October 5, 2015 Project No. 1537372

Mr. Donald Metzler, PG
United States Department of Energy
200 Grand Avenue
Grand Junction, CO 81501

RE: CALCULATIONS OF THE LIFTING REQUIREMENTS AND SAFETY CONSIDERATIONS FOR REMOVAL OF BURIED AUTOCLAVES FROM THE MOAB TAILINGS PILE

Dear Mr. Metzler:

As requested under Task 00001 of the DOE purchase order DE-EM0003882, Golder Associates Inc. (Golder) has been tasked to provide review and technical support services to the Moab UMTRA project related to rock slope monitoring, slope condition assessment and, in addition, to provide a determination of the required lifting weights for 14 autoclaves that were buried in the Moab Tailings Pile. This report summarizes the weight determinations of the autoclaves, an assessment of the environmental issues that will affect the removal of these vessels and will address the safety considerations that will need to be implemented in order to lift and transport these autoclave vessels in a safe and environmentally acceptable manner.

Golder is pleased to provide the UMTRA team with continuing assistance for the Moab Project including our evaluations of the weight determinations and lifting requirements for the autoclaves and an assessment of the environmental and safety aspects of lifting, loading and transportation.

Background

The Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) project is located approximately 3-miles northwest of the City of Moab, in Grand County, Utah, and includes the former Atlas Minerals Corporation uranium-ore processing facility. The Moab UMTRA site is situated on the west bank of the Colorado River at the confluence of the Moab Wash. The site encompasses 439-acres, with approximately 130-acres of covered uranium mill tailings.

An estimated 12 million cubic yards of uranium mill tailings, or Residual Radioactive Material (RRM), and contaminated soil are present in an unlined impoundment located in the western portion of the property. The DOE mission is the cleanup and reclamation of the mill site property, vicinity properties and contaminated groundwater.

As part of the baseline work the excavation, transfer, shipment, placement and compaction of RRM has been underway for several years. Progress on the Moab excavation has proceeded to the point that certain buried Atlas Mill facility process equipment will soon be encountered as the excavation proceeds. This process equipment includes various tanks, piping and other equipment that will have to properly handled and transported to the Crescent Junction burial facility or other suitable disposal site. Of special concern is the removal of fourteen (14) large autoclaves that were buried in the mill tailings which will have to be excavated, lifted out and prepared for shipment.

Evaluation of the Atlas Mill Autoclaves

While it is known that the autoclaves used in the Atlas Mill were buried in the Moab tailings, the details of these vessels and the condition during burial is uncertain. A review of existing information was made to determine size and manner in which these autoclaves were prepared during burial. (Ref: 1 – 5)

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The following assumptions about the nature of the buried autoclaves were made to establish a basis for the weight calculation which follows. (Attachment 1: Moab Autoclave Weight Calculations)

- Autoclave Size: 12' (D) X 14' (Sidewall Height)
- Elliptically domed top and bottom (Ref: 4, Atlas Pictures)
- Steel Construction with ¾ inch thick walls (Note 1)
- All autoclaves are insulated with fire brick and coated with asbestos-based mortar and covered with a tar-base coating. (Ref: 3)
- The autoclaves were filled with asbestos coated piping and native soil/tailings prior to burial. (Ref: 5)
- The autoclaves were buried with the support stands in place which could add to the complexity of the lifting and transportation of the vessels. (Ref 5)

The fact that the autoclaves were filled with piping and soil prior to burial adds a great deal of weight to the requirements for lifting of these vessels from the pile. In addition, if the autoclaves are to be pulled from the tailings pile while partially covered with tailings, added weight should be considered to account for the frictional resistance to the actual weight of the vessels. The additional weight of this complication is not considered in this evaluation as it is assumed that the autoclaves will be fully excavated prior to lifting to minimize the lifting requirements.

Autoclave Weight Calculations

The details of the calculations to arrive at the various weights for the different aspects of the autoclaves are shown in Attachment 1: Moab Autoclave Weight Calculations.

A summary of the calculated weight, based on the information provided, is given below:

Autoclave Vessels (3/4" Steel Wall)	25,690 lb	(Note 1)
Vessel Support Stands	686 lb	
Firebrick	22,200 lb	
Saturated Sands/Soil Fill in Autoclaves	223,850 lb	
TOTAL WEIGHT OF LIFT (lb.)	**272,426 lb**	
TOTAL WEIGHT OF LIFT (tons)	**136 tons**	

Note 1. Several references on the wall thickness for the autoclave vessels present a conflicting view of the actual value for these steel autoclaves. The report submitted to the State of Utah on the Asbestos Abatement indicates that the autoclaves were likely to have a 1/2"' wall thickness (Ref: 3). Additional information was provided, however, that would indicate that the wall thickness was 3/4" or even 1" (Ref: 5).

In order to verify what the likely wall thickness would be Golder prepared an independent vessel design calculation to determine the required ASTM wall thickness for the application encountered by the autoclaves. This design calculation showed that a 0.65" wall thickness would be needed to achieve the safety requirement for a coded steel tank pressure vessel (autoclave) operating under pressure and temperature. Using this design calculation as additional verification, a value of 3/4" was used in the calculation for the empty autoclave vessel weight. Calculations for all three wall thicknesses (1/2", 3/4" and 1") were also made and are shown in Attachment 1.

The above autoclave lift weight does not include any safety factor and this should be discussed and determined in consultation with the crane operator so that they can include their required safety factor in the lift calculation. Typical safety factors in the range of 10 – 25% should be considered.

Environmental Considerations

It is known that the autoclave vessels were covered with a layer of fire brick which was coated with an asbestos mortar and covered with a tar coating. Since these autoclaves have been buried for a considerable number of years, it is not possible to determine if the fire brick and asbestos mortar will remain intact once the autoclaves are excavated. In addition, it has been reported that the autoclaves were filled with asbestos covered piping prior to burial. These two factors would necessitate handling these autoclaves as asbestos materials. Special handling and packaging requirements will be necessary as these vessels are removed and prepared for shipment. The 1995 Asbestos Report filed with the State of Utah (Ref.3) should be re-evaluated to determine the regulatory requirements for the disposal of asbestos containing materials. Soil in the vicinity of the buried autoclaves will also have to be evaluated for asbestos and handled appropriately for disposal.

It has also been reported that the autoclave vessels were filled with soil or tailings to prevent them from floating in the tailings pile. It is not known what material was used to fill these vessels; however, it should be assumed that they are filled with radioactive tailings to some extent. This will also necessitate special handling requirements due to the radioactive nature of the autoclave contents.

Autoclave Lifting Requirements – Mechanical and Safety Considerations

Special equipment to lift and handle approximately 136 tons of weight will be required. It is assumed that the autoclaves are buried in the tailings pile and the stability of the tailings to handle the load requirements for the proposed lifts will have to be carefully evaluated. The safety of the operation to remove these autoclaves will be of paramount consideration as the weight loads are high and the stability of the area surrounding the autoclave burial sites is uncertain and potentially unstable.

Golder understands that the remediation contractor plans to utilize a crane and/or heavy construction equipment to remove the buried autoclaves from the existing tailings pile. It is assumed that the autoclaves were buried somewhere in the interior of the pile, which consists of beach areas of coarse, sandy tailings near the embankment, grading to wet, fine tailings or slimes in the central and pool areas. Much of the tailings are expected to be saturated, resulting in areas of potentially soft and yielding subgrade. Given the high bearing pressures anticipated from the crane tracks and equipment tires/tracks, and the variable subgrade bearing conditions, there is the potential for equipment instability if the access route is not carefully planned and evaluated.

A geotechnical study should be performed to evaluate soil bearing conditions along the planned construction access route and lifting site on the tailings pile. This study will be required to provide recommendations for wooden or composite crane mats (as needed) to allow for safe and economical equipment removal. It is recommended that this work be performed once the exact location of the autoclaves is determined and the route for removal is established. Both the lifting requirements for the proposed 136 ton lifts will need to be evaluated as well as the rotational requirements for the crane support pads as it lifts and moves the autoclaves to a transportation vehicle. Given the high loading, a large crawler crane with lattice boom will likely be required. There is also the potential that subgrade stabilization may be required to provide safe access and lifting of the autoclaves.

If requested, Golder can provide a review of available geotechnical data for the Moab tailings impoundment (e.g., cone penetration test (CPT) logs, tailings characterization data, drilling logs; Ref 6.) and perform an engineering analysis to evaluate the requirements for bearing capacity along potential access routes and lifting locations. It is also recommended that the DOE develop a safety plan to insure that proper protocols are followed for a safe and efficient transport of the crane into the tailings facility and determine what the combined weight bearing requirements will be for the crane and lift load. Depending on the location of the buried autoclaves a plan for a safe access route for removal of the autoclaves will also need to be established.

