ENCLOSURE B

TVA

EDGEMONT URANIUM MILL DECOMMISSIONING

REPORT NO. 2

CONTAMINATED MATERIALS HANDLING AND DISPOSAL CONSIDERATIONS

OCTOBER 1982

MacLAREN ENGINEERS INC.

In Association With

GOLDER ASSOCIATES

ARIX, ENGINEERS ARCHITECTS PLANNERS

EDGEMONT MILL DECOMMISSIONING
CONTAMINATED MATERIALS HANDLING AND DISPOSAL CONSIDERATIONS

INTRODUCTION

As part of the detailed engineering studies for the decommissioning of the Edgemont uranium mill, alternative methods of excavating and transporting the various contaminated wastes and of designing and operating the waste disposal area were reviewed. This report summarizes the results of this review and assesses the available options in view of the known engineering properties of the wastes and the subsurface conditions at the proposed disposal area.

BACKGROUND INFORMATION

Numerous studies have been carried out over the past several years to evaluate alternative remedial action programs for the existing uranium mill wastes in Edgemont, South Dakota. Based on the results of these studies, it was considered necessary to move the uranium mill wastes from their existing location to a new engineered disposal site. Based on the results of the previous studies a site located approximately 2 miles southeast of the Town of Edgemont was selected for the new disposal area.

Four different types of material were identified that could potentially require disposal in the engineered facility. The major bulk of the material was the process wastes from the operation of the mill. These wastes consist of two substantially different materials, referred to as sand tailings and slimes in previous reports. Other materials requiring disposal are contaminated existing structures and equipment and native soils in and around the mill site that have become contaminated.

The Final Environmental Statement (Ref. 1) proposes that a combination of methods be used to transport the contaminated wastes to the disposal area. A portion of the sand tailings are to be transported hydraulically. The remaining portion of the sand tailings are to be mixed with the slimes and transported mechanically. The building rubble and contaminated native soils are to be transported mechanically.

Further, the Final Environmental Statement (F.E.S.) proposes that the disposal area be excavated into the existing topography, and that the lower end of the basin be closed by means of an impervious dam.

In this regard, it should be noted that preliminary results of geotechnical investigations undertaken at the disposal area as part of the current detailed engineering studies (Ref. 2) indicate that the depth to the low permeability material is greater than was previously anticipated.

ALTERNATIVE MATERIALS HANDLING AND DISPOSAL OPTIONS

There are several options available for the excavation and transport of the contaminated materials at the existing mill site. Further, as the transport method and the design of the disposal site are directly interrelated, the choice of transport option will significantly influence the design of the disposal area.

A schematic diagram outlining the various waste materials, alternative transport methods for each type or condition of material and the disposal options associated with these transport methods is presented on the attached Figure 1.

Contaminated Waste Materials

Based on the results of the present study, it is estimated that the total volume of sand tailings and slimes to be disposed of is approximately 2.5 million cubic yards. This total is made up of approximately 60 per cent sand tailings and approximately 40 per cent slimes.

The sand tailings are primarily located in Pond 2, Sand Tailings Areas A & B and in the East Sand Tailings pile. Based on the preliminary results of laboratory testing, the sand tailings consist predominantly of fine to medium size sands with a trace of some silt. The in situ moisture content of the tailings sands is typically about 6 per cent where the tailings sands are encountered above the groundwater level and about 15 per cent below the groundwater level. Because of the configuration and location of the sand tailings areas, most of the volume of sand tailings is above the groundwater level.

The slimes are located in a series of man-made retention ponds. Typically, the slimes consist of silt size particles with a trace to some fine sand intermixed. The silt size particles in the slimes are essentially rock flour from the milling operation. The moisture content of the slimes is estimated to be in the order of 40 to 60 per cent and except for the near surface zone the slimes are at or close to saturation.

The contaminated native soils requiring excavation and disposal will consist predominantly of silty clay materials. However, some native sand and gravel will also be included.

Wastes from the existing mill will consist variously of contaminated building rubble (broken concrete, steel, lumber and the like); vessels, piping and the like from the dismantled mill circuit; and other solid debris which is not suitable for decontamination and salvage.

