| AD-A06 | AD-A063 941 BERGER ASSOCIATES INC HARRISBURG PA F/G 13/2 NATIONAL DAM INSPECTION PROGRAM. LAUREL CREEK DAM, SUSQUEHANNAETC(U) JUL 78 DACW31-78-C-0044 NL | | | | | | | | | | | |
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PHASE I REPORT NATIONAL DAM INSPECTION PROGRAM

| Name of Dam: | LAUREL CREEK DAM |
|-----------------------|---------------------------|
| State & State Number: | PENNSYLVANIA - 44-62 |
| County Located: | MIFFLIN |
| Stream: | LAUREL CREEK, SUSQUEHANNA |
| Date of Inspection: | May 12, 1978 |

Based on a visual inspection, past performance and available engineering data, the dam and its appurtenances appear to be in excellent condition. The following recommendations are made:

- 1. Owner should install a staff gauge.
- 2. Repair crack in spillway wall.

The spillway capacity is not sufficient to pass the Probable Maximum Flood (PMF), as defined in the Corps of Engineers guidelines, without overtopping the dam. The spillway, however, has the capacity to pass 81% of the PMF peak flow and while it is rated inadequate on the PMF basis, it is not considered seriously inadequate.

A formal surveillance and downstream warning system should be developed to be used during periods of high precipitation.

Submitted By:

PROFESSIONAL

HENDRIX JONGSMA

APPROVED BY:

BERGER ASSOCIATES, INC. HARRISBURG, PENNSYLVANIA Contract No. DACW-31-78-C-0044 Date: July 5, 1978

G. K. WITHERS Colonel. Corps of Engineers District Engineer

DATE: 28 July 1978

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1.1 GENERAL

a. <u>Authority</u>

The Dam Inspection Act, Public Law 92-237 (Appendix III), authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States. The Phase I Inspection and Report is limited to a review of available data, a visual inspection of the dam site and the basic calculations to determine the hydraulic adequacy of the spillway.

SECTION 1 - PROJECT INFORMATION

b. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property. $_$

Abstract

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances

Laurel Creek Dam is composed of a rockfill embankment with an upstream impervious asphaltic concrete membrane. For a general plan view and a typical section, see Appendix D, Plates VI and VII. The embankment is approximately 600 feet long and has a maximum height of 135 feet above streambed. The minimum crest elevation is 1175 and the crest width is 20 feet. The spillway is an ogee section having a crest elevation of 1161 and a crest length of 135 feet. The spillway chute and deflector bucket were excavated into rock. They are composed of a concrete slab and retaining walls. An intake tower is located upstream of the dam in the right abutment and is accessible by a footbridge.

b. Location: U.S. Quadrangle, Barrville, Pa. Latitude 40°43.8', Longitude 77°37.8' (Appendix D, Plates I & II)

| с. | Size classification: | Large (over 100 feet high) |
|----|------------------------|---|
| d. | Hazard Classification: | High (See Section 3.1.e) |
| e. | Ownership: | Municipal Authority of the Borough of Lewistown, Pa. |
| | | 70 Chartent Course |

70 Chestnut Street Lewistown, Pennsylvania 17044

f. Purpose of Dam:

Water Supply

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g. Design and Construction History

The dam was designed by Gwin Engineers, Altoona, Pa. The Permit Application was approved by Pennsylvania Department of Environmental Resources (PennDER) in March, 1968. The contractor was Green Construction Company, Des Moines, Iowa, who started the project in the spring of 1969. Due to strike by the operators, the actual construction did not start until April, 1970. Construction was completed in September. 1972 and filling of the impoundment lake started in July, 1972. Full pool level was reached in December, 1972.

h. Normal Operating Procedures

The reservoir has been constructed and is used for domestic water supply for the Borough of Lewistown, Pennsylvania. Water is taken from the impounded lake at different elevations at the intake tower and carried through a pressure conduit to an outlet control pit located at the downstream toe of the dam. From this point the water flows through a 24 inch cast iron pipe to the treatment plant, which is situated approximately 1200 feet further downstream.

1.3 PERTINENT DATA

| Drainage Area (square miles) | 12.8 |
|--|-----------|
| Discharge at Dam Site (cubic feet per second) See Appendix B for calculations | |
| Maximum known flood at dam site June, 1972 - Estimated | .1,000 |
| Warm water outlet at pool elevation 1161.0 | 93 |
| Outlet tunnel at low pool elevation 1060.0 | 93 |
| Outlet tunnel at normal pool elevation 1161.0 | 200 |
| Spillway capacity at maximum design pool elevation 1170.0 | 13,700 |
| Spillway capacity at maximum pool elevation 1175.0 - Estimate | 25,000 |
| Elevation (feet above mean sea level) | |
| Top of dam (low point of camber) | 1,175.0 |
| Maximum pool design surcharge | 1, 170, 0 |

X

| | Normal pool | 1,161.0 |
|----|--|---------|
| | Upstream portal invert of outlet conduit | 1,047.0 |
| | Downstream portal invert of outlet conduit | 1,031.5 |
| | Streambed at centerline of dam | 1,040.0 |
| | Maximum tailwater - Estimate | 1,036.0 |
| ł. | Reservoir (miles) | |
| | Length of maximum pool | 1.0 |
| | Length of normal pool | 0.9 |
| e. | Storage (acre-feet) | |
| | Spillway crest | 3,050 |
| | Design surcharge | 3,690 |
| | Top of dam | 4,080 |
| £. | Reservoir Surface (acres) | |
| | Top of dam | 80 |
| | Design surcharge | 75 |
| | Spillway crest | 67 |

g. Dam

AN

0

For general plan and typical section see Plates VI and VII of Appendix D.

| Type: | Rolled Rockfill, hydraulically sluiced. |
|--------------|---|
| Length: | 600 feet |
| Height: | 135 feet above streambed |
| Top Width: | 20 feet |
| Side Slopes: | Upstream 1.75H to 1V Downstream 1.4H to 1V |

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Zoning: Main section is a rockfill. A 15 foot thick zone of material, between 3" and 18" in size is placed on the upstream side as a support for the asphaltic concrete membrane.