Recommendations Moving Forward

The evaluation of the weight determinations and the lifting requirements will have to be carefully evaluated prior to the execution of the work in order to insure that the autoclaves can be removed in a safe and efficient manner.

1. A geotechnical evaluation which will focus on the stability of the tailings/soils in the area of the excavation and lift site is very important. This should be undertaken once the exact location of the autoclave excavation site(s) and crane lift site is determined.
2. Once an access route is established, additional geotechnical evaluations will be necessary for the crane and transport vehicle routes. Soil bearing calculations and recommendations for support mats or other soil support methods will be needed to insure the safe transport of the crane, trucks to and from the lifting site.
3. Preliminary contact with a reliable crane operator should be undertaken who can give advice on crane size and lifting capacity of various crane options. Discussions on lift safety factors should also be undertaken to establish a crane size that can safely lift the combined weight of the autoclaves.
4. Crane operations companies typically have elaborate software programs which are designed to analyze safe crane lifting operations and the requirements for pad support during transport of the crane and lifting of the autoclaves. It is recommended that this be undertaken as soon as practical as it will give the DOE and its contractors the necessary technical information needed to plan the autoclave removal operations.
5. A carefully designed Health and Safety Plan should be developed which will incorporate both the environmental and safety aspects of the planned operation. Additional technical information will be required in order for this plan to take into consideration all of the geotechnical, mechanical, environmental and personnel safety considerations.

Golder's commitment to the DOE team is to provide whatever technical support will be required in order for the autoclave removal process to be conducted in a safe and economical manner.

Closure

Golder appreciates the opportunity to be of service to the Department of Energy on this interesting and important project. Please contact the undersigned if you have any questions regarding the content of this report.

Sincerely,

GOLDER ASSOCIATES INC.

Erich W. Tiepel

Roman S. Popielak

Erich W. Tiepel, PhD
Principal and Program Leader

Roman S. Popielak
Senior Consultant

cc: David L. O'Sadnick, Golder Associates Inc. – Denver

Attachments: Attachment 1 – Moab Autoclave Weight Calculations
Attachment 2 – References

ATTACHMENT 1
MOAB AUTOCLAVE WEIGHT CALCULATIONS

Golder Associates	SUBJECT MOAB PROJECT : Atlas Mill Autoclave Calcs.		
	Job No. 1537372 Ref. 00001	Made by E. TIEPEL Checked Reviewed Elizabeth Tani	Date 9/29/15 Sheet 1 of 4

Calculation of Autoclave Pressure Vessel

Ref: 1. Atlas Process/Plant Description
2. License Renewal Application: No. SUA-917
NRC Docket No. 40-3453; MAY, 1984
3. State of Utah, DEQ; Asbestos Abatement Report
4. Atlas Plant Photos
5. Verbal Correspondence from Carl Dixon:
Former Atlas Mill Employee; September, 2015
6. Golder Geotechnical Evaluation; S.M. Stoller 8/19/05

A. Description of Autoclaves

Dimensions: 12 ft (D) x 14 ft (H)

Elliptical Domed top & bottom; 24" Manway

Wall Thickness: Various recollections that range from 1/2 in.; 3/4 in; 1 in

Configuration at time of burial:

- Vessels intact plus 4-6 ft (H) legs (Est.)
- Vessels filled with soil/tailings
- Vessels could have some amount of asbestos containing pipe
- 24" Manhole lid configuration unknown; Assume soil is saturated inside vessel
- All tanks were insulated with a fire brick layer and covered with an asbestos-based mortar and coated with a tar-base coating

B. Calculation of Weights

1. Autoclave Vessels.

Sidewall: 528 ft^2

2 Elliptical Domes = 311 ft^2

TOTAL SURFACE AREA = 839 ft^2

2. Weight of Vessel

Assume density of steel = 490 lb/ft^3

Wall Thickness: 1/2" = 17,130 lb.

3/4" = 25,690 lb.

1" = 34,260 lb.

Note: The assumptions on wall thickness vary based on verbal information (Ref. 5) which indicate a 3/4" and 1" thickness. Calculations of minimum required wall thickness of a steel pressure vessel operating at elevated temperatures yielded a result of 0.65 in (minimum).

∴ It should be conservatively assumed that the wall thickness is a minimum of 0.75 in.

Golder Associates	SUBJECT MOAB Project : Autoclaves		
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3. Weight of Support Legs.

4 legs ; 6 ft (H) ; 6" φ (Sch. 80; Heavy)

Weight / ft = 28.6 lb/ft

Weight = 4 × 6 × 28.6 = 686 lb / vessel

4. Weight of Sat'd Sand Fill (Assume Tank full of Sand)

Density of Wet Tailings = 110 lb/ft³ (Ref. 6)

Volume of Vessel = 15,225 gal.

= 2,035 ft³

Weight of Fill in Vessel = 223,850 lb.

5. Weight of Firebrick

Assume Fire brick covers all surfaces of the Autoclaves

Typical Firebrick = 2½" Thick.

Firebrick Density = 127 lb/ft³ (Moderate Temp)

Weight = 839 ft³ × 127 lb/ft³ × $\frac{2.5 \text{ in}}{12 \text{ in/ft}}$

= 22,200 lb

Golder Associates	SUBJECT MOAB PROJECT : Autoclaves		
	Job No. 1537372 Ref. 00001	Made by E. TIEPEL Checked Reviewed Elizabeth Travis	Date 9/29/15 Sheet 4 of 4

C. TOTAL LIFT WEIGHT

Autoclave (Steel)	=	25,690 lb.
Vessel Support Legs	=	686 lb
Sat'd Sand Fill	=	223,850 lb.
Firebrick	=	22,200 lb.
TOTAL LIFT WT	=	272,426 lb.
	=	136 TONS

ATTACHMENT 2
REFERENCES

REFERENCE 1

-inch, 45-plate, plate-and-frame filter presses are used for
ıg and washing of the yellow cake. The filter cake is then
agitated tanks and fed to two 42-inch by 90-inch double-drum
l dryers which heat the product to a discharge temperature of
250°F. Dust recovered from the dryer stack has been found
chloride and therefore is returned to first stage precipitation.
ltrate from the presses, containing about 0.003 grams of U_3O_8
cycled for use as brine make-up, for eluting solution makeup,
ı the dust collection system. When required to maintain the
ıce, part of this filtrate is also bled to tailings. Wash filtrates
ow chloride concentrations are kept separate, with the high
te being used as wash in the filtration following the first stage
ın, and as brine make-up. Low chloride wash filtrate is used
ng circuit.
duct is loaded by means of automatic filling controls to 55-
for shipment, with each drum containing from 650 to 700
ıduct. The final yellow cake contains an average of 87 per-
o 2.5 percent Na, 5 to 6 percent H_2O, 0.65 percent CO_3^{--},
V_2O_5, and small amounts of PO_4^{---}, SO_4^{--}, Mo, Fe,
Methods are under investigation for producing a drier and
re dense cake. The addition of a solvent extraction circuit to
eluate solution is also being studied as a means of improving
ıct purity.

NGS DISPOSAL

ıgs from the classifiers and slimes from the RIP circuit are
pumped to a 180-acre disposal area about 2 miles from the
lings area covers a somewhat porous stratum which, although
d with slimes, was at one time considered to be a pollution
ıd water. For this reason Anaconda, in 1959, constructed
ater disposal well drilled to a maximum depth of 2,530 feet
ıta containing water not suitable for other use. Waste water
the tailings pond is put through precoat-type pressure filters
ndissolved solids content to less than 0.1 ppm, and then
well head for gravity flow underground at a maximum rate
allons per minute. Tailings water is not returnable for use
ıuse of its high dissolved solids content.
rifting sand on the tailings pile are controlled at present by
t fences. Abandoned areas are covered with local soils,
ble of nurturing a weed cover, as a means of stabilizing the

15-3.9 CARBONATE PROCESS MILL

Initial operations of The Anaconda Company for the proc
high lime ores occurring near Grants, New Mexico, utilized the
process. Subsequent expansions and mill adaptations to permit
of both high lime and amenable sandstone ores resulted in a
leach capacity of about 1,000 tons per day by 1959. By that ti
ever, it became more economical to treat the available ore in
process mill, and the carbonate mill was shut down.

