URANIUM MILL DECOMMISSIONING - AN UPDATE ON THE EDGEMONT EXPERIENCE

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ABSTRACT

The Edgemont Uranium Mill Decommissioning Project has moved through the various regulatory and environmental phases and is ready to begin the final construction phase. In all, an estimated 5.4 million tons of contaminated material, including approximately 2.5 million tons of uranium mill tailings, will be moved to a disposal site approved by the Nuclear Regulatory Commission (NRC).

The decommissioning project began in early 1979 when the Tennessee Valley Authority (TVA) submitted a conceptual decommissioning plan and accompanying environmental report to the NRC. The NRC used these documents and subsequent revisions as the basis for an environmental statement on the project. The NRC issued its draft environmental statement in 1980, and the final statement in September of 1982. Shortly after the issuance of the Final Environmental Statement (FES), TVA completed its compliance with the National Environmental Protection Act Physical activities associated with the project will begin in the near future.

The decommissioning activities will be carried out by Silver King Mines, Inc. (SKM), under a management services contract to TVA. MacLaren Engineers, Inc., of Toronto, Canada, is under contract to SKM to provide the necessary engineering details for the decommissioning project.

The disposal site was chosen by a site selection process which examined a total of 27 sites. This process narrowed the options for disposal sites to three, including the one chosen and approved by the NRC. The primary advantages of the site are the short distance from the exisiting site and the approximately 650 feet of relatively dense impermeable shales above the shallowest known aquifer. The two-mile distance from the existing site will lower transportation costs and the impermeable shales should preclude the necessity of expensive natural or synthetic liners.

Three large ore stockpiles containing about 100,000 pounds of uranium have been moved from the mill site to a proposed mine site. Removal of the ore stockpiles has provided space for a staging area for rubble from the building demolition operations.

Since the NRC's FES was based on a conceptual plan, license conditions will require NRC's review and approval of the detailed engineering plans. This review and approval process is currently underway. Once this process has been completed, construction of the haul road and disposal site can begin. It is currently anticipated that the haul road will be completed in 1983 and the disposal site construction will be far enough along to allow placement of contaminated materials during the 1984 construction season. The decommissioning project will be carried out by using the existing labor force to the maximum extent possible thus preventing a population influx and the accompanying socioeconomic input to the city of Edgemont, South Dakota.

HISTORY

The Edgemont mill, located adjacent to the town of Edgemont, Fall River County, South Dakota, was built in 1956 by Mines Development, Inc. (Fig. 1). The mill was constructed under a contract between the Atomic Energy Commission (AEC) and Mines Development, Inc., and was situated on the site where the AEC had established a uranium ore-buying site four years earlier.

Although originally designed as a 250 ton per day (t/d) mill, the Edgemont mill was subsequently expanded to a capacity of 500 t/d. From 1956 through 1972 (when the uranium circuit was shut down and the mill stopped producing uranium concentrates), approximately 2,500,000 tons of mill tailings tons were produced onsite. Of this total, approximately 80 percent were produced under contract with the AEC for defense purposes. In fact, all of the uranium concentrates produced through December 31, 1966, and a portion of those produced between that time and 1968, were sold to the AEC. The remaining 20 percent were produced under contracts for commercial sales.

Production of uranium concentrates--and the attendant generation of uranium mill tailings--ceased in 1972. The mill continued to operate, producing vanadium from fly ash, slags, and boiler residues until 1974 when TVA, prior to the purchase of the mill, requested that all production cease. Based on that request, the entire mill was shut down and has remained inoperative since that date.

