high shear mixer and disposed of as low-level waste. The sludge will be washed to remove residual sodium and prepared for feeding to the solidification system.

I have not mentioned it specifically, but in fact we have a second inventory of high-level wastes. This is a relatively small quantity (some 50,000 liters) of acidic waste resulting from the reprocessing of the Indian Point Unit 1 core which had a thorium-based fuel.

We next come to the solidification system itself. Three feed streams: cesium, washed sludge, and acidic Thorex wastes, have been identified. These feed streams are mixed with appropriate glass formers and fed to a joule heated ceramic lined melter to make borosilicate glass. The glass is then poured directly into stainless canisters which are welded closed, decontaminated, and in our case stored until a federal repository is ready to receive them. The third paper in this session will describe in more detail the particular approach that has been adopted by the Project.

Let me turn next to decontamination and decommissioning activities. This is also the subject of a later paper. One of the key aspects of the Project is that, to the extent reasonable, we will utilize existing West Valley facilities. While superfically the rationale for this is economic (reuse should be cheaper than replacement), I am sure that many of you realize that the facts may be otherwise. Replacement is frequently cheaper than reuse of contaminated facilities. However, since the facilities must ultimately be decontaminated and decommissioned anyway, reuse is reasonable and may actually be economical in this case. Certainly the normal plant services, including off-gas systems and utilities, can be reused. Space within the existing facility will be used for supernatant treatment, storage of the borosilicate glass logs and of TRU waste awaiting repository availability, low-level waste processing, and perhaps other activities. A variety of service areas have been decontaminated and put back into service, including a manipulator repair shop, radiological laboratories, a crane room, and other areas. We have begun decontaminating the first major cell. During the next calendar year, with the decommissioning and decontamination of two major highly contaminated cells, we expect to learn a great deal and to be in a position to plan the remainder of the D and D.

Somewhat more complex is the management of large transuranic contaminated vessels which are being removed from the plant. For practical purposes, these must be decontaminated and cut to reduced *size and* disposal requirements. We have identified the use of the spent fuel pool as the best location for this decon and size reduction. With vessels coming out soon, we would like to have access to this size reduction capability immediately, but we have had 750 elements that NFS brought in for reprocessing and which we are currently monitoring for the State of New York. During the past months, we have worked with New York State and the utilities who own the fuel stored here to make arrangements for the prompt removal of this fuel. The utilities have now begun removal of their fuel and a significant number of elements have now been shipped back to their utility owners. We have established a date of September 1985 for removal of all fuel; by that time an exponentially increasing volume of storage for vessels awaiting size reduction will be occurring. Continued storage of spent nuclear fuel and other material in the FRS after September 30, 1985, would preclude conduct of the Project as currently planned and would thereby materially delay or materially increase the cost of the WVDP.

There is one aspect that I have not spoken to; i.e., what happens beyond solidification? The law specifies that the Department will turn the facilities back to New York State, decontaminated and decommissioned in accordance with such criteria as NRC may prescribe. Thus, beyond the D and D currently underway and in planning, a much more thorough but as yet undefined D and D will be required. We have not yet begun the planning for this.

It may be noted that we are involved in all phases of nuclear waste management other than mill tailings. I have implicitly covered most of these, but let me highlight just a few of the others. Low-level wastes are obviously generated by anyone dealing with nuclear materials. To date, we have a compactor for handling low-level compactable solids and a liquid waste treatment plant (ion exchange) for lightly contaminated water. We will be installing shortly a cement system capable of qualifying low-level waste to DOE Order 5820 or NRC 10 CFR 61. Subsequently, we will install evaporators and equipment for handling decon and incidental liquids. Current housekeeping wastes are disposed of on-site in the area formerly operated under NRC license, but appropriate environmental reviews will be required before a determination is made as to how to dispose of Project low-level wastes. We are presuming at this time that TRU wastes will not be disposed of on-site but that non-TRU wastes will be disposed of on-site. Paper number four will provide some details.

COSTS

We have recently completed an estimate of the total Project cost through solidification. The bottom line is about $380 million without escalation, or about $470 million with escalation through mid-1990. The first impression is that this is a lot of money for the amount of waste involved. This can be put in a bit better context by reviewing the components. As shown in Fig. 2, these costs are roughly equally divided among solidification (including all equipment), D and D, and site operations.

The costs specifically identified with solidifying the high-level waste, including process development, equipment design and operations, is about $150 million. While this will solidify only the 2 million liters of high-level waste at West Valley, it is important to note that the same investment would handle considerably more waste if it were there, at a minimal additional cost. The melter service life is projected as five years but will only be used for one to two years. Much of the other equipment will have a significantly longer service life--up to thirty years.