Parallel mill circuits were provided in the carbonate mill with
ore treated in one circuit and a blend of sandstone and limestor
the other. Ore was ground in recirculated carbonate solutions, the
in autoclaves for up to 10 hours at 250°F and 30 psi air pres
added $KMnO_4$ to oxidize tetravalent uranium. Calcined magn
added in the grinding circuit to assist in adsorbing organics that
could cause blinding of filter cloths. Fine grinding was necessary
mineral liberation in the limestone circuit. Pulps in the limestone-
circuit were flocculated, filtered, and washed on three stages of dr
Flocculated pulps fed to the Burt pressure filters from the strai
stone leach were washed with four batch stages. After filtration
nant solutions were joined and clarified through plate-and-fr
presses. Caustic soda was then added and the yellow cake preci
heating with steam to near boiling. The final product was rec
plate-and-frame filters, with the filtrate being regenerated by
gas carbonation, and recirculated to the grinding circuit.

15-4 ATLAS MINERALS DIVISION OF ATLAS CORPO MOAB MILL[6,7]

15-4.1 GENERAL

The Moab, Utah, mill of the Atlas Minerals Division of
Corporation has undergone several major changes in process sinc
operations in November 1956. Due primarily to changes in th
original acid process was changed to an alkaline process which
same resin-in-pulp equipment, and recently, in 1967, an acid le
solvent extraction process was added, with recovery of vana
copper as by-products. Operations in 1967 are on a 7-day-per-
at a treatment rate of between 850 and 950 tons of ore per
alkaline circuit and about 400 tons per day in the acid circuit.
mill throughput has exceeded 1,700 tons per day at times.

High lime ores are treated by carbonate leaching using a
resin-in-pulp process to extract the uranium from the leach liqu

used for high vanadium ores and other low lime ores more
o this technique using countercurrent decantation thickeners to
larified liquor which is then treated by solvent extraction. Preg-
ons from both the RIP and SX circuits are combined and the
ecipitated with ammonia. Total uranium recovery for both
rages 96 percent. Vanadium is recovered from the uranium
action circuit raffinates.
ntaining sufficient copper to justify its recovery are treated by
e flotation tailings being returned to the alkaline leach circuit.
acid leaching and solvent extraction circuit is used to recover
m the copper concentrate.
15-4 shows the current process flowsheet for the Moab mill.

E

hipped to Moab from approximately 30 underground mines
al area of southeastern Utah and adjoining areas of Colorado.
mines, including the famous Mi Vida, are either owned by
als or operated by the company, and these mines supply most
the mill.
racteristics vary widely depending upon the source, and this
s required the provision of both acid and alkaline leaching
he mill. Most of the uranium occurs in the mineral uraninite,
um found as oxides, silicates, and some tyuyamunite. Host
to medium-grained sandstone with calcareous cementing, along
e and conglomerate pebbles of mudstone and limestone. Car-
aterial up to 0.5 percent may be present. Some of the ores,
from the White Canyon area of Utah, contain pyrite and
ounts of chalcopyrite and bornite to justify flotation treatment
ecovery.
l averages 0.28 percent U_3O_8 to the alkaline circuit and 0.40
$_8$ to the acid circuit.

E PREPARATION

dling. Individual truckloads of ore are weighed, sampled for
d then stored temporarily on the pad. Previous history of the
s sufficient to establish its subsequent disposition, although if
igh analyses for U_3O_8, V_2O_5, $CaCO_3$, or Cu may be conduct-
isture sample rejects. Ore containing over 10 percent $CaCO_3$,
ng less than about 0.5 percent V_2O_5, is normally sent to the
it via crushing, sampling, and intermediate fine-ore storage.

High vanadium, low lime ore selected for treatment by aci
crushed, sampled, and then returned to a pad stockpile. Bl
complished as this pile is formed and as the ore is picked up
mill feed. A second sample for mill feed accounting is taken a
ore passes back through the sampling plant.

Ores containing over 0.35 percent Cu are placed in a se
pile to be processed on a campaign basis. The mill feed t
flotation circuit averages 0.75 percent Cu.

Crushing and Sampling. Mine run ore is accumulated o
pad in lots of 50 to 1,000 tons depending upon the circums
to the crushing plant is sized through a 12-inch grizzly with
putting coarser lumps through a single-roll crusher. In the i
reduction the ore is screened and the plus 2-inch is crush
crusher. The minus 2-inch size product then feeds to a vib
operating in closed circuit with a cone crusher to produce
¾-inch size product.

Sampling is in three stages with intermediate crushing thr
produce one pound of sample per ton of ore at a minus ¼-in

An interesting feature of the crushing and sampling plant
the use of closed circuit television to monitor critical points.
located in the main control booth and at other operator st
plant.

Ten 300-ton bins are provided for fine ore storage. Th
equipped with louvre-type openings around the sides to perm
and have steeply inclined wedge-shaped bottoms to minimize
Difficulty is usually encountered if the moisture content in th
8 percent and if over 10 percent a penalty is imposed on cus
The last or tenth bin is used as a transfer bin to return crushe
storage. Ore is pulled from each bin by adjustable speed belt
discharge to chutes arranged to feed either of two transvers
These conveyors in turn carry the ore to feed either the alk
grinding circuit.

Grinding. Division of the plant into separate acid and alka
begins with the grinding operation. Feed to the acid circuit
about a minus 28-mesh size using a ball mill and screw classi
circuit. Grinding is in water with the classifier overflow at 50
sent directly to acid leaching.

Grinding in the alkaline circuit is two-stage to produce
mesh size product. Feed ore is ground to approximately m

:tage ball mill-classifier circuit. This classifier overflow is
o two 15-inch cyclones operating in closed circuit with a
l. Cyclone overflow is finished product. Mill solution used
the alkaline grinding circuit contains approximately 50
O_3, 15 grams of $NaHCO_3$, and 8 grams of U_3O_8 per liter.

IING—ALKALINE CIRCUIT

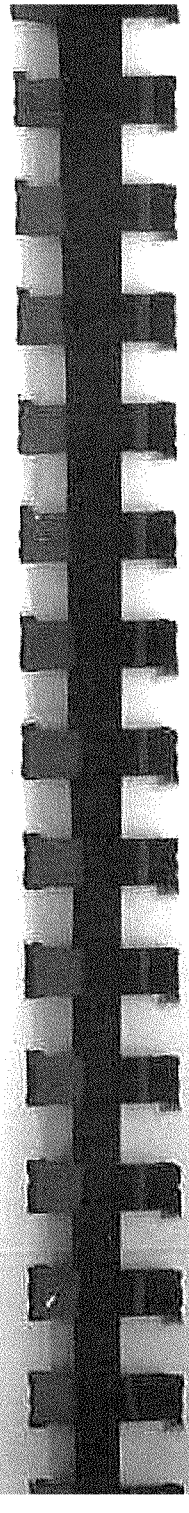
ı the grinding operation is thickened to about 50 percent
;-foot diameter thickener before entering the preheat and
ıing stages of treatment. Approximately 0.07 pound of
flocculant per ton of ore is added to the thickener feed to
ttling characteristics. The thickener overflow returns to a
orage tank for make-up and reuse in the grinding circuit.

of the thickener underflow is accomplished in two stages.
ge the pulp is passed through the outer pipe of concentric
ıngers in which it is heated to between 160 and 170°F by
ıt flow of hot slurry discharging from the leaching circuit.
then is further preheated to 165 to 180°F in two tanks in
y blowoff vapors from the autoclaves.

ɔpper-ammonium solution) is added to the last preheat tank
This tank also serves as the autoclave feed surge tank with
he contained slurry monitored to control the speed of the
pump.

ave circuit consists of two parallel banks of seven 8,000-
'es in series. The autoclaves are equipped with mechanical
ıg air sparge lines mounted under the impellers to obtain
rsion. The first two autoclaves in each bank are equipped
ls which provide for additional heating to about 240°F in
ave and 250°F in the second autoclave. Leaching time is
6½ hours at a pressure of 50 psig with about 1,000 stand-
ɔer minute of air used in the circuit. Sodium carbonate con-
ır 60 pounds per ton of ore. Bicarbonate is produced during
e action of carbonate on the sulfides present. Oxidant is
ıtion containing 34 grams of Cu and 53 grams of NH_3 per
sumption of $CuSO_4 \cdot 5H_2O$ has averaged 1.25 pounds per

leaves the autoclave circuit at 240 to 242°F and, depend-
rates, is distributed to two or more of the four available heat
obtain cooling to below the flash point.



