WESTERN NUCLEAR, INC.

SPLIT ROCK MILL

DECOMMISSIONING PLAN

SOURCE MATERIALS LICENSE NO. SUA-56

NRC DOCKET NO. 40-1162

November 30, 1987

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TABLE 3-1

MILL DECOMMISSIONING & DISMANTLING OF ALL SUPPORT FACILITIES

SUMMARY OF ESTIMATED DISMANTLED VOLUMES

	Item	Estimated Dismantled & Compacted Vol. Cubic Feet
1.	Old Crusher	14,000
2.	Acid Plant	15,000
3.	Electric Shop	2,000
4.	Reagent Warehouse	8,000
5.	SX Building	11,000
6.	Chem Lab	5,000
7.	Compressor Building	4,000
8.	Fire Protection Building	3,000
9.	Mill Warehouse & Mill Office Building	20,000
10.	Fire Pump Building	1,000
11.	Mill Maintenance & Machine Shop	3,000
12.	Rubber Shop	2,000
13.	Truck Weighing Building	7,000
14.	Treasure Island	23,000
15.	Mill	362,000
16.	All other nonsalvageable equipment to include tanks, barrels, tailings transport system, scrap steel, poles, and sundries	20,000
17.	Contingencies at 20%	100,000
	TOTAL	600,000

TABLE 3-2

DECOMMISSIONING SCHEDULE

Phase	Item	Duration In Weeks	Dismantled & Compacted Vol in Cubic Feet
1	Old Crusher	3	14,000
2	Acid Plant	5	15,000
3	Mill including Compressor, Fire Protection, & SX Buildings	17	380,000
4	Chem Lab & Electric Shop	4	7,000
5	Reagent Warehouse	1	8,000
6	Mill Warehouse & Mill Office Building	5	20,000
7	Fire Pump Building & Rubber Shop	1	3,000
8	Treasure Island	2	23,000
9	All Other Nonsalvageable Sundries	3	20,000
10	Truck Weighing Building	2 1/2	7,000
11	Mill Maintenance & Machine Shop	1/2	3,000
-	Contingencies	8	100,000
	TOTAL	52	600,000 or, 22,000 yds^3

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TABLE 3-3
SPLIT ROCK MILLSITE
DECOMMISSIONING & RECLAMATION COSTS
(In Constant 1987 Dollars)

Activity	Affected Areas (Acres)	Volume of Materials (Cubic Yards)	Estimated Cost
1. Decommissioning and Reclamation of Entire Millsite Area			
a. Mill decommissioning & dismantling of all mill support facilities to include old crusher bldg, lab, mill offices, various auxiliary shops, acid plant, and sundries as per Table 3.6-1	9.0	22,000	$ 638,000(a)
b. Earthwork: Final reclamation of entire millsite area including 2-foot soil cover over mill-site "burial" area	45.0	285,000	690,000(b)
c. Rock Cover: 6" thick cover over entire millsite area, with 12" thick cover on outslopes	39.0	39,000	527,000(c)
TOTAL			$1,855,000

(a) Lump sum cost of $630,000 for mill decommissioning and dismantling of all support facilities as provided by outside contractor (October 1987).

(b) Based on reclamation and earthwork unit costs provided by the Lander Office of the Wyoming Department of Environmental Quality (June 1987).

(c) Cost for placement of rock cover is based on outside contractor unit cost estimate of $13.50 per cubic yard (June 1987).

LIST OF FIGURES

1.0 Introduction

Western Nuclear, Inc. (WNI) has been mining and milling uranium in the Crooks Gap and Gas Hills Uranium districts of Fremont County, Wyoming since the mid-50s. The Split Rock Mill, the first uranium mill to be built in Wyoming, was constructed in 1957. The mill is located in a remote area in south-central Wyoming, approximately 55 miles south of the nearest measured population center of Riverton, Wyoming. The nearest community is Jeffrey City which is about two miles south of the millsite.

Early operations included primary and secondary crushing units. What remains today of these units is contained in the "old crusher building." Concrete foundations for coarse ore feed to the old crusher building are buried within the ore pad which is covered with concrete. By early 1976, the crushing sections were superseded by installation of a semiautogenous grind unit. Mill processing then consisted of the following: ore receiving, grinding, leaching, classification and washing using a resin-in-pulp system, solvent extraction, and precipitation/dewatering/drying. Milling operations continued until June 1981 when the facilities were put on a temporary shutdown and standby status pending improvements in the uranium market.

Following the June 1981 shutdown, all source materials in all sections of the mill except the precipitation section were removed, and the integrity of all equipment was maintained for future mill startup. Yellowcake concentrate produced at the Green Mountain IX facility was stored in the precipitation section of the mill until March 1987 when all of the concentrate was removed.

In addition to the milling facilities, numerous auxiliary buildings--e.g., mill offices and warehouse, electric shop, chemical laboratory, rubber shop--were constructed to support the milling operations (see Figure 1). Sulfuric acid was provided not only to the Split Rock Mill, but also to outside parties by a sulfuric acid plant constructed just north of the mill.

Furthermore, during the approximately 25 years of milling operations, considerable equipment scrap and waste materials were produced. These materials have been stored in proximity to the mill, the old crusher building, and the acid plant, as well as in "Treasure Island."

The decommissioning plan described herein addresses the dismantling of the mill process and auxiliary buildings with compaction and consolidation of the dismantled structures and corresponding scrap within a designated millsite "burial" area and, also, addresses ultimate reclamation and stabilization of the area.

2.0 Facilities and Equipment to be Dismantled

For purposes of convenience, this plan segregates the main mill building from auxiliary buildings, including the old crusher building, and sundry scrap and wastes. All materials that will not be released for salvage will be consolidated within the millsite "burial" area designated in Figure 2.

The general dismantling scheme for all buildings includes removal and compaction of all equipment and materials contained therein with subsequent removal of the roof, structural support, and walls. Since all foundations of buildings to be dismantled are already contained within the millsite "burial" area that will be covered with clean soil materials, reclaimed, and stabilized, no dismantling of building foundations is warranted. Instead, the foundations will remain unbroken in-place and eventually covered with a minimum of 2 feet of cover during millsite reclamation.

Although radioactive materials were processed in the main mill building, auxiliary facilities may contain residual radioactive materials. Therefore, all buildings and equipment will be treated initially as if they may contain radioactive materials and corresponding precautions set forth in Section 4.4, Radiation Work Permit Procedures, will be adhered to for determining potential radiological hazards associated with the dismantling of all buildings and equipment.

Section 2.1 Split Rock Mill

Attached Table 2-1 provides a detailed list of major equipment in the mill. Equipment that has been removed to date for salvage has been so noted on the table. Remaining equipment has been assumed to be unsalvageable and will therefore be dismantled for disposal onsite.

All source materials have been removed from the mill. All chemicals, including PCBs, have been removed and properly disposed of. All by-product materials, including nuclear density gauges, as licensed by NRC Materials License 05-16354-01 have been removed and disposed of by the manufacturer-supplier.

Section 2.2 Auxiliary Buildings and Equipment

Auxiliary buildings and equipment scrap to be dismantled include the following (see Figure 1):

1. Old Crusher
2. Acid Plant
3. Electric Shop
4. Reagent Warehouse
5. SX Building
6. Chem Lab
7. Compressor Building
8. Fire Protection Building
9. Mill Warehouse & Mill Office Building
10. Fire Pump Building
11. Mill Maintenance & Machine Shop
12. Rubber Shop
13. Truck Weighing Building
14. Treasure Island
15. All other nonsalvageable equipment to include tanks, barrels, tailings transport system, scrap steel, poles, and sundries

All equipment will be dismantled and consolidated to the extent practicable and building structures and walls will be torn down and consolidated within the millsite "burial" area. All nonsalvageable scrap and equipment will also be consolidated within the millsite "burial" area.

Section 2.3 Salvageable Equipment

Any equipment or materials that have been salvaged from the restricted area have been released in accordance with NRC guidelines for "Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-product or Source Materials" dated December 1984 (see Attachment A). For this plan, it has been assumed all salvageable equipment already has been removed from the site. However, WNI retains the right to salvage any or all equipment at any time prior to, during, or after mill decommissioning.

The transformer station located on the southwest corner of the ore pad will remain intact until final surface reclamation is to commence. At that time, the station will be disassembled and released to the Hot Springs Rural Electric Association for unrestricted use. Prior to commencement of surface reclamation, two gasoline fuel tanks, located on a hill southwest of the mill warehouse and office building, will be drained and released for unrestricted use to the supplier.

Section 3.0 Decommissioning Plan

WNI has evaluated the options of removing all materials to the tailings pond versus "burying" the materials in-place. To remove all equipment, buildings, foundations, and contaminated subsoils to the tailings pond with subsequent reclamation of the millsite area is not cost-effective. The preferred option, then, is to dismantle and consolidate all materials within the millsite "burial" area for future surface reclamation.

Section 3.1 Millsite Abandonment

As shown in Figures 2 and 3, all equipment and structures will be dismantled and consolidated for final burial within the millsite "burial" area. While the designated millsite "burial" area encompasses approximately 9 acres, only 4 acres will be utilized to accommodate the total dismantled volume. Therefore, the abandonment plan, when activated, will allow additional burial area should there be a need. The existing topography defines this 4-acre area as a natural pit with bottom elevation contours for the most part ranging from approximately 6344 to 6350 feet (MSL) (see Figure 3). The area is bound to the west by the ore pad (the surface elevation is at approximately 6351 ft (MSL)) and granite outcrops and to the east by the earthen mound underlying the acid plant (the surface elevation is at approximately 6362 ft (MSL)) and the tailings retention area.

This decommissioning plan addresses dismantling and consolidation of equipment on the surface of the millsite area rather than subsurface burial for the following reasons:

1. Dismantling will occur prior to surface reclamation of the site. The phreatic surface under the millsite is not projected to recede to the level of the regional aquifer for several years following surface reclamation of the tailings. Therefore, subsurface burial within the millsite area is not preferred because of water that would be encountered.

2. Subsurface burial of all equipment and structures within the millsite area merely increases the costs of decommissioning.

3. The surface topography of the millsite area affords the cost-effective opportunity to dismantle and consolidate all equipment on the surface whereby subsequent placement of a soil cover during final reclamation will blend the contours of the reclaimed millsite into the reclaimed tailings pond without excessive fill requirements.

Section 3.2 Dismantling Sequence

The general sequence for dismantling is listed below and applies to the auxiliary buildings and equipment described in Section 2.2. The main mill building dismantling sequence is outlined in Section 3.2.1.

1. De-energize the equipment or area to be dismantled

2. Remove inner components and equipment that do not alter structural integrity

3. Remove roof

4. Remove walls

5. Install temporary supports (where required in larger buildings)

6. Remove original structure supports

7. Dismantle temporary supports and frames

Dismantling will include compaction of materials to fill in voids and to reduce settlement.

Section 3.2.1 Split Rock Mill Discommissioning

In order to establish the overall decommissioning schedule presented herein, the mill will be dismantled systematically, area by area, with appropriate consideration for radiation safety, industrial safety, and environmental controls. Such a schedule will also optimize continued usage of needed facilities and services. The estimated dismantled volumes of the mill building and its contents, and small accessory buildings directly attached thereto, including the compressor building, fire protection building, and SX building, are shown in Table 3-1. The gross dismantled and compacted volume is estimated to be 14,000 cubic yards.

With the exception of the first two items described below, i.e., roof and leach circuit, dismantling will commence from the east end of the mill at the precipitation/drying/packaging section and progress to the west end of the mill with concurrent dismantling of both the upper and lower levels before moving to the next structural bay or area. Figure 7 shows the mill layout plan. The first two items, the roof and leach circuit, are sequenced at the start to provide light and access to the concrete vault for prompt disposal of contaminated equipment and materials, respectively. The contaminated equipment, specifically the roaster, thickener, yellowcake storage tanks, and, generally, materials from other areas within the mill, will be preferentially handled and placed in the concrete vault at the west end of the building where the semiautogenous grind was located during milling operations. All remaining dismantled equipment and structural components will be hauled, compacted, and piled in the millsite "burial" area. Since the millsite "burial" area eventually will be covered with at least two feet of clean cover material and stabilized, foundations and concrete slabs at or below the ground level will not be disturbed.

Listed below is the general sequence for mill decommissioning (refer to Figure 7):

1. Structures

   a. Roof

2. Leach Circuit

   a. Motors
   b. Agitators
   c. Piping
   d. Pumps
   e. Tanks
   f. Structural steel

3. Precipitation

   a. Tanks
   b. Yellowcake thickener
   c. Pumps, piping, and controls
   d. Structural steel

4. Yellowcake Drying and Packaging

   a. Dust collector and pipes
   b. Scrubber
   c. Hopper
   d. Dryers
   e. Structural steel

5. Clarification

   a. Pipes
   b. Pumps
   c. Filters
   d. Cone

6. Resin-in-Pulp Circuit (Dismantling of this circuit will progress concurrently with sequential activities #7, #8, and #9 below)

a. Piping
b. Tanks

7. Solvent Extraction

a. Pipes
b. Mixers
c. Settlers
d. Pumps
e. Tanks

8. Make Up and Storage (Pulp Storage)

a. Piping
b. Pumps
c. Tanks

9. Classification and Wash

a. Drags
b. Pipes
c. Pumps
d. Tanks
e. Structural steel

10. Grinding

a. Primary leach tanks
b. Pumps & piping
c. Structural steel

11. Ore Receiving

a. Piping
b. Structural steel

12. Compressor Building

a. Compressors

13. Structures (Mill, SX, and Compressor Buildings)

a. Gables
b. Walls
c. Structural steel

Should salvage potential, contamination control, weather, or personnel availability considered in setting the above sequence of activities change, the RSO may authorize deviations from this sequence after evaluating the potential hazards.

Section 3.2.2 Auxiliary Buildings and Equipment

The estimated dismantled volumes of auxiliary buildings, support facilities, scrap equipment, wastes, and other sundries are included in Table 3-1. For buildings contained within the millsite "burial" area, foundations will be left undisturbed. Only one structure, the truck weighing station, is located outside the designated millsite "burial" area at the entrance to the restricted area. The structural supports, walls, and foundations of the truck weighing station will be removed and transported to the millsite "burial" area.

All scrap equipment and wastes from "Treasure Island" located outside the "burial" area will be dismantled and returned to the millsite "burial" area.

Section 3.3 Interim Containment

To allow for settlement, consolidated materials will be piled and left in-place. Posting with "Caution-Radioactive Materials" signs will be established around the stockpiles. A limited number of roadways through the millsite "burial" area to provide access to the tailings pond and surrounding areas will be maintained until surface reclamation of both the tailings and entire millsite area commences. Since the restricted area will remain fenced and access thereby will be restricted until surface reclamation is completed, no further controls are deemed warranted.

Section 3.4 Final Reclamation Scheme

The final dismantled volumes of the mill, auxiliary buildings, and equipment following compaction and settlement, estimated at 22,000 cubic yards (Table 3-1), will be accommodated in the millsite "burial" area.

First, a minimum of two feet of clean soil from borrow areas will be placed over the millsite "burial" area. Then a limited volume of cut materials, but mostly fill materials, will be placed to blend the reclaimed millsite area into the final contours of the reclaimed tailings retention system. Fill volumes calculated in Appendix I include consideration for settlement estimated at 10%.

The borrow areas for clean earthen fill are shown in Figure 6. These areas are identical to the borrow areas for reclamation of the tailings retention system depicted in the WNI reclamation plan submitted June 30, 1987. It is estimated the borrow areas would provide approximately 271,000 bank cubic yards of the total fill requirement of 285,000 compacted cubic yards. Material excavated from within the millsite area during recontouring will provide the remaining fill material. An elevation of approximately 6360 ft (MSL) is where the interface between the reclaimed tailings surface and the reclaimed millsite "burial" area will occur. To the east, additional borrow materials will be used to raise the existing 6350 ft (MSL) contours of the millsite "burial" area to an approximate 6360 ft elevation where the contours will blend into the reclaimed tailings surface.

To the west of the "burial" area, the surface of the ore pad, situated at an approximate elevation of 6351 ft, is presently covered with concrete and therefore will be allowed to remain intact. At least two feet of clean borrow material will be used to cover the ore pad.

The entire millsite area will be recontoured as necessary to achieve a final contour design pattern as shown in Figure 5. The cross-sections of the reclaimed millsite area including the millsite "burial" area following final reclamation are shown in Figure 4. See Figure 6 for location of these cross-sections. Included in reclamation of the millsite area is backfill of the acid plant cooling water pond located west of the ore pad. The post-mill decommissioning contours, drainage restoration, and material placement plan are shown in Figure 5.

The final topslopes of the reclaimed millsite area will range from 800h:1v to 21h:1v. The topslopes will be covered with six inches of rock. The rock cover will extend over the entire millsite area (see Figure 5). Outslopes of the reclaimed millsite area will be no steeper than 10h:1v. The outslopes will be covered with twelve inches of rock.

The rock cover on both topslopes and outslopes will consist of 1.5- to 3-inch diameter rock as well as some finer materials. The borrow area for rock cover is shown in Figure 6 and is the same rock borrow area depicted for reclamation of the tailings retention system in the WNI reclamation plan submitted June 30, 1987. Because of the age of existing granite, the integrity of the granitic rock cover over the reclaimed millsite area will not be degraded by erosional forces.

On the northern edge of the reclaimed millsite area, drainage established around the reclaimed tailings retention system (as incorporated in the WNI reclamation plan submitted June 30, 1987) which accommodates the probable maximum flood will be extended westerly beyond the edge of the reclaimed millsite area (see Figure 5). The drainage channel established to the west of the reclaimed tailings retention system and to the south of the reclaimed millsite area will intercept runoff from precipitation events directed to that channel (see Figure 5). With the final slope configurations, as well as the rock cover to be provided for final reclamation, the integrity of the reclaimed millsite will achieve the design objectives specified by criterion 4 of Appendix A to 10 CFR 40.

As one of the final phases of the entire millsite and tailings reclamation scheme, topsoil to a depth of 18 inches from the borrow areas will be stockpiled for subsequent revegetation. Borrow areas will be recontoured to provide a regraded configuration approximating original conditions. These areas subsequently will be stabilized by revegetating.

Section 3.5 Decommissioning Schedule

The decommissioning schedule encompasses a period of twelve months and is shown in Table 3-2. As indicated in Section 3.3, Interim Containment, the consolidated equipment and buildings will remain piled in place to allow for settlement. The millsite "burial" area will be covered and stabilized when surface reclamation of the tailings pond occurs.

Section 3.6 Cost Estimates

Detailed cost estimates are provided in attached Table 3-3. Cost estimates include: (a) dismantling and compaction of all equipment and materials within the millsite "burial" area; and (b) ultimate reclamation of the entire millsite area, including interfacing with reclaimed tailings by placement of a minimum of 2 feet of soil cover and rock rip-rap of 6 inches on topslopes and 12 inches on outslopes.

The cost estimates for mill decommissioning and millsite reclamation presented herein differ from the estimates provided in item 1, Table 10-1 of the June 30, 1987 WNI reclamation plan for the tailings retention system. Specific independent contractor estimates have been used to develop more accurate and somewhat reduced costs for the dismantling of equipment and buildings. Whereas the June 30, 1987 costs for dismantling were estimated to total $1,050,000, the dismantling costs estimated herein have been reduced to $638,0000 (see Table 3-3).

In contrast with the June 30, 1987 independent contractor estimated costs for earthwork (for 2 feet of soil plus a rock cover), increased soil fill and rock requirements for reclamation of millsite area have correspondingly increased from $818,000 to $1,217,000 in this plan (see Table 3-3).

The June 30, 1987 reclamation plan for the tailings retention system estimated total millsite reclamation costs at $1,868,000. Revised cost estimates of the detailed decommissioning plan provided herein are projected to be $1,855,000, which does not significantly differ from the previous estimate of June 30, 1987.

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Section 4.0 Radiation Safety Procedures and Precautions

Decommissioning work is a straightforward exercise of dismantling and handling of equipment with the exception that added precautions must be taken to protect workers from residual radioactive materials. Accordingly, all dismantling and decommissioning procedures will be conducted under the auspices of radiation work permit procedures that WNI originally developed during milling operations for both routine and nonroutine maintenance activities.

Because of the extent of residual radioactive contamination anticipated to be present, no preliminary surveys for radioactive contamination were deemed useful. Rather, detailed surveys will be conducted under the auspices of issuance of radiation work permits. Prior removal of source materials from the mill necessarily reduces problems encountered during previous milling operations with airborne uranium and the daughter products of uranium. The primary radiological hazards that may be encountered during decommissioning include resuspension of residual airborne radioactive materials that would follow an inhalation pathway as well as exposure to alpha, beta, and gamma radiation that would follow an external exposure pathway. The radiation work permit procedures described herein will isolate and identify potential radiological hazards prior to the commencement of dismantling or decommissioning work to assure appropriate precautions for worker protection are maintained.

Because of the potential radiological hazards associated with decommissioning activities, a comprehensive radiation safety protection program will be adhered to which consists of the following elements:

1. Management control
2. Radiation safety training
3. Security
4. Radiation work permits
5. Radiation protection and monitoring
6. Contamination control
7. Instrument maintenance
8. Site monitoring
9. Written Operating Procedures

All decommissioning activities will be performed with the intent of maintaining radiation exposures to workers as low as is reasonably achievable (ALARA).

Section 4.1 Management Control

Primary individuals responsible for the implementation and adherence to dismantling procedures and radiation protection programs include the Resident Manager and the Radiation Safety Officer (RSO). Professional qualifications for the RSO will comply with the provisions of NRC Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be As Low As is Reasonably Achievable."

The Resident Manager is responsible for assuring dismantling and decommissioning activities are performed in the most cost- and time-effective manners.

The RSO is responsible for the implementation of and adherence to the radiation safety programs. The RSO works closely with the Resident Manager to ensure established radiation protection measures are maintained. The RSO is responsible to assure facilities are inspected to verify compliance with applicable requirements. The RSO is also responsible for the collection and interpretation of all monitoring data, to include data from industrial and radiological safety monitoring programs. The RSO recommends measures, as necessary, to improve any and all safety-related controls.

The RSO has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or is a violation of Nuclear Regulatory Commission (NRC) requirements. The RSO is also responsible for administering the ALARA program and is active in review and approval of plans or changes in plans for dismantling to assure that the procedures do not adversely affect worker protection.

Section 4.1.1 Management Audits

Independent auditing of all radiation associated practices will be performed at least every six months during decommissioning activities. Auditing for purposes of verifying compliance with applicable radiation protection requirements will be performed by a professional qualified in radiation health physics protection practices. Results of the audits and recommendations will be submitted to the Resident Manager. In addition to auditing for verification for compliance with applicable radiation protection requirements, a review of all radiation protection practices and monitoring data will also be performed to determine whether worker exposures are maintained ALARA. Results and recommendations of the ALARA review will also be submitted to the Resident Manager for follow-up action. Written Operating Procedures for the audit/ALARA review are attached hereto as Appendix B.

Section 4.1.2 ALARA Program

To assure worker exposures are maintained as low as reasonably achievable, WNI will maintain an active ALARA review program. The program will consist of specific worker training regarding the potential radiological hazards of each task, independent inspections by management personnel and the RSO, and continuing review of both personnel and onsite monitoring data.

Section 4.1.3 Radiation Safety Administrative Procedures

In addition to the initial inspection performed prior to issuance of radiation work permits, documented daily inspections for radiation safety hazards will be conducted by the RSO or delegate. Results of these daily inspections will be submitted to the Resident Manager for periodic review and corrective action as warranted.

Once per month, the RSO will submit a written report to the Resident Manager that summarizes and evaluates monitoring data, address any trends or anomalous conditions, identifies any conditions of noncompliance, and recommends any corrective actions appropriate to reducing worker exposures ALARA.

Section 4.2 Radiation Safety Training

All workers will be given general radiation safety training that complies with the provisions of 10 CFR 19.12, Instructions to Workers. Female workers will also be instructed in the potential health problems associated with prenatal radiation exposures outlined in NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." A general outline of the radiation safety training is attached to this plan as Appendix C. A written test addressing applicable principles of the radiation safety program will be administered to each worker. Test results will be reviewed and any incorrect answers discussed to assure worker understanding of appropriate protection practices. Results of testing will be maintained in each worker's file.

Although retraining would routinely be appropriate on an annual basis, no retraining is deemed warranted since dismantling actvities are to be completed within a twelve-month period.

In addition, task training will be performed as necessary in accordance with specific hazards identified at the time of issuance of radiation work permits.

Section 4.3 Security

Access to the restricted area is maintained via posting and fencing. This access restriction will be maintained until surface reclamation is completed.

All visitors are required to register at the main office and are not permitted within the restricted area without proper authorization. Where appropriate, visitors will be instructed in radiation safety requirements specific to their project activities. All visitors touring the restricted area will be escorted by an individual who is properly trained and knowledgeable about potential radiation safety hazards associated with decommissioning.

Parking for visitors and personal vehicles will be available outside the retricted area.

Section 4.4 Radiation Work Permit Procedures

All decommissioning activities will be performed under the auspices of radiation work permits (RWPs). The protocol dictated by a RWP includes the following:

1. Identify areas within which the dismantling activities will be conducted.

2. Perform inspections and surveys--alpha, beta, and gamma, where appropriate, to define potential radiological hazards.

3. Where residual radioactive materials may be involved, perform initial sampling for airborne uranium and for presence of radon daughters and to determine the need to continue sampling

during dismantling activities. Identify potential radiological hazards.

4. Specify precautions to be taken and monitoring to be performed. Precautions will include hosing down areas where the potential for resuspension of airborne radioactive dust may occur as well as time and access restrictions where there is a potential for elevated external radiation exposures.

5. Identify additional personnel protective devices, including protective clothing or respirators to be worn.

6. Provide task-specific training as appropriate to assure exposures are ALARA and activities are conducted in a safe manner.

7. Specify that any anomalous conditions not encountered at the time of the issuance of the RWP be reported immediately to the RSO for further investigation.

Following completion of the activities authorized by the RWP, an exit interview with the RSO will be performed to complete the RWP. This process assures active control over all activities. Written Operating Procedures (WOPs) regarding Radiation Work Permits are attached hereto as Appendix F. WOPs for alpha, beta, and gamma surveys are included in attached Appendix D.

Section 4.5 Radiation Protection and Monitoring Program

The radiation protection measures described herein as well as monitoring will assure work exposures remain ALARA.

Section 4.5.1 Internal Exposure Control

Prior to initiation of work activities, the RSO or delegate will determine the need for personal lapel sampling as well as area sampling for airborne radioactive materials. Where the potential for resuspension of residual radioactive materials is determined, sampling for airborne uranium will be conducted. Written operating procedures describing both personal lapel sampling and "high-volume" area sampling are presented in attached Appendix E.

Where "high-volume" area sampling is determined to be appropriate, at least one "high-volume" air sampler will be stationed in the specific work area authorized by the RWP.

For work involving equipment and materials contained in the precipitation/drying/packaging sections of the mill, all workers will wear personal lapel samplers. For work in any tank that routinely contained radioactive materials, all workers will wear personal lapel samplers. As an added precaution, no tanks or vessels contained in the precipitation/drying/packaging sections of the mill will be entered for purposes of dismantling; rather, all work will be conducted from the outside of the tank or vessel. For work in all other areas involving residual radioactive materials, at least twenty-five percent (25%) of all workers will wear lapel samplers.

Air sample filters will be routinely analyzed for uranium using a gross-alpha analysis. Results of area monitoring data will be correlated with any personal lapel sampling data to calculate employee exposures in accordance with 10 CFR 20.103.