Cutoff: A cutoff trench is located at the toe of the membrane. This trench was filled with concrete and a special key connects this concrete to the membrane.

Grout Curtain: A grout curtain is indicated at the cutoff trench.

h. Outlet Conduit

Type: 42-inch and 60-inch diameter concrete pipes.

Length: 71 feet of 42-inch diameter pipe and 719 feet of 60inch diameter pipe. Total length 790 feet.

Closure: 24-inch Howell-Bunger valve at downstream end.

Access: Valve pit at downstream toe of dam.

Regulating Facilities:

Howell-Bunger valve, manually operated. There is also a 5-inch bypass and gate valve for small releases.

i. Spillway

Type: Uncontrolled ogee weir with side channel and concrete lined rectangular chute.

Length of weir: 135 feet.

Crest elevation: 1161.0

Upstream channel: Paved area between reservoir and weir at elevation 1141.0.

Downstream channel: Ogee weir delivers water to the rectangular concrete side channel having a 50-foot width. The chute descends a vertical distance of about 120 feet over a horizontal distance of about 660 feet. It narrows to a width of 30 feet at the bottom and terminates in a deflector bucket.

j. Regulating Outlets

The regulating outlet includes a low flow inlet to the outlet conduit with an invert elevation of 1047.0 in intake tower.

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SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Data Available

1. Hydrology and Hydraulics

The files of PennDER contained a report by the Consulting Design Engineer covering the hydrology and spillway calculations for this dam. The permit application report dated January 19, 1968, states that the required discharge at this site should be 9,600 cfs. This report also reviews the hydrologic analysis and states that the maximum probable storm would produce a peak inflow of 33,800 cfs., which can be handled by the spillway. Included in the report by the design engineer were design flood hydrographs, flood routing data, side channel spillway design calculations, a spillway rating curve, spillway chute and bucket calculations, outlet tunnel rating data and a reservoir capacity curve.

2. Embankment

The embankment design was based on a geological report by Lawrence H. Lattman, Geologist, State College, Pennsylvania, and the embankment stability calculations were made by Gwin Engineers, Inc. Design calculations for embankment stability, embankment zoning and cutoff wall are available in the files of PennDER.

3. Appurtenant Structures

Design criteria and calculations prepared by the design engineer are available in the files of PennDER. These computations include the following structures:

- a. Intake tower and footbridge.
- b. Outlet works.
- c. Spillway.
- d. Bridges over the Spillway (upper and lower bridge).

b. Design Features

1. Embankment

The dam embankment is a rolled rockfill embankment with two zones and a asphaltic concrete membrane on the upstream side (Plate VII, Appendix D). Zone one is the main portion of the dam and the material used in this zone is graded between the limits of 100% passing 36-inch and less than 10% passing 4-inch size. The zone two material

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had to be free of rock smaller than 3-inches with a maximum size of 18 inches. The stone was placed in layers of 36 inches in zone one and of 18 inches in zone two and sluiced with water immediately after dumping of each truck load. The rockfill was compacted by vibratory rollers. The embankment slopes are 1.75H to 1V at the upstream side and 1.4H to 1V on the downstream side. The top width of the embankment is 20 feet. The asphaltic concrete membrane varies in thickness from 8 inches at the crest to 10 inches at the base. The asphalt was to be placed in at least 10 foot strips along the slope and sealed with a hot asphalt seal coat. At the toe of the upstream slope, a cutoff trench was excavated and a grout curtain was placed in this trench. This concrete filled trench was tied together with the asphalt concrete membrane.

2. Appurtenant Structures

a. <u>Intake Tower</u>. The tower is located about 200 feet upstream from the dam and accessible by way of a footbridge. The height of the tower is 135 feet above stream bottom and is founded on rock. The footing is fastened to the rock with rock anchor bolts. The tower is circular in shape with an inside diameter of 9 feet and a 2 foot thick reinforced concrete wall. The operating platform is at elevation 1175.75.