15-4.5 REAGENT RECOVERY—ALKALINE CIRCUIT

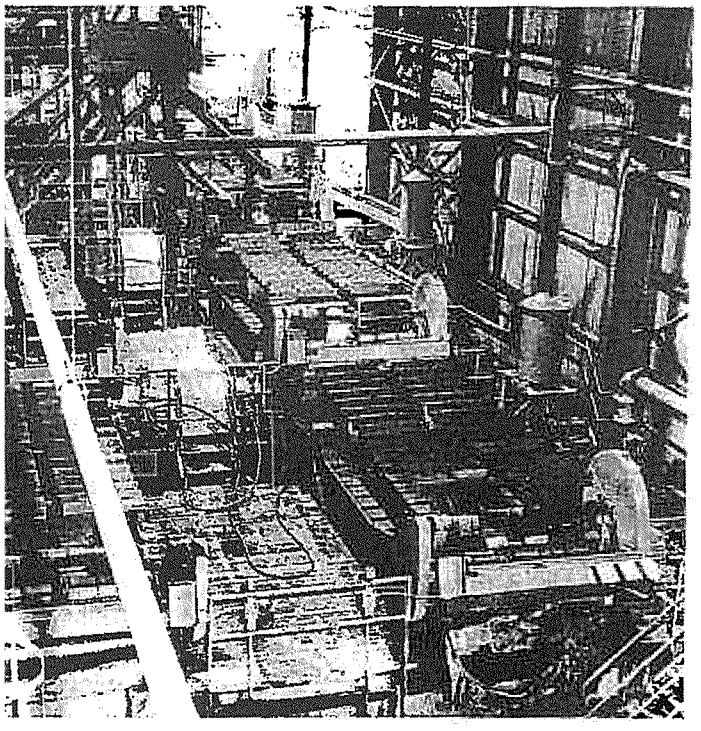
Two 85-foot thickeners are operated in a countercurrent
cuit to recover approximately two-thirds of the carbonate and
remaining in the leached slurry to a recirculated stream. Th
pregnant solution is returned to the grinding circuit. Conse
uranium concentration in the solution increases to an equilibri
about 8 grams per liter in the return solution and to about 1
liter in the pregnant leach solution.

The reagent recovery circuit operates with a ratio of 1 t
water per ton of ore added to the last thickener. Underflc
average 50 percent solids. The final underflow is fed to the
separation circuit. Flow rates in the underflows are automa
trolled. Overflow from the first thickener returns to the n
storage tank where soda ash is added to a stream circulated in
this tank to maintain the reagent strength in the mill solution.
addition is not required since this reagent is generated during

Flocculant addition in this circuit can be automatically
through a special device developed by company personnel.
adjusts the reagent addition rate as a function of changes i
settling rate as determined for a sample taken continuously fr
culated feed pulp stream. Total flocculant consumption in t
0.09 pound per ton of ore.

15-4.6 SAND-SLIME SEPARATION—ALKALINE CIRCUIT

Dissolved uranium and slimes are separated from a sand
the leached ore residue by means of a countercurrent classifi
ation. A photograph of this installation may be seen in Figure
identical circuits consist of two series of four 7½-foot by 17-
anza classifiers operated in a parallel arrangement with fo
10-inch cyclones. Feed to each circuit is split to enter the first
each series, with the separated sand fraction then passed
classifiers in turn to final disposal as sand tailings. Wash wat
final classifier in a six to one ratio of water to feed pulp ar
countercurrent flow through the circuit. Classifier overflows
to the corresponding stage of cyclones and the cyclone overflo
to feed to the preceding classifier in each series. Cyclone und
parallel to the classifier sands progressively through each bank
and join with the final classifier sands as tailings. Overflow f
bank of cyclones feeds to 35-mesh size trash removal screens
the RIP circuit. Slime separation is at approximately 325-m



'.—Sand-slime separation circuit using Esperanza classifiers. Photo courtesy of Atlas Minerals.

ing 5 to 6 percent solids and with a U_3O_8 content in the solu- 0.5 grams per liter.

N-IN-PULP EXCHANGE—ALKALINE CIRCUIT

nal acid leaching resin-in-pulp process was selected for the . view of the high slime content in the ores, at a time which hniques of reliable slime flocculation. Later conversion to processing to accommodate ores having both a high lime and content was simplified by the fact that the strong base anion n contained in the RIP circuit was suitable to both processes. it consists of two parallel sections with 14 resin banks per ith four 6-foot cubical baskets per bank. Basket frames are vith stainless steel angles covered with plastic screen cloth ice with epoxy cements. Each bank contains 152 cubic feet K resin. Figure 15-18 shows a general view of the instal-

Initial slime feed and fresh eluant entering the resin ban a distributor which may be set to direct the flow to any Discharge from each bank is elevated by means of an air lift as required to either the next bank, to tailings, to pregnant so or return to the feed tank.

Eleven stages are in use on the loading (or exhaustio continuous flow of the slime pulp through the resin banks in discharge and to tailings. At the conclusion of a loading bank on stream is removed from the circuit as a fully loaded second bank on the line then becomes the first bank. Cyc from 1½ to 2 hours depending upon feed rate and U_3O_8 con charts are provided to the operators to relate feed variables tailings analyses and resin loading. Resin loading is normall U_3O_8 per cubic foot of resin, and over 99 percent of the sol extracted from the feed slurry.

A freshly loaded resin bank is washed with water prior t elution cycle and the washings returned to the feed tank. Elut operation with three banks in process at a time, using a soluti 60 grams of sodium chloride and 1.6 grams of $NaHCO_3$ pe eluant. Fresh eluant in 6,000-gallon batches is fed to the resin

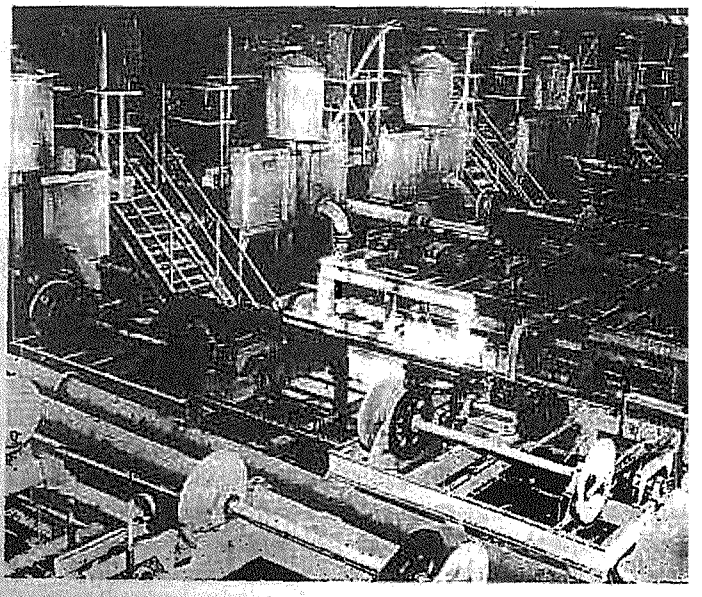


FIGURE 15-18.—Basket resin-in-pulp circuit. Photo courtesy of Atla

ɔn the longest and this solution batch is progressively advanced
le change to the adjacent loaded bank. After the third change
ɔecomes pregnant eluate and will contain 9 to 10 grams of
:r. This solution is combined with SX product solution for
ipitation. After precipitation, part of the barren solution re-
o the eluant tank where it's concentration is adjusted with
ıe solution.

nce problems in the alkaline RIP circuit have not been serious
ɜre corrosion of the original stainless steel basket screens
acid leach RIP operations did require a changeover to plastic
in losses have been minor, amounting to less than 0.0014
: ton of ore processed over a one-year period of operation.
of the resin with nitric acid is required on approximately a
:o remove buildups of carbonaceous material and calcium-
.dium complexes which tend to plug the pores in the resin

ı and molybdenum, when present in the feed solutions, tend
with the uranium through the RIP circuit and thus con-
final product. The amount of this carryover is diminished
ım loading of the resin but this technique does not completely
problem.

:HING—ACID CIRCUIT

t of high vanadium ores by acid leaching has the combined
ecovering this constituent as a by-product and of minimizing
f vanadium which might be carried with uranium through the
ıit.

ry to the acid leaching circuit enters a preheat tank where
sparging raises the temperature to between 170 and 180°F.
.urry then passes to another tank where about 330 pounds of
n of ore are added to obtain a free acid concentration between
rams per liter. Sodium chlorate may also be added at this
:d to obtain an emf between −400 and −430 millivolts. The
the leaching circuit consists of a series of five 24-foot diameter
gh, mechanically agitated, wood stave tanks lined with fiber-
:nce time is about 16 hours. The fifth tank of the series is
ralization of excess free acid in the leached slurry. Limestone
a special ball mill-classifier circuit for this purpose and is
ain a terminal pH of 1.1 to 1.2. The leached slurry is air
wing across baffled partitions in a special tank and then is sent
ıer circuit.