These figures are not directly useful for conversion into m/KWhr because of several opposing considerations. The Project will incur significant cost related to a first-of-a-kind process development and the Project will use equipment for only a small fraction of its useful life. On the other side, the site operations costs are providing many necessary general services, and the D and D costs are providing most of the required space. That

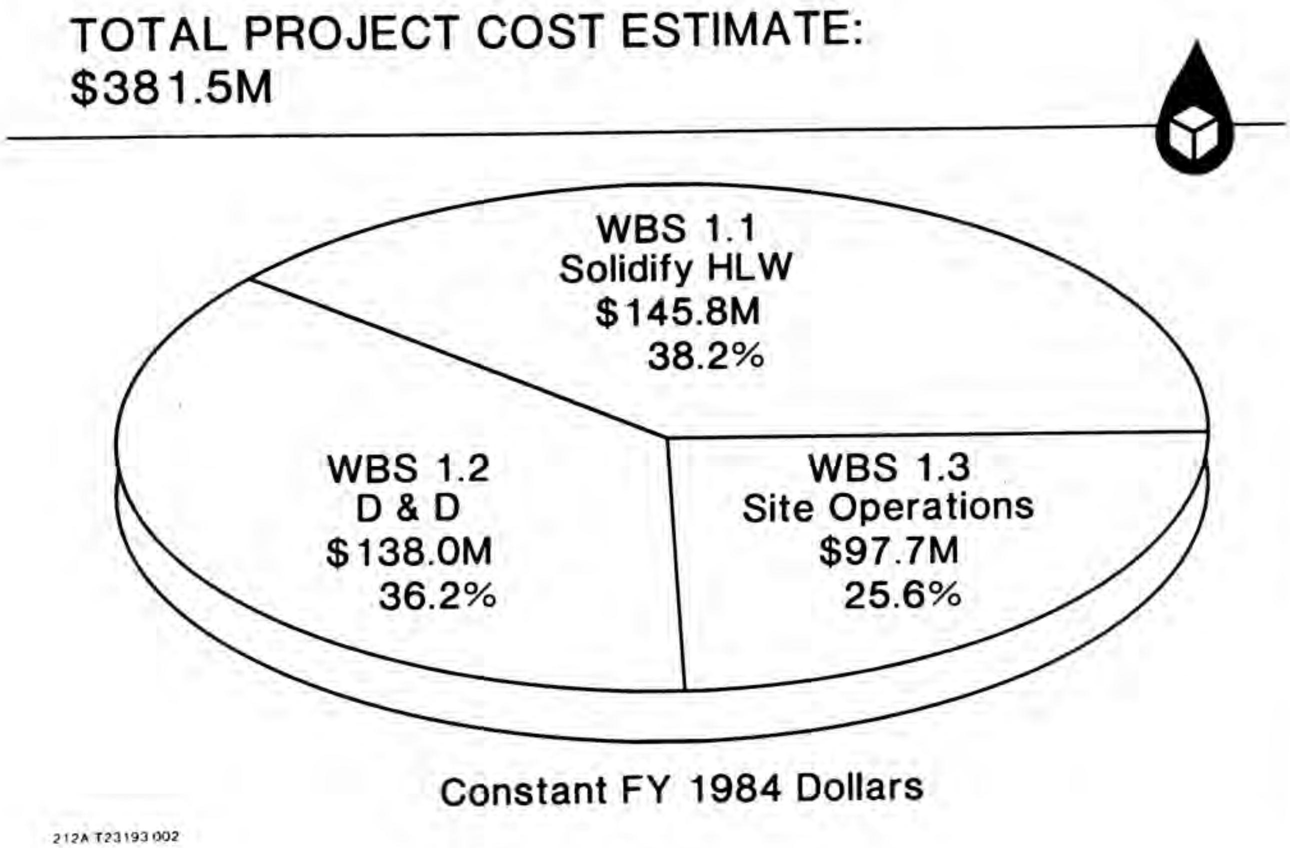

Fig. 2. Total Project cost estimate.

portion of the space so provided (but excluding the cost of providing interim storage space required because a repository is not available) should be charged in lieu of new construction. To first order, we may consider that the first-of-a-kind costs more or less offset the contribution from D and D and site operations.

The West Valley waste comes from fuel that generated approximately 4 million MWD_{th}. Associating the $150 million with solidifying the wastes from the actual 4M MWD_{th} would correspond to about 5 mils/kWh_e. At typical burn-up, this same amount of waste would correspond to about 1 mil/kWh_e. Even recognizing that the $150M is a crudely rationalized approximation (D and D and operations offsetting a peculiar first-of-a-kind adaptation), these costs for an extremely short campaign demonstrate that solidification of high-level waste will add only a fraction of a mil per kWh to nuclear power costs when done on a routine basis.

SUMMARY

In summary, I could describe the West Valley Demonstration Project as a rather routine, basically straightforward engineering task; I could equally validly describe the Project as a complex challenge requiring the balancing and sequencing of priorities; but I prefer to think of the Project as an opportunity to demonstrate that this phase, which may be the most feared part of the nuclear fuel cycle, is not all that difficult. I believe the intent of Congress to be clear: we are to do what needs to be done, without setting massive and complex precedents; just do the job.

It is clear that the job is doable. A very solid team has been assembled, along with a dedicated supporting structure. And the evident rate of progress in these early phases is impressive. Assuming that the current degree of commitment (including funding support) is maintained, and assuming that we can continue to avoid the trap that "if it is nuclear, it must be expensive," West Valley should soon be persuasive evidence that the nuclear fuel cycle is now closing, and at a reasonable cost.