

Enclosure A

JUL 12 1979

SAFETY EVALUATION REPORT - GEOTECHNICAL ENGINEERING
Project Name: Federal American Partners
Docket No.: 40-4492
Tac No.: 4733
Subject: Proposed Addition to Tailings Dam #2

Introduction

Federal American Partners is the applicant for a license to modify the existing Tailings Dam #2 by :

- a) raising the height of the existing Tailings Dam #2 by 15 ft from El 6495 to El 6510, and
- b) constructing solids-retention dikes on existing tailings in the east and south parts of Tailings Dam #2.

We have reviewed the information submitted by the applicant and have based our evaluation on the following documents:

1. Tailings Dams and Appurtenance Works, Area Information and Design Report for Application to Construct, Federal American Partners, received Oct. 31, 1977.
2. Geotechnical Investigation for the Proposed Extensions of Tailings Dams Numbers 1 and 2, by F. M. Fox & Assoc., June 16, 1978.
3. Revision of Design for the Proposed Tailing Dam No. 2, by F. M. Fox and Associates, July 19, 1978.
4. Stability Analysis for the Revised Design of Tailing Dam No. 2, by F. M. Fox and Associates, November 24, 1978.
5. Supplemented Geotechnical Investigation and Stability Analysis for the Proposed Tailing Dam No. 2, by F. M. Fox and Associates, April 1979.
6. Letter from K. Wright, FAP to L. Rouse, NMSS, providing details of applicant's commitments to meet license conditions, dated October 24, 1978.

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Project Description

The Federal American Partners uranium mine and mill is located in Gas Hills Mining District, Gas Hills, Wyoming. The tailing and liquor wastes from the mill are discharged into Tailings Dam #2 which is located about 800 ft north of the mill structures. Liquids and part of the slimes (fine material) are decanted into Tailings Dam #1, located about 1500 ft northwest of Dam #2. Thus, Dam #2 is mostly a solids-retention system and retains only small quantities of liquids.

The existing pond formed by Dam #2 is almost full with tailings. The existing embankment crest is at El 6495. The interior tailings surface is at about El 6480 in the north part, and at about El 6525 in the south part of the pond.

In order to provide additional tailings capacity, the applicant proposes to raise the height of the existing Dam #2 by 15 ft, from El 6495 to El 6510. The new side slopes will be 3 horizontal to 1 vertical compared to the existing slopes of about 2 to 1. The new top width will be 20 ft. The new embankment will extend about 150 ft beyond the toe of the existing embankment. Thus the new embankment will be supported partly on the existing embankment and partly on undisturbed soil beyond the existing toe.

On the east and south sides of the pond, where the existing embankment slopes upwards to higher existing embankment and tailings surfaces, solids-retention dikes will be provided to contain additional tailings. The dike crests

will also be at El 6510. The top widths will be 20 ft and the side slopes 3 horizontal to 1 vertical. The dikes will be constructed the same as the proposed addition to the dam except that their foundations will be existing tailings.

The proposed modification to Tailings Dam #2 will provide storage capacity for an additional 1.3 million tons of tailings which is expected to be adequate capacity for about 3 years of mill operation.

Subsurface Investigation

Test borings and test pit excavations were made at the dam site. About 60 test borings and 4 test pits were made in February 1978 for a proposed extension of Dam #2. When this proposal was abandoned, additional subsurface information was needed and 36 test borings were made along the crest of the existing embankment and in the proposed foundation area under the downstream slope. These borings were made in March 1979. Soils were sampled by 2 inch diameter California barrel sampler or thin walled tube. Rock was sampled by NX coring. Penetration tests were made with the California barrel sampler.

The fill material for embankment construction is to be obtained from the Sagebrush-Tablestakes pit located about 3000 ft southwest of Dam #2. No special subsurface investigation was needed in this pit because information was already available. The pit is being studied for possible use as an underground tailings disposal site.

Logs of test holes are provided in the referenced documents. The logs include soil descriptions, sampling details, and ground water levels observed during the exploration.

The subsurface investigation provides an adequate description of the subsurface conditions present at the site and has provided adequate samples for laboratory testing.