15-4.9 LIQUID-SOLID SEPARATION—ACID CIRCUIT

Leached solids are separated from the leach solution i
countercurrent decantation circuit, using 40-foot diameter thi
flocculant added as required. Underflow from the fifth thic
tailings. Wash water is added to the fifth thickener, and soluti
from 0.8 to 0.9 grams of U_3O_8 per liter overflows the fi
Dilution in the thickener circuit will normally produce the
solution pH of 1.8 to 2.0, but sodium carbonate solution n
to obtain this pH if required.

Final clarification of the pregnant solution enroute to solv
is accomplished in U.S. pressure filters with Dicalite and asb
precoating and additional Dicalite used as filter aid.

15-4.10 SOLVENT EXTRACTION—ACID CIRCUIT

Extraction of the uranium from the pregnant solutions is
four-stage solvent extraction circuit. Aqueous and organic
countercurrently into the bottom of each mixing compar
pump-type agitators mix and elevate the solution to over
settling compartment. An organic continuous system is main
circulation of part of the organic phase.

The organic consists of 3 per cent Alamine 336, 2½
decanol, and the balance Napoleum 470 (high flash point ker
rate for the aqueous phase is about 90 to 100 gallons per m
the organic phase about 80 gallons per minute. Uranium-ba
solution (raffinate) passes through a settling chamber to rem
organic and is then stored for subsequent treatment in the van
extraction and precipitation circuits.

Stripping of the uranium from the loaded organic is acco
single stage of treatment using an average of 2 gallons p
sodium carbonate solution with the flow rate varied as requi
pH of 7.8 in the system. Both the mixer and the settler are
the mixer set inside of the settler. Aqueous solution is recir
mixer to maintain an aqueous-continuous system. Final p
solution contains about 40 grams of U_3O_8 per liter.

Soda ash solution used in the stripping circuit and else
plant is made up by an automatic system to contain 100 gran
per liter. The system is preprogrammed to fill an agitated tan
heat it with steam, measure and add the desired amount of s
then pump the final solution to storage, all without operator a

ECIPITATION

eluate from carbonate RIP and strip solutions from the acid re joined in a common precipitation circuit. This circuit is nuously with steam. Twenty-five pounds of sulfuric acid per e added in the first tank of a two-tank series to obtain a tem- 75°F and a pH of 3.2 to 3.5 in the second tank. This treat- s the uranyl carbonate complex and other carbonates present f the CO_2. Yellow cake is precipitated in a subsequent series -foot diameter by 8-foot high tanks by the addition of am- obtain a pH of 4.4 in the first tank, 5.8 in the second, and 7.6 esidence time in this circuit is 2 to 3 hours.

ike slurry discharged from the precipitation tanks is dewatered liameter thickener followed by two 4-foot diameter by 4-foot ters operated in series. The filters are top-washed with water repulped with water between stages. Filtrate is returned to and the thickener overflow is returned to the RIP circuit tanks. The final filter cake is again repulped with water and 6-hearth Skinner roaster for drying at a maximum tempera- °F. The dried yellow cake passes through a small hammer cked in drums for shipment.

perations are producing a product which meets AEC specifica- er, the vanadium, molybdenum, and sodium contents in this lose to the limits established for the industrial market. This ing investigated.

LINGS DISPOSAL

tailings are combined into a common sump and pumped to ipes located on three sides of the impounded disposal area. nearly neutral as a result of combining residues from the acid perations.

er is removed from the tailings pond through two decant ted by piping under the main pond to two additional small located outside of the diked area. Part of this water recycles reatment plant for eventual reuse in the mill circuit. The the solution flows through the ponds in series. A small Cl_2 is added to the stream entering the second pond. The with sulfates present to form $BaSO_4$ which coprecipitates he radium present and settles out in the second pond. Clari- rom the second pond is monitored and discharged to the ado River.

The tailings dikes are built up on a 3-year cycle using a push the settled sands to a higher dike level. The sides of t presently being covered with a locally quarried shale to provid weed growth. A good covering of Russian thistle has resu irrigation.

15-4.13 COPPER-URANIUM ORE PROCESSING

Uranium ore containing sufficient copper to justify recov processed intermittently in the alkaline circuit. Approximately of the alkaline plant total operating time at a feed rate of 25 t (compared with a present normal rate of 40 tons per hour) is process the available copper-bearing ore.

Ore is ground to minus 48-mesh in a single stage of the r line grinding circuit using recirculated carbonate mill solutions Approximately 0.07 pound of potassium amyl xanthate per t added to the grinding circuit as a promoter for the subsequent flotation.

Classifier overflow from the grinding circuit at 40 percent directly to a rougher flotation circuit using five 43- by 43-inc average of 0.004 pound of frother per ton of ore is added in feed. The rougher concentrate is cleaned once in two addition the cleaner tailing recycled back to the rougher circuit fee flotation tailing, containing an average of 0.075 percent Cu, is the normal alkaline leaching circuit as feed to the two 15-inch the second stage of grinding.

Flotation concentrates are dewatered in a small thickener a drum filter. The filter cake is washed lightly with water to bonate solution and this filtrate together with the thickener turned to the mill solution tank. The filter cake is then rep percent solids and pumped to a small acid leaching circuit. concentrate at this point contains about 20 percent Cu and percent U_3O_8 and accounts for 90 percent of the Cu originall the ore processed in this circuit.

Acid leaching is accomplished in a four-tank series with added to the first tank and air used for oxidation in all tanks time is 12 hours. After leaching, the residue is separated from by filtration and water washing of the cake. The residue is st copper concentrate.

Dissolved uranium in the pregnant leach solution is rec special solvent extraction unit. The process uses a three-stag

a two-stage stripping circuit to recover the uranium into a olution which joins with eluates from the other circuits in the for precipitation of the uranium. Feed to the SX circuit contains rams of Cu and 3 grams of U_3O_8 per liter and the flow rate is ns per minute. The organic phase consists of a 10 percent solu- rtiary amine in a base of No. 2 diesel oil. Stripping is with 10 $_2CO_3$ solution and the pregnant eluate contains about 30 grams : liter.

te from the SX circuit is partially recycled to repulp the filter o acid leaching or may be saved in part for use in making up ate-ammonia solutions for use as an oxidant in the alkaline eration. The remainder of the raffinate is passed through two ks in series where powdered iron additions are made to cement r product. This product is recovered by separation in a 2- by ranza classifier and combined with the previous filter cake entrate. The classifier overflow, now containing only 0.2 grams ter, is passed through a 32-inch by 32-inch by 22-foot long ch is filled with scrap iron to cement out most of the remaining pper. The final solution, averaging 0.03 grams of Cu per liter, lings.

ATER TREATMENT PLANT

sed in the Moab mill is obtained from the Colorado River and ted to remove silt and, in the winter months, to lower the cal- t. Calcium compounds present in the water are particularly during the winter months, since they will precipitate out as the ed in the plant circuit. This type of precipitation has caused ing of the resin in the RIP circuit but is avoided by water treat- g the summer months a calcium content of up to 0.12 grams r liter may be handled without difficulty. Below a water tem- 6 to 57°F, however, calcium removal becomes important and reated to obtain a maximum of 0.03 to 0.04 grams of $CaCO_3$

om the Colorado River is pumped to an initial treatment tank cycled water from the tailing ponds to which sodium hydrox- added. Lime, alum, and a flocculant are also added to this k as required and the pH is regulated to 9.8. Slimes and hard uents settle out in the tank and are removed as an underflow turn to the river, while the clarified water overflows to two in series. During 16 hours of residence in these ponds much m carbonate precipitates and settles out, and a satisfactory

plant feed water is thus produced. To insure a softened wa Calgon is added to the effluent from the second pond to obtain tion of 1 to 2 ppm of phosphate. This water is then stored i water tank.

15-5 COTTER CORPORATION[8]

15-5.1 GENERAL

The Cotter Corporation mill at Canon City, Colorado, facility for processing uranium ore on the eastern slope of Rocky Mountains. An initial 50 to 75 ton-per-day pilot pl structed and placed in service in mid-1958. It was enlarged after to a capacity of between 150 and 220 tons per day. P are presently being further expanded to permit treatment of at of ore per day averaging over 0.5 percent U_3O_8 content.