Where initial sampling prior to the issuance of a RWP determines radon daughters to be present in concentrations in excess of 0.04 W.L., (10% of MPC), additional sampling will be provided on at least a daily basis until the dismantling activities authorized by the RWP are completed. Radon daughter concentrations will be determined using the modified Kusnetz method or equivalent.

Section 4.5.2 External Radiation Exposure Control

External gamma radiation exposure to all workers physically involved with decommissioning work activities will be monitored by use of thermoluminescent dosimeter (TLD) badges. Badges will be exchanged quarterly and returned to the manufacturer-supplier for processing. The supplier will provide immediate notification for any result that exceeds 1 rem.

Results of TLD monitoring will be correlated with external gamma radiation rate surveys performed at the time of issuance of radiation work permit. In addition, where external gamma exposure rates exceed 2 mR/hr, either additional spot surveys will be performed or individual pocket dosimeters will be provided during dismantling activities. As necessary, work restrictions will be imposed to maintain worker exposures ALARA. Results of all surveys will be documented and maintained on file.

Section 4.5.3 Bioassay

Urine samples will be collected and analyzed in accordance with the requirements of NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills." Where respiratory protective equipment is used in accordance with NRC Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," urine samples will be taken pursuant to provisions of the regulatory guide.

For dismantling work involving the leaching, RIP, SX, classification, and precipitation/drying/packaging sections of the mill, urine samples will be routinely collected on a weekly basis. For all other dismantling work, urine samples will be collected on a monthly basis. In all instances where respirators have been used in areas where soluble uranium may be present, urine samples will be taken within 48 to 96 hours following respirator usage.

Samples will be collected outside the restricted area after the worker has showered. From the time of sample collection, turnaround time for analyses will not exceed twenty-one (21) days. Quality assurance procedures will include the following:

1. Blanks will be submitted with all urine samples

2. Since a chemical laboratory affording appropriate radiation protection practices will not be available onsite to spike samples, twenty-five percent (25%) of all samples submitted will be split and submitted to a separate laboratory for analyses. Both laboratories will spike samples in accordance with Regulatory Guide 8.22. Should results of spiked sample values exceed 30% of "true" values, the laboratory will repeat all analyses. Results of all analyses, including results of spiked samples, will be reported to the RSO who will evaluate the data and compare split sample data from the two laboratories.

3. Laboratories will be required to submit surface contamination survey results verifying all surfaces where urinalyses are performed do not exceed 10 dpm removable alpha/100 square centimeter prior to analyses.

The laboratories will immediately report any urinalysis results that exceed fifteen (15) micrograms of uranium per liter. The RSO will perform an investigation which will include confirmation sampling and a review of airborne sampling data to ascertain the probable cause and impact on other workers. Work restrictions will be imposed as necessary. Furthermore, additional protective measures including engineering controls and respiratory protection will be implemented where deemed warranted. Detailed precautions are set forth in written operating procedures attached hereto as Appendix G.

Whole body counting (in-vivo) will be conducted on any individual suspected of exceeding the quarterly MPE for insoluble airborne uranium. This procedure will be conducted at an offsite facility where the individual will be isolated and monitored by qualified personnel. All results will be reviewed by the RSO and reporting will be conducted in accordance with 10 CFR 20 regulations.

Section 4.5.4 Personnel Contamination Control

All workers involved with decommissioning work will be required to change clothing and monitor themselves prior to leaving the property.

In addition, where work with yellowcake concentrate is to be performed, special protective clothing will be provided which will be laundered onsite, and workers will be required to shower and monitor themselves prior to leaving the restricted area.

A written operating procedure, included in attached Appendix D, will be posted near the personnel monitor and all workers will be instructed in proper use of the instrument. If the preset alarm indicating an action level of 1000 dpm total alpha/100 square centimeters is exceeded, the worker will shower and perform a follow-up survey. Results of all exit surveys will be documented in a log book positioned near the survey monitor. Performance testing of monitor response will be performed and documented on a daily basis by using a check source. Once per week, the RSO will verify instrument response by this same performance testing method. Should the performance test reveal a deviation by a factor of 20% from the anticipated check source response determined at the time of calibration, the instrument will be recalibrated. The exit monitor will be calibrated at least semi-annually or after repair.

Section 4.5.5 Contamination Surveys and Control

Designated eating areas, change rooms, and offices, will be surveyed on a weekly basis in accordance with NRC Regulatory Guide 8.30, "Health Physics Surveys at Uranium Mills." An action level of 1000 dpm removable alpha/100 square centimeters will prompt decontamination procedures and subsequent contamination surveys. Results of all surveys will be documented and maintained in file. Written Operating Procedures for alpha surveys are included in attached Appendix D.

Section 4.5.6 Respiratory Protection

Respirators will be used in accordance with provisions of NRC Regulatory Guide 8.15, "Acceptable Programs for Repiratory Protection." The written operating procedures for the WNI respiratory protection program are attached hereto as Appendix H. Where respirators are used in accordance with Reg Guide 8.15, allowances will be taken for respirator usage in determining internal exposures to airborne radioactive materials.

Section 4.5.7 Protective Clothing

All workers who will be involved with decommissioning activities will be required to wear protective work clothing. This clothing will be laundered by facilities to be provided onsite at the time of decommissioning.

For work in the precipitation/drying/packaging sections of the mill where beta contamination exists, workers will be provided with additional protective clothing, e.g., rubber gloves and rubber steel-toed boots. Rubber boots will be washed onsite. Rubber gloves will be buried with dismantled equipment.

Section 4.5.8 Instrument Maintenance

All beta, gamma, and alpha survey instruments will be calibrated on at least a semi-annual basis or following repair. At least daily when an instrument is to be used, performance checks will be performed using a radiation check source. Should the instrument response deviate more than 20% from the reference reading for that source as determined at the time of calibration, the instrument will be repaired and recalibrated.

"High-volume" air sample pumps to be used for area airborne air sampling will be calibrated at least weekly. Personal lapel samplers will be performance-tested prior to each issuance to calibrate flow rates.

Section 4.6 Site Monitoring

Environmental monitoring will continue at the Split Rock Millsite. At least one air sampling station downwind of the millsite, as well as one station at a remote background site, will be maintained through millsite and tailings reclamation.

Section 4.7 Hazard Control

At least daily inspections will identify potential radiological safety hazards. Precautionary measures will be taken as appropriate.

In the event of fire, the Jeffrey City fire department will be called for assistance.

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LIST OF TABLES

TABLE 2-1
MAJOR EQUIPMENT LIST--MILL

Equipment	Status*	Qty	Description	Alternate Capacity or Specifications
Ore Receiving;				
Grizzly Ore Receiving	c	1	24" Grizzly & steel hopper	25-ton storage capacity
Apron Feeder	c	1	Ore feed system	48"x20' variable speed
Grinding:				
Pulp Storage	d	2	Closed, vertical steel tanks	25'x50' 675-ton capacity
Semi-autogenous grind mill	c	1	Cylindrical steel grind mill	18'x6' variable capacity
DSM screens	d	6	Stationary size separators	4'x4'
Leach:				
Leach tanks	d/a	11	Cylindrical wood stove mixing tanks w/mechanical agitators	16'x16', 20'x16', & 10'x22' w/25-30 hp agitators
Clarification & Wash:				
Classifiers	d	4	Drag classifiers for wash & separation	10'x18', 5 to 10 hp drive
Resin-in-Pulp Section:				
Cyclones	a	28	Hydroclone-size separators & wash units	6"x10" dia. of variable capacity
Screens	c	44	Vibrating screen separators	4' square--variable capacity & mesh

* See Footnotes

- continued

TABLE 2-1
MAJOR EQUIPMENT LIST--MILL
(continued)

Equipment	Status*	Qty	Description	Alternate Capacity or Specifications
Screens	c	14	Vibrating screen separators	5' dia--variable capacity & mesh
RIP Tanks	d/a	14	Cylindrical wood-stove mixing tanks w/mechanical agitators	14' dia x 14' depth w/10 hp agitators
RIP Tanks	d/a	22	Cylindrical wood-stove mixing tanks w/mechanical agitators	7' dia x 8' depth w/5 hp agitators
Clarification:				
Storage & Make-up	d/a	6	Cylindrical wood/steel storage tanks; air or mechanical agitation	Variable--16'x16' & 12'x12'
Filters	d	1	Pressure type leaf clarification filters	100 sq ft filter area
Solvent Extraction:				
Mixer-Settlers Extraction	d	4	Two-compartment mixer & settler sections	12'x20'x5' w/5 hp agitators
Mixer-Settlers Stripping	d	4	Two-compartment mixer & settler sections	4'x20'x5' w/5 hp agitators
Mixer-Settler Organic Scrub	d	1	Two-compartment mixer & settler sections	4"x20"x5' w/5 hp agitators

* See Footnotes

- continued

TABLE 2-1
MAJOR EQUIPMENT LIST--MILL
(continued)

Equipment	Status*	Qty	Description	Alternate Capacity or Specifications
Precipitation:				
Precipitation Tanks	d	2	Cylindrical steel tanks, FRP lined	5' dia x 5' depth
Steam Boiler	d	1	Gas-fired 100 psi steam boiler	150 hp, 5180 lbs steam per hr, 5020 M BTU/hr output
Steam Boiler	d	1	Gas/oil-fired steam boiler	50 hp 1680 M BTU/hr output
Sodium Chlorate Feed Tanks	d	2	Cylindrical steel tanks, open, one agitated	8' dia x 8' depth, 2300 gal working capacity, 10 hp agitator drive
Yellowcake Thickeners:				
Thickeners	d	2	Cylindrical lined steel tanks	20' dia x 10' depth, 5 hp rake drive
Centrifuge	c	2	Centrifugal Separator	18x28 horizontal bowl, 15 hp drive, continuous
Drying & Packaging:				
Yellowcake Dryer	d	2	Multiple hearth, gas-fired w/diesel option, raking arms	6' dia up to 10,000 lb/day capacity
Yellowcake Storage Hopper	d	1	Closed steel storage tank w/valved bottom outlet	20,000 lb capacity

* See Footnotes

- continued

TABLE 2-1
MAJOR EQUIPMENT LIST--MILL
(continued)

Equipment	Status*	Qty	Description	Alternate Capacity or Specifications
Scrubber, Y.C. Dryer Stack	d	1	Vertical venturi wet scrubber	1213 ACFM inlet & 785 ACFM outlet air flow 99.0^{+} % efficiency @ 25" W.C.
Scrubber, Y.C. Packaging	d	1	Water injection scrubber	2000 ACFM inlet & 1600 ACFM outlet air flow 99.0% efficiency @ 1-2 microns
Fuel & Reagent Storage:				
Water Storage Tank	d	1	Closed cylindrical steel tank	40' dia x 24' depth 225,000 gal capacity
Lime Storage	a	1	Storage hopper w/screw feeder	50-ton storage w/1.5 hp feeder
Lime Slurry Tanks	d	3	Cylindrical steel tanks--agitated	10' x 10' w/7.5 hp agitator drives
Sodium Chlorate Storage Tanks	d	2	Cylindrical steel tanks	12' dia x 16' depth 12,500 gal working capacity
Ammonia Storage Tanks	b	3	Pressurized cylindrical vessels (horizontal)	7.75' dia & variable length, total capacity 41,000 gal
Sulfuric Acid Storage Tank	c	1	Closed steel tank	30' dia dome-topped, 20' depth

* See Footnotes

- continued

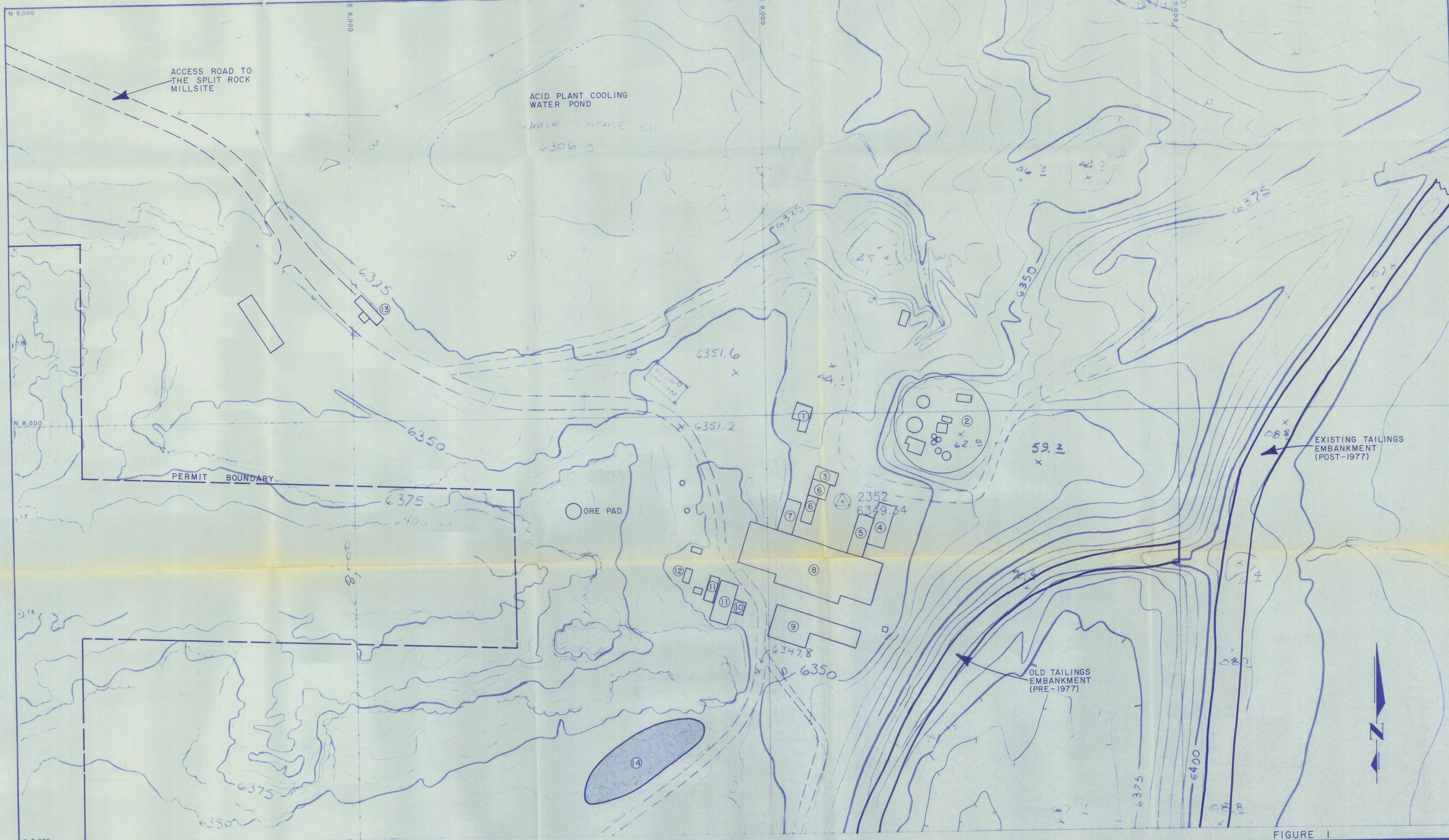
TABLE 2-1
MAJOR EQUIPMENT LIST--MILL
(continued)

Equipment	Status*	Qty	Description	Alternate Capacity or Specifications
Diesel Storage	b	3	Closed cylindrical steel tanks	Total capacity 19,000 gal
Kerosene Storage Tank	b	1	Closed cylindrdical steel tank	6000 gal capacity
Organic Tank	d	1	Kerosene-Amine storage tank	12' dia x 12' depth
Ammonia Vaporizer	d	1	Horizontal gas/oil fired water bath anhydrous NH_3 vaporizer	1200 lb/hr capacity from 20°F
Ammonia Vaporizer	d	1	Vertical, steam-heated anhydrous NH_3 vaporizer	860 lb/hr capacity from 32°F
Compressors;				
L.P. Compressors	d	5	Low pressure, reciprocating type air compressors	1500 cfm @ 50 psig w/ 150 hp drive
H.P. Air Compressors	c	2	High pressure screw-type air compressors	1500 cfm @ 100 psig w/ 300 hp drive

----

* Footnotes:

a = Equipment removed from mill, but still on property
b = Equipment sold or to be sold, but still on property
c = Equipment sold and removed from property
d = Equipment intact in mill complex
d/a = Equipment intact with the exception of mechanical agitators that have been removed from mill, but still on property



LEGEND

1. OLD CRUSHER
2. ACID PLANT
3. ELECTRIC SHOP
4. REAGENT WAREHOUSE
5. SX BUILDING
6. CHEM LAB
7. COMPRESSOR BUILDING
8. MAIN MILL BUILDING
9. MILL WAREHOUSE & OFFICE BUILDING
10. FIRE PUMP BUILDING
11. MILL MAINTENANCE & MACHINE SHOP
12. RUBBER SHOP
13. TRUCK WEIGHING BUILDING
14. TREASURE ISLAND

DATE OF PHOTOGRAPHY
4/16/87

0 50 100 200 300 FEET

CONTOUR INTERVAL 5 FT.

FIGURE I

REVISIONS		
DATE	BY	

PROJECT AREA

STATE ____ COUNTY ____

SECTION ____ TWP ____ RGE ____

TITLE

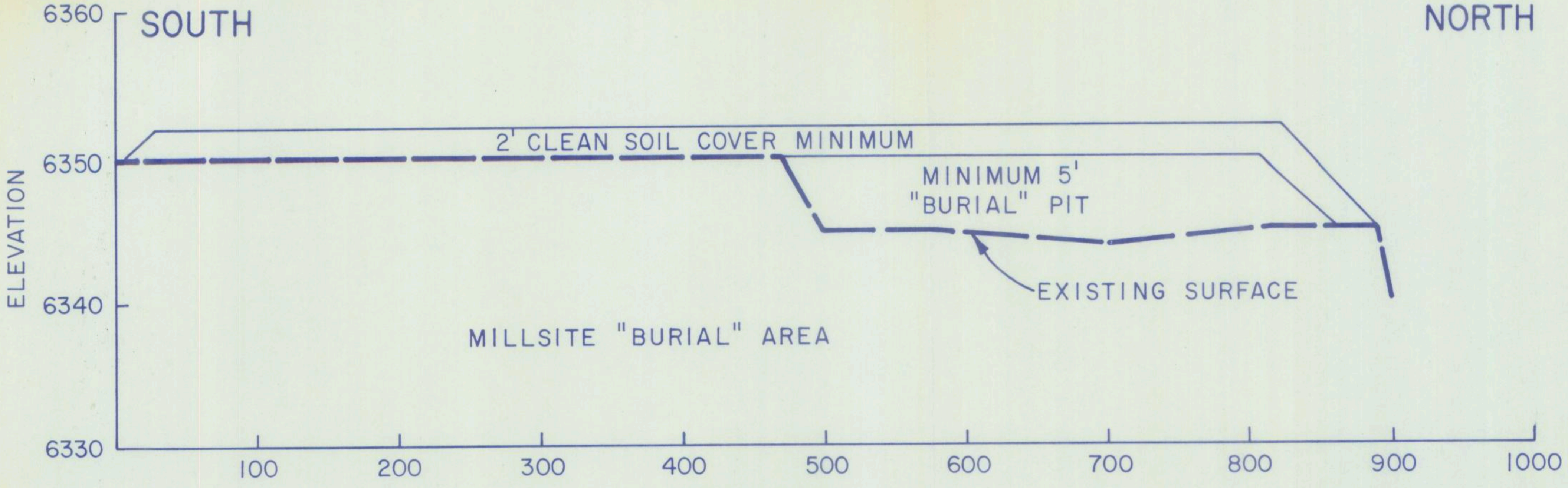
EXISTING SITE CONDITIONS

Design By M.A.P.	Scale	Date	DWG. NO.
Drawn By	Checked By M.A.P.	Sheet ___ of ___	

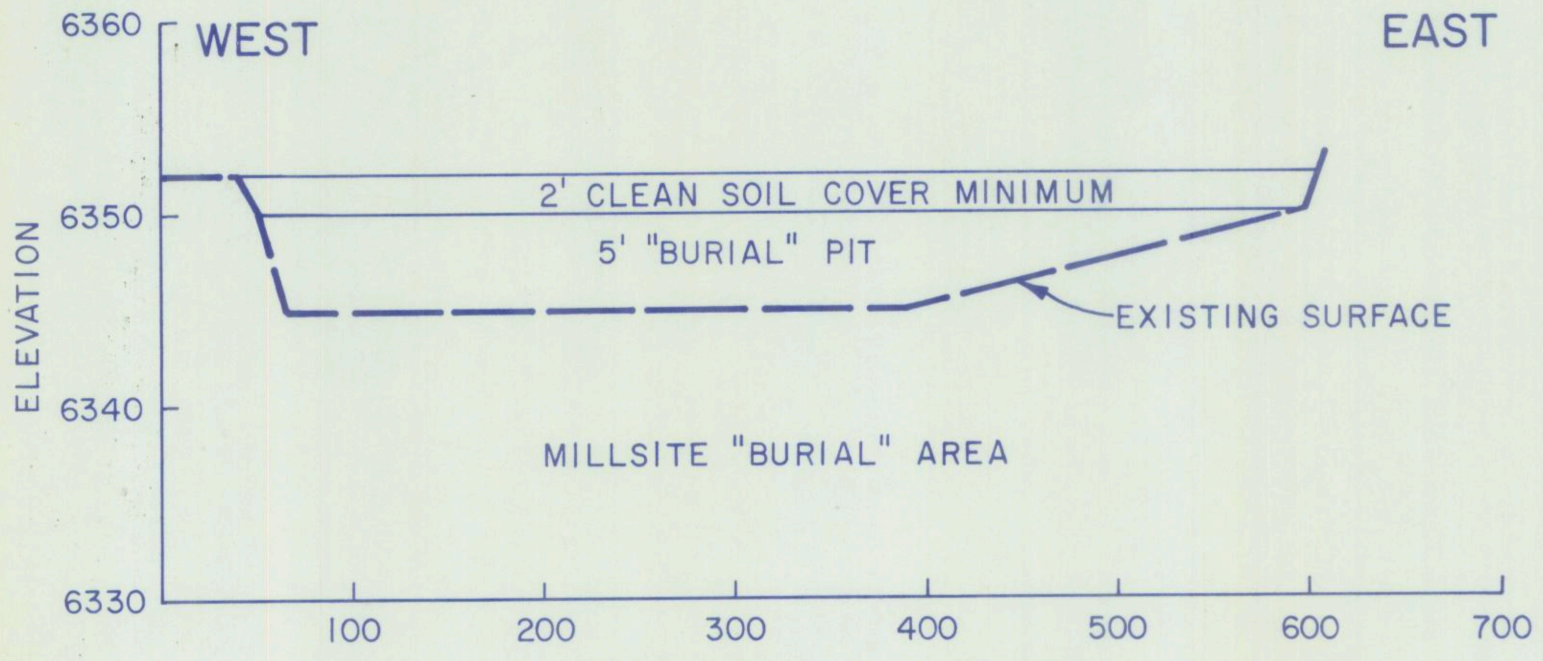
WESTERN NUCLEAR INC.

N 9,000
E 8,000
E 9,000
E 10,000
WATER SURFACE EL
6306.0
6325
6350
6375
6400
6351.6
6351.2
6347.8
2352
6349.34
59.2
N 8,000
N 7,000
PERMIT BOUNDARY
"BURIAL" LIMIT FOR CONTAMINATED EQUIPMENT
A
B
N
DATE OF PHOTOGRAPHY 4/16/87
0 50 100 200 300 FEET
CONTOUR INTERVAL 5 FT.
REVISIONS
DATE
BY
PROJECT AREA
STATE
COUNTY
SECTION
TWP
RGE
TITLE:
MILLSITE "BURIAL" AREA
Design By M.A.P.
Scale
Date
Drawn By
Checked By M.A.P.
Sheet of
WESTERN NUCLEAR INC.
DWG. NO.

FIGURE 2



SECTION A-A



SECTION B-B

HORIZONTAL SCALE 1" = 100'
VERTICAL SCALE 1" = 10'

FIGURE 3

REVISIONS		
DATE	BY	

PROJECT AREA:

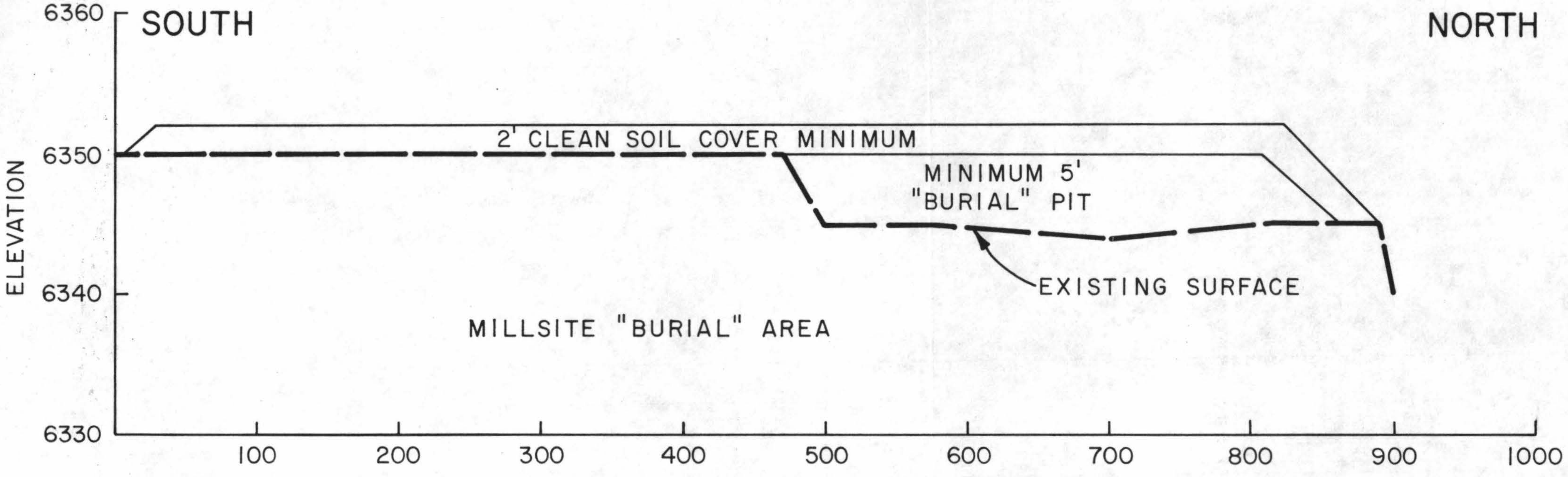
STATE ______ COUNTY ______

SECTION ______ TWP. ______ RGE. ______

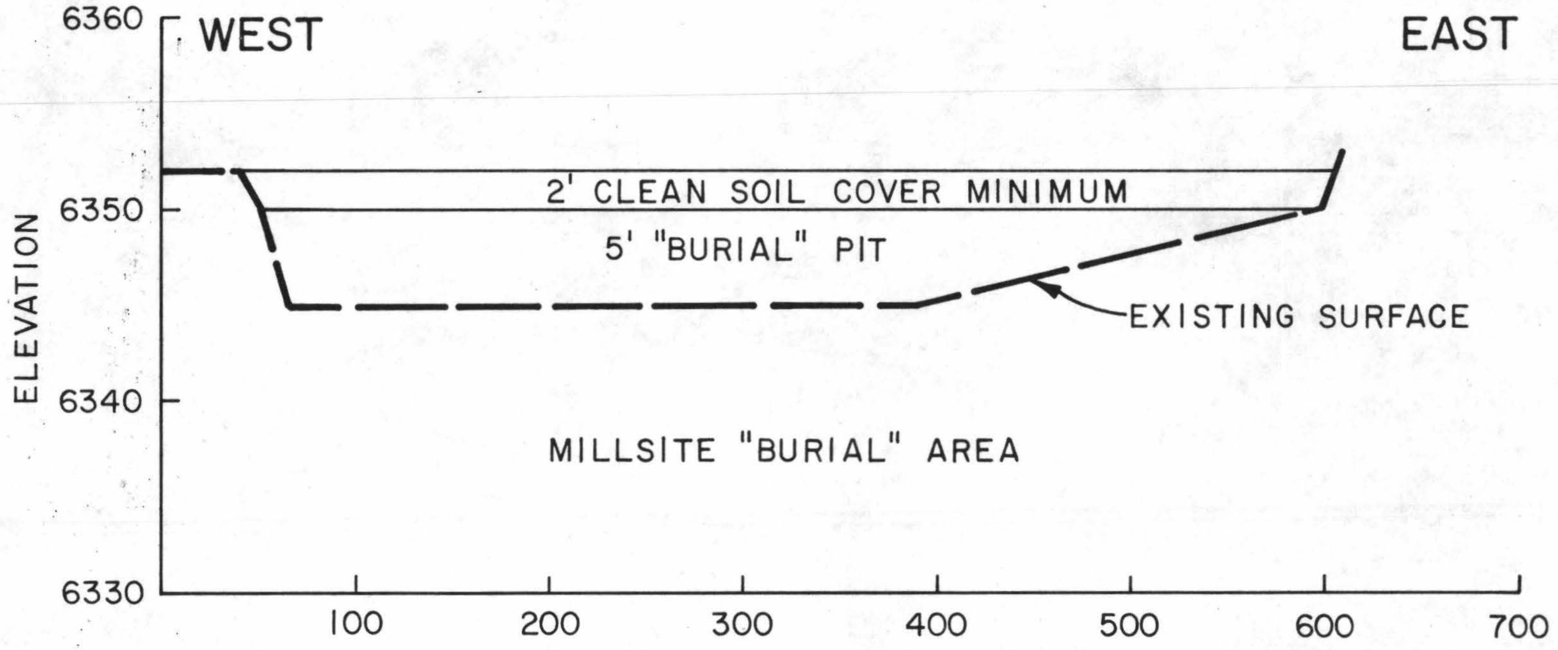
TITLE:
CROSS SECTIONS OF
MILLSITE "BURIAL" AREA

WESTERN NUCLEAR INC.