An emergency drawdown sluice gate $(36" \times 48")$ is at elevation 1055.0 (invert). There are four intakes, each controlled by a 30 inch round sluice gate at the outside of the tower and a 30 inch gate valve on the inside of the tower.

b. Outlet Works. The intake tower is connected to the outlet control building located at the downstream toe of the dam by a pressure conduit. The first 70 feet of this conduit is 42 inches in diameter. At this point, an increaser was installed to transition to a 60 inch pipe. This 60 inch pipe was used as a bypass during construction. The conduit is placed in a trench and encased in concrete. Flow in the conduit is controlled at the downstream end in the outlet control building. The end of the conduit has a 60 inch by 24 inch reducer and a 24 inch Howell-Bunger valve. The water supply takeoff is a 24 inch pipe located just above the reducer. The control building is reinforced concrete and is approximately 20 feet by 23 feet by 17 feet deep.

c. <u>Spillway</u>. The spillway is located in the left abutment of the dam and has a 135 foot long ogee shaped overflow section, with a side channel spillway chute. The available discharge head is 14 feet (Elevation 1061 to Elevation 1175.0) and the width of the channel is 50 feet. The chute narrows down to 30 feet just above a deflector bucket. All walls and slabs are of reinforced concrete construction and

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the chute slab is anchored to the rock strata with rockbolts. A drainage system is installed beneath the slab and clean backfill is placed behind the walls.

c. Design Data

1. Hydrology and Hydraulics

PennDER's Permit Application Report states that a discharge of 13,700 cfs would have a discharge depth of 9 feet, leaving a freeboard of 5 feet. The maximum probable storm is indicated as having a peak inflow of 33,800 cfs and it is stated that the spillway is sufficient for this discharge. A complete hydrologic and hydraulic analysis report by the design engineer is available in the files.

2. Embankment

The embankment design was based on a geological report. Results of test borings were not available. The design report includes computations for mass sliding, arc sliding and for the thickness of zone two for bridging of settlements.

3. Appurtenant Structures

A full set of design calculations for all appurtenant structures is in the file. No summary of design criteria was found, but all computations for overturning, foundation pressure, uplift, sudden drawdown and high groundwater were included.

2.2 CONSTRUCTION

The available construction data consists of progress reports and photographs. In April, 1971, Harza Engineering Company inspected the site and submitted an inspection report with recommendations for the cutoff trench and grouting. Mr. A. N. Vanderlip was the consulting engineer at the site assisting with the installation of the asphaltic concrete.

2.3 OPERATION

The purpose of the dam is to supply domestic drinking water. Formal records of operation are not available for review.

2.4 EVALUATION

a. Availability

A complete set of design drawings is available in the file of PennDER. Although the files indicate that as-built drawings were submitted

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to PennDER, these were not obtained. The files do, however, include copies of a geologic report, embankment calculations, hydrology and hydraulic calculations and structural computations for the appurtenant structures. The contract specifications for this project are also in the files.

b. Adequacy

1. Hydrology and Hydraulics

A considerable amount of hydrologic and hydraulic information is available. This data was submitted by the consulting engineer to PennDER and describes the design criteria used for this dam.

2. Embankment

The design calculations for the embankment were reviewed and the design is considered adequate and in accordance with acceptable engineering practice for this type of construction.

3. Appurtenant Structures

A review of the design drawings indicate that all appurtenant structures are properly designed and detailed. The footings of retaining walls appear to be adequate and the drainage system under the spillway slab should prevent uplift.

c. Operating Records

While no formal operating records were available for review, it was reported that no major problems have occurred since this facility became operational in 1972.

d. Post Construction Changes

There have been no reported modifications to the original dam design, except that grouting was not staged due to the small take of grout.

e. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The general appearance of the dam is excellent. The appearance of the facilities indicate that the dam was constructed by a good contractor under good supervision and that all appurtenant structures are well maintained. The visual checklist is in Appendix A.

b. Embankment

The dam is in good condition. The vertical camber on the crest of the dam is still noticeable. Records indicate that maximum settlement after construction has been approximately .03 feet. Maintenance has not been required on the downstream rock slopes and the visible part of the upstream membrane is in good condition. It was reported that the membrane becomes soft in hot weather. No apparent seepage was detected.

c. Appurtenant Structures

All appurtenant structures were in good condition. Besides some shrinkage cracking, a crack was noticed near the entrance of the spillway (Appendix D, Plate V). The manager stated that this crack will be pressure grouted during the summer (1978), when the pool level falls 3 or 4 feet below spillway crest. The cause of the crack could not be determined. Water over the spillway has not been high enough to cause any stresses in this wall. It could have been a cold joint with poor workmanship after the pour started.

All the gates on the intake tower are operated on a regular basis, except the 42×30 inch gate at the bottom, which has never been opened, Opening of the 42×30 inch gate would cause turbidity in the water supply.

d. Reservoir Area

Sedimentation was not reported in the reservoir. The reservoir slopes are a mixture of well protected banks and some open cut areas. During heavy precipitation the upstream end of the lake becomes slightly turbid. The rock for this dam was excavated in an area adjacent to the spillway (Plate IV, Appendix D). No exceptional erosion, sloughing or sliding were noticed.

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e. Downstream Channel

The downstream channel below the deflector bucket is well defined. The slopes are stable and protected with riprap. The creek flows past the treatment plant and under Route 322 through a large culvert. The Borough of Milroy is located approximately 2.3 miles downstream from the dam. Many houses and trailers in this community are located close to the stream. A failure of the dam would cause considerable loss of life and property and therefore, this dam is considered to be in the "High" Hazard Classification.

3.2 EVALUATION

The observed condition of the facility was excellent. No major points of concern were noticed.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The impoundment dam was constructed to serve as a storage reservoir for drinking water for the Borough of Lewistown. Water is taken from the lake as demands require through the 24 inch pipe in the control building.

4.2 MAINTENANCE OF DAM

The treatment plant has around-the-clock attendance. Mr. Bob Sellers, plant operator for the Borough, stated that a casual inspection of the dam is made daily.

4.3 MAINTENANCE OF OPERATING FACILITIES

The treatment plant operator stated that the gates and values on the intake tower are operated regularly (2 to 3 times a year), except the low drawdown gate, which has not been operated since 1972. Ice damage to the stem of the highest intake prevents operation of this gate until repairs are made.