The current flowsheet utilizes the carbonate leach proces liquid-solid separation by means of filters and thickeners and of the product with caustic soda. To meet commercial spec low sodium yellow cake the caustic precipitated material is acid then reprecipitated using ammonia.

A preliminary flotation treatment is employed on ore from walder mine to remove a bulk sulfide concentrate prior to flowsheet including new facilities being added for the expand is shown in Figure 15-5.

Recovery has been between 95 and 96 percent of the U_3 on the types of ores being treated.

15-5.2 ORE

The principal source of ore for the Cotter mill is the Sc mine, now company owned. This ore is shipped by truck fr ground mine near Golden, Colorado, at a rate of about 150 The ore contains pitchblende as the source of uranium, in as from 10 to 15 percent sulfides, mainly pyrite. The ore will co 0.6 and 1.2 percent U_3O_8 and about 0.1 percent molybdenu of ores are processed from mines in the general vicinity of th ever, some ore has been shipped considerable distances, shipped by rail from the Orphan Lode Mine in Arizona.

15-5.3 ORE PREPARATION

Crushing and Sampling. When the ore is received, eacl sampled for moisture and either stockpiled on the pad or fed

REFERENCE 2

bins to a ball mill circuit which grinds the ore in recycled mill solution to 99% minus 65 mesh. See Figure 3.0-3. The circuit is composed of a primary ball mill, spiral classifier, cyclones and a regrind ball mill operating in closed circuit to produce a 25% solids slurry product.

The slurry from the ball mill area is pumped to a density control thickener which produces a 50% solids underflow slurry for feed to the alkaline leach circuit. Overflow solution from the thickener is recycled as mill solution to the ball mill section. Soda ash and sodium bicarbonate are added to the mill solution as required to maintain sufficient concentrations of Na_2CO_3 and $NaHCO_3$ as the lixiviant in the leach circuit.

The underflow slurry from the density control thickener is pumped to two pre-leach tanks prior to being fed to the autoclave section. Here the temperature is adjusted to 180° F. through steam addition. Some of the more easily leached uranium is dissolved in the pre-leach tanks; however, the remaining uranium requires the high temperature (250° F.) and high pressure (50 psig) of the autoclave circuit for more complete extraction. The autoclave section contains 14 autoclave reactors operated in series. The leached slurry is discharged through heat exchangers into a surge tank which feeds the alkaline filter circuit.

At the alkaline filter circuit separation of the uranium-bearing solution from the waste solids is accomplished in three stages of drum filtration. The filtrate obtained from the first stage of filtration is pumped to solution clarification. The first stage filter

REFERENCE 3

State of Utah
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY

Michael O. Leavitt
Governor
Dianne R. Nielson, Ph.D.
Executive Director
Russell A. Roberts
Director

150 North 1950 West
P.O. Box 144820
Salt Lake City, Utah 84114-4820
(801) 536-4000 Voice
(801) 536-4099 Fax
(801) 536-4414 T.D.D.

FILE COPY
Landfill

June 29, 1995

DAQH-717-95

Larry Gorell
Atlas Corporation
Republic Plaza
370 Seventeenth Street, Suite 3150
Denver, CO 80202

Re: Moab Uranium Mill - asbestos waste disposal site.

Dear Mr. Gorell:

Atlas Corporation's application to permanently dispose of asbestos-containing material on its property located near Moab, Grand County, Utah has been reviewed by this office. The procedures outlined by Atlas Corporation in the original application (May 2, 1995) and in subsequent revisions (May 8, and June 5, 1995) have been found to comply with the federal regulations regarding asbestos landfills, specifically CFR 40 part 61.151, and part 61.154.

If these procedures are followed, the Atlas Moab landfill would be acceptable for the disposal of asbestos waste removed from the adjacent uranium mill facility.

Please direct questions regarding this matter to Ben Dattilo at 536-4173.

Sincerely,

Russell A. Roberts, Executive Secretary
Utah Air Quality Board

RAR:BFD:bfd

cc: Utah DSHW, Ralph Bohn
Utah DERR, Brad Johnson
Utah DRC, Loren Morton

Printed on recycled paper

STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS
STATIONARY SOURCE REPORTING FORM
ASBESTOS WASTE DISPOSAL SITES

INSTRUCTIONS: Complete each item below. Use additional pages if necessary. If there is a change in any of the information listed below, report the changes to the Utah Division of Air Quality within 30 days after they occur.

Mail form to: Russel A. Roberts, Division of Air Quality, Department of Environmental Quality, State of Utah, Salt Lake City, UT 84114-4820; Telephone: (801) 536-4000

Atlas' Uranium Mill Site
Source Name

North Hwy. 191
Street Address (Location of Source)

P.O. Box 1207
Mailing Address - Street

Moab Grand UT
City County State

Moab UT
City State

84532
Zip Code

VIII
Region

84532
Zip Code

Atlas Corporation
Name of Source Owner/Operator

Contact: Indicate the name and telephone number of the owner/operator or other responsible official whom the DAQ may contact concerning this report.

Atlas Corporation - Richard E. Blubaugh
Contact Name

(303) 825-1200
Telephone Number

TYPE OF WASTE DISPOSAL SITE (e.g., "landfill that only accepts asbestos waste")

Uranium Mill Tailings Pond

POLLUTANT EMITTED - Indicate the type of hazardous pollutant emitted by the source.

Asbestos/Radiation/Radioactive Particulates

CONFIGURATION OF WASTE DISPOSAL SITE - Briefly describe the site, including its size, location, and configuration. Attach a sketch or map of the waste disposal site and delineate the asbestos waste disposal areas(s) within the site.

Atlas' disposal site is a pit approximately 460'x 60', located adjacent to the uranium mill Tailings Pond contained in approximately 130 acres in the west half of section 27 and the east half of Section 28 Township 25 South, Range 21 East (see attached figure).

DISTANCE BETWEEN SITE AND CLOSEST CITY OR TOWN	1.7 air miles
DISTANCE BETWEEN SITE AND CLOSEST RESIDENCE	4,400 feet
DISTANCE BETWEEN SITE AND CLOSEST PRIMARY ROAD	150 feet

NATURE OF THE SOURCE - (e.g., "open pit, lined with plastic")

Existing pit immediately adjacent to uranium tailings and uranium mill debris.

METHOD OF OPERATION OF THE SOURCE - List days and hours of operation. Detail how asbestos waste is handled.

Five days per week (Monday to Friday), 8 hours per day for duration of this project. ACM will be handled by trained personnel pursuant to regulations cited in 40 CFR 61.

All asbestos contaminated materials will be wetted to prevent air-borne emissions. Asbestos-containing material will be double-bagged (where practicable) and then placed in the designated disposal site.

Where removal of ACM is not practicable, the entire component will be encased in an approved plastic wrap, sealed, and placed in the designated disposal site.

OPERATING DESIGN CAPACITY - Indicate the total amount of asbestos the site can take.

Approximately 110 tons of asbestos-containing materials (ACM), consisting of:

- (14) 12'x 14' vessels, @ 16,000 lbs. each
- associated piping
- double-bagged asbestos material
- miscellaneous drums, tubing, piping, etc.
- ACM contaminated soils

AMOUNT OF POLLUTANT - Indicate the average weight (in pounds) per month of asbestos waste disposed of by the source, over the last 12 months preceding the date of this report.

None.

COMPLIANCE METHOD DESCRIPTION - Describe the method(s) used to comply with the 40 CFR Part 61 National Emission Standard for Hazardous Air Pollutants, Asbestos NESHAP, Final Rule or describe alternative methods that will be used; and method(s) to be used to prevent public access.

The methods used to comply with 40 CFR 61 consist of wetting, double-bagging and/or encasement of asbestos and asbestos-containing materials, and their burial with a minimum of four feet of material in dedicated and permanent site. The site is fenced and access is restricted.

See attached procedures, *Asbestos Abatement Master Plan* prepared by American Reclamation and Dismantling.

INACTIVATION - After the site is inactivated, indicate the method(s) to be used to comply with 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants, Asbestos NESHAPS, Final Rule and send a list of the actions that will be undertaken to maintain the inactivated site.

The site is fenced, and acess is restricted. Inspection of the site will be conducted periodically (not less than once per year) to ensure compliance.