Laboratory testing

Laboratory tests performed for routine soil identification were: gradation, Atterberg limits and specific gravity. The characteristics of proposed borrow materials were determined from Proctor compaction and relative density tests. Strength and consolidation parameters were determined from direct shear, triaxial, unconfined compression and consolidation tests on both undisturbed and remolded samples.

We find that the laboratory test results are reasonable and that the testing program has provided adequate laboratory data for dam and dike design.

Geologic and Soil Conditions

a. Geology:

At the site of Dam #2 the area base rock is impervious shales of the Cody formation of the upper middle Cretaceous age, 0 to 2000 ± ft thick. The Cody formation is unconformably overlain by low permeability silt and mudstone belonging to the lower Eocene, Lower Wind River formation, 0 to 120 ft thick. The Lower Wind River formation is unconformably overlain by conglomerates and sandstones of the Upper Wind River formation, 0 to 600 ft thick.

Faulting is not known to exist in the immediate confines of the tailings dam site. One Tertiary fault occurs about one-half mile southwest of the site, but hinges south of the area. The project site is located in a minor seismic risk area (Seismic Zone 1, after Algermissen, "Seismic Risk Studies in the United States," 1969).

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b. Existing Embankment Conditions:

The fill soils in the existing embankment of Dam #2 are heterogeneous mixtures of silty and clayey sand (SM-SC), and sandy clays (ML-CL). The fill is generally firm as indicated by penetration values in excess of 20 blows/ft except for localized loose or soft pockets within the upper 10 to 15 ft of the existing embankment.

Groundwater observations show that the existing embankment is not saturated and the groundwater level is at about El 6390--that is, about 40 ft below the base of the existing embankment. This is evidence which shows that there is very little seepage out of the Dam #2.

c. Foundation Conditions for Dam (between existing and proposed toes):

The foundation soils under the downstream face of the proposed embankment are alluvial materials from the Willow Springs drainage area. On the west side the soils are about 15 feet deep and on the east side as much as 60 ft deep over sandstone, claystone or siltstone bedrock. The soils are predominantly silty sand (SM) and clayey sand (SC) with some cleaner sands and gravels (GP, SP) and localized layers of fine grained soils (ML, CL). The foundation soils are firm as indicated by penetration test values mostly greater than 12 blow/ft.

d. Foundation Conditions for Dikes:

The existing tailings which will support the dikes are silty sand (SM) to sandy silt (ML) materials with a maximum size of about 4 mm and about 50% finer than the U. S. #200 (0.074 mm) sieve. The liquid limit is about 26% and the plasticity index about 4%. The tailings are medium dense.

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e. Borrow Materials:

The proposed soil borrow from the Sagebrush-Tablestakes pit is silty and clayey sand (SM-SC). The maximum particle size is about 4 mm and about 10% to 30% is finer than the U.S. #200 (0.074 mm) sieve.

Embankment Design

A. Stability:

The new embankment for the dam and dikes will be homogeneous earthfill using material from the Sagebrush-Tablestakes pit. This material is predominantly silty and clayey sand (SM-SC). Strength parameters of $\phi = 40$ deg. and cohesion = 3.5 KSF were used in the stability analyses (Ref. 5). The staff's consultant made an independent check of stability using $\phi = 30$ deg. and found an acceptable factor of safety in excess of 1.4. We also found the factor of safety during earthquake loading to be adequate based on a pseudo-static analysis using a horizontal seismic coefficient of 0.10. We consider this coefficient to be conservative.

J. Settlement:

The total settlement of the embankment and foundation is predicted to be less than 1 ft. Due to the sandy nature of the fill material, most of the settlement is expected to occur during construction and thus the recommended 1 ft of overbuild is considered to be adequate.

c. Liquefaction:

The only materials in the proposed construction which are considered to be susceptible to liquefaction are the tailings foundations under the dikes. The applicant has not shown that the tailings will not liquefy during the design earthquake. We agree with the applicant that movement of tailings beyond the dam is not likely to occur but, in order to ensure that the unexpected liquefaction conditions do not occur, the piezometric level in the pond or tailings must not be permitted to rise about El 6490. If the piezometric

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level should rise about this elevation, liquids must be decanted or pumped out of the pond and/or tailings to maintain the desired maximum piezometric level. Measurement of piezometric levels is discussed later in this report.