4.4 WARNING SYSTEM

There is no formal warning system in effect. However, there is around-the-clock attendance in the treatment plant. There were no staff gages on the spillway or intake tower.

4.5 EVALUATION

The dam is well maintained, except that the drawdown gate has not been used. There is no formal warning system in effect.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data

The hydrologic and hydraulic analysis available from the PennDER files for Laurel Creek Dam was complete. Included were design flood hydrographs, flood routing, side channel spillway design calculations, spillway rating curve, spillway chute and bucket calculations, outlet tunnel rating and reservoir capacity curves.

The design inflow of 17,900 cfs is based on a Jarvis-Meyer coefficient of 5,000 and a unit hydrograph developed from the records for the USGS gaging station on Standing Stone Creek. Routing of this flood through the proposed reservoir gave a maximum outflow of 13,700 cfs with a freeboard of 5.0 feet.

In a review dated September 13, 1967, the Pennsylvania Department of Forests and Waters expressed the belief that the above design assumptions were on the low side. On the other hand, the thought was expressed that the 5.0 foot freeboard might raise the spillway capacity to 33,800 cfs which was given as the maximum probable flood.

b. Experience Data

Examination of records for the two nearby USGS gaging stations indicates that inflow for the June, 1972 flood was probably about 1,000 cfs (See Appendix B).

c. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtoppped.

d. Overtopping Potential

Comparison of the estimated PMF peak inflow of 31,000 cfs, with the estimated ultimate spillway capacity of 25,000 cfs, indicates that the potential for overtopping of Laurel Creek Dam exists. An estimate of the storage effect of the reservoir shows that Laurel Creek Dam Reservoir does not have the storage available that would be necessary to pass the PMF without overtopping (See Appendix B).

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e. Spillway Adequacy

Laurel Creek Dam Reservoir can store 4,080 acre-feet of water and the dam has a total height of 135 feet. These dimensions indicate a size classification of "Large". Failure of this dam could cause extensive loss of life and property. The indicated hazard classification is "High" (Section 3.1.e). These two classifications indicate a recommended spillway design flood (SDF) equal to the Probable Maximum Flood (PMF).

The spillway capacity of the dam is sufficient to pass the design discharge as calculated by the design engineer, but only 81 percent of the PMF peak inflow as determined by using the Corps of Engineers guidelines. Therefore, the spillway is considered to be inadequate, but not seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Embankment

There were no visual indications of undue embankment stresses or sloughage. The embankment was in excellent shape and the upstream membrane appeared to be in good condition. No unusual amount of seepage was detected.

2. Appurtenant Structures

Visual observations indicate no present stability or stress problems in any of the appurtenant structures.

b. Design and Construction Data

1. Embankment

The inspection report prepared by Harza Engineering Company describes the foundation of the dam after most of the stripping and excavation to "solid" rock had occurred. Most of the foundation is a severely folded quartzite, with the folds normal to the creek bed, which is favorable for stability and water tightness. This report describes the recommended grouting procedure. Mr. A. N. Vanderlip, who had considerable experience with this type of membrane, acted as a consulting engineer during the installation of the asphaltic concrete. The design computations indicate that acceptable safety factors were used. The minimal amount of settlement that has occurred, indicates that the method of sluicing and embankment rolling was excellent.

2. Appurtenant Structures

A review of the design drawings indicates a properly engineered intake tower and control building. Reinforcing appears adequate and a review of the foundation of the tower indicates a design against uplift. The detailing of the spillway weir and chute applied good engineering techniques.

c. Operating Records

While no formal operating records were available, Mr. Bob Sellers, operator for the Borough, stated that no major problems have occurred since the dam became operational in 1972.

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d. Post Construction Changes

There have been no reported modifications to the original dam design.

e. Seismic Stability

This dam is located in Seismic Zone No.l and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, studies, etc., were made to confirm this conclusion.

SECTION 7 - ASSESSMENT & REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The visual inspection, the review of design drawings and the operational history indicates that the dam is in excellent condition and that it has been designed and constructed in accordance with acceptable engineering practice.

The only concern is the spillway capacity and the possible damage which could occur downstream. The dam is considered to be a high hazard dam with a large size classification. The recommended Spillway Design Flood (SDF) is the PMF but the spillway capacity is actually 81 percent of the PMF peak inflow as obtained from the Corps of Engineers guidelines. The spillway capacity is, however, capable of passing the PMF based on the design engineer's calculations.

b. Adequacy of Information

The available hydraulic information is considered to be adequate to make a detailed assessment of the project.

c. Urgency

It is considered that the recommended suggestions in this section should be implemented as soon as practical

d. Necessity for Additional Studies

Additional studies are not required at this time. However, attention should be given to the recommendations presented below.

7.2 RECOMMENDATIONS

a. Facilities

In order to assure continued adequate operation of this dam, the following recommendations are made:

- 1. The owner should install an outside staff gage on the control tower.
- The owner should repair the crack in the wall near the spillway.

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b. Operation and Maintenance Procedure

It is considered important that a formal surveillance and downstream warning system be developed to be used during periods of high precipitation.