Design By M.A.P.	Scale	Date	DWG. NO.
Drawn By	Checked By M.A.P.	Sheet ___ of ___	



SECTION A-A



SECTION B-B

HORIZONTAL SCALE 1" = 100'
VERTICAL SCALE 1" = 10'

FIGURE 3

REVISIONS		
DATE	BY	

PROJECT AREA:

STATE ______ COUNTY ______

SECTION ______ TWP. ______ RGE. ______

TITLE:
CROSS SECTIONS OF
MILLSITE "BURIAL" AREA

WESTERN NUCLEAR INC.

Design By M.A.P.	Scale	Date
Drawn By	Checked By M.A.P.	Sheet ___ of ___

DWG. NO.

LEGEND

- ROCK COVER & RIPRAP BORROW AREA
- SOIL COVER BORROW AREA
- POTENTIAL SOIL BORROW AREA

FIGURE 6

SCALE: 1" = 400'
CONTOUR INTERVAL: 5'
DATE OF PHOTOGRAPHY: 4/16/87

REVISIONS		
DATE	BY	

PROJECT AREA:
STATE ______ COUNTY ______
SECTION ______ TWP. ______ RGE. ______
TITLE:
BORROW AREA

Design By M.A.P.	Scale	Date
Drawn By	Checked By M.A.P.	Sheet __ of __

DWG. NO.

Prepared by IntraSearch Denver, Colorado

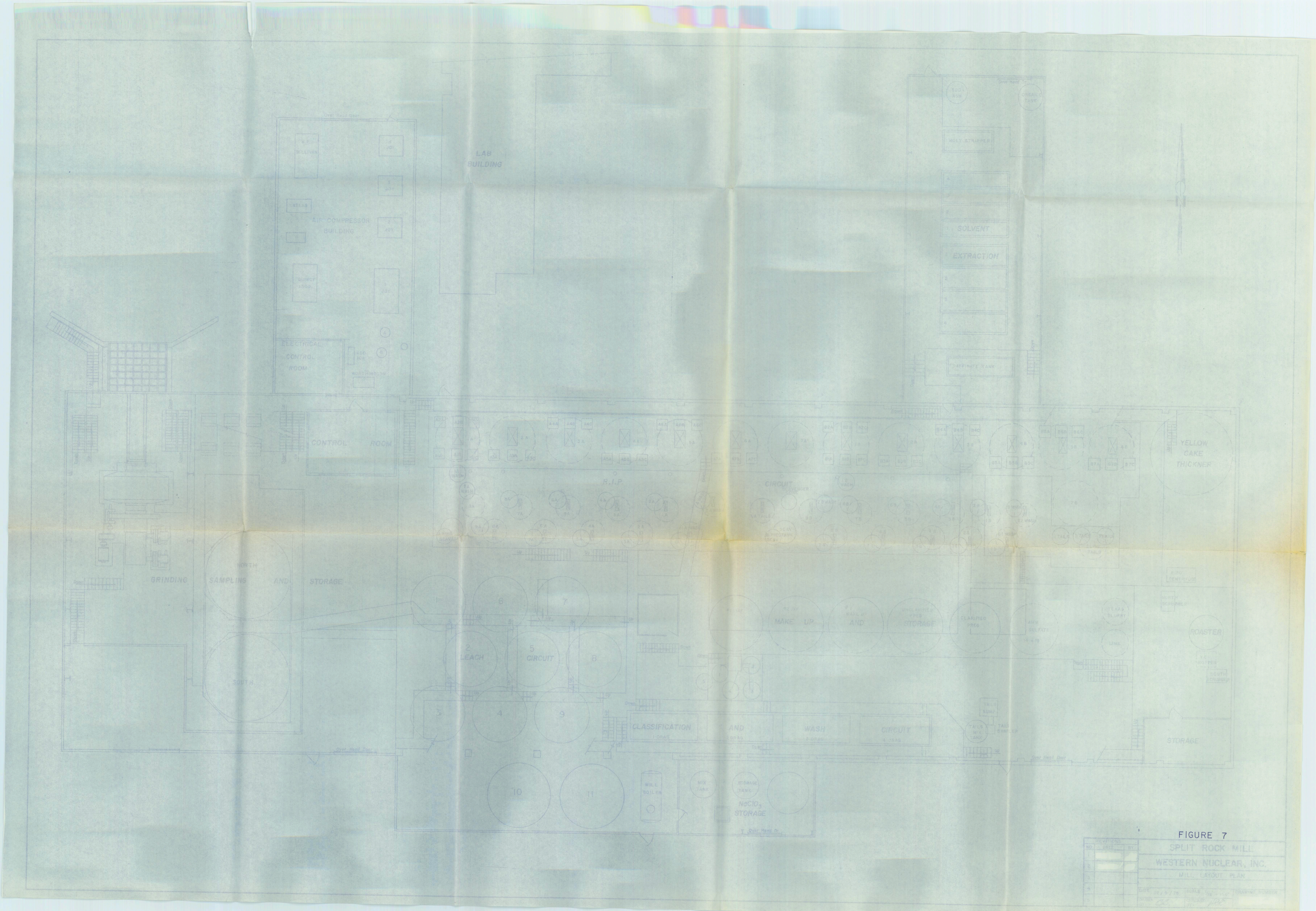
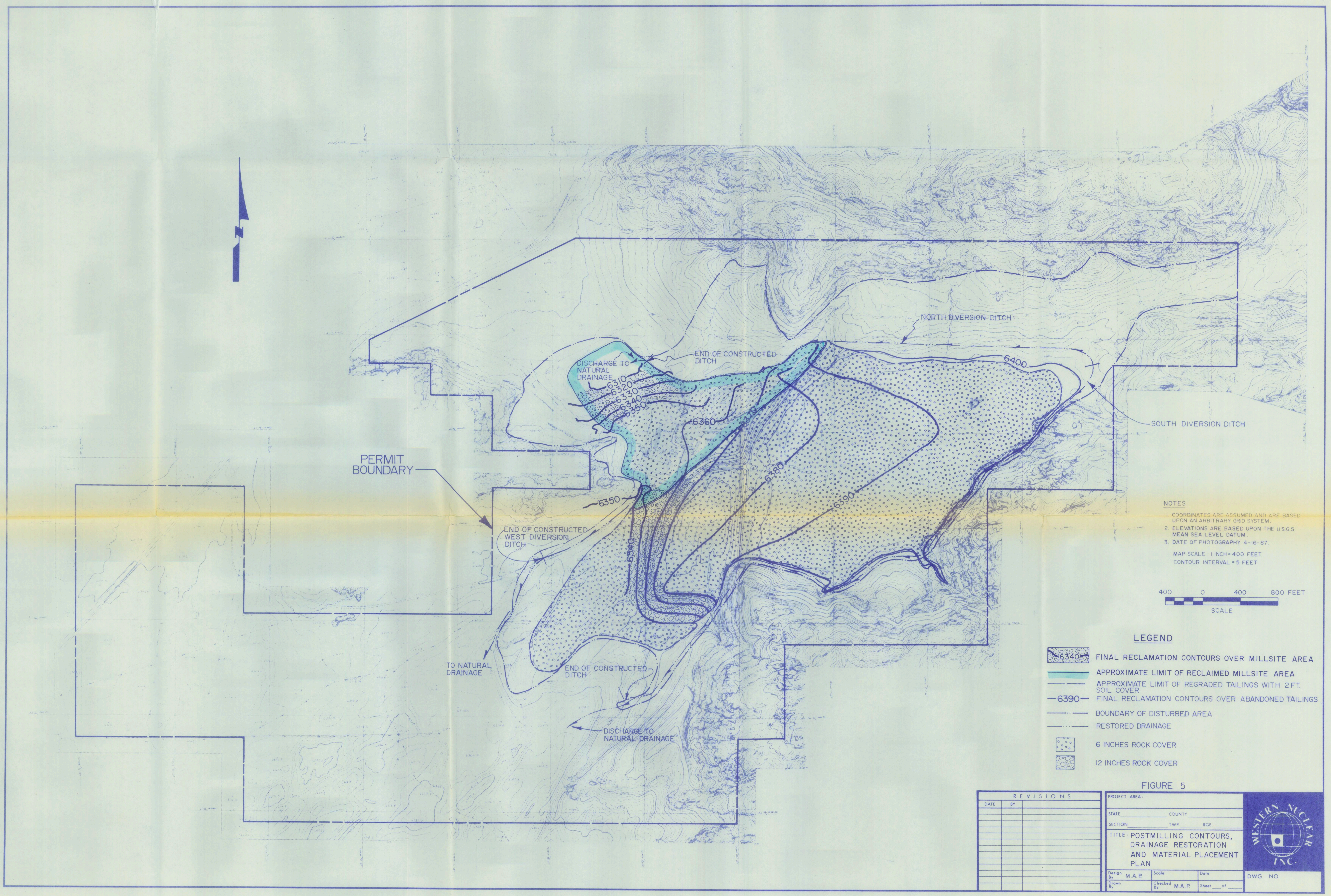
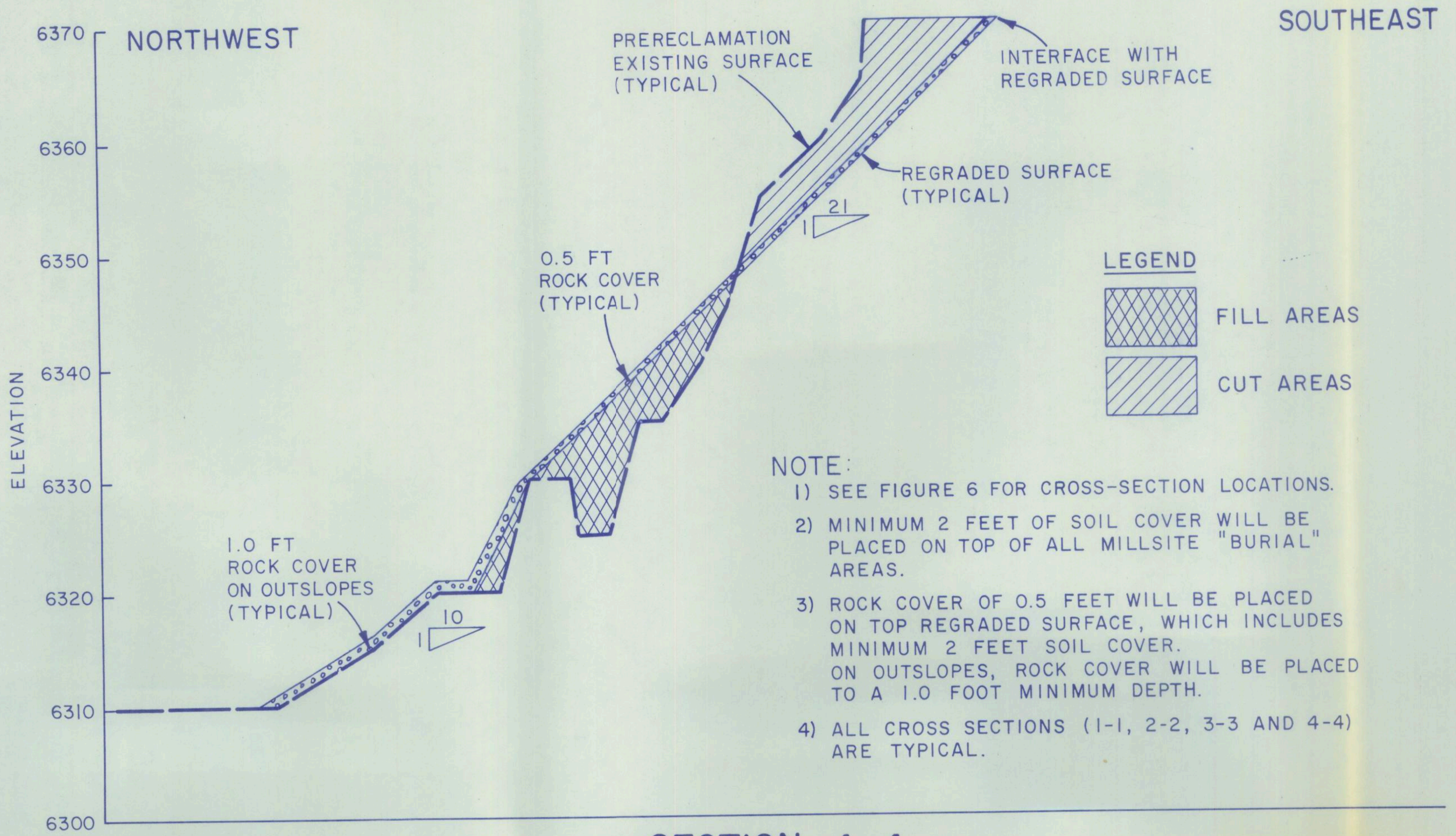

LAB BUILDING
AIR COMPRESSOR BUILDING
ELECTRICAL CONTROL ROOM
SOLVENT
EXTRACTION
CONTROL ROOM
R.I.P.
CIRCUIT
YELLOW CAKE THICKNER
GRINDING
NORTH
SAMPLING AND STORAGE
SOUTH
LEACH
CIRCUIT
MAKE UP
AND
STORAGE
ROASTER
CLASSIFICATION
AND
WASH
CIRCUIT
STORAGE
$NaClO_3$ STORAGE
REVISIONS
NO.
DATE
BY
SPLIT ROCK MILL
WESTERN NUCLEAR, INC.
MILL LAYOUT PLAN
DATE 12 / 9 / 75
SCALE 3/32" = 1'-0"
DRAWING NUMBER
DRAWN BY:
CHECKED BY:

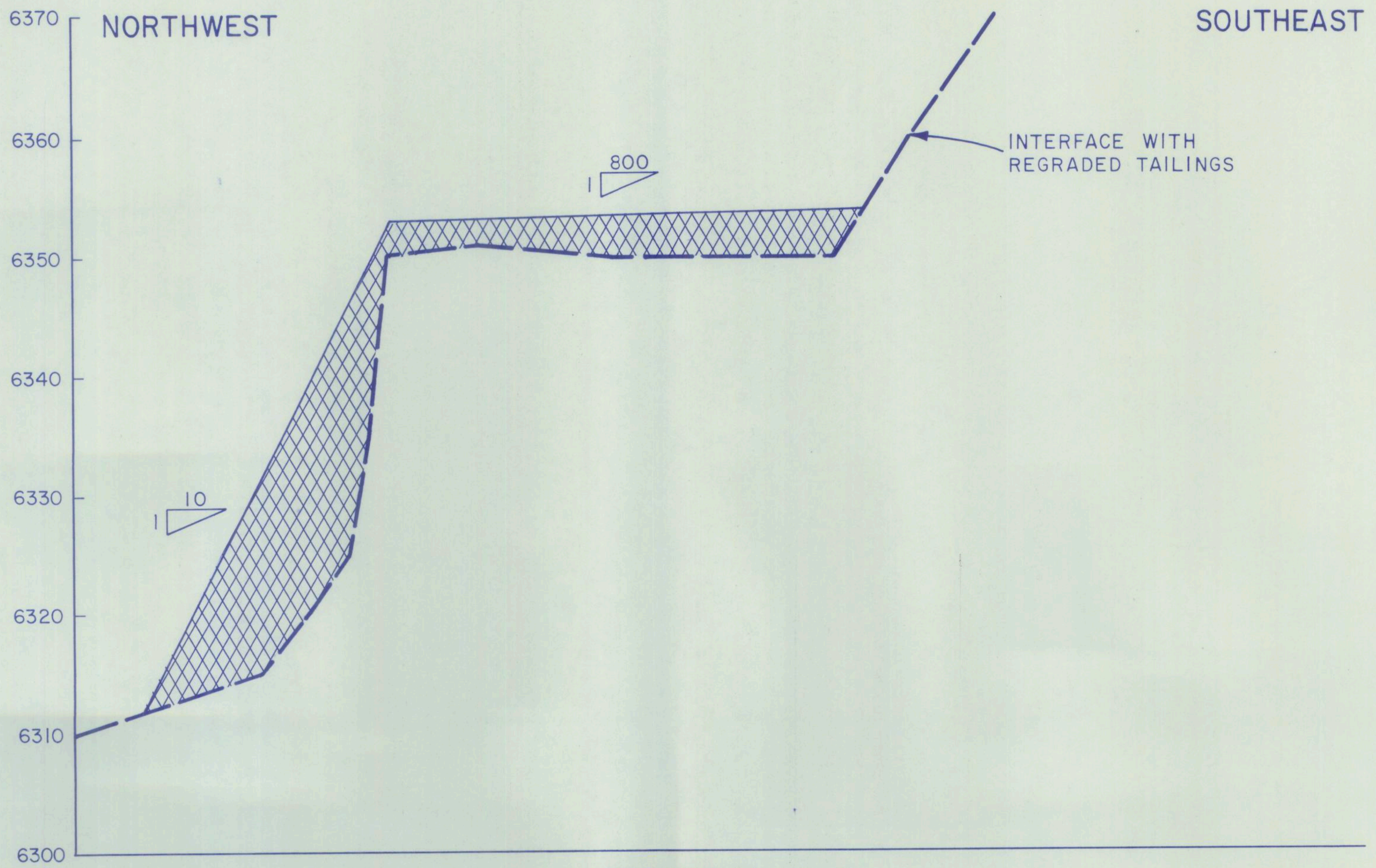
FIGURE 7


PERMIT BOUNDARY
NORTH DIVERSION DITCH
SOUTH DIVERSION DITCH
END OF CONSTRUCTED DITCH
DISCHARGE TO NATURAL DRAINAGE
END OF CONSTRUCTED WEST DIVERSION DITCH
TO NATURAL DRAINAGE
END OF CONSTRUCTED DITCH
DISCHARGE TO NATURAL DRAINAGE
6310
6320
6330
6340
6350
6360
6350
6380
6380
6390
6400
NOTES:
1. COORDINATES ARE ASSUMED AND ARE BASED UPON AN ARBITRARY GRID SYSTEM.
2. ELEVATIONS ARE BASED UPON THE U.S.G.S. MEAN SEA LEVEL DATUM.
3. DATE OF PHOTOGRAPHY 4-16-87.
MAP SCALE: 1 INCH = 400 FEET
CONTOUR INTERVAL = 5 FEET
400 0 400 800 FEET
SCALE
LEGEND
6340 FINAL RECLAMATION CONTOURS OVER MILLSITE AREA
APPROXIMATE LIMIT OF RECLAIMED MILLSITE AREA
APPROXIMATE LIMIT OF REGRADED TAILINGS WITH 2 FT. SOIL COVER
6390 FINAL RECLAMATION CONTOURS OVER ABANDONED TAILINGS
BOUNDARY OF DISTURBED AREA
RESTORED DRAINAGE
6 INCHES ROCK COVER
12 INCHES ROCK COVER
FIGURE 5
REVISIONS
DATE
BY
PROJECT AREA:
STATE
COUNTY
SECTION
TWP.
RGE.
TITLE: POSTMILLING CONTOURS, DRAINAGE RESTORATION AND MATERIAL PLACEMENT PLAN
Design By M.A.P.
Scale
Date
Drawn By
Checked By M.A.P.
Sheet of
WESTERN NUCLEAR INC.
DWG. NO.

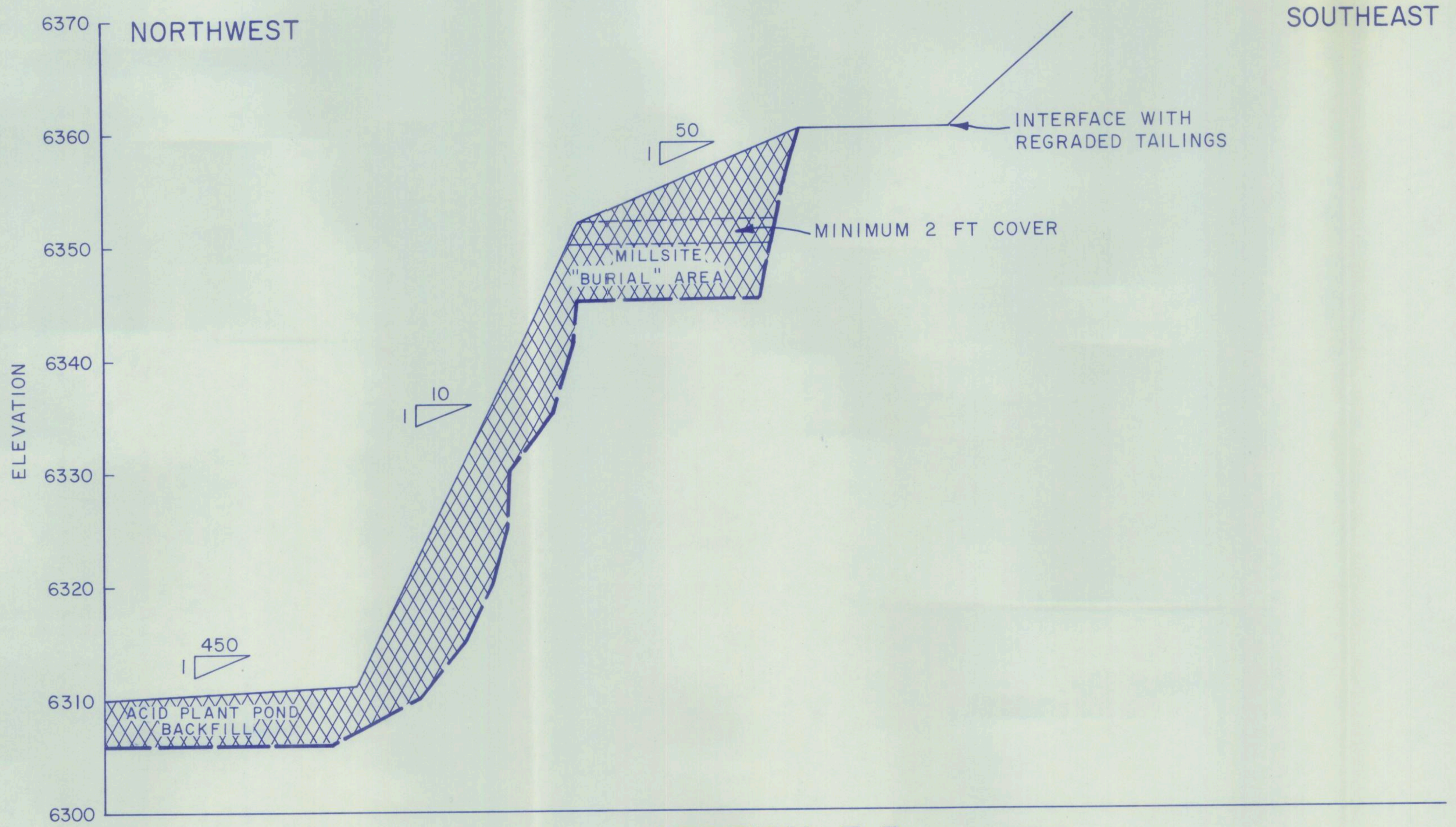


NOTE:
1) SEE FIGURE 6 FOR CROSS-SECTION LOCATIONS.
2) MINIMUM 2 FEET OF SOIL COVER WILL BE PLACED ON TOP OF ALL MILLSITE "BURIAL" AREAS.
3) ROCK COVER OF 0.5 FEET WILL BE PLACED ON TOP REGRADED SURFACE, WHICH INCLUDES MINIMUM 2 FEET SOIL COVER. ON OUTSLOPES, ROCK COVER WILL BE PLACED TO A 1.0 FOOT MINIMUM DEPTH.
4) ALL CROSS SECTIONS (1-1, 2-2, 3-3 AND 4-4) ARE TYPICAL.

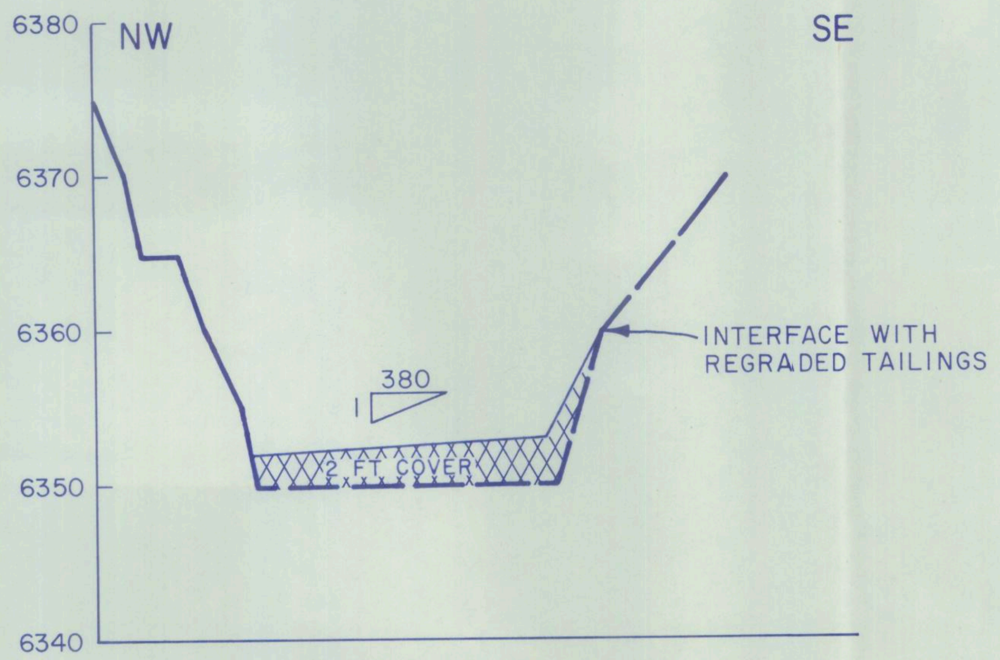
SECTION 4-4



SECTION 2-2



SECTION 3-3



SECTION 1-1

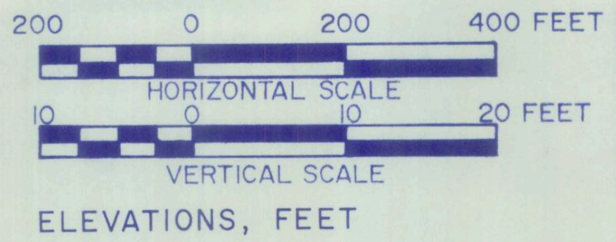


FIGURE 4

REVISIONS	
DATE	BY

PROJECT AREA:
STATE ______ COUNTY ______
SECTION ______ TWP. ______ RGE. ______
TITLE: CROSS SECTIONS OF MILLSITE AREA INCLUDING "BURIAL" AREA AFTER LONG-TERM STABILIZATION

Design By MAP	Scale	Date
Drawn By	Checked By M.A.P.	Sheet ___ of ___

WESTERN NUCLEAR INC.