Construction

All fill will be placed in lifts not exceeding 8 inches loose and compacted to a density of at least 95% of maximum density (ASTM D-698) at a moisture content within 2% of optimum moisture content. The foundation area will be stripped of unsuitable material and the exposed surface will be compacted. The foundation soils will be inspected, tested and approved by the Geotechnical Engineer.

Monitoring

Periodic measurements of piezometric levels and settlement must be made in order to assure that the structure performs as anticipated.

Piezometric levels in and under the new embankment are to be measured in open check wells located along the maximum section at the crest (2 wells) at the center of the downstream face (2 wells) and in each sand tailing dike (3 wells each dike). The wells will be monitored weekly for the first 2 months and monthly thereafter for the life of the project.

Settlements of the new embankment are to be measured on monuments located on the crest (3 monuments) and on the center of the downstream face (3 monuments). The monuments will be monitored monthly for the first year and quarterly thereafter for the life of the project.

Conclusions

Review of the geotechnical considerations permit us to conclude that the proposed addition to Tailings Dam #2 will result in a safe retention system which meets the intent of Reg. Guide 3.11. This conclusion is based on our review of the documents listed in the introduction.

License Conditions

The addition to Tailings Dam #2 must be constructed in accordance with the descriptions provided in the referenced documents. The applicant must submit documentary evidence at the completion of construction which verifies compliance with this condition.

The piezometric level in the pond or in the tailings under the solids-retention dikes must be maintained below El 649.

Piezometric level, settlement and groundwater quality measurements must be observed and recorded as specified in the referenced documents. These records must be available at the site for NRC inspection.

Any unusual conditions which could affect the safe construction or operation of the dam must immediately be communicated to NRC, Office of Nuclear Material Safety and Safeguards.

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Enclosure B

JUL 12 1979

HYDROLOGIC ENGINEERING SUMMARY
FEDERAL AMERICAN PARTNERS
GAS HILLS PROJECT, WYOMING

BACKGROUND

The Federal American Partners Project (FAPP) is located in the Gas Hills Mining District of Fremont County, Wyoming near the town of Riverton. Under existing operations, mine tailings are discharged to the No. 2 Tailings Pond. Liquids are periodically decanted to Pond No. 1 for impoundment and additional evaporation so Pond No. 2 retains only a very small amount of liquids.

In the original application, Federal American Partners (FAP) proposed to enlarge the two tailings dams. Dam No. 1 was to be enlarged by raising the existing embankment crest from elevation 6335 feet above mean sea level (ft. msl) to 6345 ft. msl, and Dam No. 2 was to be enlarged by constructing a new embankment north of the existing dam with a crest at about the same elevation as the existing Dam No. 2.

In a later modification, the proposal to enlarge Dam No. 2 was dropped. The proposal to raise Dam No. 1 by 10 feet was retained and FAP proposed to change its mill operations by recycling fluids from Pond No. 1 through the plant in order to reduce the liquid in Pond No. 1 to a maximum depth of 24 inches. Subsequently, the applicant again proposed to modify dam No. 2. The current proposal is for raising the existing embankment by 15 feet and flattening the side slopes. This is the proposal addressed by this Hydrologic Engineering Summary.

FLOODING

The applicant assessed the potential of flooding from two sources: (1) Willow Springs Draw, and (2) the local 100 acre basin. The information submitted for Willow Springs Draw shows that a Probable Maximum Flood (PMF) may cause some minor damage to the toe of the east embankment. We agree with this analysis and conclude that a PMF in Willow Springs Draw will not pose a hazard to the embankment because any water reaching the embankment will be of very short duration (15 minutes), low velocity and shallow depth (2 feet or less).

For the local drainage basin, the applicant will provide sufficient storage space in the tailings reservoir to store the entire volume of the PMF series as suggested in Regulatory Guide 3.11, Design, Construction and Inspection of Uranium Mills," (Revision 2).