APPENDIX A

VISUAL INSPECTION

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CHECK LIST - DAM INSPECTION PROGRAM PHASE I - VISUAL INSPECTION REPORT

NAD NO. 578

PA. ID # 44-62 NAME OF DAM Laurel Creek Dam HAZARD CATEGORY High TYPE OF DAM: Rockfill with Asphaltic Concrete Membrane TOWNSHIP Mifflin COUNTY, PENNSYLVANIA LOCATION: Armagh INSPECTION DATE 5/12/78 WEATHER Cloudy - Cool TEMPERATURE 60's INSPECTORS: H. Jongsma Bob Sellers - Borough Stewart Giansell - DER R. Houseal R. Steacy NORMAL POOL ELEVATION: 1161.0 AT TIME OF INSPECTION: BREAST ELEVATION: 1175.0 POOL ELEVATION: 1161.3± (Vert.Curve to 1179.50) SPILLWAY ELEVATION: 1161.0 TAILWATER ELEVATION: MAXIMUM RECORDED POOL ELEVATION: Spillway + 1' ± (Visual Observation)

GENERAL COMMENTS:

Project - excellent appearance - very well maintained.

Access to all facilities excellent. Paved roads at outlet, top of embankment and to control tower.

Operation - 24 hours attendance at plant.

DAM NO. NAD 578

VISUAL INSPECTION

| FMR | ANKMENT | OBSERVATIONS | REMARKS & |
|-----|-----------------------|----------------------------|----------------------------|
| Α. | SURFACE CRACKS | None evident | |
| | | Upstream slope paved | |
| | | bituminous concrete | concrete |
| | | Top paved foad bituminous | concrete |
| Β. | UNUSUAL MOVEMENT | | |
| | BETUND TUE | None evident | |
| | | | |
| | | | |
| C. | SLOUGHING OR EROSION | No sloughing ovident | |
| | OF EMBANKMENT OR | downstream | |
| | ABUTMENT SLOPES | Upstream paved - no | |
| | | distress evident | |
| | • | | |
| D. | VERTICAL & HORIZONTAL | | |
| | ALIGNMENT OF CREST | Vertical camber - as | |
| | | designed. | |
| | | | |
| Ē. | RIPRAP FAILURES | Downstream dumped rock | |
| | | No failures evident | |
| | | | |
| | | | |
| | | | |
| F. | JUNCTION EMBANKMENT | Embankment abuts exposed | |
| | SPILLWAY | rock face vertical beddi | hg - |
| | | Inactured very blocky sa | lascone |
| | | | |
| G. | SEEPAGE | From rock face left side | |
| | | looking upstream - but | |
| | | downstream from contact | vith |
| | | embankment slope line. | dway (ILS 322) |
| Н. | DRAINS | Above this area shows see | page from rock slope above |
| | | roadway on the other side | of U.S.322. |
| | | Appears thus to be a patu | al drainage phononome |
| J. | GAGES & RECORDER | lippears thus to be a natu | ar urainage phenonoma |
| | | None | |
| | | | |
| Κ. | COVER (GROWTH) | Downstream rock, cobbles, | boulders, some small |
| | | patches of grass. Grass | on flat at toe. |
| | | | |
| | | 1 | |

DAM NO. NAD 578

VISUAL INSPECTION

| OUTLET WORKS | OBSERVATIONS | REMARKS & |
|---------------------|-------------------------------------|-----------------|
| | Concrete tower | RECOMMENDATIONS |
| A. INTAKE STRUCTURE | Good condition | |
| | | |
| | | |
| | | |
| B. OUTLET STRUCTURE | Good | |
| | | |
| | | |
| | | |
| C. OUTLET CHANNEL | | |
| | Bridge across stilling ba Riprap | sin |
| | | |
| | | |
| D. GATES | | |
| | 4 - 30'' | not used) |
| | | |
| | | |
| | | |
| E. EMERGENCY GATE | | |
| | Bottom large gate | |
| | | |
| | | |
| F. OPERATION & | Ice damage to air lines w | ith |
| CONTROL | the movement of ice towa | rd |
| | Spillway | |
| | | |
| G BRIDGE (ACCESS) | | |
| a. DRIDGE (ACCESS) | Concrete - fenced | |
| | Good | |
| | | |

S. Mary

DAM NO. NAD _____578

VISUAL INSPECTION

| SPILLWAY | | OBSERVATIONS | REMARKS & RECOMMENDATIONS |
|-----------|--|---|--|
| Α. | APPROACH CHANNEL | Clear - direct from impoundment | |
| Β. | WEIR: Crest Condition Cracks Deterioration Foundation Abutments | Ogee Section Good In embankment side Nil Good | |
| <u>C.</u> | DISCHARGE CHANNEL Lining Cracks Spilling Basin | Concrete Longitudinal crack on spi spillway crest. Left si No weep holes anywhere Long Chute - good appeara | llway wall about 2 feet± below de of spillway looking D/S. nce |
| D. | BRIDGE & PIERS | Roadway bridge across spi channel walls Good condition | llway |
| E. | GATES & OPERATION EQUIPMENT | No gates in spillway area (see control tower - inle | t control) |
| F. | CONTROL & HISTORY | No staff gage - to identi flow over spillway | Fy depths of |
| | | | |

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DAM NO. NAD 578

C. DISCHARGE CHANNEL

Indications are from representative of owner that when the reservoir gets below spillway level and the crack level repairs are going to be made. (7' to 8' normal drop below spillway during summer) has been as much as 14' below.