Excavation and Transport

It is anticipated that all of the contaminated native soils and the rubble from the demolished structures will be transported to the disposal area using either trucks or scrapers. As shown on Figure 1, the disposal of the contaminated soil (7) and rubble (8) is common to all disposal options.

There are two basic methods of transporting both the slimes and the sand tailings; a "dry" method (i.e. no additional water is used) and a "wet" method (i.e. make-up water is used to slurry the materials).

As previously noted, most of the sand tailings are located in "piles" above the groundwater level. Consequently, hydraulic excavation of the bulk of the sands is not considered feasible. As a result, mechanical excavation using scrapers, backhoes, draglines or loaders will be required. Hauling of the dry sands to either a repulper for hydraulic transport or directly to the disposal area can be carried out using either trucks or scrapers.

Two options may be considered for excavating the slimes; mechanical excavation using backhoes, draglines or loaders and hydraulic excavation using floating dredges. Following excavation, the "dry" slimes may be either hauled to a repulper for hydraulic transport to the disposal site or hauled directly to the disposal site ("dry" transport).

For the case of hydraulic excavation, only hydraulic transport is feasible.

To assess the feasibility of mechanically excavating and transporting the saturated slimes, test excavations were dug in each of the existing slimes ponds. These tests confirmed that the slimes can be excavated by mechanical methods, little inflow of water into the excavation occurs, and the spoil can be handled mechanically. Subsequent loading and transport trials carried out to assess the load performance and dumping characteristics of the slimes confirmed that mechanical (truck) transport was practical.

Finally, as indicated on Figure 1, the sand tailings and slimes could be transported to the disposal site either as separate constituents or they could be blended to produce either a "dry" or a "wet" mix of sand tailings and slimes. In this regard, it should be noted that preliminary estimates based on the in situ water contents and the engineering behaviour of the materials suggest that virtually all of the tailings sands (about 1.5 million cubic yards) would have to be blended with the slimes (about 1 million cubic yards) to produce a "dry" mix which can be spread and compacted as proposed in the F.E.S.

<u>Disposal Site Design Options</u>

As indicated on Figure 1, depending upon which materials handling (excavation and transport) option is selected, three basic options or concepts are available for the design and operation of the disposal facility itself. These are a "wet" disposal option, a "dry" disposal option and a "combined" disposal option. These basic alternatives together with the advantages and disadvantages of each concept are discussed below.

(i) "Wet" Disposal Option

If the sand tailings and slimes are moved to the disposal site hydraulically, a "wet" disposal option for the disposal site will be required. Essentially the wet disposal option would involve the initial construction of a containment dam to the full, final design elevation as well as the preparation of the entire base of the disposal area. Following completion of the base preparation and the earth dam, the building rubble could be mechanically placed in the bottom of the basin and the sand tailings and slimes then placed hydraulically into the basin. Decant water from the slurry operation would be returned to Pond 10 for evaporation or re-use as make-up water. A substantial amount of water would be utilized in this process and it is anticipated that the water level in the disposal area at the completion of filling would coincide approximately with the top of the slurried wastes. While partial drainage of the saturated slurry could be achieved by the installation of an underdrainage system, significant consolidation settlements particularly of the slimes portion of the tailings will result as the water level in the disposal basin recedes.

In summary, the adoption of the "wet" disposal option will necessitate construction of a full-height embankment and preparation of the entire disposal site base prior to the placement of any rubble, contaminated soil or mill wastes.

Further, the process will involve the use of substantial quantities of water, which in a semi-arid environment, could by itself be considered a disadvantage. However, the major disadvantage of adding water for slurry transport is the resulting potential for long term seepage out of the sides and bottom of the disposal site. While this potential can be minimized by the provision of underdrains, it still makes the "wet" disposal option less attractive than the "dry" alternative discussed below.

Another disadvantage of the entirely "wet" disposal option is the potential for long term consolidation settlements of particularly the slimes portion of the hydraulic fill. This long term settlement of the fill could result in differential movement and cracking of the impervious cap resulting in an on-going maintenance problem.

The primary advantage of the entirely "wet" disposal system is that the requirements for fugitive dust control during transport and placement of the sand tailings and slimes will be minimized. However, it would probably be impractical to place temporary caps on the hydraulic fill during periods of shut down and contingency plans to control surface dusting in the basin area would be necessary.