DWG. NO.

LIST OF APPENDICES

APPENDIX A

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT

PRIOR TO RELEASE FOR UNRESTRICTED USE

OR TERMINATION OF LICENSES FOR

BYPRODUCT OR SOURCE MATERIALS

U. S. Nuclear Regulatory Commission
Uranium Recovery Field Office
Region IV
Denver, Colorado 80225

SEPTEMBER 1984

The instructions in this guide in conjunction with Table I specify the radioactivity and radiation exposure rate limits which should be used in accomplishing the decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table I prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

    a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature extent, and degree of residual surface contamination.

    b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table I. A copy of the survey report shall be filed with the Uranium Recovery Field Office, Region IV, P.O. Box 25325, Denver, CO 80225. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey. The licensee shall not release the premises for unrestricted use without the written approval of the USNRC staff.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[b c f]	MAXIMUM[b d f]	REMOVABLE[b e f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm /100 cm^2	15,000 dpm /100 cm^2	1,000 dpm /100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-118, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except SR-90 and others noted above.	5,000 dpm /100 cm^2	15,000 dpm /100 cm^2	1,000 dpm /100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

APPENDIX B

Management Audits and ALARA Review

DATE: November 1, 1987

SUBJECT: Written Operating Procedures for Radiation Safety Audit/ALARA Review During Decommissioning Activities

---

As part of the WNI management control program, a radiation safety audit/ALARA review is performed. The purpose of the radiation safety audit is both to verify compliance with applicable rules, regulations, and decommissioning requirements and to notify WNI management of corrective actions necessary to achieve compliance. The purpose of the ALARA review is to determine if there are any identifiable trends developing in worker exposures as well as to determine if there are any exposures that might be lowered under the concept of as low as reasonably achievable (ALARA).

I. The Radiation Safety Audit

A. The following individuals are required to participate in the audit:

1. The Radiation Safety Officer (RSO)

2. One radiation health physicist representing radiation health

B. Scope of Audit

Preparation of the audit entails developing a written outline--i.e., the "scope," which is used during the onsite audit and which includes the following:

1. Review, by license condition, recommendations of preceding audit/ALARA reports.

2. Review applicable regulations to determine if there have been any changes in the regulations since the preceding audit/ALARA review and corresponding WNI programs developed to verify compliance with any changes in the regulations.

Applicable regulations include the following:

10 CFR 19, 20 (Nuclear Regulatory Commission, NRC)

3. Review other pertinent documents or literature that would provide information to facilitate

compliance verification or to improve the radiation protection program. Examples include, but are not limited to:

NRC Regulatory Guides (in certain cases, Branch or Staff Position Papers) such as:

a. Reg Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)--Effluent Streams and the Environment" (Revision 1, February 1979)

b. Reg Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" (Proposed Revision 1, August 1981)

c. Reg Guide 8.15, "Acceptable Programs for Respiratory Protection" (October 1976)

d. Reg Guide 8.22, "Bioassay at Uranium Mills" (July 1978)

e. Reg Guide 8.29, "Instruction Concerning Risks From Occupational Radiation Exposure" (July 1981)

f. Reg Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be as Low as Reasonably Achievable" (May 1983)

g. Reg Guide 8.30, "Health Physics Surveys in Uranium Mills" (June 1983)

C. Onsite Audit

The audit follows the general outline developed during the scoping period (see I.B. above). The specific activities to be followed include the following:

1. License Conditions and Amendments

a. Review and detail documentation to verify compliance with all license conditions and appropriate sections of the WNI Decommissioning Plan.

b. Review a representative sampling of worker exposure records to verify completeness. Complete records include records of time-weighted exposure calculations, records of bioassays, records of both respiratory and radiation safety training, records of evaluations performed in accordance with applicable requirements, documentation (copies) of submittals of exposure records to workers, documentation of instruction regarding WNI policies related to radiation protection practices (e.g., instruction regarding pregnancy, clean-shaven faces for respirator usage, bioassay).

c. Review data from surveys/monitoring to verify documentation is adequate.

d. Review documentation regarding equipment maintenance to verify equipment used for exposure control is properly used, maintained, and inspected.

e. Verify QA procedures and written operating procedures by selecting a procedure to be "acted-out" (actually performed) by the individual responsible for the procedure. Compare written procedures with observed procedures.

f. Verify all references or submittals referred to in the license conditions are available onsite.

g. Verify documentation of follow-up actions, corrective actions, and evaluations performed as appropriate where action levels are exceeded.

h. Document the highest exposure/monitoring values observed since the preceding audit and compare against both action levels requiring corrective actions/evaluations as applicable.

2. Review implementation of applicable regulations by verifying documentation is provided as necessary--e.g, training programs required pursuant to 10 CFR 19.

3. Conduct a site visit. The site visit should include the following:

a. Verify compliance with posting requirements

   (1) Posting requirements in accordance with 10 CFR 19.

   (2) Posting of signs in accordance with applicable regulations and license conditions.

b. Verbally quiz workers and supervisors in radiation safety procedures and principles. Also, request demonstrations by workers, where appropriate, of procedures routinely followed and compare with proper radiation protection practices.

c. Review the physical structure and design/layout of the facilities to evaluate possible "problem" areas requiring further review/evaluation.

4. Document follow-up of recommendations made by the preceding radiation safety audit/ALARA review.

5. Where activities are not in compliance, determine a schedule for achieving full compliance.

II. ALARA Review

A. The following individuals are required to participate in the ALARA review:

1. Audit team members (see I.A. above)

2. The Resident Manager or designate

B. The ALARA review includes the following:

1. Review monitoring and personnel exposure data (for identifiable categories of workers or types of operations) to determine if there are any trends developing. Both upward and downward trends should be evaluated. Also, look for any anomolous data that would require further attention or follow-up.

2. Identify source terms for dismantling activities.

3. Evaluate decommissioning procedures, etc. to determine how exposures might be lowered ALARA by mitigating the impact of source terms or by restricting access.

4. Document both a follow-up of previous ALARA recommendations and the effectiveness of procedural changes implemented to lower values ALARA.

III. Exit Interview (Provide an oral summary)

A. Review significant findings of the audit.

B. With all members of the ALARA Committee (see II.A. above), discuss and make recommendations of corrective actions to be taken and personnel protection or other engineering controls to be incorporated to lower values ALARA. Determine a schedule for implementing the recommendations.

IV. Report

A. The results of the audit should be documented by itemizing, by license condition or corresponding WNI commitment, activities not in compliance.

B. Where activities are not in compliance, provide a schedule for achieving full compliance for implementing recommendations made by the Audit Committee.

C. Any urinalyses values which have exceeded an action level of 15 micrograms U/liter are to be reported in the audit memo.

D. ALARA Review: Document all evaluations performed and corresponding recommendations of the ALARA Committee. Include numerical values--e.g., gamma survey data compared with TLD data. Include a schedule for implementation of ALARA Committee recommendations.

E. Direct the report to the Resident Manager.

APPENDIX C

Radiation Safety Training

"Dos and Don'ts" of Radiation Safety

(Industrial) Hazard Checklist

Radiological Hazards Associated with Split Rock Mill

Radiation Training Examination

RADIATION SAFETY TRAINING

I. Radiation

A. Release of energy

B. Heat, light sound and nuclear particles

II. Radioactive

A. Nuclear radiation

B. Release of particles and photons from atom

III. Two types of ionizing radiation

A. Indirectly ionizing

1. Gamma Radiation

a. Photons

b. Most penetrating (lead or concrete stop)

2. Neutron - not problem

B. Directly ionizing

1. Alpha particle

a. Two protons, two neutrons

b. Heaviest natural radiation

c. Penetrates 2 cm air, won't penetrate paper or water layer

d. Internal hazard

2. Beta particle

a. Electron

b. Range of energies - negative charge

c. Up to 12 feet of air, stopped by tin

d. Eye exposure limiting factor, with safety glasses, skin exposure

IV. Half life

A. Time half gone

B. Long half life - low radiation source

C. Short half life - high radiation source

V. Two types of radiation exposure

A. Internal - exposure to body from sources within body

1. Sources of internal exposure

a. Inhalation - airborne radioactivity

(1) Dusts, sprays, mists, gasses and smoke

(a) Uranium insoluble

-Concentrated mainly on ore pad and yellow cake packaging room

-While still ore

-After drying above 400 degrees C

(2) Particulates

(a) Radon daughters - metal particulates

-Can be throughout mill

-Normally concentrated

--In grind (especially above screen and storage tanks)

--Leach (above & below leach tanks)

--Above drag classifiers

-Smoking in radon areas increase chance of lung cancer by factor of 300 times

(3) Insoluble uranium and radon exposures are combined - action limit 25% MPC

(4) Soluble uranium

(a) Soluble between leach and SX

(b) Most toxic as heavy metal

2. Skin absorbtion

a. Skin absorbtion

b. Amount not clear

3. Ingestion

a. Poorly absorbed

b. Hygiene important

c. Exposure to ingestion controlled by employees

B. Measuring and controlling internal exposure

1. Measuring internal radiation exposure

a. Air samples

(1) Lapel samples

(2) Grab samples

(3) Sampling stations

b. Time studies

(1) Time card cost codes - maintenance

(2) Semi-annual time studies - operators

c. Computer exposure calculations

(1) Time studies related to grab sampling stations

(2) Calculated weekly for soluble areas

(3) Calculated quarterly for insoluble areas

d. In-vivo counting

(1) Bi-annually for all employees

(2) Annually if any quarterly exposures were above 25% of MPC

e. Urine samples - taken to measure and control uranium - to avoid kidney damage

(1) To be taken -

(a) At home within 48 - 96 hours of last shift worked

(b) First urination in morning

(c) Must be taken on time

(e) Wash hands first

(f) Label bottle with date taken

(2) Measures uranium content of urine

(a) If sample above 15 ug/L, must take samples every other day for next week and fill out investigation form.

(b) If sample above 30 ug/L must take samples every day until they drop back below 30 ug/L, can not work in mill until below 30 ug/L and must fill out investigation form.

(c) If four samples continue above 30 ug/L or one sample is above 130 ug/L kidney damage may occur. Worker will submit daily urine sample until the samples are below 15 ug/L, is not allowed to work in mill.

f. Do not tamper with sampling equipment

g. Do not contaminate samples - violation of safety standards, NRC license and condiions of employment.

2. Controlling internal radiation exposure

a. Protective clothing and equipment

(1) Coveralls - cloth and disposable

(2) Rubber gloves

(3) Protective hood

(4) Respirators

(a) Face seal

(b) Types

(5) Rubber boots

(6) Wet suit

b. Personal hygiene

(1) Eating areas

(a) Snack food outside eating areas

(b) Gum etc. inside respirators

(c) Washing hands

(d) Removing contaminated clothing

(2) Clean feet of yellow cake before leaving mill

(3) Yellow cake packaging operator/precip operator

(a) Must shower before leaving

(b) Be sure to wash hands and face and remove clothing before eating

(c) Must monitor for alpha contamination before going home

(4) All employees who handle yellow cake during the course of their job must shower or monitor before leaving property

(5) Wash work clothing in company washing machine

c. Radiation Work Permits are required

(1) For the period of decommissioning.

(2) For all vessel or tank entry

(3) RWP conditions

(a) All requirements listed on the permit must be followed

(b) The employees performing the job must sign the RWP

(c) Records of all surveys will be listed on the permit

B. External exposure

1. Types of external exposure

a. Gamma radiation

(1) Measured by TLD badges or pocket dosimeters.

(2) Partially absorbed by body

(3) Mainly from radium

(a) Certain types of rubber absorb uranium

(b) Carbon (especially activated carbon) attracts radium.

b. Beta radiation

(1) Measured with beta survey meter

(2) Aged yellow cake (9 month old +) only source

(3) Can be fairly large source

(4) Wear safety glasses

(5) Wash off while still fresh

(6) Work at arms length

(7) Skin dose

2. External sources

a. Gamma

(1) Barreled yellow cake

(2) Yellow cake storage tanks

(3) Carbon waste

b. Beta radiation

(1) Aged yellow cake outside of metal containers

(a) Unsealed floors with yellow cake spills accumulations

(b) Inside unwashed yellow cake storage tanks

(c) Yellow cake dried on walls etc.

(2) Aged yellow cake samples - laboratory

3. Controlling external radiation exposure

a. Distance

(1) Decreased as inverse square - example

(2) Arms length

b. Time

(1) The longer the time interval of exposure, the more exposure

(2) Plan actions and work rapidly

c. Shielding - not practicle in uranium milling

VI. Fire as example of radiation exposure

A. Radiation - heat and light

B. Airborne activity - smoke

C. Spark or ember - contamination

D. Fuel - radioactive material

VII. Two types of radiation dose

A. Individual

B. Collective Dose

VIII. Biological effects of low level ionizing radiation

Risk
Chance of injury illness or death from some activity

Health effects
Cancer, Birth defects in future kids of exposed parents & cataracts

Prompt effects (acute exposure)
Effects observed after a large dose in a short period of time
25 R/hr ---------- no observable reaction
50 R/hr ---------- detectable changes in the blood
100 R/hr --------- nausea and vomiting
450 R/hr --------- loss of hair, fever, & 50% chance of survival
640 R/hr --------- lethal dose

Delayed effects (chronic exposure)
Effects observed after small doses over a period of time
Cancer may occur years after exposure to radiation

Genetic effects
Effects that can occur when there is radiation damage to the genitic material

How does radiation cause cancer
Damage chromosomes in cell
Reduces normal resistance to existing viruses - damages cells
Activates existing viruses - attacks cell

Immpossible to tell if cancer is result of radiation (other factors)
General physical condition
inherited traits
age
sex
exposure to other cancer causing agents - cigarettes

Does Radiation dose = Cancer?
No!! Get radiation every day from natual sources
Some evidence that some radiation damage can be repaired
effects observed at high doses-small doses are estimated
Must practice ALARA concept -- reduce risk

What are estimates of cancer risk from radiation exposure?
One rem exposure/million people = 300 excess cancer cases or
One rem exposure/thousand people = 3 excess cancer cases or
One rem exposure/100 people = 0.3 excess cancer cases
25% of all adults in 20 to 65 bracket will develop cancer from all contaminates; smoking; food; drugs; alcohol; etc

Can you become sterile or impotent from occupational radiation exp
500 to 800 R/hr to the gonads --- whole body = lethal dose
20 R/ hr to gonads causes measurable but temporary reduction of sperm
Exposure to permitted occupational levels of radiation has no observed effect on fertility and no effect on the ability to function sexually

NRC dose limits
Whole body
1 1/4 rems in any calender quarter or specified 3 month period
5 rems rems per calender year
3 rems per quarter if NO or low previous occupational dose
Accumulated dose may not exceed 5(N-18) rems

What happens is you exceed the quarterly limit?
Exceeding the limit does not imply that you have suffered a injury increased risk
Uranium mills -- whole body -- 380 mrems average

Radiation from sources other than Uranium mills

Natural background ----	100 mrem/yr
Released from mining --	5 mrem/yr
Medical ------	90 mrem/yr
Bombs (fallout) -------	5-8 mrem/yr
Nuclear energy -------	0.28 mrem/yr
Consumer products -----	0.03 mrem/yr
	200 mrem/yr

Internal exposure
Monitored by air sampling program to obtain dose estimates
Uptake is by breathing, taken in with food or drink or through skin
Uranium to bones, eliminated through the kidneys
Radium also to bones
Bioassay

Limits for internal exposure
Uranium --- 1 x 10 uci/ml Unat for 40 hours over 13 weeks -- MPE

IX. NRC FORM 3

What is the NRC

What does the NRC do

What responsibility does the employer have

What are your responsibility

How do you report violations

What if you work in a radiation area

May you get a record of your radiation exposure

How are violations identified

May you talk with an NRC inspector

May you request an inspection

How do you contact the NRC

Can you be fired for talking to the NRC

What forms of discrimination are prohibited

How are you protected from discrimination

What can the labor department do

What will the NRC do

Part of initail and annual radiation training.

DO'S AND DON'TS OF RADIATION SAFETY

DO'S

1. Wear your TLD badges every day and wear them between the neck and thighs.
2. Wear respirators in respiratory protection areas.
3. Wash your hands and remove contaminated clothing or equipment before eating.
4. Pay attention to, and try to avoid potential sources of contamination.
5. Wear work clothes while performing your job and change into street clothes before leaving work.
6. Wash your work clothes in the change room washing machine.
7. Keep your eating area clean and wash it down before eating or drinking.
8. Immediately wash down yellow cake spills as they occur.
9. Wear protective clothing while handling yellow cake.
10. Take a shower after working in the yellow cake room.
11. Check your respirator seal each time you put it on. (Put your hands over the respirator cartridges and make sure the respirator seals when you breath in.)
12. Make sure a radiation work permit has been obtained before proceeding with any decommissioning work or work within a vessel which contained radioactive materials. If in doubt ask your supervisor or radiation safety.
13. Respect yellow cake as a low level radioactive source and, where possible, work at arms length from it.
14. Wash your boots before leaving the precipitation area or yellow cake packaging room.
15. Take urine samples at home.

DO'S AND DON'TS OF RADIATION SAFETY

DON'TS

1. Don't wear leather boots in the yellow cake packaging or precipitation areas.
2. Don't leave yellow cake splattered everywhere when washing down yellow cake spills. Sloppy housekeeping causes yellow cake build-up, which increases beta radiation build-up.
3. Don't take contamination home to your families.
4. Don't smoke or chew outside designated areas.
5. Don't wear contaminated boots or gloves around; wash them off.
6. Don't work in the middle of yellow cake spills. Wash the yellow cake away and your job will be easier, quicker, and safer.
7. Don't wear leather gloves or cotton gloves in the yellow cake packaging or precipitation areas.
8. Don't hang your respirator around your neck with both straps, use the upper strap.
9. Don't store your street clothes and work clothes in the same locker.
10. Don't tamper with radiation safety monitoring equipment (or radiation safety personnel).
11. Don't eat or drink in undesignated areas.
12. Don't purposely expose or contaminate your personal radiation monitoring equipment or samples. Such actions will only cause you and the company much grief since all high samples or exposures are investigated.

Revised 4/6/84
Revised 2/15/85 - S.W.
Revised 11/10/87 - J.G.

HAZARD CHECKLIST FOR SPLIT ROCK MILL - WESTERN NUCLEAR, INC.

PHYSICAL HAZARDS

1. Safety glasses, hard hats, and substancial footwear MUST be worn at all times, except in offices and vehicles.

2. Visitors, who have not completed the "Radiation Hazard Orientation Training", must be accompanied by a Company employee.

3. Be especially carefull of openings in floors and decking.

4. Obey all hazard ribbons and warning signs.

5. No smoking permitted in the laboratory, maintenance shop (eating area excepted), chlorate mixing room, yellowcake packaging room, scrubber and precipitation areas, paint and oil buildings, when fueling vehicles or handling fuels, oils or other flammable materials or wherever "No Smoking" signs exsist.

6. Do not walk under a suspended load when hoisting equipment is being used.

7. Climbing over, on, or under any moving equipment and machinery is prohibited.

8. All electrical circuits are to be treated as though they are hot.

9. Beware of tripping hazards such as rubber water hoses, protruding boards and nails, and extraneous materials.

10. Speed limit throughout the Mill area is 15 M.P.H.

11. Watch out for heavy equipment operating in the area and yield right-of-way to them.

12. Observe and obey all warning and instruction sign, and verbal instructions from the escort.

I HAVE READ AND UNDERSTAND THE RULES OF THE MILL AREA.

Name______________________________ Date ________________

Company Name____

RADIOLOGICAL HAZARDS ASSOCIATED WITH SPLIT ROCK MILL

1. Uranium - is a heavy metal, as such, uranium oxide can be chemically toxic to the kidneys if it is inhaled, ingested or absorbed in large enough amounts.

Since uranium is a radioactive element, you will be exposed to the following forms of radiation:

A. Gamma-Beta

This form of radiation is present, but not in sufficient quantity to cause any concern. This can be demonstrated by observation of past film badge records of Gamma-Beta exposure levels for past yellowcake packaging operators. Even though these radiation leveles are low, we still monitor this form of radiation by the use of the above mentioned film badges.

B. Alpha

Uranium is an alpha emitter and is a large particle similar to a helium atom. Because of its size and density, it cannot travel more than 5 or 6 inches and cannot penetrate the outer skin layer of the body. The problem exists with this particular form of radiation when Uranium dust enters the body through inhalation, ingestion or absorbtion through the skin. Then damage can occur to the soft tissues of the body, especially in the lung.

C. Radon

Radon is a gaseous element and a high alpha emitter. While dangerous, it is rarely present in hazardous concentrations in the Mill.

RADIATION TRAINING EXAMINATION

1. What does the sign "Airborne Radiation Area" mean?
   A. The air within this area contains radioactive material. I should therefore read any other information posted with this sign and follow the precautions listed. If no other signs are posted, I should try to limit the time spent within the area. I should also enter this area only if my job requires it.
   B. I should go get a respirator before entering this area.
   C. If I enter the area I will be exposed to radiation in excess of what is allowed.
   D. I should reduce my breathing rate and try to breath very shallow while working within this area.
2. The TLD badge should be worn between the neck and thighs on the front of the body. True False
3. When you are worried about a radiation related problem you should:
   A. Tell your supervisor or the Safety Department.
   B. Immediately notify the NRC.
   C. Inform the press and local environmental groups.
   D. Say nothing until the problem passes or someone else does something about it.
   E. Inform the Union.
4. Urine sample are taken to:
   A. Measure the amount of uranium in the urine.
   B. Check your general health conditions.
   C. Maintain control of your exposure to beta radiation.
5. Uranium is classified as soluble after it is extracted from the ore and before it is dried. True False
6. What does it mean to say you are "contaminated"?
   A. Your body has become permanently radioactive.
   B. Removable radioactive material is clinging to your clothing or certain portions of your body.
   C. Your body will have to be buried at a radioactive disposal site when you die.
   D. You will remain "contaminated" until treated with special drugs.
7. How does one "decontaminate" the radioactive material we handle at WNI from himself or any contaminated surface?
   A. With Dow clean.
   B. With a steam cleaner.
   C. It will and must wear off.
   D. With soap and water.
8. Trash from within the mill is disposited:
   A. At the new county land fill.
   B. In the tail pond.
   C. At the WNI dump within the restricted area.
   D. Any of the above.
9. Alpha radiation from uranium and radon daughters will pass through protective clothing and even large portions of the body and thus is mainly a external radiation hazard. True False
10. A radiation work permit (RWP) is required:
    A. When any decommissioning is performed.
    B. When decommissioning the yellow cake room.
    C. When entering a tank.
    D. All of the above.

11. What does the "Caution Radioactive Materials" sign mean?
   A. Any area beyond this sign may contain material which is radioactive. All rules and directives should therefore be followed.
   B. Caution should be used when entering this area to avoid exposure to high levels of radiation.
   C. You should avoid entering the area if at all possible.
12. What does ALARA mean?
   A. Alert: Laboratory Airborne Radiation Area
   B. Accounting of Labor And Radiation Accessment
   C. Actual Labor And Radiation Analysis
   D. As Low As Reasonably Achievable
13. A High uranium concentration (greater than 30 ug/liter) in the urine means?
   A. Possible damage has been done to the kidneys.
   B. You have had a large exposure of insoluble uranium.
   C. You will be restricted to working in insoluble uranium exposure areas until the uranium concentrations in your urine drop below 15 ug/L.
   D. You will be assigned a job outside the areas of exposure and are required to submit daily urine samples for the next seven days or until your urine samples drop below 15 ug/L.
14. Those who participate in the urine analysis program do so:
   A. On a voluntary basis.
   B. Only when they remember to take the sample.
   C. As a license requirement and condition of employment.
15. What do respirators do?
   A. Provide oxygen to breath.
   B. Take radioactive particulates out of the air.
   C. Removes un-needed gasses from the air.
   D. Conserve air.
16. Smoking when exposed to concentrations of radon increaes the risk of getting lung cancer. True False
17. Low level exposures to radiation have a high probability of causing?
   A. Sterility
   B. Cancer
   C. Genetic Defects
   D. None of the above
   E. All of the above
18. There is a well varified correlation between low level exposures to radiation and cancer. True False
19. TLD badges/pocket dosimeters measure?
   A. Radon Daughters
   B. Gamma Radiation
   C. Radioactive Dust Concentrations
   D. All of the above
20. When is an exit survey for alpha radiation required?
   A. When you have been working in the mill.
   B. When you have been working under a RWP.
   C. When you have been working with yellow cake.
   D. Any time you enter the restricted area at the mill.
21. What is the difference between internal and external radiation exposure?
   A. Internal radiation exposure occurs when radiation from an external source damages the body within the skin while external radiation damages only the skin.
   B. External radiation is radiation of the type that won't penetrate tin while internal radiation is capable of penetrating the whole body.
   C. Internal radiation exposure comes from sources deposited within the

body while external exposure comes from sources outside the body.

22. Alpha radiation will not penetrate __________ while beta radiation will not penetrate __________ and gamma radiation will not penetrate __________ .
    A. Tin, paper, lead
    B. Paper, tin, lead
    C. Lead, paper, tin
    D. Lead, tin, paper
23. What documents are available to me for review?
    A. Personal exposure records.
    B. WNI's license from the NRC.
    C. Sampling and survey results.
    D. Regulations involving exposure control and employee rights.
    E. All of the above.
24. What does in-vivo counting measure?
    A. Internal uranium deposition in the lungs.
    B. Radiation which the body normally contains.
    C. The soluble uranium you have inhaled.
25. Which two areas of the mill are classified as insoluble uranium exposure areas?
    A. Grind, Leach
    B. Leach, Precipitation
    C. Grind, SX
    D. Grind, Yellow Cake Packaging
26. The levels at which uranium mill workers are exposed to radiation present risks which are significantly higher than other industries? True False
27. What types of protective gear are available for reducing exposure to radiation?
    A. Hard hats, cotton gloves and steel toed leather boots.
    B. Respirators, rubber boots, rubber gloves, coveralls, wet suits and safety glasses.
    C. Self contained breathing apparatus, lapel samplers, hard hats and cold weather gear.
28. What is the ALARA philosophy?
    A. Nothing, especially radiation safety procedures, should get in the way of producing yellow cake and running the mill at full capacity.
    B. The radiation emitted while milling and refining uranium ore is so low level that it can be disregarded.
    C. Management continually tries to get more and more work for less wages.
    D. Everyone should do their part to reduce radiation exposures as low as possible by following safe procedures. Radiation safety is responsible to try and eliminate or otherwise control the sources of radiation exposure.
29. What are the two possible ill health effects of exposure to low doses of radiation?
    A. Sterility and kidney failure.
    B. Heart and lung problems.
    C. Increased risk of cancer and genetic defects.
    E. Allergies and paralysis.
30. When decommissioning is progress, exposures to uranium dusts and mists are calculated by:
    A. Determining the average time spent in each location of the mill through time studies, relating the time spent to the dust sample taken within that area and summing the exposures from each area in which you work.