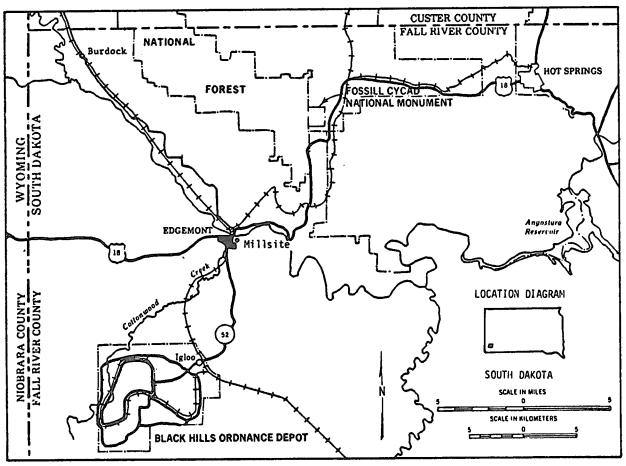

Fig. 1. Regional Location of Edgemont Mill Site.

In August 1974, TVA purchased the Edgemont mill from Mines Development, Inc., as one part of a $6 million package that included lease hold interest in 99,000 acres of uranium mineral rights, a partially delineated ore body, and a small ore stockpile. Although the estimated value of the mill and its equipment was $1.5 million, TVA believed that the acreage alone (estimated to contain 4 million pounds of uranium concentrates) justified the purchase price. Figure 2 shows the present configuration of the mill site.

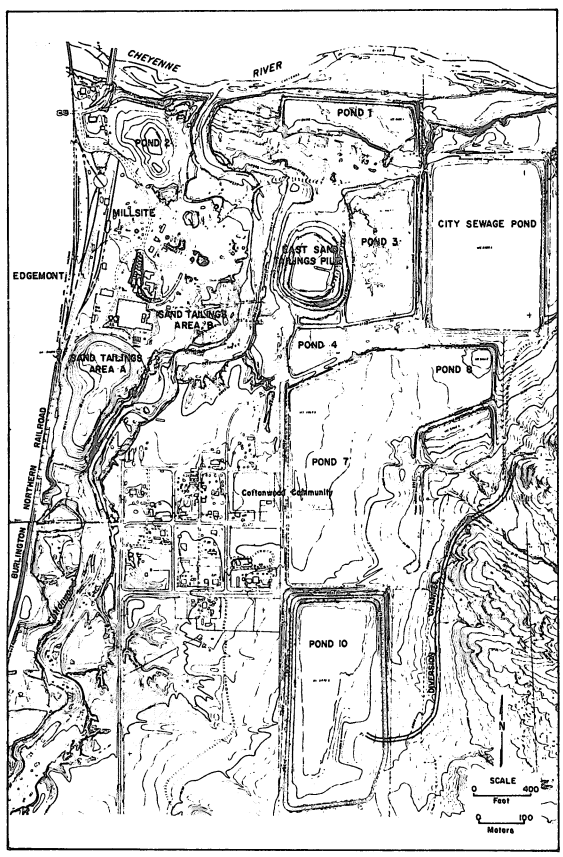

Fig. 2. *Edgemont Mill Site* Layout.

At the time of acquisition, TVA planned to refurbish the mill if it was economically feasible. In furtherance of these plans and despite the mill's inoperative status, in 1976 TVA applied to the NRC for renewal of the existing source material license (SUA-816). Later, when cost estimates of refurbishing ranged from $10 million to $20 million, TVA determined that refurbishing was neither worthwhile nor feasible; therefore, TVA petitioned NRC to withdraw its license renewal application effective August 15, 1978. NRC responded by immediately issuing a license amendment which stipulated that TVA should prepare and submit to NRC a decommissioning plan and an envionmental report which NRC would use to prepare an environmental statement.

TVA responded to that amendment and submitted a conceptual decommissioning plan and environmental report to the NRC in February, 1979. After several revisions to the environmental report, the NRC issued a Draft Environmental Report (DES) on the decommissioning project (NUREG-0846) which was noticed in the Federal Register on September 29, 1981. After allowing for public and agency comment on the DES, as well as appropriate revisions and corrections, the FES on the project was noticed in the Federal Register on October 14, 1982.