Economically, there are substantial capital costs associated with a "wet" disposal system including approximately 5 miles of slurry and return water pipeline, a repulping plant, pumping station, booster stations and floating decant pumps for the return line. Further, the use of a hydraulic transport system would not eliminate the need for the construction of the haul roads since they would still be required for transport of contaminated native soils and building rubble.

(ii) "Dry" Disposal Option

If the sand tailings and slimes are transported to the disposal area in a "dry" condition a substantially different approach could be adopted for the design and operation of the disposal area. Unlike the "wet" disposal option, it would not be necessary at the outset to construct an earth dam to the full, final design elevation. Initially, it would only be necessary to construct a soil structure to sufficient height to adequately retain any surface runoff which might become contaminated as a result of contact with the tailings. Using the "dry" method, placement of the rubble could be carried out concurrent with the placement of the tailings and contaminated native soils. The disposal facility could be developed progressively as the contaminated materials could be placed using a downstream method starting from the uppermost reaches of the basin area as indicated on Figure 1. Placement of the materials in the "dry" state would also facilitate the use of some compactive effort during placement which would reduce the amount of long term consolidation of the wastes.

The primary advantage of the "dry" disposal option is the avoidance of introducing excess free water during placement of the wastes in the disposal area as this will essentially eliminate the potential for groundwater seepage out of the disposal area during and following decommissioning operations. Development of the basin can be carried out in a controlled and scheduled manner. Only minimal dam construction and basin preparation will be required prior to the start of waste placement and the dam will essentially retain only surface water runoff from the basin area. Further, after each seasons operation or, as construction proceeds during an individual season, the final cap could be constructed over the wastes to minimize dusting and prevent surface water infiltration into the wastes.

The major disadvantage of this alternative is the potential for fugitive dust spreading along the haul road. However, it is anticipated that dust control during hauling can be achieved by spraying each individual load at the mill site.

As well, it is believed that filling of the voids associated with the disposal of the building rubble should not present a major problem with the "dry" option. The majority of the demolition material will consist of broken concrete, structural steel members and steel sheeting. This material can be initially stockpiled and with the progressive development of the site, judiciously placed and spread out on the bottom of the basin in conjunction with the filling and compaction of sand tailings and native soils. It is recognized as it is with the "wet" option, that special attention (filling, cutting, compaction etc.) may be required for the proper disposal of tanks and other vessels associated with the process equipment.

Economically, a portion of the savings associated with the elimination of the pipeline will probably be offset by the additional haulage costs. It is, however, anticipated that some savings in the overall costs will be achieved if the "dry" disposal option is adopted.

(iii) <u>"Combined" Disposal Option</u>

The "combined" option encompasses some of the features of both the "wet" and "dry" disposal schemes. For the combined option, preparation of the entire basin and the construction of an intermediate height dam would be required prior to placement of any contaminated materials. Following preparation of the disposal area and embankment construction, the building rubble would be placed and the sands and/or slimes would be hydraulically placed in the bottom of the basin. Following hydraulic placement, the contaminated soil, "dry" sands or a mixture of "dry" sands and slimes could be placed over the hydraulic fill. Some mechanical compaction of the "dry" sands and contaminated soils could be carried out during placement.

The "combined" option represents most of the disadvantages of both the "wet" and "dry" methods. As with the "wet" disposal method, the primary disadvantage of this option is that significant excess water will be introduced into the disposal facility with the slurried wastes. Further, substantial capital and operating costs will be involved in establishing and maintaining both a hydraulic transport system and an extensive haul fleet.

Long term settlements of the fill in the disposal area could result as consolidation of the slurried material takes place and therefore continued maintenance of the cap would be required. While fugitive dust would be minimized during transport, the potential of a substantial spill due to a pipeline break still exists. Control of dust in the disposal site could also be a problem particularly during the period between the slurry operation and the mechanical hauling and placement. However, the cap could be constructed during the latter stages of "dry" placement.

ASSESSMENT OF ALTERNATIVES

Based on the above review of available options for excavating and transporting the various contaminated waste materials, it is our opinion that:

(a) The only practical method of transporting the demolished mill buildings and process equipment is by truck.