B. Taking lapel samples from each contract worker each shift, and relating the time during each shift to the uranium concentration on the sample and the volume of the pump.
C. No exposure calculations are ever done.
D. Exposures to uranium dust are only estimated from the analysed dust samples.

31. When endeavoring to measure and control radiation, what three types of radiation are measured at uranium mills?
A. Alpha, gamma and neutrons.
B. Beta, gamma and neutrons.
C. Alpha, beta and neutrons.
D. Alpha, beta and gamma.

32. How does one go about requesting a special NRC inspection?
A. Call the nearest NRC office and request that the inspection be made.
B. Call an antinuclear organization and request that they pressure the NRC and company to resolve the bad working conditions.
C. Ask the company to request that the NRC conduct a special inspection.
D. Have the union representative call the NRC.
E. Send a written request to the NRC explaining the hazard as it is preceived and the reasons you are requesting the inspection.

33. How can you personally follow the ALARA philosophy while working?
A. I should follow the safe work practices requested by the Safety Department as well as my own judgement in avoiding radiation exposures.
B. I should wear all sampling equipment and refrain from tampering with stationary sampling equipment.
C. I can take a bath in chlorox every day and every day wear several extra layers of clothing.
D. I can transfer to the mine or get another job.

34. The Safety Department will only issue respirators when conditions require it. True False

35. I am in-vivo counted.....
A. To check my lung capacity and fitness for wearing respirators.
B. To determine how much insoluble uranium has been deposited in my lungs.
C. To reactivate my bodies natural defences against uranium injestion.
D. Make my lungs radioactive and, since like repels like in matter, help my lungs to repel uranium from getting into my lungs.

36. What other possible sources of radioactivity besides uranium and uranium ore are located in the mill and laboratory?
A. Not applicable

37. What should I do if I notice that the yellow cake thickener has sprung a bad leak?
A. NOT APPLICABLE

39. I should not wear permeable gloves or boots while working in the yellow cake packaging room because......
A. Yellow cake is absorbed through the skin.
B. When yellow cake is trapped within an object and not removed over a period of time, it becomes a strong beta radiation source.
C. Impermeable clothing is much easier to decontaminate.
D. When working with yellow cake, one has to wash down the area fairly often and clothing will get wet and absorb yellow cake into the pores.
E. All of the above.

40. How can you minimize your exposure to radiation?
A. Spend as little time as possible in Airborne Radiation areas which don't require respiratory protection.

B. Remember to place your TLD badge in the lead container at the end of shift.
C. Drink lots of fluids and eat lettuce.
D. Wash your hands before eating and don't eat while wearing contaminated equipment.
E. Work at arms length while handling any known gamma or beta source.
F. All of the above.
G. A, B, D, E & F above.
H. A, C, D, E & F above.

41. What can I do to reduce my exposure to radiation?

____

____

____

43. When should I take my urine sample after the bottle is issued?
A. On the due date.
B. The first thing in the morning after the bottle is issued.
C. Within 48 to 96 hours after my last shift of the week and the first thing in the morning.
D. Before leaving the mill restricted area.

44. Where should I take my urine sample?
A. At home.
B. In the mill dry.
C. In the maintenance dry.
D. Out behind the office.
E. In the mill office restroom.

45. What precautions should I take before taking my urine sample?
A. I should drink lots of beer or some other diuretic to dilute my sample.
B. Take the sample after I wash my hands and while wearing uncontaminated clothing.
C. Use diluted coffee instead of urine.
D. Rinse the bottle out with tap water before filling it.

46. What consequences will I face if I purposely violate radiation protection procedures and regulations?

____

____

____

47. How often should you check the fit of your respirator?
A. When the respirator is issued.
B. Each time I go into the Safety Office.
C. Every time I see my boss or Safety Department personnel.
D. Every time I don the respirator.

48. What are the two radioactive materials monitored in the air at uranium milling operations?
A. Tritium and uranium.
B. Iodine and tritium.
C. Uranium and cesium.
D. Platonium and uranium.
E. Uranium and radon.

51. Where are radioactive materials found within the mill?
A. In nearly every tank, pump and piece of equipment within the mill.
B. In the SX, precipitation and yellow cake packaging areas.
C. Only in the precipitation and packaging areas.
D. Everywhere except in the drag classifiers and the tail pump.

Reviewed 2/28/85 - C.P.
Revised 2/28/85 - S.W.

ANSWER SHEET
RADIATION TEST

1. ______________
2. ______________
3. ______________
4. ______________
5. ______________
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40. ______________
41. ____

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42. ______________
43. ______________
44. ______________
45. ______________
46. ____

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47. ______________

48. __________
49. __________
50. __________
51. __________

I have completed the Radiation Training.
Signature: ____________________________________
Date: ____________________

APPENDIX D

External Radiation Survey Procedures

Alpha Surveys

Beta Surveys

Gamma Surveys

Personnel Alpha Monitoring

Removable Alpha Contamination Sampling

ALPHA SURVEYS

DISCUSSION:

All desks and/or chairs, benches and eating areas in the mill, mill office, change room and GMIX must be surveyed for alpha radiation weekly. All employees who work with yellow cake concentrate, upon leaving the restricted area at the end of their respective shifts, must receive a complete alpha body survey unless they have showered. Equipment released from the mill area for repair or unrestricted use must also be surveyed. All surfaces and/or employees that exceed 1000 dpm/100cm² must be decontaminated to a level below 1000 dpm/100cm², and the action taken to eliminate the contamination must be documented.

EQUIPMENT:

1. Alpha survey meter sensitive to 500 disintegrations per minute on the lowest sensitivity scale with an adjustable alarm.
2. Large area alpha sensitive probe (Eberline AC-3 or equivalent).
3. Alpha check source.

PROCEDURE:

1. Check the instrument with a calibrated alpha check source and record: The instrument serial number, calibration date, high voltage reading, calibrated alpha check source cpm, 4 dpm and instrument efficiency along with the initials of the individual performing the survey in the log book.
2. Point the probe toward a light source. A light leak in the probe face will cause the instrument to read and must be repaired with liquid paper or a new face before use.
3. Using the instrument efficiency and probe face area determine the instrument reading in counts per minute (see calculations) which would indicate 1000 disintegrations per minute of contamination.
4. Set the instrument on fast response and survey the object or person being surveyed at a rate of about 100cm (1 meter) per thirty seconds. The probe face should always be approximately 1cm from the surface being surveyed.
5. If any areas exceed the 1000 dpm/100cm² limit, put the instrument on slow response and check that area again.
6. The person or object that exceeds the limits must be decontaminated as soon as possible. No person or equipment should be allowed to leave the property with contamination above 1000 dpm/100cm².
7. Record the results in the log book, on the personnel alpha scan sheets or on the equipment release form. Any excursions should be reported to the proper supervisory personnel and the corrective action taken should be documented.
8. Re-calibrate the instrument as in No. 1 and record in the log book at the end of each sampling day.

CALCULATIONS:

$$E \text{ (Efficiency)} = \frac{\text{cpm source}}{\text{dpm source}}$$

Solve for X

$$1000 \text{ dpm}/100\text{cm}^2 = \frac{X}{\text{Eff.} \times A}$$

Where

Eff. = Counting efficiency

A = Probe face size in cm^2
$100\ cm^2$

X= cpm

March 28, 1983 -------- Revised: 9/21/83 -------- Reviewed & Revised 2/5/85

BETA SURVEY PROCEDURE

DISCUSSION:

When U-238 is allowed to reach secular equilibrium with its two short lived daughters, Thorium-234 and Protactinium-234 (secular equilibrium is achieved after 8 or 9 months of decay time), the resultant isotopic mixture is a strong beta radiation emitter. Half of the beta radiation is emitted by Th-234 and half by Pa-234. Surface beta emission after U-238 achieves secular equilibrium is approximately 150-230 mRad/hr. In order to maintain control of beta radiation exposures, the following precautions should be implemented:

1. Workers who handle yellow cake on a regular basis should wear safety glasses at all times to protect the cornea of their eyes.
2. Tanks requiring entry for decommissioning purposes and which routinely contained uranium and/or uranium bearing solutions should be surveyed for beta radiation prior to the entry by contract personnel.
3. Though NRC regulations do not stipulate how often beta surveys should be conducted other than requiring "adequate" surveys to control radiation exposures, a yearly walk through beta survey should be conducted within each work area of the mill (yearly surveys should locate any contaminated areas which have reached secular equilibrium).
4. Remember that only approximately 15% of beta radiation is absorbed by clothing and the rest is skin dose with a limit of 7.5 rems per quarter whole body or 18.75 rems per quarter to the hands, forearms, feet, and ankles.
5. Areas where beta emission is above 100 mRem/hr must be labeled "High Radiation" areas and must be controlled in accordance with the regulations set forth in 10 CRF 20 20.203 section (c).

EQUIPMENT:

1. Eberline E-140 Count Rate Meter with an HP-210 or HP-260 GM tube or equivalent.
2. About twenty sheets of paper.
3. A thin lead sheet for shielding the detector from the associated bremsstrahlung radiation.
4. Sealed container of "aged" (secular equilibrated) yellow cake.

PROCEDURE:

1. Using the Sr/Y source, place the beta detector (HP-210 or HP-260) probe directly on the surface of the source (make sure the source is centered on the window) and record the reading.(OPEN FACED)
2. Insert layers of paper (one at a time) between the source and the probe until the source reads half of what it did read (this is called a "half value layer"). Continue layering the paper until the source reads 1/8 of what it originally read (three half value layers). Bind and cut the layers of paper to make a shield for the detector. (CLOSED FACED)
3. Place the OPEN FACED (without the paper shield) beta (B) detector on the surface of the yellow cake and record the reading.
4. Place the CLOSED FACED (with the paper shield) beta (B) detector on the surface of the yellow cake and record the reading.
5. Calculate and record the difference (Δ Rs) of the OPEN FACED reading and the CLOSED FACED reading.
6. Since the beta dose rate at the surface of the yellow cake is 150 mrem/hr, the calibration factor (CFs) can be calculate from the equation below.

Observed dose rate = The difference (Δ Rs) of the OPEN FACED and CLOSED FACED readings.

Actual dose rate = 150 mrem/hr

$$CFs = \frac{\text{Actual dose rate}}{\text{Observed dose rate}} = \frac{150\text{mrem/hr}}{\Delta\ \text{Rs mR/hr}}$$

7. Place the OPEN FACED (without the paper shield) beta detector 2 cm above the yellow cake surface and record the reading.
8. Place the CLOSED FACED (with the paper shield) beta detector 2 cm above the yellow cake surface and record the reading.
9. Calculate and record the difference (Δ R) of the OPEN FACED reading and the CLOSED FACE reading.
10. Since the beta dose rate at 2 cm is 75 mrem/hr, the calibration factor (CF) can be calculated from the equation below.

    Observed dose rate = The difference (Δ R) of the OPEN FACED reading and the CLOSED FACED reading.
    Actual dose rate = 75 mrem/hr

    $$CF = \frac{\text{Actual dose rate}}{\text{Observed dose rate}} = \frac{75\ \text{mrem/hr}}{\Delta\ \text{R mR/hr}}$$

11. Survey each area about waist height. Obtain an OPEN FACED (without the paper shield) and a CLOSED FACED (with the paper shield) reading at the surface and about two (2) feet from the surface of the area or object. Record the readings (in mR/hr) on the Beta Survey form. Calculate beta dose rate from the equation below.

    Ds = The dose to the body at the area or object surface
    D = The dose to the body at a distance from the area or object surface
    Δ Rs = Difference of the OPEN and CLOSED FACED readings at the surface of the area or object.
    Δ R = Difference of the OPEN and CLOSED FACED readings at a distance from the area or object surface.

    $$Ds = Cfs \times \Delta\ Rs$$

    $$D = CF \times \Delta\ R$$

12. When doing the calculations, care must be taken to ensure that the methodology used to calculate the exposured rate fits the actual circumstance of the exposure.
    Example: When calculating the exposure to the hands and forearms, the survey done at the surface of the object handled must be used as the source strengh.
    It is also possible that the source might be in front of the individual working along the wall of the interior of a tank. The individual would receive a much higher exposure in front than his back (which would be exposed from the walls on the other side of the tank.
13. Periodically, the inside surface of work clothing and boots worn by the contractor personnel should be surveyed (to assure no beta emitter buildup on clothing).
14. When conducting the survey pay particular attention to unsealed surfaces in areas where splashing or accumulations of yellow cake have occured.

Revised 2/84
Reviewed 11/27/84 - C.P.
Revised 2/27/85 - S.W.
Revised 4/3/85 - C.P. - S.W.
Revised 11/9/87 - th

GAMMA SURVEY

DISCUSSION:

Several of the natural uranium decay products are gamma emitters. Therefore it is necessary to conduct a baseline gamma survey to insure that there is no undetected gamma build-up. A gamma survey will be conducted prior to decommissioning by measuring gamma dose rates at each station listed in Table No. 3.

EQUIPMENT:

1. Eberline PRM-7 micro R meter
2. 0.2uCi Cs 137 source

PROCEDURE:

1. Measure the background radiation in mR/hr. and record on the gamma survey form.
2. Place a Cs 137 (0.2uCi) source against the black circle at the end of the PRM-7 and record the value indicated on the meter in the gamma survey form.
3. Subtract the background from the 0.2uCi source reading and record.
4. Record the instrument serial number, the battery check, the last date the instrument was calibrated, and the high voltage (H.V.) value.
5. Compare the 0.2uCi Cs 137 value with the value from the last calibration. If the difference is more than 10%, the instrument should go in for calibration. The instrument shall also be calibrated every six (6) months.
6. Turn the survey meter to slow response.
7. Measure the values of the gamma survey at each location listed in Table 3 and record the station number, station location, and gamma value in mR/hr. in the gamma survey form. (The micro Roentgen value is changed to milli roentgens by dividing the uR value by 1000.)
8. Surveys should be conducted at waist height and about 12 inches from the object being surveyed.
9. When the survey is completed, check the high voltage and the battery. Record these values in the gamma survey form.

Rev. 1 - Date 8-3-83
Rev. 2 - Date 2-84
Reviewed 11-15-84 C.P.
Reviewed 2-5-85 S.W.
Revised 11/6/87 T.H. & J.G.

GAMMA RADIATION SURVEY

Surveyor ____________________ Date ____________________

Calibration check:

Instrument	________	Serial number	________	Battery ck	______
Calibration date	________	High voltage	________	Cal.	____ mR/hr
Background	____ mR/hr	Cs 137 source	____ mR/hr	Δ	____ mR/hr

STATION	AREA	uR/hr	mR/hr	
40-7	Grind foremans office			
40-11	Leach section top deck			
40-12	" operators desk			
40-13	Rip operator's desk			
40-14	Rip above MU tanks			
40-15	Rip above sump			
40-16	Rip north side walkway			
40-17	Sand drag section 2nd floor			
40-18	Sand drag gound section			
40-19	Lime mix section			
40-20	Eluex room desk			
40-21	Pulverizing room (3 sample average)			
40-22	Bucking room (2 sample average)			
40-23	Chemical laboratory			
40-24	North side of mill			
40-25	Change room			
40-26	Met. lab.			
40-27	Warehouse			
40-28	Maintenance shop			
40-29	Rubber shop			
40-30	Between mill and office			
40-31	West of paint and oil storage shed			
40-32	Between acid plant and yard #3			
40-33	Walkway between centrifuge and roaster feed			
40-34	Precip. section (2 sample average)			
40-35	Scrubber clean up			
40-36	Roaster control feed			
40-37	Vibrator control panel			
40-38	Product operator's desk			
40-39	Roaster discharge			
40-40	Compressor room			
40-41	Elution deck			
40-41	Electrical Shop			
40-42	Main floor between grind and leach			

PERSONNEL ALPHA MONITORING PROCEDURE

INTRODUCTION:

The NRC requires that no individual with alpha contamination in excess of 1000 disintegration per min./100 cm^2 be allowed to leave the restricted area. Monitoring individuals for alpha contamination before they leave the restricted area insures that no radioactive material is carried home to their families and to the community as a whole. Since radiation cannot be seen, heard or felt, monitoring with an instrument capable of detecting the specific type of radiation is of the utmost importance. NOTE: Alpha radiation will not penetrate more than 1/2" of air or through anything that is wet.

EQUIPMENT:

1. Ludlum 177 alarm rate meter with broad surface probe or equivalent.
2. NBS traceable calibrated Th-230 source of between $1x10^3$ and $2x10^4$ disintegrations per minute.

PROCEDURE:

1. Turn the response switch to "Slow Response", and the multiplication factor switch to a scale that will measure the check source at mid-scale.
2. Place the check source on the face of the probe (at about the middle of the probe face) and record the reading in the log book in counts per minute. (Check the source at the beginning and end of each period of monitoring.)
3. Turn the scale multiplication factor switch to the marked location.
4. Place the response switch on "Fast Response".
5. Survey by placing the alpha probe within 1/2 inch of the individual, (alpha radiation only penetrates approximately 1/2" of air) and move the probe over the individuals clothing at the rate of about 2.5 feet per 10 seconds. Be careful not to puncture the thin mylar probe face with a sharp object.
6. If the alpha alarm triggers, put the response switch on slow and place it over the area that caused it to trigger. Wait 10 seconds. If the alarm doesn't trigger the area still passes. Survey legs (including boots), hands, arms and trunk of body back and front.*
7. If the individual passes have him sign and check that he passed. If the alarm triggers, check that he didn't pass and send him back for a shower or change of clothing. No individual is allowed off of the property until he is decontaminated. When the individual is contamination free, sign him in as such. Individuals who shower need not be surveyed, but must sign the log book and note that they did shower.

* If you are measuring the contamination with an instrument without an alarm, the instrument meter should not exceed (1/eff. X 1000)cpm (counts per minute). Otherwise follow the above procedure.

Revised 2/15/85 - S.W.

CHECK FOR RADIATION CONTAMINATION

NAME	DATE	TIME	CPM* LEVEL	DID YOU Shower		CPM AFTER DECONTAMINATION	Constancy check
				Yes	No		

***Must be less than** counts per minute (CPM).

Inc.

TH/th 09/22/86

REMOVABLE ALPHA RADIATION SAMPLING

DISCUSSION:

Removable alpha contamination is defined as: That portion of radioactive alpha emitting material deposited on a surface which is removed by application of a medium pressure swipe to that surface. The swipe is taken from an area of known dimensions and measured with an alpha scintillator to determine the quantity of surface contamination per unit of surface area (normally this measurement is expressed in disintegrations per minute (dpm) per 100 cm^2).

Swipe samples are taken only when the limits for total alpha contamination are greater than the limits for removable contamination. (Total contamination is measured by surveying the surface with a broad faced alpha scintillation probe, thus measuring all surface contamination.) When swipe samples are required, total alpha must also be measured in most cases to assure that total contamination limits also are not exceeded.

Areas generally requiring swipe sampling are; tables where urine samples are prepared for shipment or analysis, equipment released for unrestricted use, yellow cake shipments and yellow cake slurry shipments. (See Table 1)

EQUIPMENT:

1. Filter paper (2.5 cm).
2. Template, 100 cm^2.
3. Ludlum 2000 scaler/scintillator or equivalent.
4. Coin envelopes.
5. National Bureau of Standards Traceable alpha standard (Th-230).

PROCEDURE:

1. Place a blank paper filter in the scintillator counting chamber and measure background for a minimum of 20, 99 minute samples on a monthly basis. (When background is not being counted at the time swipes are counted, count background for 10 minutes to insure that it is less than one (1) count per minute.) Record the counts per number of minutes sampled and the calculated counts per minute in the Alpha Swipe - Alpha Survey log book. Calculate the minimum detectable activity and record in the log book. (See Calculations)
2. The background alpha radiation as measured by the scintillation detector should not exceed 1.0 count per minute. When this limit is exceeded the detector/sample tray assembly should be decontaminated as follows:
   A. Disconnect the power source from the detector.
   B. Remove the sample tray screws from the detector housing and separate the tray from its O-ring.
   C. Wash the sample tray and O-ring in warm soapy water. Use a Q-tip to clean all grooves and hard to clean areas.
   D. Again, using a wet soapy Q'tip, very gently clean the aluminumized mylar detector window and the associated O-ring which holds it in place. This surface should then be rinsed with a wash bottle and gently blotted dry with a soft paper towel.
   E. Reassemble the detector sample tray and check the background production rate.
   F. If the above procedure does not sufficiently reduce the detector background, the sample tray should be soaked in a 50% volume/volume hydrochloric acid solution for five minutes, rinsed, dried and reassembled.
   G. When a hydrochloric acid soak and/or wash with soapy water fail to correct the background problem, the unit should be sent to a vendor for

replacement of the mylar window.

3. Calibrate the scaler/scintillator with a certified Th-230 alpha source and record the counts per number of minutes and the counting efficiency in the log book (see calculations).
4. Number paper filters according to the number of locations to be swipe sampled and place them in coin envelopes. (See Attachment 1, 2 or 3)
5. Using medium pressure, with an S motion swipe, at random, 100 cm^2 at each sampling area and label the coin envelope accordingly. (See Table 1 for a list of the sampling areas.)
6. Count the alpha activity on each swipe sample for a minimum of five (5) minutes. Record the counts per number of minutes, the counts per minute, the disintegrations per minute per 100 cm^2 and twice the standard deviation (for 95% confidence) in the log book or on the appropriate work sheet. The action levels for removable alpha activity are listed in Table 1.
7. When action levels are exceeded, the surface(s) being sampled must be cleaned and resampled until all swipes are less than the acion level.

CALCULATIONS:

$$\text{Efficiency} = \frac{\text{Certified std cpm}}{4 \quad \text{dpm of standard}} = \text{Decimal } \frac{\text{cpm}}{\text{dpm}}$$

$$\text{Disintegrations per 100 cm}^2 = \frac{\frac{C_S}{T_S} - \frac{C_B}{T_B}}{\text{Eff.}}$$

Where

C_S = Total counts sample

T_S = Time sample was counted

C_B = Total counts background

T_B = Total time background counted

And

$$\frac{1.96}{100\ cm^2} = \frac{1.96 \quad \frac{C_S}{T_S^2} - \frac{C_B}{T_B^2}}{\text{Eff.}}$$

And

$$LLD(dpm) = \frac{4.66\ _{BKG}}{E}$$

Where

$_{BKG}$ = The standard deviation in counts per minute of background

TABLE 1

LOCATION	ACTION LEVEL
Tables and cabinets used to prepare urine samples	10 dpm/100 cm^2
Equipment released for unrestricted use	1000 dpm/100 cm^2
Yellow cake slurry and dried product shipments	2200 dpm/100 cm^2
Eating areas	1000 dpm/100 cm^2

Revised March 15, 1984

Revised Sept. 26, 1984

Revised March 29, 1985 - S.W. - C.P.

APPENDIX E

Airborne Uranium Sampling Procedures

Uranium Dust Grab Sampling

Grab Sample Pump Calibration Procedure

Personal (Lapel) Sampling

Gross Alpha Dust Filter Analyses

URANIUM DUST GRAB SAMPLING

DISCUSSION:

Natural uranium is a toxic heavy metal, and a low specific activity (LSA) radiologic hazard. Federal law requires that uranium milling operations maintain strict control over the amount of uranium bearing dust to which workers are exposed.

Various stages of the milling process produce uranium dust of differing chemical composition and solubility. Classification of this dust into soluble or insoluble categories (for the purpose of radiologic control) is based upon the way in which uranium compounds react with body fluids and tissue.

Soluble uranium dust is defined as any airborne uranium mists or particulates which, after ingestion into the body, (primarily into the lungs since uranium compounds are very poorly absorbed by the digestive system) have a biological lung half life of ten (10) days or less. With regard to milling uranium ore, uranium is considered to be in its soluble form from the leach circuit until it is dried at temperatures above four hundred degrees centigrade (400°C). The grind and yellow cake packaging areas are thus insoluble uranium areas.

Insoluble uranium compounds are composed of natural uranium ore dust and "yellow cake" concentrates which, when dried at temperatures above four hundred degrees centigrade (400°C), become relatively insoluble to dissolution by body fluids. The biological lung half life of insoluble uranium is greater than ten (10) days.

The Nuclear Regulatory Commissions', "Standards For Protection Against Radiation", set the limit of exposure from airborne soluble uranium compounds to a "Maximum Permissible (sustained) Concentration" (MPC) of $10uCi \times 10^{-11}$/ml of air during a forty (40) hour work week, or a maximum of 9.6 milli-grams per week ingested into the lungs. While the contribution of soluble uranium dust to the bodys radiation exposure is negligible, the rapid elimination of uranium through body waste which is processed by the kidneys can cause kidney damage. Thus, soluble uranium dust exposure is calculated separately from insoluble uranium dust exposure.

Insoluble uranium ore dust consists of U-238 and certain concentrations of its' daughter products (Th-230, Ra-226 & U-234). Since ore dust is made up of several alpha emitters, when uranium alone is assayed the MPC for a 520 hour work quarter is $5uCi \times 10^{-11}$/ml of air, but when gross alpha is measured the MPC for a 520 hour work quarter is $10uCi \times 10^{-11}$/ml. (The reason the MPC is lower when only uranium is assayed is that a uranium assay doesn't measure the entire concentration of alpha emitters.) The MPC for uranium product dried at temperatures above 400°C is $10uCi \times 10^{-11}$/ml for a 520 hour work quarter.

Respiratory protection is required when ever a chance exists that someone could be exposed to greater than MPC levels of airborne radiation.

When grab samples are taken, a known volume of air is drawn through a fiberglass filter for a predetermined amount of time. The filter is then analyzed for either gross alpha or total uranium.

EQUIPMENT:

1. Stop watch
2. 3/8" I.D. Tygon tubing
3. 2.5 cm (1") filter holders
4. Numbered filter caps
5. Gelman type AE fiberglass filters, 2.5 cm
6. Dry test meter with NBC traceable calibration

7. Low volume, 0-80 liter per minute regulated air flow pumps (Eberline RAS-1 or equivalent)

PROCEDURE:

1. Place a 2.5 cm filter head and filter on the dry test meter inlet.
2. Using the dry test meter and stop watch, calibrate each sampling pump to a flow rate of between 45 and 80 liters per minute. Record the flow rate, time, date and initials of the individual doing the calibration in the "Grab Dust Sample" form. NOTE: Currently, the pumps in use calibrate at greater than 70 liters per minute or less than 50 liters per minute depending on the specific pump.
3. Using a new filter for each sample, take minimum 2100 liter air samples for a minimum of 30 minutes (which ever is appropriate to the pump in use) at each station listed in Table I. Record the starting time, time stopped, filter cap number, flow rate, pump number and mill operating conditions on the sample work sheet.
4. Document the sample number, flow rate, length of time sampled and total flow in the "Grab Dust Sample" form.
5. Samples are assayed using gross alpha counting. Follow the gross alpha counting procedure. NOTE: Dust assays must be completed within three (3) to five (5) days after the samples are taken.
6. Record the assays and calculated dust concentrations in the grab dust sample form.

CALCULATIONS:

$$uCi \times 10^{-11}/ml \text{ uranium} = \frac{\text{Assay in } uCi \times 10^{-6}}{\text{Milliliters of air sampled}}$$

Date Issues: 3/1983 S.W.

Date Reviewed: 2/17/84 S.W.

Date Reviewed: 2/5/85 S.W.