Because both the DES and FES were based on a conceptual decommissioning plan, many of the details of the actual activities were not known. The primary concerns which the NRC expressed in the FES were in the areas of geotechnical investigations, engineering plans, and radiological protection. To provide the necessary engineering details for both regulatory review and for construction, architect/engineering services were contracted from MacLaren, Inc., of Toronto, Canada. MacLaren, working in conjunction with ARIX and Golder Associates, has provided the geotechnical, radiological, and engineering details of both the existing mill site and disposal site. Actual construction activities will be carried out by SKM.

RADIATION SAFETY REQUIREMENTS

Radiation safety requirements for the mill site structure decommissioning phase of the project have been suggested by the A/E contractor. These requirements are presently being reviewed by TVA. They will be submitted to the NRC for subsequent approval.

To limit liability to job-related occurrences and to ensure regulatory compliance, medical control procedures (pre and post employment physicals), and personnel indoctrination and training in radiological safety aspects will be prerequisites. Additionally, a Radiological Safety Operating Procedures manual, including procedures for decontamination and record keeping, will be prepared to ensure regulatory compliance and operational consistency.

Although most onsite areas are presently contaminated to some degree, "clean" and "controlled" radiation areas will be established to accommodate contamination control and provide a basis for proper training of personnel in contamination control procedures. The primary components of the contamination control facilities are realignment of the existing site security fence with the clean area basically on the west side, and remodeling of the north section of the main mill building (Fig. 3) to accommodate a women's and men's change room, a lunch room, and health physics operations. Radiological measurements inside the structures suggested for clean use (office, mobil equipment shop, reagent warehouse,

carpentry shop, and storage shed) are mostly below regulatory guidelines and should require only spot decontamination of dirt and dust to achieve acceptable surface contamination levels. The plan will control vehicle, equipment, and personnel traffic to ensure that no significant radioactive contamination is released from the controlled area. Radiation monitoring will be performed before anything or anyone leaves the controlled area and decontamination will be accomplished (in facilities provided) as required to achieve acceptable contamination limits before release to the clean area.

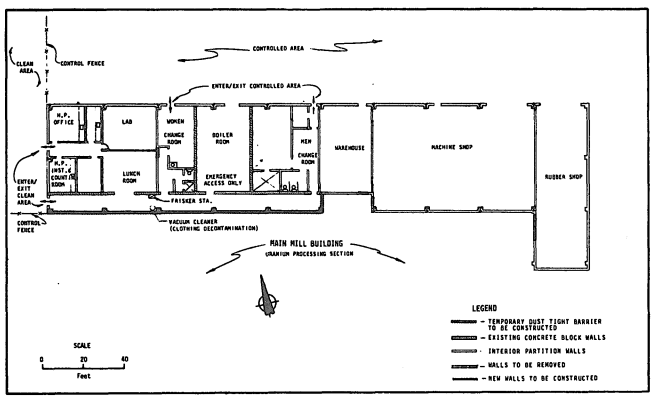

Fig. 3. Contamination Control Facility.

To accommodate an appropriate radiation safety program, adhere to the ALARA principle, ensure compliance with all specific regulations (10-CFR-20 and appropriate Guides), and maintain a cost effective program, the following operational policy with regard to internal and external radiation exposure control will be used:

> This program will use the most restrictive (generally 25 percent of any limit) regulatory "action level" as its "administrative limit." To ensure maintenance of these program limits, 60 percent of the administrative limit (generally 15 percent of any regulatory limit) will be used as the program "action level."

Based on the above program policy, Table I shows recommended permissible radiological concentrations, exposures and sampling frequencies. Additionally, the table shows recommended surface and personnel contamination limits to accommodate consolidation of all pertinent radiological limits and guidelines for the program. These program policies will ensure regulatory compliance.

Table I. Recommended Permissible Radiological Concentrations and Exposures.