(b) The only practical method of excavating and transporting the contaminated native soils is by mechanical methods (e.g. draglines loading into trucks).

(c) The majority of the tailings sands can only be excavated by mechanical equipment (e.g. front-end loaders into trucks). Thereafter, the sands can be either transported directly to the disposal area ("dry" transport) or to a repulper where they would be slurried and pumped to the disposal area ("wet" transport).

(d) The slimes can be excavated either hydraulically (e.g. a floating dredge) or mechanically (e.g. draglines loading into trucks). In the case of hydraulic excavation, only slurry ("wet") transport can be considered. In the case of mechanical excavation, the slimes could be either transported directly to the disposal area ("dry" transport) or to a repulper where they would be slurried and pumped to the disposal area ("wet" transport).

(e) Virtually all of the sands would have to be blended with the slimes to produce a dry "workable" mixture which can be spread and compacted as proposed in the F.E.S. In this regard the sands and slimes could be either layered or mixed by ploughing, disking or the like during placement in the disposal area.

With regard to the development of the proposed disposal area, it should be noted that the preliminary results of the recent subsurface investigation indicate that the depth to the low permeability, unweathered shale is greater than was previously anticipated (see Ref. 2).

As well, the results of recent, excavation trials have indicated that while the in situ slimes are at or close to saturation the material is sufficiently impermeable that little or no porewater will drain out of the slimes under gravity. Further, the bulk of the tailings sands are virtually dry and those that are below the groundwater level will be drained prior to excavation and transport. Consequently, if the "dry" disposal option is adopted and surface water infiltration is controlled by progressive contouring and covering of the wastes during placement, there will be virtually no contaminated effluent discharge from the emplaced wastes during the decommissioning operations.

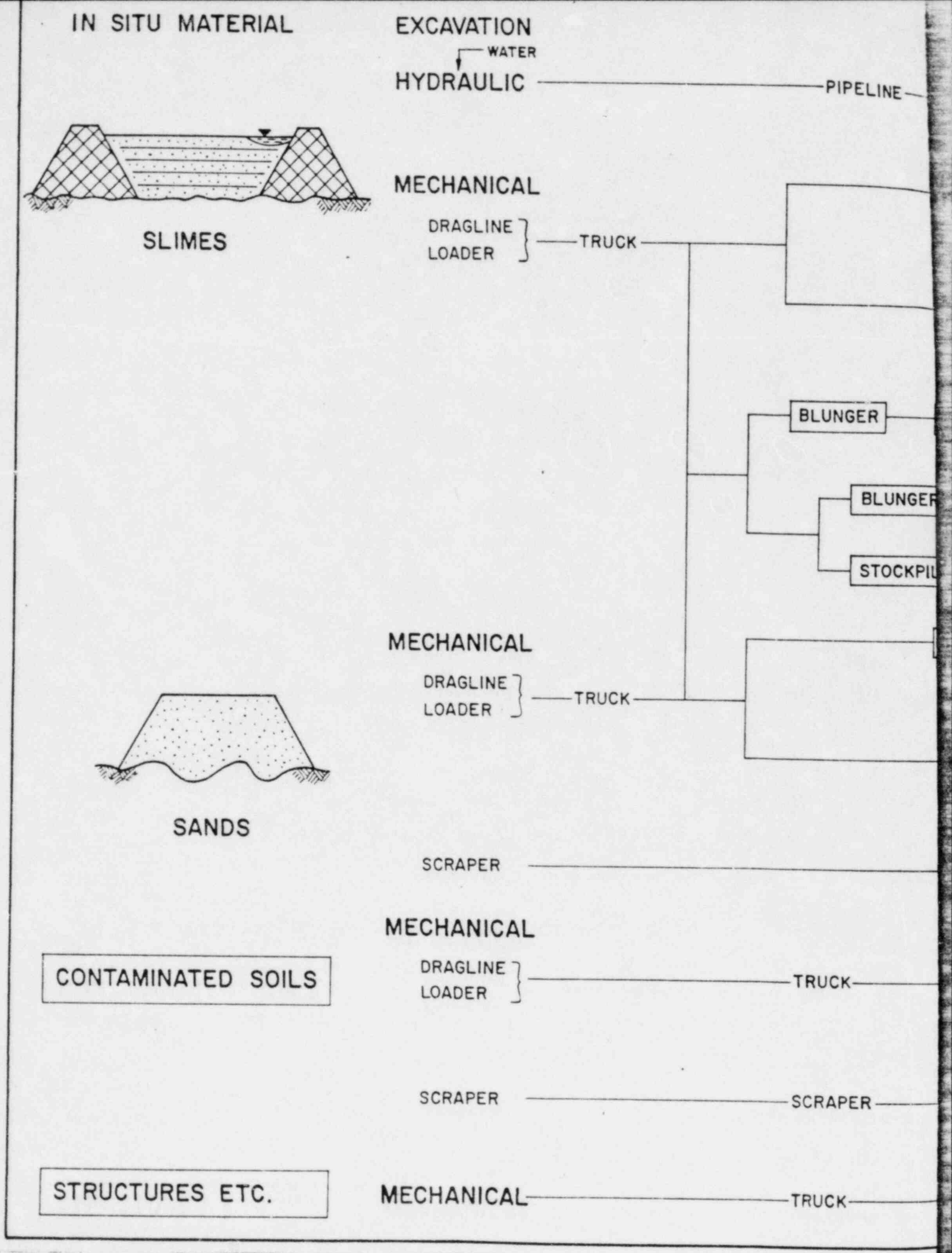
If, on the other hand, "wet" disposal is adopted for all or part of the wastes as proposed in the F.E.S., excess free water will inevitably be introduced into the basin and even if an impermeable liner and underdrainage system are provided, the potential for contaminated seepage out of the basin will be greatly increased.