DAM NO. NAD 578

VISUAL INSPECTION

| MISCELLANEOUS | OBSERVATIONS | REMARKS & RECOMMENDATIONS |
|---------------------------------|--|---|
| INSTRUMENTATION | | |
| Monumentation | None | |
| Observation Wells | None | |
| Weirs | None | |
| Piezometers | None | |
| Other | Recorder on minimum discha | rge pipe |
| RESERVOIR Slopes | Light timber along edges o Heavier above slopes expos Seeded with light cover - Runoff erosion. | f reservoir. ed from excavation some soil exposed |
| Sedimentation | None to date | |
| DOWNSTREAM CHANNEL Condition | Good | |
| Slopes | Sandstone cobbles - boulde | rs |
| Approximate Population | 6,000± | |
| No. Homes | Town of Milroy | |

2 2 Maynes a spectra .

APPENDIX B

HYDROLOGY/HYDRAULICS

LAV estigation PROJECT Laurel Greek Dam ID#578 SUBJECT_ CHECKED BY JJRJ 6-7-78 RES __ DATE_6-1-78 COMPUTED BY_ Maximum Known flood at damsite No records are kept of Pool stage discharge, Dam operator vecalls that dam was under construction of the time of the June 22, 1972 flood. The diversion works backed up a pool that came within 12 feet of the spillway crest. Discharge is estimated below on the basis of nearby gaging stations. Dischargenz Prain age (cf5) Gage Area (Sq.Mil Oakland Mills 468 6,52 Snow Shop 12,2 1170 $\begin{pmatrix} 12.8 \\ \overline{6.52} \end{pmatrix} \times {}^{468} = 803 \quad \begin{pmatrix} 12.8 \\ \overline{12.2} \end{pmatrix} \times {}^{170} = 1216'$ 803+1216 = 1,010 Use 1,000 cfs Warm-water outlet Normal pool elar. & Highest Intake (30"Dia, Value) 1161.0 - 1145,0' h = 16.0 CTTCHELLE = 0,59×4,91× (64,3×16) Kinge Handbook, 6th Ed. Q= Calzqu $a = TT (1,25)^2 = 4,91$ = 93 cfs The card man and the second Outlet tunnel at low pool clev. 1060,0 Check computation 979ph 93 cfs 3- 5t ky 4- 5t gate, & at 1057.0 Q=Colzq4. C=0.60 4 = 3.0 = 0.6x 12x 64:3x 3 a = 3x4 = 12= 100 cfs Use 93 cfs Outlet tunnel at normal pool clar. 1161. From designer's graph 200 cfs Rough check - Assume control is 24 -inch Howell-Bunger Value at point of discharge h=1161-1032.5=128.5 C=0.6 Q= CAJZ9h = 0.6x 3.14 64.3x128,5 = 171 cfs, Use 200 efs.

Investigation Don PROJECT. SHEET NO. RES DATE 6-1-78 ID # SUBJECT_ RES JJPJ COMPUTED BY____ CHECKED BY_ 6-7-78 Spillway capacity at tep of dam - cler, 1175.0 1175.0. Bridge 1180 1172.47 Top of damy 1175.0 1140.9. Design head 1170 1170.0 58' Section of chute Spillway Crest 1161. at bridge about 60 feet downstream 1160 10,000 20,000 30,000 Spillway Discharger in cubic feet per second. Stor end of over-1 flow section spillway capacity for pool elevation at top of dam (1175.0) has been estimated at 25,000 of by extending the curve calculated by the designer. The extended curve has been given a reversal of curvature breakse due to the limited capacity of the side channel and the possible effect of the bridge over the side channel. Using the straight weir formala with a code of 4.1 the Q would be 29,000 cfs Use 25,000 cfs THIS PAGE IS BEST QUALITY FRACTICABLE FROM COPY FURNISHED TO DOC

Lourel Creek Dom PROJEC ID # 578 SUBJECT_ ____ DATE 6-2-78 RES CHECKED BY JPJY 6-7-78 COMPUTED BY_ Reservoir Area and Capacit 1200 06010 1150 Elevotion in feet mean sea level đ 1000 100 50 0 Area in acres 2000 4000 6000 0 Volume in acre feet Av. Area Total 00 Area Vol. Elev. (acres) (ocres) (acre-ft) (++) (acte- ft) 1040 0 0 1,5 30. 1060 3. 30 6.5. 130. 10 1080 160. 15,5. 310. 1100 21: 470. 27,01 540. 33 1120 1010. 41,0: 820. 49 1140 1830 1150. 57.5 1160 66 . 2980 66.6 67. 67.2 3047 1161 71.1. 640 . 75. 3687 1170 388 . 77.5 80. 1175 4075 THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

ES DATE 6-6-78 CHECKED BW JPJr 6-7-78 SUBJECT_ COMPUTED BY_RES Overtopping Potentia Prinage Area = 12.8 sq. min PNIF = 2,200 CSs per Sq. MI Time = 30 hours. PMIF = 33,800 0531. Corps of Engineers, Time = 16 hours . From PMF hydrograph prepared by Pa. Dept. of Folosty and Haters in 1967. Use PMF = 31,000 cfs T = 23 hours $\frac{Max, spillnay Q}{Paah inflow} = \frac{25,000}{31,000} = 0.81$ Req. Rest. Storage = 0.19. Vol. of Inflow Hyd, = 0.19 Vol of Inflow = 31,000×23 14,900 cfs-days 26" Runoff= 26 × 12,8× 640= 17,700 acre ft (use) Reg- Resd. Storage = 0,19 × 17,700 = 3,400 acla-feet. From relations Surnisher by Baltimole Dist, Corps of Engineers. Available storage = 4080-3050 = 1,030 ac.ft. Since sufficient storage is not quailable Would be overtapped by a PASF. Since the spillway can pors 25,000 = 81. To of the PMF it is not considered to be seriously inadequate. THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

APPENDIX C

GEOLOGIC REPORT

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GEOLOGIC REPORT

Bedrock - Dam

Formation Names: Tuscarora Formation, Juniata Formation, Ref.(1).