Signature of Owner/Operator
or Other Responsible Official

May 2, 1995
Date

ASBESTOS ABATEMENT MASTER PLAN
American Reclamation and Dismantling

4.0 SITE SPECIFICATION

See the following work plan for specific site considerations.

Due to the fact that most of the aforementioned specifications are mainly concerned with indoor asbestos abatement, following is the plan for the Atlas Minerals Project.

A. All of the asbestos on the Atlas Project is outdoors, and most of the asbestos, at this time, is non-friable. Some of the previously non-friable asbestos has been weather damaged and is now classified as friable. All of the asbestos will be treated as friable.

B. An eight (8) foot barrier of 6-mil plastic will be erected around the complete asbestos area. Attached to the barrier will be appropriate signs and warnings concerning asbestos and its hazards.

C. Due to the large area involved, and the need for large equipment, two (2) inches of soil will be removed and treated as ACM.

D. The complete area is already graded so that the water will drain into an enclosed drainage system. This water will run through an HEPA filter before discharge.

E. All ACM will be wetted with amended water prior to removal or containment.

F. There are fourteen (14) vessels, twelve (12) feet wide by fifteen (15) feet tall. These weigh, approximately, eight (8) tons each. These vessels are covered with fire brick and sealed with asbestos-base mortar. The exterior of the vessels is covered with a tar-base coat. The plan is to cover each vessel with two (2) layers of 6-mil plastic and adequately wet, then lift with a crane or trackhoe and set on a truck for transportation to the disposal site.

There is also heat exchanger made up of twenty-four (24) six (6) inch pipes, approximately, sixty (60) feet long, that is covered with asbestos-lagging and encased in tar paper. These pipes will be covered with two (2) layers of 6-mil plastic and lifted with a crane or trackhoe onto a truck and transported to the disposal site.

There is also, approximately, 400 feet of assorted pipe that connects the vessels to heat exchanger. This pipe is covered the same way as the heat exchanger pipe and will be treated the same way. This pipe is connected with exposed metal flanges. These flanges will be disconnected where located and moved so as not to disturb the asbestos.

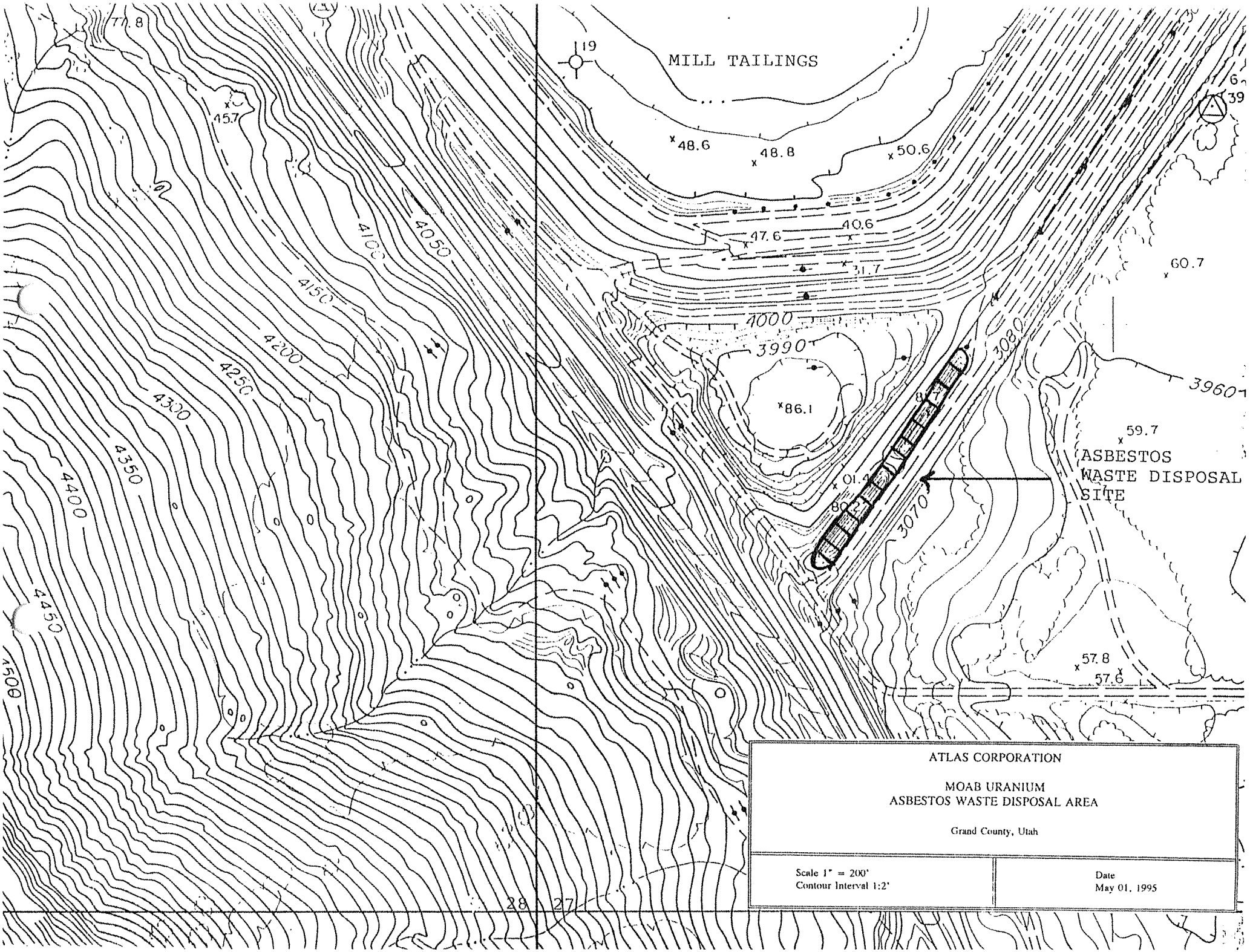
G. While work is being conducted, the people involved will be completely enclosed in Tyvec suits and will be wearing Recal forced-air respirators. They will also have personal air monitors attached to them to monnitor asbestos exposure. A high-volume pump shall be monitoring the surrounding air.

H. The disposal site is at the site where the ACM is located. The ground shall be prepared before any ACM is moved. The ACM shall be covered the same day as transported.

I. At all times, the ACM shall be adequately wet to control the fiber released.

J. At the completion of removal of pipe and vessels, the dirt shall be scraped up and loaded into a metal tank that is 8x6x30 that will be lined with two (2) layers of 6-mil plastic and covered with two (2) layers of 6-mil plastic and then transported to burial site. The drive shall, at all times, be adequately wet and treated with care so that the asbestos release is minimal. The plastic enclosing the area shall be disposed of as ACM.

K. At all times during the abatement process, care shall be taken to minimize exposure of asbestos fiber to people and to the environment.