LAPEL SAMPLE PROCEDURES

DISCUSSION:

To facilitate a more accurate determination of individual airborne uranium dust exposure, a worker from each working area is required to wear a calibrated constant flow air sampling pump daily. All decommissioning personnel working in the mill, workers doing decommissioning of the roaster or yellow cake packaging equipment, or any employee who is performing work which requires a Radiation Work Permit must wear a constant flow air sampler. At the end of each day these samples are taken to the Safety Dept. for analysis. The accuracy of these samples depends, in large, on how well the individuals wearing the samples document the time they spend in different areas of the mill and record the type of respiratory protection, if any, they were wearing. The assay is then applied to the individuals exposure data.

EQUIPMENT:

1. 2.5 cm filter holder
2. Bendix 60 or equivalent 1-3Lpm pump
3. Gelman type AE 2.5 cm fiberglass filter or equivalent
4. 1 liter bubble tube with vacuum flask & inline filter
5. Stop watch

PROCEDURE:

1. Calibrate the constant flow pump at 2.50 to 2.75 liters per minute and record the following information on the sample sheet: The pump serial number, name of individual or location, date, time out, type of respiratory protection used, filter holder number, and the calibration rate (in liters per minute) at the time the pump is issued.
2. Distribute the pumps to the appropriate individual or location.
3. Pick up the pumps at the end of the shift. Calibrate in liters per number of seconds and record in log book. Record the time returned on the time study sheet.
4. Let the sample decay for a minimum of two days (to eliminate the radon and thoron daughters) and measure the gross alpha count on the alpha scintillator.
5. All samples must be analyzed within five days of the time they were taken.
6. Follow the calculation format established on the exposure work sheet.

Rev. 1 - 8/15/83
Rev. 2 - 2/84
Reviewed 11/15/84 - C.P.
Revised 2/15/85 - S.W.
Revised 11/10/87 - J.G.

EMPLOYEE EXPOSURE CALCULATIONS

Contractor ______________________
Address ______________________
Employee Name ______________________
Address ______________________ Pump No. ________

DATE	COLLECTION						ANALYSIS						
	TIME FROM	TIME TO	TOTAL TIME	FLOW RATE START	FLOW RATE END	TOTAL VOLUME	CNT TIME	GROSS COUNTS	CPM	BKG	CPM-BKG	ACTIVITY uCi/ml	EXPOSURE

$$\frac{(\text{CPM-BKG})(4.5 \times 10^{-7}\ \text{uCi/dpm})}{(\alpha\ \text{eff})(\text{Volume in ml})} = \text{uCi/ml}$$

CNT = count   CPM = count per minute

DPM = disintegrations per minute

Exposure(MPC/hrs) = activity X time X 1.2

Calibration Check
Thorium 230 standard   ID No. ________
DPM ________
Five minute count ________

$\frac{\text{CPM}}{\text{DPM}}$ X 100 = % eff   eff = ________ %

Maximum Permissible Exposure = 40 MPC/hrs/week

Note: Analysis minimum of 24 hours after collection

Counting Instrument
Name. ______________________
Model: ______________________
Serial No.: ______________________
Calibration Date, ______________________

GROSS ALPHA DUST FILTER ANALYSIS

DISCUSSION:

Measurement of uranium dust concentrations by using a gross alpha counter is simple, accurate and conservative. Uranium-238 and several of its daughters (notably Ra-226 and Th-230) are alpha radiation emitters and are consequently sources of radiation. Thus when gross alpha radiation is measured, each agent of exposure is measured. When chemical toxicity is the limiting factor, measurement of uranium and its daughters provides a conservative estimate for exposure calculations. Since uranium ore dust is composed of uranium and its daughters, when only uranium is measured, its MPC is 5×10^{-11} uCi/ml, while gross alpha measurement increases the MPC to 10×10^{-11} uCi/ml.

EQUIPMENT:

1. NBS traceable Th-230 source of between ten thousand (10,000) and twenty thousand (20,000) disintegrations per minute.
2. Ludlum 2000 scaler with alpha scintillator and 2.5 cm sample holder or equivalent.
3. Plastic tipped tweezers.

PROCEDURE:

1. Filters must be no larger than 2.5 cm in diameter as described in the grab and lapel dust sampling procedures.
2. Count a blank fiberglass filter for background radiation twenty times using a 99 minute time interval. Background should be counted once per month or ten minutes prior to running the samples and must be entered into the log book each time.
3. The background alpha radiation as measured by the scintillation detector should not exceed 1.0 count per minute. When this limit is exceeded the detector/sample tray assembly should be decontaminated as follows:
   A. Disconnect the power source from the detector.
   B. Remove the sample tray screws from the detector housing and separate the tray from its O-ring.
   C. Wash the sample tray and O-ring in warm soapy water. Use a Q-tip to clean all grooves and hard to clean areas.
   D. Again, using a wet soapy Q-tip, very gently clean the aluminumized mylar detector window and the associated O-ring which holds it in place. This surface should then be rinsed with a wash bottle and gently blotted dry with a soft paper towel.
   E. Reassemble the detector sample tray and check the background production rate.
   F. If the above procedure does not sufficiently reduce the detector background, the sample tray should be soaked in a 50% volume/volume hydrochloric acid solution for five minutes, rinsed, dried and reassembled.
   G. When a hydrochloric acid soak and/or wash with soapy water fail to correct the background problem, the unit should be sent to a vendor for replacement of the mylar window.
4. Count the Th-230 standard twice using five minute time intervals and enter the date, standards' serial number, time interval of count, total counts and the standards' calibrated 4 disintegration rate into the log book. If the calculated efficiency varies more than 5% from the last calculation the instrument must be re-calibrated.
5. Allow the radon daughters and (if present in significant quantities) the thoron daughters to decay into annihilation. The samples should then be analysed on a timely basis in order to provide exposure calculations within

the seven consecutive day limit imposed by 10 CFR 20.

6. Count each dust filter five (5) minutes. Record the total count of each filter in the log book.
7. Samples which have a heavy layer of dust on the surface should be handled carefully to avoid contaminating the detector. If possible a separate scintillator detector should be used for clean dust filters and radon samples so that a good lower limit of detection (LLD) can be maintained.
8. Calculate the dust filter assays and record them in a log book (see calculations).

<u>CALCULATIONS:</u>

$$CPM_{BKG} \text{ (counts per minute)} = \frac{C_{BKG}}{T_{BKG}}$$

$$C_{BKG} \text{ (CPM average background)} = \overset{N}{\underset{i=1}{}} \; \frac{C_{IBKG}}{N}$$

<u>And</u>

$$E \text{ (instrument efficiency)} = \frac{\frac{C_{STD}}{T_{STD}} - CPM_{BKG}}{4 \; dpm_{STD}} = \frac{CPM}{DPM}$$

$$DPM = \frac{\frac{C_S}{T_S} \times FSA - C_{BKG}}{E}$$

<u>Where</u>

DPM_S = Disintegrations per minute of sample

C_S = Total counts of sample

C_{STD} = Total counts of standard

T_S = Time sample was counted

T_{STD} = Time standard was counted

C_{BKG} = Total counts background

N = Total number of Bkg samples

C_{IBKG} = CPM_{BKG} of the i^{TH} sample

T_{BKG} = Minutes each Bkg sample was counted

C_{BKG} = Average CPM background

<u>And</u>

$$FSA \text{ (Filter Self Absorbtion Factor)} = \frac{C_2 - C_3}{2C_1 + C_2 - C_3} + 1$$

Where

C_1 = Total Counts Sample

C_2 = Total Counts Reverse Side of Filter

C_3 = Total Counts Sample with Blank Filter Over it

All three count times (C_1, C_2 & C_3) must be equal

And

$$uCi \times 10_s^{-6} = \frac{DPM_s \times 1.0 \times 10^6 \frac{uCi}{Ci}}{3.7 \times 10^{10} \frac{dps}{Ci} \times 60 \text{ sec. per minute}}$$

And

$$LLD_{DPM} \text{ (lower limit of detection)} = \frac{4.66\ _{BKG}}{E}$$

Or

$$LLD \text{ in } uCi \times 10^{-6} = \frac{4.66\ _{BKG}\ (1 \times 10^6 \frac{uCi}{Ci})}{E\ (3.7 \times 10^{10} \frac{dps}{Ci})(60 \text{ sec./min.})}$$

Where

$$_{BKG} = \frac{1}{N-1} \cdot \sum_{i-1}^{N} (C_{IBKG} - C_{BKG})^2$$

The standard deviation of the assay for 95% confidence is then:

$$1.96 = \frac{1.96 \times \frac{(C_s - FSA)}{T_s^2} - \frac{TC_{BKG}}{TT_{BKG}^2}}{E} = DPM_s$$

And

$$1.96_{\text{assay}} = \frac{DPM_s \times 1.0 \times 10^6 \text{ uCi/Ci}}{2.22 \text{ dpm/Ci}}$$

$$= \text{uCi in sample}$$

Where

TC_{BKG} = Total counts of background

TT_{BKG} = Total time of background

September 26, 1983

Revised 2/84

Revised 8/84

Revised 9/84

Revised 2/14/85 - S.W.

Revised 3/28/85 - S.W. - C.P.

GRAB SAMPLE PUMP CALIBRATION PROCEDURE

DISCUSSION:

Pumps used to take both environmental and inplant airborne radiation dust samples are of the self regulating type. (That is, initially a certain amount of air is bypassed around the new dust filter and as the filter loads this excess air capability is diverted to increase the pressure drop across the filter and thus maintain a constant flow.)

The pumps which are used to take radon daughter samples are either of the regulated or non-regulated type. (The samples taken for radon daughters are of short duration and small volume and filter loading is not a factor.)

Environmental dust sampling pumps must maintain a minimum flow of 70 lpm while inplant dust sampling pumps must maintain a minimum flow of 45 lmp. If the flow drops below these rates the pump must be repaired.

Radon daughter sampling pumps must maintain a minimum flow rate of 2 lpm.

All pumps must be calibrated quarterly at the minimum.

EQUIPMENT:

1. RAS-1 or RAP-1 air sampling pumps or equivalent.
2. Bendix 60 or Bendix C115 personal air sampling pump or equivalent.
3. Singer DTM 200 dry test meter or equivalent.
4. One liter bubble tube.
5. Stop watch capable of measuring to 1/10 second.

PROCEDURE:

A. RAS-1 and RAP-1 Calibration:
   1. Calibration of perimeter environmental dust sampling pumps is performed by placing a 47 mm filter head and filter on the dry test meter inlet while inhouse radiation dust sampling pumps are calibrated using a 25 mm filter head and filter on the dry test meter.
   2. Connect the dry test meter to the pump being calibrated by slipping the 1/4" I.D. tygon tubing from dry test meter on to the 1/4" pipe nipple to which the filter head is normally attached.
   3. Start the pump and measure the time the dry test meter takes to make three (3) revolutions (30 liters) using a stop watch.
   4. Calculate the flow rate (see calculations) and if necessary adjust the flow to obtain the values listed in the discussion.
   5. Record the flow on the sheet including the date, time and initials of the individual doing the calibration.
   6. Pumps used for dust exposure sampling should be calibrated before each use while those used for perimeter dust measurement should be exchanged and calibrated (before they are put out and when they are returned) every seven weeks.
   7. Send the dry test meter out for calibration every six (6) months. As a secondary standard, the dry test meter should not be off by more than 2%.

B. Pump Calibration For Radon Monitoring:
   1. Measure the pressure drop across an inline 25 mm filter and adjust the flow meter for the desired pressure drop.
   2. Connect the radon daughter pump to the bubble tube, turn the pump on and move the soap solution up to the bubble tube until bubbles are forming regularly. Fill the bubble tube with bubbles until the entire tube surface is wet.
   3. After no more bubbles are present in the bubble tube dip the end of the

tube in the soap solution quickly so that one bubble forms and time the bubble from the starting mark to the one liter mark.

4. Calculate the flow rate (see calculations) and record the value on the BDX-60 calibration log sheet with the date and initials of the individual performing the calibration.

CALCULATIONS:

$$F = \frac{T}{V} \times 60 \text{ sec./min.}$$

Where

F = Flow Rate In lpm

T = Length of Time The Volume Was Measured

V = Total Volume During The Time Measurement

September 21, 1983

Reviewed 11/15/84 C.P.

Revised 2/5/85 S.W.
Revised 11/10/87

APPENDIX F

Radiation Work Permit Procedures

RADIATION WORK PERMIT ISSUANCE

According to SUA-56 License

INTRODUCTION:

In accordance with SUA-56 license condition #44, a Radiation Work Permit (RWP) is to be issued when any non-routine maintenance, repair and decommissioning activities are performed; whenever a vessel, tank or other enclosed structure which has contained radioactive materials is to be entered; whenever a decommissioning activity could result in an individual's exposure (based on a time weighed average) in excess of 25% of MPC; or for any work or maintenance for which there is no effective operating procedure.

The RWP must contain information pertaining to all precautions taken before, during and after completing the decommissioning activity.

Reference shall also be made to all surveys conducted before or during the time the decommissioning is in progress.

Please note: Input regarding all hazards (especially radiation related) is encouraged from contractor personnel.

RWPs are issued as a method of controlling and maintaining exposures ALARA and are, as the word "Permit" implies, a release to contract personnel allowing them to perform an activity. Caution must therefore be taken to ensure that a license or safety requirement is not overlooked at the time of issuance. The policy concerning RWP issuance will be one of requiring the contractor to inquire before proceeding with a job unless it is obviously routine, covered under the blanket RWP, or no radiation hazards exist.

As RWPs are issued, a list of areas where RWPs are required, accessory equipment and associated safety requirements will be compiled and thus provide some assurance that nothing has been overlooked. A radiation safety technician will observe the proposed work area and conduct any surveys required before and during the decomissioning operation.

RWP REQUIREMENTS:

RWPs will be required for all activity from which an unprotected exposure (to combined dust and radon, soluble uranium dust, or beta, gamma) could reasonable be expected to expose individuals to doses greater than 25% of MPC for dust, 556 mRem for beta or 100 mRem for gamma. In addition, RWPs will be issued without exception for all entries into vessels, tanks or other enclosed structures which have contained ore or uranium bearing solutions and all yellow cake packaging and drying systems.

Precautions must be taken to limit possible skin absorbtion and off site contamination in addition to respiratory equipment requirements. Therefore, any or all of the following equipment or precautions must be used while work is performed under a RWP:

Urine Sample Bottles
Gloves (rubber)
Boots (rubber)
Hard Hat
Safety Glasses
Full Face Respirator
Half Mask Respirator
Air Powered Respirator
Coverall
Impermeable Disposable Coverall
Shower
Impermeable Hood
High Efficiency Vacuum Cleaner
Taped Clothing
Regular Coveralls

Lapel Sampler
TLD Badge
Ring or Extremity TLD Badge

Individuals who are involved in the decomissioning activity must receive instruction concerning precautions and read and sign the RWP when it is issued. Employees who refuse to sign the permit will not be allowed to work on the project and further, a refusal to sign the permit will constitute a refusal to do the work for which appropriate disciplinary action will be taken. The Radiation Safety Department must also be notified when the work begins and when the work is competed.

Work activities under an RWP will be discontinued if the RWP requirements are not being met and will not be started again until they are met.

The Radiation Safety Officer or his designate will walk through the Mill at least twice daily to assure no work activities which would require RWPs are being done without them.

All tanks must be ventilated before entry.

Everyone involved in the yellow cake circuit decomissioning activity must give a urine sample within 48 hours after completetion of the job or at least once a week during the activity.

TYPES OF HAZARDS AND PROTECTION REQUIRED:

Radiation hazards requiring special RWP protection can be grouped into three basic types:

1. External Radiation Exposure
2. Internal Radiation Exposure
3. Surface Contamination and Skin Absorption

1. External Radiation Exposure

External radiation comes from either gamma or beta sources.

Gamma radiation associated with natural uranium comes primarily from Ra-226. Thus all surfaces and filters within the milling circuit where radium gamma exceeds 2.5 mR/hr. must be controlled so an employee will not receive an exposure in excess of 1.2 Rem per quarter. Radium is selectively absorbed in some elemental carbon products and on to some types of rubbers and is also precipitated with calcium carbonate and calcium sulface precipitates.

Beta radiation is emitted primarily from protactinium-234 and Th-234 (short lived uranium daughters). Beta radiation become a problem only in areas where concentrated uranium is allowed to build up for long periods of time. Beta dose to skin is limited to 14 mR/hr. Safety glasses must be worn at all times since the eye is the limiting organ of the body for exposure to beta radiation at 1.25 rem per quarter. Safety glasses effectively shield beta exposure to the eye.

2. Internal Radiation Exposure

Internal radiation comes from inhalation of radon daughters and uranium dust or ingestion of uranium dust. It is quite important that radon daughter and uranium dust levels be estimated before a maintenance task is performed so that the proper type of respiratory protection is chosen. If there is a doubt concerning dust or radon levels to be encountered in the activity the RWP covers, an air powered or air supplied respirator with either a half or full face mask shall be used. An air supplied respirator with a full face mask must be used in areas where there is a high uranium dust and ammonia or acid fume concentration.

3. Surface Contamination and Skin Absorption

Uranium (in the oxide or ammonia salt) tends to be very mobile and is freely transported when smoking, chewing tobacco, eating on contaminated surfaces, through personal hygiene and skin absorption. Precautions should therefore be taken to eliminate all contact with soluble yellow cake on internal and external body surfaces.

When working in a tank which contains or has contained soluble concentrated uranium, individuals must wear rubber gloves and impermeable disposable coveralls. In addition, a full face mask respirator must be worn in order to protect the face from splashing and an impermeable disposable hood to protect the rest of the head and neck areas.

Welding or cutting on surfaces which are contaminated with uranium presents a special problem since the uranium could be vaporized and inhaled. Welding or cutting operations on contaminated surfaces will require an RWP and an air powered respirator.

RWP SURVEYS:

Surveys for RWP activities shall be conducted in such a manner as to protect the decomissioning crew from any type of radiation hazard (internal or external) above 25% of MPC and shall include, as a minimum, lapel samples for dust, gamma measurement and radon daughter measurement (before entry into a vessel, tank etc).

In addition to the minimum requirements, both beta and gamma radiation should be measured inside all vessels containing concentrated uranium. Area dust samples may also be required.

SUMMARY:

If in doubt as to the need for a RWP during any activity, ask a member of the Radiation Safety staff.

All individuals involved in the activity must read and sign the RWP.

Stipulations or precautions listed must be adhered to.

A thorough inspection of the work area must be made prior to starting the RWP activity.

Care must be taken to avoid omission of important protective equipment or precautions when issuing the RWP.

Date Issued - 12/20/82
Reviewed - 2/20/84 - S.W.
Revised - 3/22/85 - C.P. - S.W.
Revised - 11/6/87 - t.h. - J.G.

RADIATION WORK PERMIT

te & Time Started: ______________________________

Date & Time Completed ______________________________

Work Location: ______________________________

Nature of Work To Be Performed: ______________________________

____

____

Protective Equipment Issued: ______________________________

____

Record of Radiation Surveys Performed Prior To and During Maintenance Activity: ______________________________

____

____

____

recautions To Be Taken During Maintenance Activity: ______________________________

____

____

____

Comments: ______________________________

____

____

I (We) understand the hazards involved and the precautions to be observed while performing the above operation:

____________	____________	____________
____________	____________	____________
____________	____________	____________

The individuals listed above have been cleared by the Radiation Safety Officer r his designate to perform the maintenance activity at the listed location.

____________	____________	____________
Radiation Safety Officer	Date	Time

WESTERN NUCLEAR, INC.
SPLIT ROCK MILL
CONTRACTOR CHECK LIST

RWP No. ______

I. ______________________ SS# ______________ Address ______________
____

have recieved instruction on the following:

1. ________ General radiation training (or annual retraining)

2. ________ Specific radiation hazards of the job.

3. ________ Form NRC-3

4. ________ Chemical hazards

5. ________ Electrical hazards.

6. ________ Importance of urinalysis

7. ________ Respirators; Must be worn on certain jobs.

8. ________ Eating and Drinking only in designated areas. Water must be carried in a readily identifiable container.

9. ________ At least three doors must be open while working in the mill to provide fire escape.

10. ________ Must report any abnormal occurance or event as soon as possible and before leaving the mill site.

11. ________ An exit interview MUST be conducted when you finish the job.

SIGNED ______________________ DATE ______________

****

EXIT INTERVIEW

1.Did you eat, drink, breath, or otherwise ingest any unusual substance? ____________

____

2. List any abnormal or unusual incident. ______________________________

____

____

SIGNED ______________________ DATE ______________

INTERVIEWER ______________________ DATE ______________

APPENDIX G

Bioassay Program

URINALYSIS SAMPLING

DISCUSSION:

Deposition of soluble uranium compounds within the body (soluble meaning any uranium compound with a biological lung half life of ten (10) days or less) occurs as a result of three methods of uptake; Inhalation, skin absorbtion or ingestion. Uranium is poorly absorbed within the digestive tract and the magnitude of skin absorbtion has not been well documented, therefore inhalation of uranium is taken to be the largest source of internal uranium deposition. Soluble uranium compounds begin dissolution into the blood stream and lymphatic system immediately after entrapment within the lung. Since uranium, in addition to being radioactive, is also a poisonous heavy metal, the kidneys remove the uranium along with other body wastes which are discharged in the form of urine. The kidneys role as filter, cleanser and concentrator of liquid body wastes places it as the critical organ with regard to heavy metal poisoning.

The Nuclear Regulatory Commission, in its' Reg. Guide 8.22 "Bioassay at Uranium Mills", establishes the criteria by which the extent of heavy metal (uranium) poisoning is to be determined and formulates urine concentration levels at which action will be taken to maintain exposure ALARA.

When the uranium concentration in the urine reaches 30 ug/l for four consecutive weeks or 130 micro-grams per liter (according to Reg. Guide 8.22), kidney damage may begin to occur. Consequently protein (albuminurea) begins showing up in the urine. Since the Western Nuclear, Jeffrey City Operation sends all urine samples off site for analysis, the protein content of urine samples from precipitation and yellow cake packaging operators is routinely monitored so action may be taken toward controlling uranium dust exposure even before the assays are available. When significant protein content is detected, the exposure of the affected worker to airborne uranium dust is restricted until the uranium content of the urine is known.

Urine samples are routinely collected from all Western Nuclear employees, including salaried personnel, who work within the restricted area. Samples are collected bi-weekly from employees who work in soluble uranium dust areas and weekly from precipitation and packaging operators. Annually, and as needed thereafter, employees are instructed concerning methods of taking contamination free samples.

EQUIPMENT:

1. Plastic sample bottles, 4 oz. with caps.
2. Disposable rubber gloves.
3. Albuminuria (protein) dip sticks.
4. Gum backed labels, 1"x3".

PROCEDURE:

1. Store sample bottles and caps in an uncontaminated area.
2. Label each bottle with the individuals name, date due, date taken and, where appropriate, the employees work number. Distribute the bottles early enough to allow sufficient time to take the sample at home.
3. At monthly safety meetings, as often as necessary, remind individuals that samples are to be taken: During days off, 48-96 hours after the last shift, at home and returned in a timely fashion.
4. Collect the urine samples for shipment regularly. Samples should not remain unshipped more than seven days after the collection date.
5. When a seven day accumulation of samples is complete, the samples are

taken to house #26 where precipitation and yellow cake packaging operator samples are dip sticked for protein. Results of the dip stick analysis are recorded in the urinalysis log book along with the individuals name, date taken, date shipped, whether or not the sample was split and any other additional comments. Employees whose urine samples indicate greater than trace values of protein are restricted from working within the mill until a uranium urinalysis indicates that no problem with uranium uptake exists.

6. Ten (10) percent of the samples will be split and sent to a reputable commercial laboratory for duplicate uranium analysis.
7. Laboratories are instructed to notify the WNI Jeffrey City Radiation Safety Officer or his designate by telephone when any urine sample assay is greater than 15 ug/l U.
8. Laboratories are also instructed to decontaminate urine sample preparation facilities to less than 200 dpm/100cm^2 before proceeding with the urinalysis. Twenty-five percent (25%) of the urine samples are spiked with a known standard.
9. Spiked samples must range within plus or minus 30% of the known value or the whole sample set must be rerun.
10. When a urine sample assay is greater than 15 ug/l U, the assay is immediately reported to the individual who gave the sample using the appropriate form attached to this procedure. (See Attachment A) The individual is also required to submit urine samples at an increased frequency through the following seven consecutive days.
11. The 15 ug/l action level triggers a prompt investigation into the reason of its occurance. A sample of the investigation form is also attached to this procedure. (See Attachment C)
12. Individuals who submit urine samples which assay at 30 ug/l U or greater are immediately restricted from working within the mill. (See Attachment B) This restriction remains effective until assays indicate that the uranium content of the individuals urine has dropped below 15 ug/l for seven consecutive days.
13. The NRC must be notified within 30 days when a sample assay is greater than 130 ug/l U or remains above 30 ug/l U for more than four consecutive weeks. Uranium content at these levels indicates possible kidney damage.
14. Accumulate all employee urinalysis records in their respective exposure files.

February 1984
Reviewed 2/5/85 - S.W.
Revised 3/14/85 - S.W. - C.P.

WESTERN NUCLEAR, INC.
JEFFREY CITY OPERATIONS

M E M O R A N D U M

DATE: ____________________

ATTENTION: ________________________________ E/N __________

FROM: JOHN GEARHART, RADIATION SAFETY OFFICER

Your urine sample given on ______________________________ contained ______________ micro-grams per liter of uranium which is above our 15 ug/l action level. You are required to fill out the attached investigation form immediately and to submit a urine sample to the Safety Department every other morning for the next seven consecutive days. The following precautions must be taken when giving these and all routine urine samples:

1. Take the sample at home the first thing in the morning.
2. Wash your hands thoroughly before taking sample.
3. Take the sample before putting on your work clothes.

____

Radiation Safety Officer

cc: Safety Director
Employees Supervisor
Radiation Safety

ATTACHMENT B

WESTERN NUCLEAR, INC.
JEFFREY CITY OPERATIONS

M E M O R A N D U M

DATE: ______________________

ATTENTION: ______________________________________ EN ______________

FROM: ____________, RADIATION SAFETY OFFICER ______________________

Your urine sample given on ______________________________________

contained ________________ micro-grams of uranium per liter of urine which is above the 30 ug/l U limit at which we must restrict your work to non-airborne radiation and non-Radiation Work Permit areas. Your shifter has received a copy of this memorandum and you will be given a restricted work assignment.

Please fill out the attached investigative form immediately. You are required to submit a urine sample each day for the next seven days. The following precautions must be taken when giving these and all routine urine samples.

1. Take the sample at home the first thing in the morning.
2. Wash your hands thoroughly before taking the sample.
3. Take the sample before putting on your work clothes.

____

Radiation Safety Officer

cc: Safety Director
Employees Supervisor
Radiation Safety

URINE-URANIUM SHEET

FOR OFFICE USE ONLY:

Date Urine Specimen Scheduled ______________________________

Date Actually Turned In ______________________________

U/U Reading Of ______________________

PLEASE ANSWER THE FOLLOWING QUESTIONS AND RETURN THIS SHEET TO THE MILL SAFETY OFFICE. THANK YOU.

Number Of Days Off Before Specimen Given ______________________

Where Did You Work This Week Before You Gave The Specimen? ____________

____

Did You Obtain the Specimen At Home Or At Work? __________________

Was The Specimen Bottle Dropped, Or Was The Lid Loose? ______________

Was Water Or Any Other Substances Added To The Specimen? ____________

Was The Specimen Your Own Urine? ______________________________

IF YOU WORKED IN A RESPIRATOR AREA:

Was The Smoke Test Done? ______________________________

Did You Use Your Own Respirator? ______________________________

Where Did You Put Your Respirator While Eating? __________________

____

Was There Possible Contamination Of The Inside Of Your Respirator During Your Shift? If Yes, Please Explain. ______________________________

____

Did You Walk Into A Respirator Area For Only A Few Minutes Without A Respirator? ______________________________

Where Did You Eat Lunch? ______________________________

Are You Able To Wash Your Hands Before Eating, Smoking, Snacking? ________

Do You Carry Cigarettes, Sunflower Seeds, Etc. Uncovered In An Outside Pocket? ______________________________

Do You Frequently Touch Your Nose, Mouth, Face Perhaps Without Realizing It?