			ADMINISTRATIVE Maximum Limit			ADMINISTRATIVE Action Level			Sample Location	Sample Frequency
			MPC		MPE/Week	MPC		MPE/Week		
AIRBORNE	Uraniums U(NAT) Raw Ore	F	18.75 µg/m³		40 MPC-hrs	11.25 µg/m³		24 MPC-hrs	Area And Breathing Zone	Weekly
		C-α	1.25x10⁻¹¹ µCi/ml			7.50x10⁻¹² µCi/ml				
		G-α	2.50x10⁻¹² µCi/ml			1.50x10⁻¹¹ µCi/ml				
	Process U (Tails-yc)	F	50.0 µg/m³		10 MPC-hrs	30.0 µg/m³		6 MPC-hrs	Breathing Zone	Weekly
		C-α	2.50x10⁻¹¹ µCi/ml			1.50x10⁻¹¹ µCi/ml				
		G-α	2.50x10⁻¹¹ µCi/ml			1.50x10⁻¹¹ µCi/ml				
	Rn-222 Daughters		0.083 WL		40 MPC-hrs	0.052 WL		24 MPC-hrs	Area	Weekly
					3.32 WL-hrs			1.25 WL-hrs		
					1.92x10⁻² WL-M			7.20x10⁻³ WL-hrs		
EXTERNAL			MPE-Rate		MPE	MPE-Rate		MPE		
	Gamma		2.4 mR/hr		312.5 mrem/qtr.	1.44 mR/hr		187.5 mrem/qtr.	Area Survey	Weekly
CONTAMINATION Alpha-DPM/100cm²			Avg/m²	Max	Removable	Avg/m²	Max	Removable		
	Lunch Rm Change Rm Offices		1250	3750	250	750	2250	150	Surface Areas	Weekly or when leaving controlled area
	Other Clean Areas & Equip.		5000	15000	1000	3000	9000	600		
	Personnel		1000 Maximum			600 Maximum			Clothing & Skin - Frisker	when leaving controlled area

MPC = Maximum Permissible Concentration
MPE = Maximum Permissible Exposure
MPC-hrs = (Time in Area x Concentration) ÷ 1MPC
F = Fluorimetric Analysis or Mass Determination
C-α = Chemical U-Separation + Alpha Determination
G-α = Gross Alpha Determination
U(NAT) U 238, 235, 234 + Decay Products in Equilibrium
Process U = U 238, 235, 234 Without Decay Products
WL-M = Working Level - Months

The primary source of potential radiological hazards associated with mill site structure decommissioning is surface contamination in the form of ore dusts and/or process material spillage. This contamination could be ingested by workmen or inhaled after resuspension as airborne radioactive dust. Based on measured gamma exposure rates (0.015 to 0.150 mR/hr), relatively low-level contamination inside the structures and the fact that cursory decontamination (wash down) will be performed prior to dismantling, personnel dosimetric devices should not be required and protective clothing and equipment may not be required. Since gamma exposure rates to 2.8 mR/hr were measured over the slime pond areas, it is recommended that these areas be designated radiation exclusion (RADEX) areas with work permit requirements, including whole body exposure badges. Additionally, use of protective clothing and/or respirators will be required in certain operations (decontamination, hand labor in slime ponds, cutting of contaminated metal, etc.) to ensure that the ALARA principle is applied. In those cases where respirators are used, it is not expected to be necessary to make exposure allowance for such use since 25 percent of the regulatory "maximum permissible exposure" is expected to be maintained under program operational policy.

To ensure maintenance of the ALARA principle, certain sampling and surveying frequencies may be increased from those shown on Table I. Surface area contamination surveys for change rooms, lunch room, laboratory, health physics facilities, and offices may be changed to daily, and such surveys may be conducted twice weekly for the mobil equipment shop, carpentry shop, and reagent warehouse. It is also recommended that gamma exposure rate monitoring be accomplished daily in the active controlled work areas, along with issuance and use of lapel type personal air samplers for each representative work area. Daily high volume air sample collection from the active controlled work areas is also suggested.

ENGINEERING CONSIDERATIONS

Under the A/E services contract, engineering investigations of the mill site and disposal site were implemented with the objective of providing:

- o Functional design reports on all aspects of the decommissioning and site restoration planning
- o A radiation safety plan for the decommissioning work
- o Schedules and costs for the total project
- o Detailed construction drawings and material specifications.