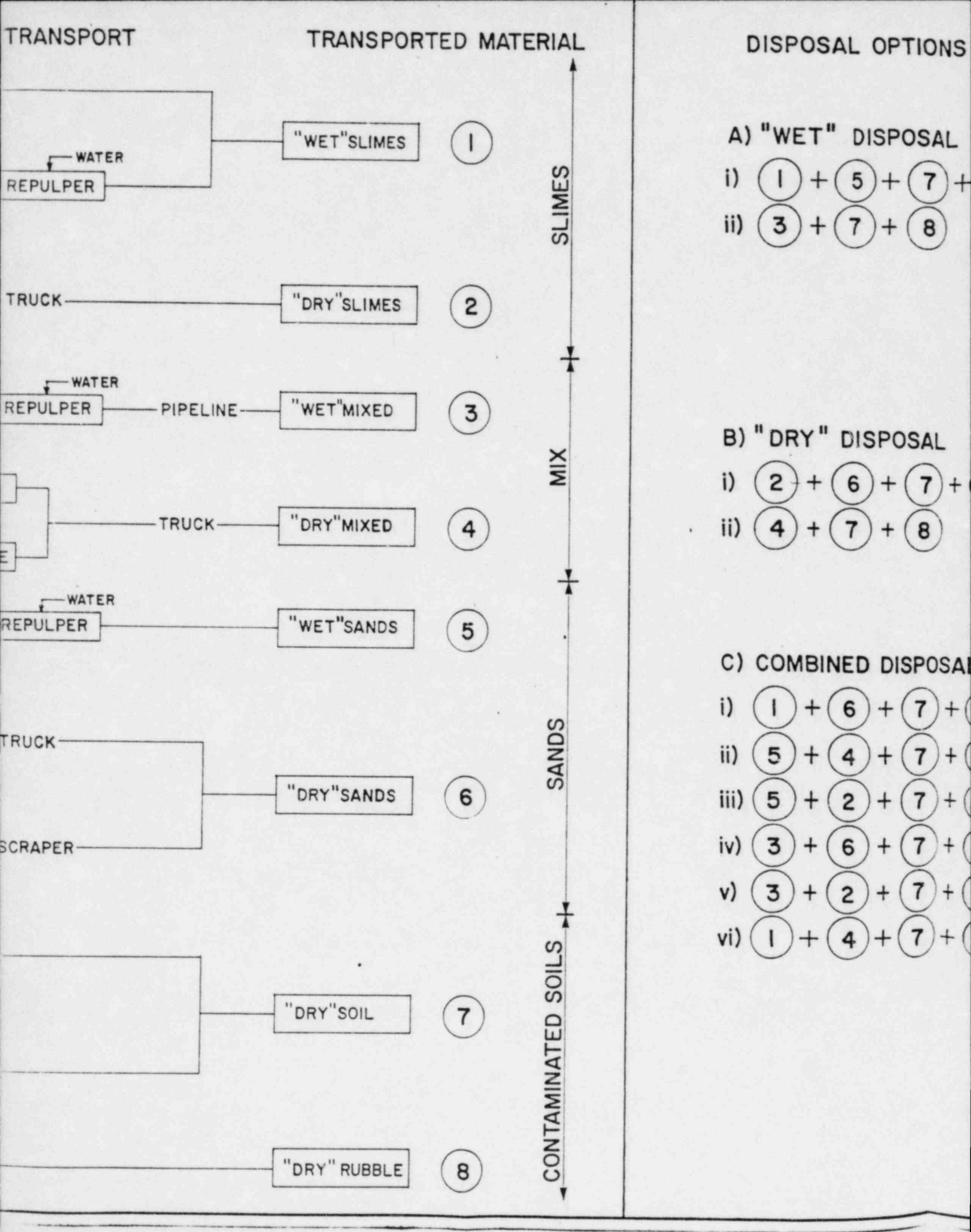
Based on the above and considering the advantages and disadvantages of the various disposal options discussed previously, we recommend that the "dry" disposal option as illustrated on Figure 1 be adopted for this project. Concomitant with the "dry" disposal option, we recommend that all of the existing contaminated materials be excavated mechanically and hauled to the disposal area. While it is recognized that "dry" transport of particularly the tailings sands may increase the potential for fugitive dust emissions during transport, a "dry" disposal option will facilitate the progressive construction of the final cap and substantially minimize the potential problem of surface dusting during periods of shut down. In any case, we consider this much less significant and more easily overcome than the potential for contaminated groundwater seepage associated with the "wet" disposal option.