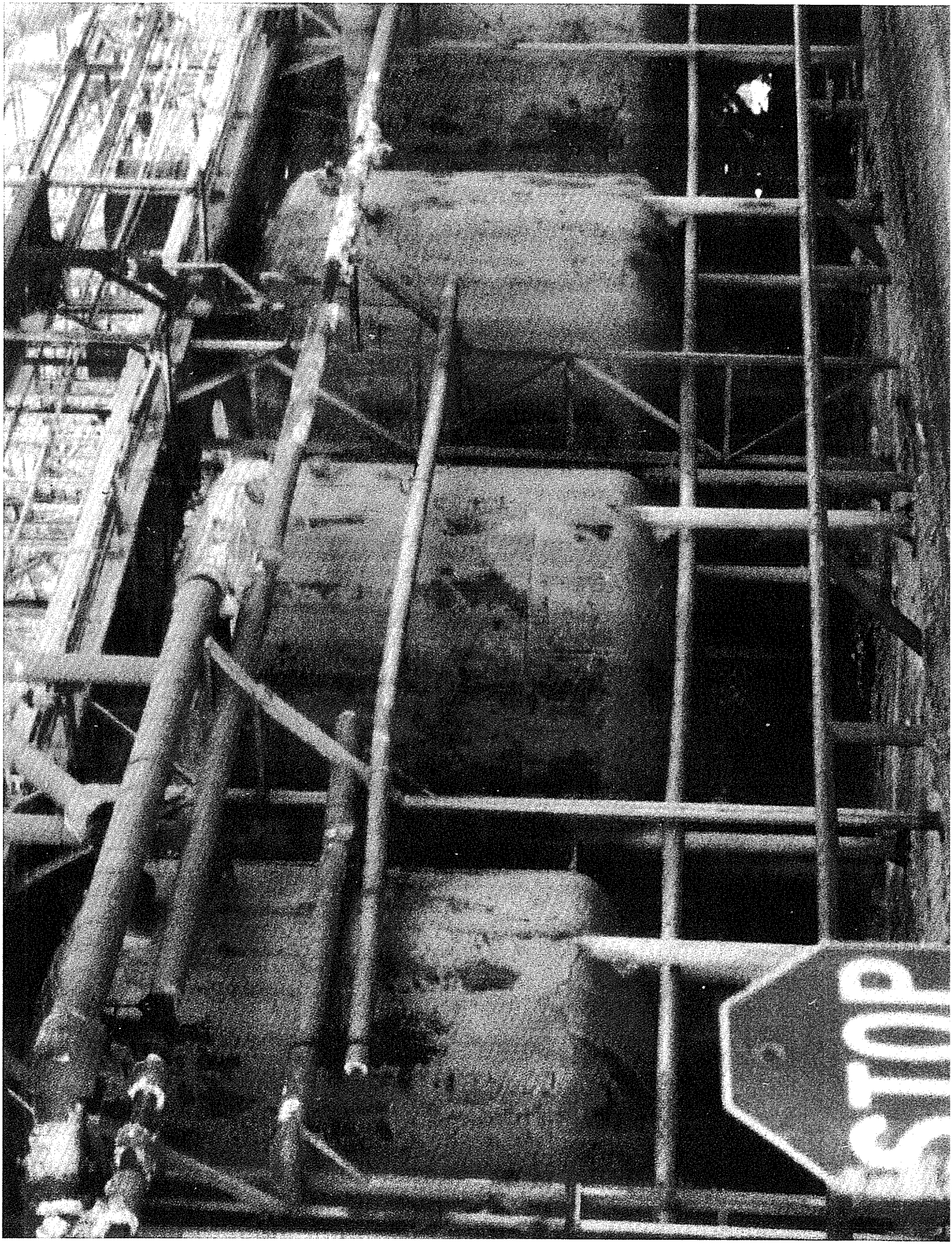
ATLAS CORPORATION

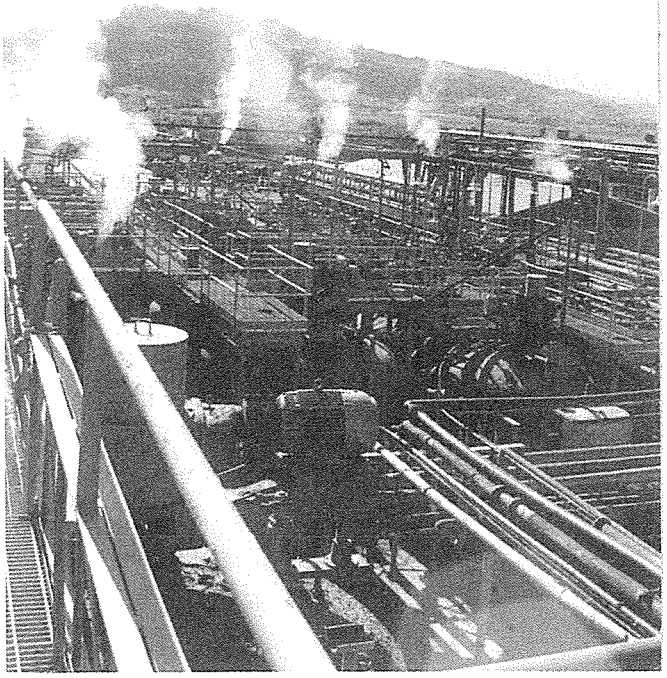
MOAB URANIUM
ASBESTOS WASTE DISPOSAL AREA

Grand County, Utah

Scale 1" = 200' Contour Interval 1:2'	Date May 01, 1995

REFERENCE 4


STOP



REFERENCE 5

I am experiencing some problems with forwarding this message to other interested parties. Simply, my new computer is not up to expectations yet.

Could you, please resend this message to the other addresses listed above.
I will be grateful and I am sorry for inconvenience.

Regards,

Roman

From: Bevan, Kym [mailto:Kym.Bevan@gjem.doe.gov]
Sent: Tuesday, September 1, 2015 10:07 AM
To: roman_popielak@earthlink.com; romansp.consult@gmail.com
Cc: Cindy Smith; Metzler, Donald
Subject: FW: Autoclave Info

Roman,

Attached is information about the Moab autoclaves; and Ken Wethington received the following verbal information.

The additional information I have is verbal from Carl Dixon (former Atlas employee). He stated that the autoclaves have an approximately 24 inch manhole into which they staffed as much of the asbestos containing pipe as they could and then filled them with dirt. He said the wall thickness varies between ¾ and 1 inch. He also stated that they buried them with the support legs attached. The legs can be seen in the first picture of your email. They were wrapped in plastic but of course that's going to be very degraded if it's still there at all.

Regards,

Kym Bevan
Moab UMTRA Project
S&K Moab TAC Team, Contractor to the
U.S. Department of Energy
970-257-2143

Project Record MOA 3.3 (C. Smith)

From: Jeff Biagini [mailto:Jeff.Biagini@gjemrac.doe.gov]
Sent: Friday, August 28, 2015 9:21 AM
To: Metzler, Donald; Bevan, Kym
Subject: Autoclave Info

Don,

Per your request, attached are the files I have on the subject. If you need any further discussion, please contact me at the information listed below.

Thanks

REFERENCE 6

Table 4
Moab Project Material Handling Evaluation Study
Summary of Available Geotechnical Laboratory Test Data

Laboratory Test	No. Data Points	Average Value	Range of Values	Reference
Tailings – slimes				
Wet Density	3	104.2 pcf	100.1 – 111.2 pcf	SRK (2000)
Dry Density	3	65.6 pcf	50.2 – 88.6 pcf	SRK (2000)
In situ Moisture Content	3	66.3%	25.5 – 99.3%	SRK (2000)
Percent Saturation	3	97.2%	75.6 – 113.9%	SRK (2000)
Effective Friction Angle, ϕ'	3	30 degrees	29 – 31 degrees	Dames & Moore (1981); NRC (1984)
Effective Cohesion, c'	3	0 psf	0 psf	Dames & Moore (1981); NRC (1984)
Friction Angle, ϕ	2	21 degrees	21 psf	Dames & Moore (1981); NRC (1984)
Cohesion, c	2	650 psf	0 – 1300 psf	Dames & Moore (1981); NRC (1984)
Liquid Limit	3	41	24 – 64	Dames & Moore (1981); NRC (1984)
Plasticity Index	3	18	8 - 41	Dames & Moore (1981); NRC (1984)
Minus #200 Sieve	14	95.1%	86.8 – 99.9%	SRK (2000)
Specific Gravity	7	2.8	2.54 – 3.03	SRK (2000)
Void Ratio	3	1.78	0.92 – 2.34	SRK (2000)
Compression Index, Cv	3	2.6E-1 m^2/day	4.2E-3 – 7.6E-1 m^2/day	SRK (2000)
Permeability, K	3	7.3E-5 cm/sec	5.7E-6 – 2.0E-4 cm/sec	SRK (2000)
Tailings – sandy slimes				
Minus #200 Sieve	1	52.2%	N/A	SRK (2000)
Tailings – slimey sands				
Minus #200 Sieve	1	48.7%	N/A	SRK (2000)
Specific Gravity	1	2.65	N/A	SRK (2000)
Tailings - sands				
Minus #200 Sieve	2	23.0%	22.0 – 23.9%	SRK (2000)
Specific Gravity	1	2.70	N/A	SRK (2000)
Effective Friction Angle, ϕ'	13	35 degrees	23 – 38 degrees	Dames & Moore (1981); NRC (1984)
Effective Cohesion, c'	13	350 psf	0 – 1450 psf	Dames & Moore (1981); NRC (1984)
Friction Angle, ϕ	1	20 degrees	N/A	Dames & Moore (1981); NRC (1984)
Cohesion, c	1	800 psf	N/A	Dames & Moore (1981); NRC (1984)

Notes:

1. The tailings types are generally classified based on material gradation, as follows: Sand - <30% fines (minus 74 micron); Slimey sands - >30% and < 50% fines; Sandy slimes - >50% and <70% fines; and Slimes - >70% fines. Where gradation information was unavailable, the classification provided in the report was used.
2. In situ dry density, moisture content, and permeability data obtained for various tailings materials and presented in Dames & Moore (1981) not presented herein, as the tailings have changed considerably since that time.
3. Majority of tailings material properties have changed since testing conducted due to consolidation settlement.

References:

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