The field portion of these engineering investigations were conducted during the summer of 1982 and covered the following activities:

- o Geotechnical investigation of the mill site to determine the engineering properties of the tailings and the native soils
- o Definition of the mill site groundwater conditions with emphasis on potential problems that could be encountered during excavation of the tailing sands and slimes
- o Geotechnical investigation of the disposal site to determine the engineering properties of the native soils and a definition of the groundwater regime within and around the perimeter of the containment basin
- o Radiological assessment of the mill site open lands to define the extent of contamination in and around the tailings ponds and piles and to facilitate radiation safety planning
- o Radiological and engineering assessment of the mill site structures and process equipment to provide a basis for planning their final disposition
- o Engineering field studies related to a number of attendant site specific situations including investigations for haul roads, creek crossings and diversions, and the evaluation of an existing evaporation pond to serve as a facility for handling potentially contaminated waters from the decommissioning work.

A number of other studies were carried on in parallel with the field work to support the decommissioning planning. These included meteorological studies and hydrologic and hydraulic modeling to determine the long term monthly and peak runoff events and the corresponding flow characteristics and capacities of the Cottonwood Creek which runs through the mill site. These studies not only provided design data for protection of adjacent excavations, but also the scheduling of excavations *within* the creek channel itself. The runoff data was also used in simulation studies to determine the capability of the existing evaporation pond to handle the potential volume of surface waters that may be accumulated over the decommissioning period.

Where logical, certain aspects of the work were broken out for stand-alone reporting to allow for their separate evaluation, approval and implementation in preparation for the main decommissioning effort.

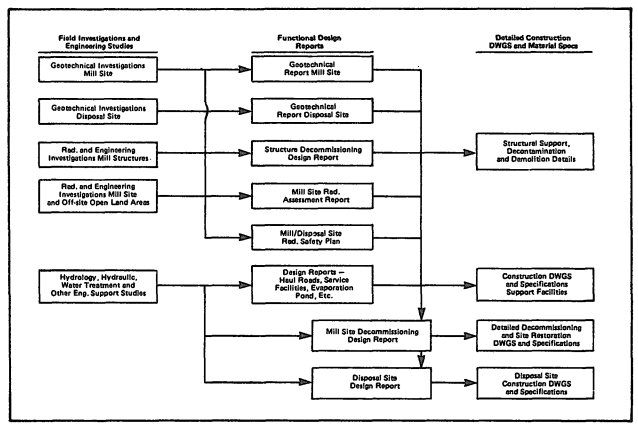

Fig. 4. A/E Activities.

The determination of quantities and an excavation plan for the site was a challenge, considering the size, topography, and lack of original containment design drawings. The basic assessment was undertaken using the following tools:

- o Geotechnical borehole logs and soil sample radioactivity analysis
- o Subsurface gamma logging of the geotechnical boreholes within the ponds/piles themselves, plus gamma logging of a series of shallow auger holes (backed up with soil analysis) to define the limits of the piles and ponds, and the contamination in other onsite and offsite areas
- o Review of historic topographical mapping prepared from pre-operational photographs.

A computer-assisted digitizing system was used in estimating the material quantities to be removed. Surfaces developed from the above data and the existing site mapping were digitized at 50-foot sections across the site and the material excavation volumes were calculated. Also, the system was utilized to produce a preliminary excavation plan and compute quantities for final site restoration.

Although the results are not surprising, the findings regarding the penetration of radioactivity into the native soils are of interest. The geotechnical investigations indicate that generally the tailings areas are underlain by an extensive deposit of firm silty clay some 10 to 40 ft. thick. The clays are in turn underlain by an alluvial aquifer which, while variable in composition, can generally be described as a clayey sand and gravel. Weathered shale bedrock of the Mowry Formation underlies this aquifer. From geotechnical interpretation (sample analysis) of the tailings/native soil interface, sample radioactivity and borehole gamma logging results, vertical penetration of Ra^{226} into the silty clays appears to be generally two feet or less.