REFERENCES

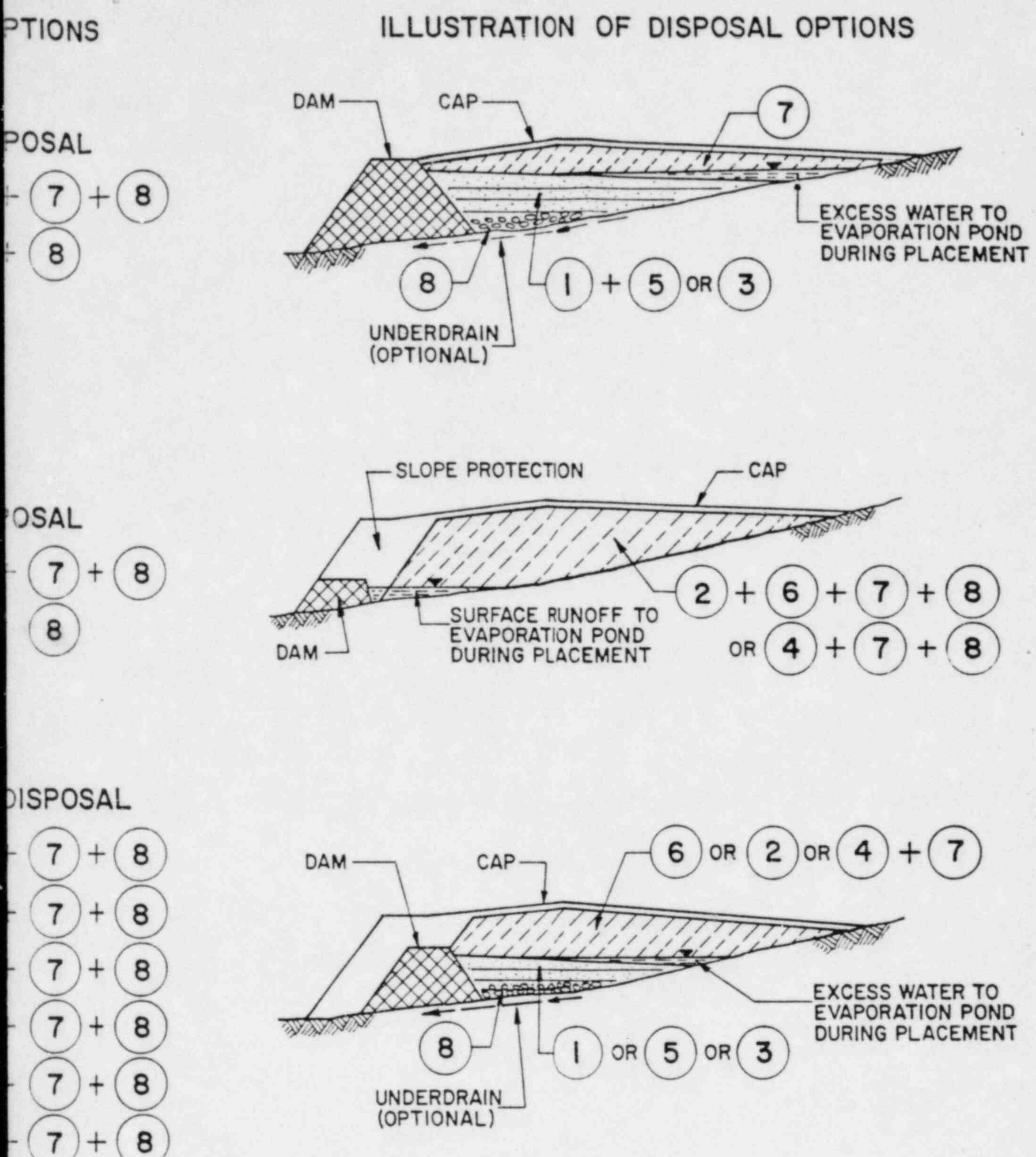
1. U.S. Nuclear Regulatory Commission (NUREG-0846), Final Environmental Statement related to the decommissioning of the Edgemont Uranium Mill, Tennessee Valley Authority, June 1982.

2. MacLaren Engineers Inc., Golder Associates, Arix, Edgemont Mill Decommissioning Report No. 1. Preliminary Results of Geotechnical Investigation Proposed Disposal Area, prepared for Silver King Mines Inc., October 1982.


IN SITU MATERIAL
EXCAVATION
WATER
HYDRAULIC
PIPELINE
MECHANICAL
DRAGLINE
LOADER
TRUCK
SLIMES
BLUNGER
BLUNGER
STOCKPIL
MECHANICAL
DRAGLINE
LOADER
TRUCK
SANDS
SCRAPER
MECHANICAL
CONTAMINATED SOILS
DRAGLINE
LOADER
TRUCK