We have evaluated the applicant's freeboard analysis and do not agree that a minimum freeboard of five feet is sufficient. At least seven feet must be provided. This places the maximum operating water level at elevation 5503 feet msl; however, as noted in the Geosciences Branch's "Draft Safety Evaluation Report," the liquifaction potential is a more restrictive design basis and will require that the water level not be permitted to rise above

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elevation 6490 feet msl. This will effectively increase the freeboard to 20 feet, which is acceptable.

GROUND WATER AND SEEPAGE

The ground water contour map provided by the applicant shows that little seepage is occurring from the pond. The applicant attributes this to the gradation and placement of the tailings (i.e., the minus 200 mesh material is filling the voids in the natural soil). Since the existing dam will only be raised to increase the storage capacity and not extended to increase the surface area, the seepage rate should not be increased. The contour map also shows a relatively constant gradient with ground water moving in a northerly direction. Based on this, the applicant has already installed two water monitoring devices about 1,000 feet and 4,500 feet north of the toe of the proposed embankment. Samples are to be taken monthly during the first year and quarterly thereafter. Since the applicant has shown that very little seepage will occur and proposes to retain only a low level of liquids in the pond, we conclude that two monitoring wells north of the proposed embankment are adequate.

POTENTIAL RUPTURE OF DISCHARGE LINE

A rupture of the tailings discharge line would not adversely affect the stability of the embankment. Tailings could, however, flow towards Willow Springs Draw. The applicant has stated that the pump station, which lifts tailing slurry to the discharge line, requires a full time operator who would be aware of a line rupture immediately and could shut down the plant in less than five minutes. Any tailings released would be intercepted by an emergency spill diversion ditch which is located at the base of the impoundment between the embankment and Willow Springs Draw. The released tailings would be contained within a designated restricted area north and east of the impoundment.

EMBANKMENT SLOPE PROTECTION

Currently the decant intake structure is located about 20 feet to the interior of the embankment. When the embankment is raised to the proposed elevation of 6510 feet msl, the structure will be a minimum of 60 feet from the crest of the embankment. In addition, the fluid surface, being very limited, reduces the fetch length to less than 30 feet so the erosion potential for the upstream face of the structure is minimized. Because of this, the applicant does not propose slope protection for the upstream face of the embankment.

CONCLUSIONS

Based on a review of the hydrologic considerations in the referenced documents, we conclude that adequate design basis for flooding have been provided, that the proposed ground water observation program is adequate and that a rupture of the tailing discharge line will not result in any releases of tailings beyond the project restricted area; providing a full time operator is available to shut the plant down in the event of a pipe rupture. We also conclude that upstream slope protection is not required, provided the decant intake structure is not relocated closer to the embankment and the liquid is maintained at a low level by periodically decanting into pond No. 1.

LICENSE CONDITION

The applicant's analysis of a postulated rupture of the tailing discharge line shows that any releases would be retained within a restricted area because the plant lift station operator would be aware of a malfunction immediately and could shut the plant down before any releases went off the site. As a license condition, the applicant should assure that the plant station has a trained operator on duty at all times who can visually inspect the tailings discharge line continuously and shut the plant down in the event of a pipe rupture.

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REFERENCES

1. Tailings Dams and Appurtenance Works, Area Information and Design Report for Application to Construct, Federal American Partners, October 1977.
2. Geotechnical Investigation for the Proposed Extentions of Tailings Dams 1 and 2, by F.M. Fox and Associates, May 5, 1978, revised June 16, 1978.
3. Revision of Design for the Proposed Tailing Dam No.2 by F. M. Fox and Associates, July 19, 1978.
4. Supplemental Geotechnical Investigation and Stability Analysis by F. M. Fox and Associates, April 1979.
5. Letter from F. M. Fox and Associates dated March 30, 1979, to Mr. Ken Wright, Federal American Partners, providing responses to Hydrologic Engineering Questions.
6. Letter from F. M. Fox and Associates dated April 18, 1979, to Pete Garcia, NMSS providing corrected area-capacity curve for pond no 2.
7. Letter from F. M. Fox and Associates dated May 21, 1979, to Pete Garcia, providing information concerning a postulated rupture of the tailings discharge line.