____

Did Anything Unusual Occur In The Week Before You Gave The Specimen Which Could Have Given You A Higher Than Usual Reading (Such As Being Splashed, Working In Different Areas, Etc.)? ______________________________

PLEASE RETURN THIS SHEET IN PERSON. THANK YOU.

SIGNED: ____________________ INTERVIEWED BY ____________________

DATE: ____________________

APPENDIX H

Respiratory Protection Manual

RESPIRATOR PROTECTION MANUAL FOR USE OF RESPIRATORS IN ATMOSPHERES CONTAINING RADIOACTIVE PARTICULATES

MILLING OPERATIONS

WESTERN NUCLEAR, INC.
JEFFREY CITY OPERATIONS

I. INTRODUCTION

A. In accordance with the provisions of 10 CFR, Part 20, Section 20.103, "Exposures of Individuals to Concentrations of Radioactive Materials in Air in Restricted Areas", paragraphs (c) through (e), which permit licensees to make allowance for the use of respiratory protection in estimating exposures of individuals to airborne radioactive material and Section 5.5.5, "Respiratory Protection", of Western Nuclear's SUA-56 license application; Western Nuclear has initiated a Respiratory Protection Program for the purpose of utilizing the respiratory protection factors described in the U. S. Nuclear Regulatory Commission Regulaory Guide 8.15.

Respiratory protective equipment is provided by Western Nuclear and shall be used in accordance with the procedures set forth in this manual, when airborne radioactive materials or toxic materials exceed acceptable concentrations. The respirator program is administered by the Safety Department.

II. RESPIRATORY PROTECTION POLICIES AND RESPONSIBILITIES

A. Respirator Usage and Certification:

Respirators will be used only for operations where it is not feasible to limit atmospheric contamination by effective engineering controls, until engineering controls have been implemented, or in areas of high potential exposure. Only approved or certified respiratory equipment is provided. Respirator certification or approval is granted by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA).

B. Written Operating Procedures and RWPs':

Written operating procedures are provided for routine maintenance activities, while all non-routine maintenance activities require the issurance of a Radiation Work Permit (RWP) which stipulates the radiation safety requirements. (See Attachment A) Respirator usage procedures are included in Section V of this manual and must be followed by all employees using respiratory protection. If you are in doubt as to the need of an RWP or respiratory protection, please contact the Safety Department. An over exposure traceable to employee neglect because an RWP was not obtained or the proper respiratory protection was not acquired is a direct violaion of Western Nuclear safety policy and subject to the disciplinary action described in Western Nuclears' "Safety Rules And Regulatons For The Prevention Of Accidents In Milling Operations."

C. Responsibilities -

Each employee is responsible for:

1. Using the respirator issued to him in accordance with instruction and training provided by the Safety Department.
2. Informing his Supervisor of any personal health problem that could be aggravated by the use of respiratory protection equipment.
3. Using the respirator without modification.
4. Reporting any malfunctioning respirator to the Safety Department.
5. Using only equipment for which he has been trained and can obtain a satisfactory fit
6. Checking the respirator fit each time it is donned.

7. Returning the respirator to Safety at the end of the job or shift.

Supervisors are responsible for:

1. Notifying the Safety Department and obtaining a RWP whenever it is necessary for an employee to enter an area in which airborne radioactive contaminants may exceed acceptable standards.
2. Enforcing the use of respirators in situations that require respiratory protection.
3. Consulting the Safety Department for evaluation of exposure hazards when it is suspected that airborne radioactive or toxic contaminants could exceed acceptable standards.
4. Notifing the Safety Department of any employee known to have an active medical work restriction and obtaining Safety Department clearance for such employee prior to assignment of a job requiring the use of respiratory protection.

The Safety Department is responsible for:

1. Providing necessary respiratory equipment to protect the health of the employees.
2. Maintaining the equipment in serviceable condition.
3. Fitting employees with proper respirators and training them in their use.
4. Radiation Work Permit issuance (see attachment A).
5. Measuring employee exposures, monitoring airborne radioactivity concentrations and evaluating additional radiation work hazards.
6. Random inspections of respirator use.
7. Establishing and keeping records of the medical approval required.

III. <u>RESPIRATORY PROTECTIVE EQUIPMENT SELECTION</u>

A. Respirator Selection:

Several different brands of respiratory protective equipment are available at the Mill Safety Office. These respirators have been chosen to facilitate proper fitting and optimal user protection.

Several factors govern respirator selection. These include:

1. The nature and extent of the hazard.
2. Work requirements and conditions.
3. Respiratory equipment protection limits.
4. Availability of approved equipment.
5. Facial characteristics (size, shape etc.).
6. Skin reactions to the material from which the respirator is made.

B. Respirator Types:

The types of respirators available for use are: Half-mask filter and cartridge respirators, full-face cartridge respirators, powered air purifying respirators with half or full face masks, air supplied respirators with half or full face mask and self contained breathing apparatus (SCBAs').

C. Protection Factors:

The overall protection given by a respirator is defined as its protection factor (PF). Table 1 of NRC Regulation Guide 8.15 lists the protection factors for each type of respirator.

The PF is defined as the ratio of the concentration of contaminants outside the respirator to that inside the respirator under conditions of use. For example, the contaminant concentration inside a half mask respirator is less than 10% of that outside the respirator and thus may be used for protection in atmospheres with a contaminant concentration up to 10 times the permissible exposure limit. When calculating the exposure of individuals wearing respiratory protection to radioactive materials, the measured intake of airborne radioactive contaminants is divided by the protection factor to determine actual intake. Consequently, when PFs were developed, laboratory tests were used to determine the face to face piece seal leakage rates for a wide variety of equipment and facial sizes. Therefore, the PFs may only be used on those people who are found to have a satisfactory fit with the device they are wearing. (Attachment B lists the PFs for various types of masks.) Employees with facial characterisics that prevent proper fitting of one type of respirator may be fitted with a different brand. Employees who cannot achieve a proper fit with any available respirator will not be allowed to enter an area which requires respiratory protecion.

D. Air-Purifying Respirators:

Air-purifying respirators remove specific gases, vapors and/or particulates from the ambient air to make it suitable for breathing. With the exception of disposible dust masks, the purifying filters are mounted in a filterholder or contained within a cartridge while sorbents are contained in either cartridges or canisters. Periodic replacement of filters, cartridges or canisters assures continued protection. The two major limitations of air purifying respirators are (1) they add <u>no</u> oxygen to the air and (2) the degree of protection against chemical vapors and gases is governed by the efficiency of the sorbant in removing them. Air-purifying respirators <u>may not</u> be used for protection against any radioactive gases or vapors, but <u>may</u> be used for protection against airborne particulates at concentrations within the allowable protection factors.

1. Half-Mask Respirators: The half mask respirator is the most widely used, comfortably worn, and versatile respirator available. Half masks are furnished in styles adapted to either nuisance dust protection or radionuclide particulate and chemical gas or vapor protection. Employees are to use only those brands and/or styles with which they can obtain a satisfactory fit and which are appropriate for the job. Each face piece is supplied with the appropiate filter or cartridge depending upon its intended use.
2. Full-Face Respirators: Full-face masks provide more protection than half-masks because they usually form a better face piece to face seal. They also provide eye protection in atmospheres containing irritating chemicals or particulates.
3. Powered Air-Purifying Respirators: Powered air-purifying full-face or half-mask respirators provide more protection than regular full-face or half-mask respirators, because they provide a continuous positive flow of filtered air (4 CFM) to the face piece. This causes a positive pressure inside the face piece which significantly reduces leakage into the mask.

E. Air Supplied Respirators:

Respirators supplied by a hose which carries respirable air from a source outside the contaminated area are defined as "air supplied" respirators. The usual source of air is a compressor from which the air passes through a filtration system. The air powered respirators supplied at WNI are of either the half mask, full face or hooded type. Continuous flow face piece and hooded type respirators provide even more protection than air powered respirators. Respirators of this type also have disadvantages in that the individual wearing the unit has limited mobility because of his attachment to a hose.

F. Self Contained Breathing Apparatus:

Self contained breathing apparatus (SCBAs) provide the ultimate respiratory protection available. A SCBA consists of a harness mounted high pressure air supply tank, a double stage regulator, emergency regulator by-pass air supply system, a full face mask and related low and high pressure hoses. Legal SCBAs must be of the pressure demand type and must be operated in the "pressure" mode. When operated in the "pressure" mode, SCBAs' provide a constant pressure of approximately 3/4 of an ounce to the face piece. Small leaks are effectively controlled by the positive pressure forcing air out though the leak even when the individual wearing the apparatus inhales.

IV. <u>RESPIRATOR FITTING REQUIREMENTS:</u>

A. General Fitting Procedure:

Every respirator wearer must be properly fitted before using a respirator for health protection. The fitting process includes:

1. Trying different types and brands for comfort and sealability.
2. Moving the head and face through various contortions while being smoke tested.
    a. Move the head up and down.
    b. Slowly move the head from side to side.
    c. Breathe deeply
    d. Read a short passage aloud.
    e. Frown.
    f. Smile.
    g. Run in place.
    h. Resume normal breathing and recheck the seal.
3. Being made aware of respirator and wearer limitations.

Employees will be fitted and trained annually. The respirators will be returned to the Mill Safety Office after work is completed or at the end of the shift for maintenance and cleaning.

B. Facial Characteristics:

Facial characteristics will be observed for abnormalities which may prevent proper respirator fitting. During each annual training/fitting session, additional scars or other facial deformaties affecting respirator fit should be observed and recorded.

C. Respirator Fit Limitations:

The following Items will cause respirator leakage and are therefore forbidden practices:

1. Individuals required to wear a respirator will not chew gum, sunflower seeds, tobacco or any other food while wearing a respiraor.
2. Individuals will not wear respirators unless they are clean shaven.

3. Do not place respirator straps across the outside of a hard hat.
4. Goggles may be worn while wearing a half mask respirator only; and then only if the wearer can maintain a proper seal.
5. Do not attempt to wear glasses inside a full face respirator unless they are specially mounted inside the face mask.
6. Individuals who wear dentures when they are fit tested must wear the dentures at all times while wearing a respirator.

V. TRAINING

A. Training Procedure:

Every employee who may have to wear a respirator for health protection must be trained in the use of the respirator and it's limitations. Training is conducted annually as follows:

1. The trainer displays each type of respirator, explains the function of its components and the problems associated with its use and/or malfunction.
2. Each trainee is then allowed to inspect the various respirator types.
3. The trainee is instructed in the methods of donning and adjusting the respirators and is smoke tested as described in Section IV (the Respirator Fitting section) of this manual.
4. Employees are shown how to test the respirator for leaks using the positive and negative pressure fit testing method.
5. Protection factors for each respirator type are described along with the respirators limitations. Employees are admonished to leave the area requiring respiratory protection if they experience any problems.
6. The last phase of the training is directed toward discussing the routine uses of each respirator at the Split Rock Mill.

B. Training Administration:

Training will be conducted and recorded by the Safety Department for all employees who must wear respirators. (See Attachment C)

VI. MEDICAL APPROVAL

A. Medical approval is required for anyone who needs or may have the need to wear a respirator. This approval must be given on an annual basis. (See Attachment C)

VII. OPERATING PROCEDURES FOR RESPIRATORY EQUIPMENT

This procedure outlines the safe use of respiratory equipment when breathing hazards may exist. Since air purifying respirators do not in any way provide additional oxygen or enhance the air supply, (other than removing limited amounts of contaminants) they are not approved for use in situations immediately hazardous to life or health. Western Nuclear provides Self Contained Breathing Apparatus for use in these situations.

A. Air-Purifying Half-Mask Respirator:

1. General - This type of respirator can be used for protection against low concentrations of toxic vapors, gases and particulates. (Concentrations no greater than 5 times the maximum permissable concentration (MPC).) Safety Department personnel will select the proper cartridge for each job application.
2. Limitations - This respirator does not supply air and so is not for use in an oxygen deficient atmosphere. Respirators are used only for protection against the contaminants listed on the

cartridge. The wearer must leave the area immediately if the gas or vapor can be detected inside the mask or if breathing becomes difficult. Contact lenses may not be worn while wearing any type of respiratory protection. Half mask respirators will not be worn in the yellow cake room for more than thirty (30) minutes per shift.

NOTE: Each respirator user may leave the area at any time for relief from respirator use in the event of respirator malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions or any other condition that might require such relief.

3. Donning the Mask -
   a. Use a brand of mask that fits well.
   b. Hold the mask so that the narrow nose cup points up.
   c. Grasp both lower straps and hook behind the neck.
   d. Grasp both top straps and hook behind top of the head. The top straps must fit above the ears for proper fit.
   e. Adjust the straps so the fit is snug, but comfortable.
   f. Check for leaks by covering the filter elements with palm of hand and inhale gently. If the mask is pulled toward the face, the fit is good.
   g. Check the seal with a qualitative smoke test while moving or contorting the head and face. If the employee can smell the smoke, the face piece must be adjusted and smoke tested again.
   h. The mask should hang by the top straps around the users neck when not in use. If the mask is hung by the bottom straps, it will be in a position to catch radioactive dusts and materials.

B. Full-Face Mask Respirator:
1. General - Full-face masks are used with air-purifying cartridges or canisters. No protection factor is applicable for canister usage, however full face respirators equipped with radionuclide cartridges provide protection in atmospheric concentrations up to 25 times MPC.
2. Limitations - Do not wear with standard eyeglasses that interfere with the face to mask seal. Obtain special glasses from the Safety Department. Contact lenses may not be worn while wearing any type respiratory protection. (See half mask section limitations.)
3. Donning the Mask -
   a. Loosen all straps, pull the harness over the face shield.
   b. Place the chin against the chin cup and position the mask against the face.
   c. Pull head harness back over the face shield and down on the back of the head until the harness is free.
   d. Tighten the harness gently, beginning with the lower, then middle and finally the top straps.
   e. Check the fit by closing off the air hose or canister opening with the palm of your hand and inhale gently. Hold your breath for 5-10 seconds. A good fit is indicated if the mask remains collasped toward the face while holding your breath.
   f. Check the seal with a qualitative smoke test. If smoke can be detected, the unit must be adjusted to obtain a better

seal and re-tested.

C. Air-Purifying Powered Half-Mask Respirator:

1. Air-Purifying powered respirators are used with high efficiency cartridges which provide protection against airborne radionuclides in concentrations up to 500 times MPC. They cannot be used in atmospheres containing toxic chemicals. (See sections on half-mask and/or full-face mask for other limitations.)
2. Only air purifying powered respirators will be worn by the yellow cake packaging operator or individuals who will be in the packaging room for more than thirty minutes per shift.
3. Donning the Mask -
    a. Fasten the battery pack and blower with high efficiency cartridges around waist using the belt provided.
    b. Two half mask face pieces are available. One has the air hose hose connection on the bottom of the face piece, the other connects to the hose from the side.
    c. Don the mask as outlined under the "Air Purifying Half Mask Respirator Donning Procedure" or "Full Face Mask Donning Procedure" as applicable.
    d. Select the face piece that you feel most comfortable with and adjust the battery pack and blower so the hose is not bent, kinked or pulling against the face piece.
    e. Make sure all hose connections are hand tight.
    f. Check the seal by disconnecting the breathing hose and sealing the hose against the palm of the hand. The respirator should pull tight against the face for 5-10 seconds if the seal is good.
    g. Turn the blower on and reconnect the hose. Check the blower/filter unit and face piece seal with irritant smoke.

D. Full Face Air Powered Respsirators:

1. Air powered respirators equipped with a full face piece are used when protection of the eyes or face is desirable or when a proper face piece seal can not be obtained with a half mask air powered respirator. Other than the above advantages, a full face piece provides no additional protection.
2. Donning The Mask -
    a. Don the mask and related equipment described in Sections VII. B. 2 & 3 of "Operating Procedures For Respiratory Equipment".
    b. Check the seal as described in Section VII. B. 3. e & f.
    c. The limitations described in Section VII. A. 2 of "Operating Procedures For Respiratory Equipment" also apply to full face air powered respirators.

E. Air Line Respirators:

1. Air line respirators provide protection against both toxic chemicals and respirable particulates. Since the air supplied to air line respirators must be free of contamination, the source from which the air is drawn must be located outside of the contaminated area. Air line respirators are not used in situations immediately hazardous to life or health since they have no built in back up system.
2. Western Nuclear has two types of air line supply systems:
    a. Wilson Ambient Air Breathing Apparatus (AABA):

        This unit should be used during maintenance activities requiring a high degree of protection, such as roaster maintenance. Half mask or full face respirators are provided for use with this unit. Compressed air powers a small compressor which in turn provides the air supplied to the respirator(s).

Air must be supplied at a constant rate of four (4) cubic feet per minute (CFM). The AABA operates from the mill compressed air system and should be supplied with air at between 60 and 100 psi with a minimum of 84 CFM. The manifold pressure guage for air supplied to the respirators should be set a 11 psi. While the unit has three (3) hose outlets and 300' of hose, no more than 100' and no less than 50' of hose should be used with each single respirator unit. The hose size is 3/8" id.

(1) Half mask respirators provide protection in atmospheres up to 500 times MPC, while full face respirators provide protection in atmospheres up to 1000 times MPC.

(2) The fitting and training requirements listed in Sections IV and V of this manual concerning fitting, testing and donning half and full face respirators apply to using air supplied respirators.

b. Sand Blasting Helmet

The sand blasting unit is equipped with an MSA Blastfoe abrasive helmet and shroud which cover the head and torso of the operator. The helmet should be equipped with no more than fifty (50) feet of supply hose. The inlet pressure to the supply hose should be regulated at between 12 and 20 psig which will supply the wearer with 12 cubic feet per minute (CFM) of air.

(1) All conditions of respirator issuance apply to the blastfoe helmet. Since sandblasting equipment is subject to extreme punishment, the integrity of the shroud/hood assembly should be checked often.

(2) Fit testing will involve adjusting the helmet to the operators head and checking the seal with a smoke tube while it is in operation.

(3) The oil/water mist filter should be changed when the inlet pressure drops below 12 psig.

F. Self Contained Breathing Apparatus:

During emergency entry, when there is usually neither time nor opportunity to evaluate the degree of possible exposure, only self-contained breathing apparatus (SCBA) in the pressure demand mode should be used. SCBAs are the only respiratory equipment approved for use in atmospheres that may be immediately hazardous to life or health and only those employees trained in the use of SCBAs are authorized to use them.

Employees using SCBAs' will operate only in pairs with at least one other person wearing a SCBA to back up the pair engaged in the emergency operation. Only certified individuals will perform maintenance on SCBAs'.

VIII. <u>RESPIRATOR MAINTENANCE PROCEDURE</u>

Introduction:

Proper hygienic procedures require that respirators and respirator filter cartridges issued for use in airborne radionuclide environments are surveyed for alpha surface contamination and checked for maintenance of proper air flow daily. The entire respirator must also be cleaned and sanitized weekly. This procedure will minimize the possibility of breathing radioactive surface contamination into the lungs, ensure that the user has an adequate supply of air, eliminate the difficulty of breathing across a large pressure drop and minimize the possibility of entraining infections viruses or bacteria in the respirator unit.

The present respiratory protection program requires that WNI maintain a minimum stock of respirators in order to supply each individual needing respiratory protection.

Maintaining Issued Respirators:

1. At the end of each shift the respirator must be returned to the safety office.
2. Remove the respirator cartridges and check the pressure drop across the cartridge. If the pressure drop is above MSA specifications the cartridge must be discarded. The cartridge must also be discarded when splattered with yellow cake or if both cartridges combined have removable surface contamination above 100 dpm/100cm^2*.
3. Wipe the respirator inside and out with a 2.5 cm paper filter. Count the filter for one (1) minute. If the calculated dpm is above 100, the respirator must be washed and sanitized.*
4. Place in respirator bag and seal.
5. Record the results of the swipe sampling and cartridge check on the respirator issuance form. The respirator must be smoke tested when it is re-issued.

   * See "Removable Alpha Radiation Sampling" procedure.

Respirator Cleaning & Sanitizing:

1. Place all used respirators in a covered container.
2. Before washing the respirator remove the head yoke and unsnap the head band straps.
3. Allow the washing machine to fill and rinse with hot water.
4. Fill the washer about 2/3 full with respirators and parts. Fill the washer with warm water and add one package of respirator sanitizer per gallon of water (approximately 6 packages).
5. Rinse the respirators in warm water.
6. After removing the metal head band yokes, place the respirators in the dryer on low heat and dry them for 60 minutes.
7. Remove the respirators from the dryer place them in a suitable container and bring them back to the office.
8. Many small parts (particularily valves) come free from the respirator during washing and drying. Therefore care must be taken to insure their removal from the washer and dryer.
9. Assemble the respirator as follows:
   A. Replace missing inhalation valves.
   B. Replace missing cartridge gaskets.
   C. Mount the head band yoke on the respirator (use correct size).
   D. Snap head band straps with D-rings on the top and bottom of the head band yoke (on the left side of the yoke with the respirator in the donning position).
   E. Snap a short clasping strap on the right bottom of the yoke, and a long clasping strap on the right top of the yoke.
   F. Double check to make sure no valves or gaskets are missing and that no internal sediment will interfere with valve or gasket sealing.
   G. Screw radionuclide cartridges into each respirator.
10. Do a swipe survey on 10% of the washed respirators. When any

respirator swipe is above an action level of 60 dpm, all the respirators in the batch which were washed together will have to be swipe surveyed. Any respirators that exceed the action level of 60 dpm must be recleaned.
11. Write a serial number on the yoke of the respirator.
12. Place each respirator in a respirator bag. Write the date, name of the person preparing the respirator and survey results on the outside of the bag and seal it with a wire tie.

Respirator Inventory:
1. Western Nuclear, Inc. maintains a minimum stock of ten new Comfo II respirators at the mill warehouse and six at the mine.
2. A monthly inventory check list is provided for other types of respirators and spare parts. (See Attachment E)

IX. RESPIRATORY PROTECTION FILTERS, CARTRIDGES AND CANISTERS

Introduction:

Western Nuclear provides a wide variety of filter, sorbent and combination filter/sorbent cartridges. These cartridges are used on half-mask or full face respirators in atmospheres not immediately dangerous to life or health. The cartridges do not provide oxygen or in any other way enhance the air being breathed. They do however, filter out airborne particulates (within the limits specified by the respiratory protection factors) and, within the limits specified on the cartridges, they remove toxic gases, and organic vapors. Only those cartridges classified as radionuclide particulate filters are used in environments containing airborne radionuclides. The types of cartridges available are listed as follows:

A. Cartridges:

TYPE OF CARTRIDGE	CONTAMINENTS REMOVED
Radionuclide Type H	Radioactive particulates, dusts, fumes & mists
Chemical Cartridge Type GMD	Ammonia and methylamine
Chemical Cartridge Type GMC	Acid gases & organic vapors
Chemical Cartridge Type GMP	Pesticides (but not fumigants)
Radionuclide/Chemical Cartridge Combination Type GMB-H	Acid gases, dust, fumes, mists and radionuclides
Radionuclide/Chemical Cartridge Combination Type GMD-H	Ammonia, Methylamine, radionuclides, dusts, fumes & mists
Chemical Cartridge Type GMB	Acid gases
Radionuclide/Chemical Cartridge Combination Type GMC-H	Organic vapors, dust, mists, fumes & radionuclides

The Safety Department will decide, at the time of respirator issuance, which type of cartridge is appropriate for use in the indicated environments. Under certain circumstances a gas sample may even be required before respirator issuance. Detection of the gas contaminant within the respirator is an indication that:

1. The respirator is malfunctioning.
2. The sorbent material within the cartridge is loaded to capacity.
3. The concentration of the contaminant gas exceeds the capacity of the cartridge to remove it.

The employee using the respirator should therefore leave the area immediately and notify the Safety Department which will conduct an investigation into the reason for the occurance.

B. Canisters:

Western Nuclear provides gas mask canisters for protection against less than 3% ammonia. Though canisters are available for protection against other chemicals and radionuclides, ammonia canisters are the only canister presently available at the Split Rock Mill.

X. BIOASSAY

A. Urine Samples:

Urine samples are required to be submitted by each individual who works within the mill. Depending upon the type of job performed, these samples are required monthly, bi-weekly or weekly. Special circumstances may even require that the urine samples be taken daily for a period of time. The results of this sampling are used to measure the exposure to ingested soluble uranium compounds. (See the Bioassay procedure)

Revised 3/5/85 - C.P. - S.W.

ATTACHMENT A

RADIATION WORK PERMIT

Date & Time Started: ______________________________

Date & Time Completed: ______________________________

Nature Of Work To Be Performed: ______________________________

____

____

Protective Equipment Issued: ______________________________

____

Record of Radiation Surveys Performed Prior To & During Maintenance Activity:

____

____

____

Precautions To Be Taken During Maintenance Activity: ______________________________

____

____

Comments: ______________________________

____

____

I (We) understand the hazards involved and the precautions to be observed while performing the above operations:

______________ ______________ ______________

______________ ______________ ______________

______________ ______________ ______________

The individuals listed above have been cleared by the Radiation Safety Officer or his designate to perform the maintenance activity at the listed location.

______________	______________	______________
Radiation Safety Officer	Date	Time

TABLE 1

PROTECTION FACTORS FOR RESPIRATORS[A]

DESCRIPTION	MODES	PROTECTION FACTORS PARTICU-LATES ONLY	PROTECTION FACTORS PARTICULATES, GASES & VAPORS	SELECTION OF TESTED & CERTIFIED EQUIPMENT BUREAU OF MINES NIOSH APPROVALS
I. AIR-PURIFYING RESP.				
Facepiece, half mask[F]	NP	10		
Facepiece, fll	NP	50		30 CFR PT.II K
Facepiece,half-mask, full or hood		1000		
II. AIR SUPPLY RESP.				
1. Air-line respirator				
Facepiece,half-mask	CF		1000	
Facepiece,half-mask	D		10	
Facepiece, full	CF		2000	
Facepiece, full	D		50	30 CFR PT.II J
Facepiece, full	PD		2000	
Hood	CF		2000[G]	
Suit	CF		[H]	[I]
2. SCBA				
Facepiece, full	D		50	
Facepiece, full	PD		10,000[J]	30 CFR PT.II II
Facepiece, full	R		50	
III. COMBINATION RESPIRATOR				
Any combination of air- & atmosphere-supplying respirators		Protection factor for type & mode of operation as listed above		30 CFR PT.II & II.63(b)

[A]For use in the selection of respiratory protective devices to be used where the contaminant has been identified and the concentration (or possible concentration) is known.

[B]Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. (Hoods and suits are excepted.)

[C]The mode symbols are defined as follows:

CF = continuous flow
D = demand
NP = negative pressure (i.e., negative phase during inhalation)
PD = pressure demand (i.e., always positive pressure)
PP = positive pressure
R = demand, recirculating (closed circuit)

[D]1. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentraion to estimate the concentration inhaled by the wearer according to the following formula:

$$\text{Concentration Inhaled} = \frac{\text{Ambient Airborne Concentration}}{\text{Protection Factor}}$$

2. The protection factors apply:
   (a) Only for trained individuals wearing properly fitted respirators used and maintained under supervision in a well-planned respiratory protective program.