SCRAPER
SCRAPER
STRUCTURES ETC.
MECHANICAL
TRUCK



TRANSPORT
TRANSPORTED MATERIAL
DISPOSAL OPTIONS
WATER
REPULPER
"WET"SLIMES
1
TRUCK
"DRY"SLIMES
2
SLIMES
WATER
REPULPER
PIPELINE
"WET"MIXED
3
TRUCK
"DRY"MIXED
4
MIX
WATER
REPULPER
"WET"SANDS
5
TRUCK
SCRAPER
"DRY"SANDS
6
SANDS
"DRY"SOIL
7
"DRY" RUBBLE
8
CONTAMINATED SOILS
A) "WET" DISPOSAL
i) 1 + 5 + 7 +
ii) 3 + 7 + 8
B) "DRY" DISPOSAL
i) 2 + 6 + 7 +
ii) 4 + 7 + 8
C) COMBINED DISPOSA
i) 1 + 6 + 7 +
ii) 5 + 4 + 7 +
iii) 5 + 2 + 7 +
iv) 3 + 6 + 7 +
v) 3 + 2 + 7 +
vi) 1 + 4 + 7 +



SILVER KING MINES INC.
TVA PROJECT

EDGEMONT MILL DECOMMISSIONING

FIGURE 1

CONTAMINATED MATERIAL EXCAVATION, TRANSPORTATION AND DISPOSAL OPTIONS