In other locations, principally where the creek meanders were diked off and tailings placed on the clayey sands and gravels, the vertical penetration has been deeper. A histogram showing these occurrences

based on the geotechnical interpretation of the interface and the interpreted "limit of contamination" (15 pCi/gm Ra^{226} or less) for 26 boreholes put down through the tailings is presented in Fig. 5.

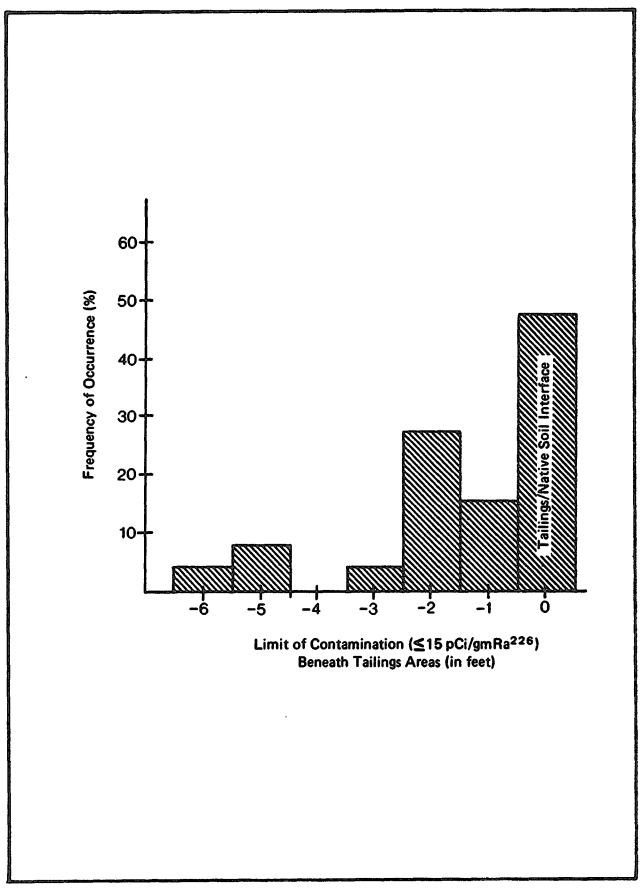

Fig. 5. Histogram-Tailings Area Borehole Data.

PROJECT STATUS

After several years of review and planning, the Edgemont uranium mill decommissioning project is ready to begin construction activities. It is currently anticipated that these activities will begin in the fall of 1983 pending the necessary regulatory approvals

Administrative action levels have been identified for the project such that exposures can be maintained below 25 percent of the maximum limits of the NRC. From a strictly technical standpoint, routine usage of protective clothing and bioassay should not be required. Two distinct laydown areas are identified for buildings scheduled for dismantling. Material which is sufficiently contaminated or unsuitable for decontamination will be stored onsite for disposal. Materials believed to be suitable for decontamination will be moved to a low background area where it will be surveyed to determine its ultimate disposition.

Twelve of the mill site structures are currently scheduled for dismantling and disposal. The other nine structures are suitable for decontamination and unrestricted use (including portions of two structures formerly scheduled for complete demolition). The final determination on structures suitable for decontamination will be based on cost effectiveness and projected future use of the site and those buildings.

Detailed engineering studies to date have indicated that the total amount of material to be handled has been revised from 7.5 million tons to about 5.0 million tons. The area adjacent to the Edgemont sewage lagoon, once believed to require sheet piling or other temporary retaining structures, can now be decontaminated without special treatment or loss of lagoon operation. Testing of materials handling characteristics of the tailings now indicate that the option of slurry transportation is no longer viable and these materials will be transported by truck. Because the haul road corridor is owned by TVA, haulage can be accommodated using large off-highway vehicles. In the absence of the slurry line, the haul road can be reduced from a divided road configuration to a single road with dual lanes. In summary, other than the radiation safety aspects, the project will be conducted using conventional excavation and construction practices.