   (b) For air-purifying respirators only when high efficiency particulate filters (above 99.97% removal efficiency by thermally generated 0.3 um dioctyl phthalate (DOP) test) are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

   (c) For atmosphere-supplying respirators only when supplied with adequate respirable air.

[F]Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentration to reach instantaneous values greater than 10 times the pertinent values in Table 1, Column 1 of Appendix B to 10 CFR Part 20, "Standards for Protection Against Radiation". This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask is to be tested for fit with irritant smoke, prior to use, each time it is donned.

[G]The design of the supplied-air hood or helmet (with a minimum flow of 6 cfm of air) may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. Such aspiration may be overcome if a short cape-like extention to the hood is worn under a coat or coveralls. Other limitations specified by the approval agency must be considered before using a hood in certain types of amospheres (see footnote h). Manufacturers' recommended pressure settings for the air supply cannot always be relied on to ensure a minimum 6 cmf air flow. Equipment must be operated in a manner that enures proper flow rates are maintined.

[H]Appropriate protection factors must be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use.

[I]No approval schedules are currently available for this equipment. Equipment is to be evaluated by testing or on the basis of reliable test information.

[J]This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption must be taken into account in such circumstances.

NOTE 1: Protection factors for respirators, as may be approved by the U.S. Bureau of Mines/National Institute for Occupational Safety and Health (NIOSH) according to applicable approvals for respirators to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances should take into account applicable approvals of the U.S. Bureau of Mines/NIOSH.

NOTE 2: Radioactive contaminants for which the concentration values in Table 1 of Appendix B to 10 CFR Part 20 are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under such circumstances, limitations on occupancy may have to be governed by external dose limits.

WESTERN NUCLEAR, INC.

RESPIRATOR TRAINING AND FITTING

______________________________ ______________________
NAME EN

has been medically approved to use the following respirators:

Half-Masks ____________

Full-Face Masks ____________

Air Line Equipment ____________

SCBA ____________

______________________________ ______________________
SIGNED DATE

The above named employee has been trained and fitted and is approved to use the following respirators:

Half-Masks ____________

Full-Face Masks ____________

Air Line Equipment ____________

SCBA ____________

______________________________ ______________________
SIGNED DATE

RESPIRATOR ISSUANCE RECORD

I ______________________________ , EN ____________________ have been inssued the following respirators:

[ ] Half Mask

[ ] Full Face Mask

[ ] Powered Air Purifying Full or Half Mask

[ ] Air Supplied with Full or Half Mask

Respirator Survey

	Date Issued	Issued By	I have been smoke tested	100 dpm/100 cm^2 removable alpha ( )	
1.	________	______________	[ ]	[ ]	[ ]
2.	________	______________	[ ]	[ ]	[ ]
3.	________	______________	[ ]	[ ]	[ ]
4.	________	______________	[ ]	[ ]	[ ]
5.	________	______________	[ ]	[ ]	[ ]

This respirator is issued for a maximum of five (5) days and must be returned to the Safety Department at the end of each shift for alpha survey and cartridge check.

This cartridge ______________ (type) has a maximum allowable pressure drop of ____________ mm water and had the following pressure drop(s) on the listed issue dates:

Pressure Drop: 1. ______ 2. ______ 3. ______ 4. ______ 5. ______

Comments: ____

Mill RSO ______________________________
Signature

RESPIRATOR MAINTENANCE PROCEDURE

INTRODUCTION:

Proper hygienic procedures require that respirators and respirator filter cartridges being issued for use in airborne radionuclide environments are surveyed for alpha surface contamination and checked for maintenance of proper air flow daily. The entire respirator must also be cleaned and sanitized weekly. This procedure will minimize the possibility of breathing radioactive surface contamination into the lungs, ensure that the user has an adequate supply of air without the ill health effects associated with breathing across a large pressure drop and minimize the possibility of entraining infectious, viruses or bacteria in the respirator unit.

The present respiratory protection program requires that WNI maintain a minimum stock of respirators in order to supply each individual needing respirator protection.

MAINTAINING ISSUED RESPIRATORS:

1. At the end of each shift the respirator must be returned to the safety office.
2. Remove the respirator cartridges and check the pressure drop across the cartridge. If the pressure drop is above MSA specifications the cartridge must be discarded. The cartridge must also be discarded when splattered with yellow cake, or if both cartridges combined have removable surface contamination above 100 dpm/100cm^2*.
3. Wipe the respirator inside and out with a 2.5 cm paper filter. Count the filter for one (1) minute. If the calculated dpm is above 100, the respirator must be washed and sanitized.*
4. Place in respirator bag and seal.
5. Record the results of the swipe sampling and cartridge check on the respirator issuance form. The respirator must be smoke tested when it is re-issued.

* See swipe sample procedure.

RESPIRATOR CLEANING & SANITIZING:

1. Place all used respirators in a covered container.
2. Before washing the respirator remove the head yoke and unsnap the head band straps.
3. Allow the washing machine to fill and rinse with hot water.
4. Fill the washer about 2/3 full with respirators and parts. Fill the washer with warm water and add one package of respirator sanitizer per gallon of water (approximately 6 packages).
5. Rinse the respirators in warm water.
6. After removing the metal head band yokes place the respirators in the dryer on low heat and dry them for 60 minutes. (Care should be taken to remove small respirator parts from the washer, such as valves.)
7. Remove the respirators from the dryer (again being careful to get all the small pieces) and place them in a suitable container to bring them back to the office.
8. Assemble the respirator as follows:
   A. Replace missing inhalation valves.
   B. Replace missing cartridge gaskets.
   C. Mount the head band yoke on the respirator (use correct size).

D. Snap head band straps with D-rings on the top and bottom of the head band yoke (on the left side of the yoke with the respirator in the donning position).
E. Snap a short clasping strap on the right bottom of the yoke, and a long clasping strap on the right top of the yoke.
F. Double check to make sure no valves or gaskets are missing and that no internal sediment will interfere with valve or gasket sealing.
G. Screw radionuclide cartridges into each respirator.

9. Do a swipe survey on 10% of the washed respirators. If any respirator surveys at or above an action level of 60 dpm, all the respirators in this batch will have to be swipe surveyed. Any respirators that exceed the action level of 60 dpm must be recleaned.
10. Write a serial number on the yoke of the respirator.
11. Place each respirator in a respirator bag. Write the date, name of the person preparing the respirator and survey results on the outside of the bag and seal it with a wire tie.

RESPIRATOR INVENTORY:

1. Western Nuclear, Inc. maintains a minimum stock of ten new Comfo II respirators at the mill warehouse and six at the mine.
2. A monthly inventory check list is provided for other types of respirators and is added to the end of this procedure.

Revised 4/6/84
Revised 2/7/85 - S.W.

APPENDIX I

Estimated Mill Decommissioning & Reclamation
Earthwork Quantities & Costs

TABLE OF CONTENTS

Appendix I:

I. Estimated Dismantled and Compacted Volumes of Mill and Other Support Facilities

1. Old Crusher

Dimensions: L = 65' W = 25' | L = 38' W = 20' | Ht = 35'

Wall Siding: $2 \times 65 \times 35 + 38 \times 35 + 45 \times 35 + 25 \times 35 + 20 \times 35 = 9{,}030 \text{ ft}^2$

Roof: $65 \times 27 + 38 \times 22 = 2{,}591 \text{ ft}^2$

Sub-total = $11{,}621 \text{ ft}^2$

Assume thickness of compacted roofing and siding sheet metal is 1"

$$\text{Dismantled Volume} = 11{,}621 \times \frac{1}{12} = 968 \text{ ft}^3$$

$$\text{Gross Volume} = 65 \times 25 \times 35 + 38 \times 20 \times 35 = 83{,}475 \text{ ft}^3$$

Net volume occupied by erected contents = 30% of Gross Volume

$$= 0.3 \times 83{,}475 = 25{,}042 \text{ ft}^3$$

$$\text{Dismantled Volume} = 50\% \text{ of Net Volume} = 0.5 \times 25{,}042 = 12{,}521 \text{ ft}^3$$

$$\text{Total Dismantled Volume} = 968 + 12{,}521 = 13{,}489 \text{ ft}^3$$

Rounded = $14{,}000 \text{ ft}^3$

2. <u>Acid Plant</u>

The following components of the acid plant will remain onsite and will be WNI's responsibility to dismantle and bury the remaining plant.

(i) System Tanks and Storage Tanks:

2 tanks, each 36' diameter and 18' high

Erected Volume = 0.7854 x $(\text{diameter})^2$ x height

= 0.7854 x $(36)^2$ x 18

= 18,321 ft^3

Volume of 2 tanks = 2 x 18,321 = 36,642 ft^3

1 tank, 12' diameter and 8' high

Volume = 0.7854 x $(12)^2$ x 8 = 905 ft^3

1 tank, 12' diameter and 15' high

Volume = 0.7854 x $(12)^2$ x 15 = 1,696 ft^3

Sub-total Erected Volume = 39,243 ft^3

Dismantled Volume = 10% of Erected Volume
= 3,924 ft^3

(ii) Absorbing Tower & Drying Tower:

2 tanks, each 10' diameter and 22' high

Volume = 2 x 0.7854 x $(10)^2$ x 22 = 3,455 ft^3

Water Cooling Unit = 15' x 15' x 20' = 4,500 ft^3

Sub-total = 7,955 ft^3

Dismantled Volume = = 0.10 x 7,955
= 796 ft^3

(iii) Sulfur Tank

1 tank, 25' diameter and 18' high

Volume = 0.7854 x $(25)^2$ x 18 = 8,836 ft^3

Sulfur Furnace

1 tank, 8' diameter and 20' high

Volume = 0.7854 x $(8)^2$ x 20 = 1,005 ft^3

Sulfur Pit

Container measuring 24' x 5' x 6' = 720 ft^3

Sub-total = 8,836 + 1,005 + 720 = 10,561 ft^3

Dismantled Volume = 0.10 x 10,561 = 1,056 ft^3

(iv) Acid Plant Building & Connected Structures

Gross Volume = 40' x 25' x 20' = 20,000 ft^3

Dismantled Volume = 20% of Gross Volume
= 0.20 x 20,000 = 4,000 ft^3

(v) All other miscellaneous parts, pipes, and junked structures are estimated to have a dismantled volume of approximately 5,000 ft^3

Total Estimated Dismantled Volume for Acid Plant

= 3,924 + 796 + 1,056 + 4,000 + 5,000 = 14,776 ft^3

Rounded = 15,000 ft^3

3. Electric Shop

Dimensions: L = 64'   Average Height = 16'
W = 27'

Wall Siding: 2 x 64' x 16' + 2 x 27' x 16'
= 2,912 ft^2

Roof: 64 x 28 = 1,792 ft^2

Sub-total = 2,912 + 1,792 = 4,704 ft^2

Again, assume thickness of compacted roofing and siding sheet metal is 1 inch.

$$\text{Dismantled Volume} = 4{,}704 \times \frac{1}{12} = 392 \text{ ft}^3$$

Gross Volume = 64 x 27 x 16 = 27,648 ft^3

Net Volume Occupied by Erected Contents
= 10% of Gross Volume
= 0.10 x 27,648 = 2,765 ft^3

Dismantled Volume = 50% of Net Volume
= 0.50 x 2,765 = 1,382 ft^3

Total Dismantled Volume = 392 + 1,382 = 1,774 ft^3

Rounded = 2,000 ft^3

4. Reagent Warehouse

Dimensions: L = 100' W = 42' Average Ht. = 22'

Siding: 2 x 100 x 22 + 2 x 42 x 22 = 6,248 ft^2

Roof: 100 x 44 = 4,400 ft^2 (Allowing 2 ft of extra width for sloping roof)

Sub-total = 6,248 + 4,400 = 10,648 ft^2

Dismantled Volume = $10,648 \times \frac{1}{12} = 887\ ft^3$

Gross Volume = 100 x 42 x 22 = 92,400 ft^3

Net Volume = 15% of Gross Volume

= 0.15 x 92,400 = 13,860 ft^3

Dismantled Volume = 50% of Net Volume

= 0.50 x 13,860 = 6,930 ft^3

Total Dismantled Volume = 887 + 6,930 = 7,817 ft^3

Rounded = 8,000 ft^3

5. SX Building

Dimensions: L = 95' W = 40' Average Ht. = 18'

Siding: 2 x 95 x 18 + 2 x 40 x 18 = 4,860 ft^2

Roof: 95 x 42 = 3,990 ft^2

Sub-total = 4,860 + 3,990 = 8,850 ft^2

Dismantled Volume = $8,850 \times \frac{1}{12} = 738\ ft^3$

Gross Volume = 95 x 40 x 18 = 68,400 ft^3

Net Volume = 30% of Gross Volume

= 0.30 x 68,400 = 20,520 ft^3

Dismantled Volume = 0.50 x 20,520 = 10,260 ft^3

Total Dismantled Volume = 738 + 10,260 = 10,998 ft^3

Rounded = 11,000 ft^3

6. <u>Chem Lab</u>

The lab essentially consists of two (2) buildings:

The northerly building measures 50'L x 40'W x 14' Average Ht

Siding: $2 \times 50 \times 14 + 2 \times 40 \times 14 = 2{,}520\ ft^2$

Roof: $50 \times 42 = 2{,}100\ ft^2$

Sub-total $= 2{,}520 + 2{,}100 = 4{,}620\ ft^2$

Dismantled Volume $= 4{,}620 \times \frac{1}{12} = 385\ ft^3$

Gross Volume $= 50 \times 40 \times 14 = 28{,}000\ ft^3$

Net Volume $=$ 15% of $28{,}000 = 4{,}200\ ft^3$

Dismantled Volume $=$ 50% of $42{,}000 = 2{,}100\ ft^3$

The southerly building measures 70'L x 30'W x 14' Average Ht

Siding: $2 \times 70 \times 14 + 2 \times 30 \times 14 = 2{,}800\ ft^2$

Roof: $70 \times 32 = 2{,}240\ ft^2$

Sub-total $= 2{,}800 + 2{,}240 = 5{,}040\ ft^2$

Dismantled Volume $= 5{,}040 \times \frac{1}{12} = 420\ ft^3$

Gross Volume $= 70 \times 30 \times 14 = 29{,}400\ ft^3$

Net Volume $=$ 10% of Gross Volume

$= 0.10 \times 29{,}400$

$= 2{,}940\ ft^3$

Dismantled Volume $=$ 50% of 2,940

$= 1{,}470\ ft^3$

Total Dismantled Volume for Chem Lab

$= 385 + 2{,}100 + 420 + 1{,}470 = 4{,}375\ ft^3$

Rounded $= 5{,}000\ ft^3$

7. Compressor Building

Dimensions: L = 80'   Average Ht = 18'
W = 40'

Wall Siding: $2 \times 80 \times 18 + 2 \times 40 \times 18 = 4{,}320\ ft^2$

Roof: $80 \times 42 = 3{,}360\ ft^2$

Sub-total = $4{,}320 + 3{,}360 = 7{,}680\ ft^2$

Dismantled Volume = $7{,}680 \times \frac{1}{12} = 640\ ft^3$

Gross Volume: $80 \times 40 \times 18 = 57{,}600\ ft^3$

Net Volume = 10% of 57,600 = 5,760 ft^3

Dismantled Volume = 50% of 5,760 = 2,880 ft^3

Total Dismantled Volume = 640 + 2,880 = 3,520 ft^3

Rounded = 4,000 ft^3

8. Fire Protection Building

The fire protection building is attached to the main mill building on the north side and essentially houses the storage tanks and associated piping for fire protection.

Dimensions: L = 68'   Ht = 12'
W = 12'

Wall Siding: $1 \times 68 \times 12 + 2 \times 12 \times 12 = 1{,}104\ ft^2$

Roof: $68 \times 13 = 884\ ft^2$

Sub-total = $1{,}104 + 884 = 1{,}988\ ft^2$

Dismantled Volume = $1{,}988 \times \frac{1}{12} = 166\ ft^3$

Gross Volume = $68 \times 12 \times 12 = 9{,}792\ ft^3$

Net Volume = 50% of 9,792 = 4,896 ft^3

Dismantled Volume = 50% of 4,896 = 2,448 ft^3

Total Dismantled Volume = 166 + 2,448 = 2,614 ft^3

Rounded = 3,000 ft^3

9. <u>Mill Warehouse & Mill Office Building</u>

The two buildings are treated as one L-shaped building measuring 220' in length and 82' wide at the west end and 42' wide at the east end with an average height of 18' for the entire building.

Wall Siding: $220 \times 18 + 82 \times 18 + 100 \times 18 + 40 \times 18 + 120 \times 18 + 42 \times 18 = 10,872 \text{ ft}^2$

Roof: $220 \times 43 + 100 \times 41 = 13,560 \text{ ft}^2$

Sub-total $= 10,872 + 13,560 = 24,432 \text{ ft}^2$

Dismantled Volume $= 24,432 \times \frac{1}{12} = 2,036 \text{ ft}^3$

Gross Volume $= 220 \times 42 \times 18 + 100 \times 40 \times 18 = 238,320 \text{ ft}^3$

Net Volume $=$ 15% of Gross Volume $= 0.15 \times 238,320 = 35,748 \text{ ft}^3$

Dismantled Volume $=$ 50% of $35,748 = 17,874 \text{ ft}^3$

Total Dismantled Volume $= 2,036 + 17,874 = 19,910 \text{ ft}^3$

Rounded $= 20,000 \text{ ft}^3$

10. <u>Firepump Building</u>

Dimensions: L = 30' Ht = 12'
W = 22'

Wall Siding: $2 \times 30 \times 12 + 2 \times 22 \times 12 = 1,248 \text{ ft}^2$

Roof: $30 \times 22 = 660 \text{ ft}^2$

Sub-total $= 1,248 + 660 = 1,908 \text{ ft}^2$

Dismantled Volume $= 1,908 \times \frac{1}{12} = 159 \text{ ft}^3$

Gross Volume $= 30 \times 22 \times 12 = 7,920 \text{ ft}^3$

Net Volume $=$ 20% of $7,920 = 1,584 \text{ ft}^3$

Dismantled Volume $=$ 50% of $1,584 = 792 \text{ ft}^3$

Total Dismantled Volume $= 159 + 792 = 951 \text{ ft}^3$

Rounded $= 1,000 \text{ ft}^3$

11. <u>Mill Maintenance & Machine Shop</u>

The two buildings are treated as one building measuring 65' long x 40' wide x 16' average height.

Wall Siding: $2 \times 65 \times 16 + 2 \times 40 \times 16 = 3,360$ ft^2

Roof: $65 \times 42 = 2,730$ ft^2

Sub-total = $3,360 + 2,730 = 6,090$ ft^2

Dismantled Volume = $6,090 \times \frac{1}{12} = 508$ ft^3

Gross Volume = $65 \times 40 \times 16 = 41,600$ ft^3

Net Volume = 10% of 41,600 = 4,160 ft^3

Dismantled Volume = 50% of 4,160 = 2,080 ft^3

Total Dismantled Volume = $508 + 2,080 = 2,588$ ft^3

Rounded = 3,000 ft^3

12. <u>Rubber Shop</u>

Dimensions: L = 37' Ht = 15'
W = 20'

Wall Siding: $2 \times 37 \times 15 + 2 \times 20 \times 15 = 1,710$ ft^2

Roof: $37 \times 22 = 814$ ft^2

Sub-total = $814 + 1,710 = 2,524$ ft^2

Dismantled Volume = $2,524 \times \frac{1}{12} = 210$ ft^3

Gross Volume = $37 \times 20 \times 15 = 11,100$ ft^3

Net Volume = 10% of 11,100 = 1,100 ft^3

Dismantled Volume = 50% of 1,100 = 555 ft^3

There is an auxiliary building measuring 24'L x 12'W x 12'H located slightly southeast of the rubber shop.

The combined dismantled volume for the rubber shop including the small auxiliary building is projected and rounded to 2,000 cubic feet.

13. Truck Weighing Building

Dimensions: L = 80' Ht = 25'
W = 24'

Wall Siding: 2 x 80 x 25 = 4,000 ft^2

Roof: 80 x 26 = 2,080 ft^2

Sub-total = 4,000 + 2,080 = 6,080 ft^2

Dismantled Volume = $6,080 \times \frac{1}{12}$ = 507 ft^3

Gross Volume = 80 x 24 x 25 = 48,000 ft^3

Net Volume = 10% of 48,000 = 4,800 ft^3

Dismantled Volume = 50% of 4,800 = 2,400 ft^3

Dismantled Volume of Concrete Pad and steel supports estimated at 4,000 ft^3

Total Dismantled Volume = 507 + 2,400 + 4,000
= 6,907 ft^3

Rounded = 7,000 ft^3

14. Treasure Island

The nonsalvageable items that make up Treasure Island are estimated to have been spread over an area measuring approximately 300'L x 175'W x 5' average height.

Gross Volume = 300 x 150 x 5 = 225,000 ft^3

Net Volume = 20% of 225,000 = 45,000 ft^3

Dismantled Volume = 50% of 45,000 = 22,500 ft^3

Rounded = 23,000 ft^3

15. Mill

The following estimates pertain to the main mill building and the south additions that are attached to the main mill building.

Main Mill Building: Overall length = 350 ft
Width = 105 ft
Average Height = 60 ft

Siding: 2 x 350 x 60 + 2 x 105 x 60 = 54,600 ft^2

Roof: 350 x 110 = 38,500 ft^2

Sub-total = 54,600 + 38,500 = 93,100 ft^2

Dismantled Volume = 93,100 x $\frac{1}{12}$ = 7,758 ft^3

Gross Volume = 350 x 105 x 60 = 2,205,000 ft^3

Net Volume = 30% of Gross Volume

= 0.30 x 2,205,000 = 661,500 ft^3

Dismantled Volume = 50% of 661,500 = 330,750 ft^3

South Addition:

There are two additions, measuring 85'L x 22'W x 45'H and 85'L x 22'W x 30'H.

Approximating the two additions by treating them as one unit, the overall dimensions are 170'L x 22'W x 40'H.

Siding: 170 x 40 + 2 x 22 x 40 = 8,560 ft^2

Roof: 170 x 23 = 3,910 ft^2

Sub-total = 8,560 + 3,910 = 12,470 ft^2

Dismantled Volume = 12,470 x $\frac{1}{12}$ = 1,039 ft^3

Gross Volume = 170 x 22 x 40 = 149,600 ft^3

Net Volume = 30% of 149,600 = 44,880 ft^3

Dismantled Volume = 50% of 44,880 = 22,440 ft^3

Total Dismantled Volume = 7,758 + 330,750 + 1,039 + 22,440

= 361,987 ft^3

Rounded = 362,000 ft^3

16. All Other Sundries

These are to include all other nonsalvageable equipment such as tanks, barrels, tailings transport system, scrap steel, poles, and miscellaneous.

The dismantled and compacted volume associated with the above is assumed to be 20,000 cubic feet.

17. Contingencies

Contingencies are assumed at 20% of items 1 through 16, totalling 100,000 ft^3.

II. Cut and Fill Volumes for Final Reclamation over Millsite Area

Refer to Figures 4 and 5.

Following are estimated cut and fill volumes for interfacing between reclaimed tailings and millsite "burial" area and for final reclaimed contours over entire millsite area.

		CUT			FILL		
Section Number	Length Ft	Area Sq Ft	Average Area Sq Ft	Volume Cubic Yds	Area Sq Ft	Average Area Sq Ft	Volume Cubic Yds
1-1	-	0			1,236		
	400		0	0		4,667	69,140
2-2	-	0			8,098		
	310		0	0		7,294	83,746
3-3	-	0			6,490		
	300		1,205	13,394		4,393	48,811
4-4		2,411			2,296		

	Cut	FILL
Estimated Sub-total	13,394	201,697

Approximately 20,000 cubic yards of fill will be placed on top of the millsite "burial" area to provide a minimum of 2 ft of clean soil cover over dismantled and compacted equipment volumes and for additional fill needed to achieve final reclaimed contours. It is assumed that settlement of this fill will be on the order of 10%. Therefore, additional fill that will be required is projected at 2,000 cubic yards. In addition, an estimated 81,000 cubic yards will be required to backfill the Acid Plant pond to an elevation of 6310 ft (MSL), which will allow for final reclaimed contours.

Therefore,

Total Cut Volume = 14,000 cubic yards

Total Fill Volume, including a minimum of 2' of clean soil cover = 285,000 cubic yards (Rounded)

III. Estimated Quantities of Rock Cover

Refer to Figure 5.

6" Rock Cover

Affected area or area requiring 6" thick rock cover is estimated to be

1,716,707 - 406,779 ft^2 = 1,309,928 ft^2

Estimated volume of rock = $\frac{1,309,928 \times 6}{27 \times 12}$

= 24,258

Rounded = 24,000 yds^3

12" Rock Cover

A 12" rock cover will be placed on the steeper outslopes

Affected area = 406,779 ft^2

Estimated volume of rock = $\frac{406,779 \times 12}{27 \times 12}$

= 15,065 yds^3

Rounded = 15,000 yds^3

Total Rock Cover = 24,000 + 15,000

= 39,000 yds^3

IV. Soil and Rock Borrow Areas

a. Soil

Refer to Figure 6

Estimated borrow area in Northwest Valley = 443,000 ft^2

Assume 8' of subsoil will be excavated

Estimated volume of subsoil = $\frac{443,000 \times 8}{27}$

= 131,000 yds^3 (rounded)

Of the 131,000 yds^3, approximately 58,000 yds^3 would be used for the surface tailings reclamation work as identified in the Reclamation Plan submitted June 30, 1987.

Therefore, net fill available for millsite reclamation work = 131,000 - 58,000 = 73,000 yds^3

Total fill required = 285,000 yds^3

Fill available from cut material within the millsite area = 14,000 yds^3

Net fill required from borrow areas

= 285,000 - 14,000

= 271,000 yds^3

Therefore, the balance fill 271,000 - 73,000

= 198,000 yds^3

will have to come from the "Potential Borrow Area" shown in Figure 6.

b. Rock

Refer to Figure 6.

Estimated borrow area = 525,000 ft^2

Blasted depth = 10 ft

Blasted rock volume = $\frac{525,000 \times 10}{27}$ = 195,000 yds^3 (rounded)

Of the 195,000 yds^3, approximately 156,000 yds^3 will be used as rock cover and rip-rap for the surface tailings reclamation work as identified in the Reclamation Plan submitted June 30, 1987.

Total rock cover required = 39,000 yds^3

The balance rock 195,000 - 156,000 = 39,000 yds^3 would provide the rock cover requirements for millsite reclamation.

V. Assumptions and Breakdown of Decommissioning & Reclamation Costs

Assumptions

1. Lump sum cost of $630,000 for mill decommissioning and dismantling of all support facilities were provided by outside contractor.

2. Earthwork costs are based on unit costs provided by the Lander Office of the Wyoming Department of Environmental Quality.

3. Cost for placement of rock cover is based on outside contractor unit cost estimate of $13.50 per cubic yard.

4. Drainage cost including culverts and final grading are assumed at $100,000, per Western Nuclear estimate.

Breakdown of Decommissioning & Reclamation Costs

1. Mill decommissioning and dismantling of all mill support facilities to include old crusher building, lab, mill offices, various auxiliary shops, acid plant, and sundries as per Table 3-2 is estimated at a cost of $638,000.

2. Estimated earthwork cost as follows:

Item	Quantity Cubic Yds	Unit Cost $/Cu Yd	Estimated Cost $
Fill from borrow area	271,000	2.10	569,000
Fill from cut within millsite area	14,000	1.50	21,000
Drainage ditches, culverts, and final grading	-	-	100,000
Sub-total			160,000

3. Cost for placement of rock cover is based on unit cost of $13.50/yd^3 of rock x 39,000 yd^3 = $527,000.

Total estimated cost for mill decommissioning and reclamation of millsite area is $1,855,000.