Lithology: The Tuscarora Formation consists of mostly light gray, quartz sandstone, cemented with quartz, with some interbeds of darker gray less pure sandstone having a higher clay content. The upper most beds of the Juniata Formation, which underlie the downstream toe of the dam only, are grayish red sandstone with silty shale interbeds. The contact between the two formations is gradational at the dam site, that is, there is interbedding of the lithologies characteristic of each unit over a distance of more than 100 feet, beginning 50 feet south of the crest of the dam, Ref. (2).

Bedrock - Reservoir

Formation Names: Juniata Formation, Tuscarora Formation, Rose Hill Formation, Ref. (1).

Lithology: Juniata and Tuscarora Formations, see above. The Coxes Valley portion of the reservoir is underlain by the Rose Hill Formation, which is dary gray silty shale, weathering to light gray and light olive gray, with some interbedded fine grained gray siltstone, Ref.(2).

Overburden

The valley side were covered with talus derived from the Tuscarora Formation. The original geologic report, Ref. (4), estimated that fresh bedrock would be below 25 feet.

Structure

The Laurel Creek Dam is located on the north limb of the Kishacoquillas anticlinorium. Here the beds have been thrown into an unusually tight series of folds, complicated by some faulting. At this dam the beds strike N60°E. The dip is vertical to steep SE, overturned. The overall steep dip is interrupted locally by small folds (a few tens of feet across), and minor faulting. The faults are parallel to, or make slight angles to, the strike of the bedding. No cross faulting has been reported here. Ref. (1) and (2). The dam is located in a gap through Spruce Mountain. This is one of several similar gaps seen on the topographic map and air photos which all have N30° to 35°W orientation. This is probably a minor fracture system along which stream erosion was possible in otherwise very resistant rocks.

Aquifer Characteristics

The Tuscarora and Juniata Formations are composed of essentially impermeable rocks. Ground water movement is almost entirely on bedding planes and fractures. The rocks are insoluble and ground water movement causes little or no change in the rocks.

Discussion

Young, Ref. (3) notes that "the fact that the bedrock bedding planes are nearly vertical and the strike of the rock is nearly parallel to the axis of the dam makes each layer of bedrock (with the exception of some fractures, of course) a potential 'watertight curtain'". He also states that the engineers were surprised how little grout was required. This suggests that the fractures paralleling the original stream course are tight, and that any leakage on them would be minor. As noted above, there is little possibility that ground water leakage would alter or weaken the bedrock.

Sources of Information

- 1). Manuscript Geologic Map, Open File, Pa. Geological Survey, Harrisburg, Pa.
- R. T. Faill, R. B. Wells and others, "Structure and Silurian Stratigraphy of the Valley and Ridge Province in Central Pennsylvania". Guidebook, 38th Annual Field Conference of Pennsylvania Geologists, 1973.
- 3). K. A. Young, "Lewistown Laurel Creek Dam Geologic Features related to construction".
- 4). Lattman, Laurence, File copy of Geologic Report on proposed dam site, Laurel Creek.



APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS









Upstream Slope Right Abutment

Upstream Left Abutment

Control Tower

PLATE IV













2

5.00

PCT 4 4.70.7

GENERAL NOTES

- CONCRETE SHALL BE GLADS A UNLESS CHARMUSE NOTED ON PLANS. ENFORCEMENT BARS SHALL BE OF ATTENEDATE GULLE, ATTUR A DUED OF BAR DESAUED FOR ALL DUE AND DETAILED IN ALL SEDAUE WITH ALL COLE, UNANUW LAR BURLE BE DO INVERTERS AND MINING WORKS SHALL BE 12, ENFORCE ALL ALLA THIS PLAN DENOTED TOP OF WALL.
- DROPORE BEDSE ACENSS THE TEANSISTON UNITION AND THE SURE BEDSE AROUSE THE DEDICTOR RULLET AROUND ON PLAN THE BLANS AND DETHING SE RELETING NEROEL
- S DEPARTOR & CHARGE AT ALL EXPOSED CONNELL WILL AT ALL VERTICAL JOINTS JULESS COMPENNESS DERCTED BY THE EXCHARGE TORCAL SECTION OF SPILLWAY CHUTE AND IMPICAL COTALS OF VERTICAL WALL JOINTS.
- MANDE PON 4 STONE AND PON "28 STONE SURFACE ON BA BENCH AROUND PERSON SECTION AND TRANSISTION SECTION SECTION AND TRANSISTION
- DECTION SEE AND DE ALE PLANS AND DETAUS.
- S PROVIDE RUBBER WATERSTOPS IN DEFLECTOR BUCKET AT TRANSVERSE CONST. JOINT STA GERASS AND WING WALLS SET APPROPRIATE DLAYS AND DEFLAS
- PROVIDE AN EFFECTIVELY CONTINUES INDEXTRAIN SUBTLY LINES STEPSING SECTION AND TRANSITION SECTION AND SPELWAY CHUTE-SE APPROVE ATE RANS AND DETAIL
- ALL SPELWAY UNTERCEANS SHALL PE & BITCH STUDIOTH TELEDERTH CLAY FITE ACTOLOGIES TO ASTM SPECIFICATION C-211-UIT (CLAW IL DIFF) AS AMMENDED.
- I PROVIDE & WROLGHT ROW DIDE (STANDARD WALL) DRAWS AND WETH HOLES W DEFICION BULKET SEL APPRING ATE PLANS AND DETAILS.
- A TAL STAL ONTEXTON JOINTS WALLS FOOTERS DAKE AND CHANNEL) POUNDE 2 PREMOUDED MASTIC JOINT WALKING OVER ENTER JOINT UNLESS OTHERWISE NOTED ON THE PLANS SEE APPROPRIATE DETAILS.
- S PROVIDE RUSTICATION AT ALL TRANSVIRGE JONTS IN CONCRETE CHANNEL-
- ALL FORMS AND FORMADER SHALL BE NUMEETED ALL APPRIATE BY THE ENGINEE PRICE TO PLAIENELT OF CONCRETE, THIS PHALE NOT "RELEVE THE CONTRACTOR OF HIS REPOSIBLETY TO PROVIDE ADEQUATE AND SAFE COMPORE.
- THAT WILL PRODUCE A CONCRETE STRUCTURE & WITH FUISHED EXPOSED DUSTACLES OF TRUE AUGUNEUT AND BRADE STRANSAT OR CURREL AS DESIGNATED ON THE PLANE PROFILES. MECTIONS AND DESIGNAS
 - DE WITH EXEMPLES SUBCRACES EXEE OF ROUGH PROTEUSIONS OF OTHER OFFICE
- NT TENRES AND ALL ELSE NECESSARY TO POPERLY PLACED AND SHALL NOT BE DE DE MOVED FROM PLACE TO PLACE OF VERTICALLY

- 1.4 Mar COUDATE - A.-

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SDILLWAY



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THIS PAGE IS BEST QUALITY PRACTICABLE BENCH FROM COPY FURNISHED TO DDC 3/4 CHAMFLR SLOPE ""PER FI. UNILESS CTITER WISE NOTED ON THE PLANE 4 4 4 1. 12 BACKFILL SHALL CONCIDE OF CLEAN IINII MIL QUARTZITE CTONE-MAX. SIZE 18", . 2 A MIN SILE S'. BACKFILL SHALL BE а _ А 2 ACED IN MAX LIFTS OF 2 FT. WITH FREE 4 THE CUSHION PLACED IN LETTE PRIM d'r TO PLACEMENT OF ROCK BACKFILL. CONTRACTOR SHIAL EXCRETE WASHED D.H. * +) EXTREME CARE TO PROTECT 3'01. CONCRETE STRUCTURE. 1. in PAINT BACKFILLED FACE OF WALL -(BELOW FINISHED GRADE) WITH ONE COAT OF BITUMASTIC PAINT- SEE GENERAL NOTE " 19 FLAN OF SPILLWAY. THE PAINT BACKFILLED FACE OF WALL CONST. JOINTS WITH TWO COATS OF BITUMASTIC PAINT - SEE GENERAL 15 NOTE \$20 PLAN OF SPILLWAY 2:0 3-6 3'C1 *44 68 40012 #5988 NOTE : PROVIDE MECHANICAL ANCHOR FOR VERTICAL-1-\$5008"-SEE NOTE TOP OF WALL THIS SHEET. '





CTICARTE THIS PAGE IS BEST QUALITY PRACTICABLE 3/4 CHAMFER TRON COPY FURNISHED TO DDC 19 BLOPE -40 2 SEE CROSS SECTIONS FOR BACKFILL SHALL CONSIST OF REQUIRED SLOPES CLEAN QUARTZITE STONE-MAX. 12 MIN. SIZE 18" MIN SIZE G' BACKFILL SHALL BE PLACED IN MAX LIFTE OF 2. FT. WITH THE CUSHION PLACED IN UFTS PRIDE TO FLACEMENT OF ROCK BACKFUL. CONTRACTOR SHALL EXERCISE EXTREME DAM EMBANKMENT CARE TO PROTECT CONCRETE SIDE STRUCTURE. PAINT BACKFILLED FACE OF WALLS (BELOW FINISHED 5408 GRADE WITH ONE COAT OF BITUMASTIC PAINT - SEE GENERAL NOTE "19 PLAN OF SPILLWAY. PAINT BACKFILLED FACE OF WALL CONST. JOINTS WITH TWO COATS OF BITUMASTIC PAINT - SEE GENERAL NOTE "20 PLAN OF SPILLWAY. CUT Z' TRENCH THROUGH BEDROCK 3.6 TO ROCKFILL PORTION OF DAM AT EACH TRANSVERSE JOINT BACKFILL WITH QUARTZITE STOME. (NO FINES). C44065 HAND PLACE QUARTZITE STONE TO FROTEST END -* 50es OF G'UNDER DRAIN AS DIRECTED BY THE ENGINEER. 5408" SLOPE 1/4 PER. FT. TO ROCKFILL PORTION OF PAM. 578 PLATE IX NOTE: PROVIDE MECHANICAL ANCHOR FOR VERTICAL "5008", VERTICAL "5008" SHALL BE FASTENED TO CONTINUOUS LONGITUDINAL *44, CONTINUOUS LONGITUDINAL #4 & SHALL BE FASTENED