INSPECTION OF MECHANICAL FEATURES

Helmand Valley Development Project

AFGHANISTAN

Prepared for Agency for International Development

by

E. E. Gonzales

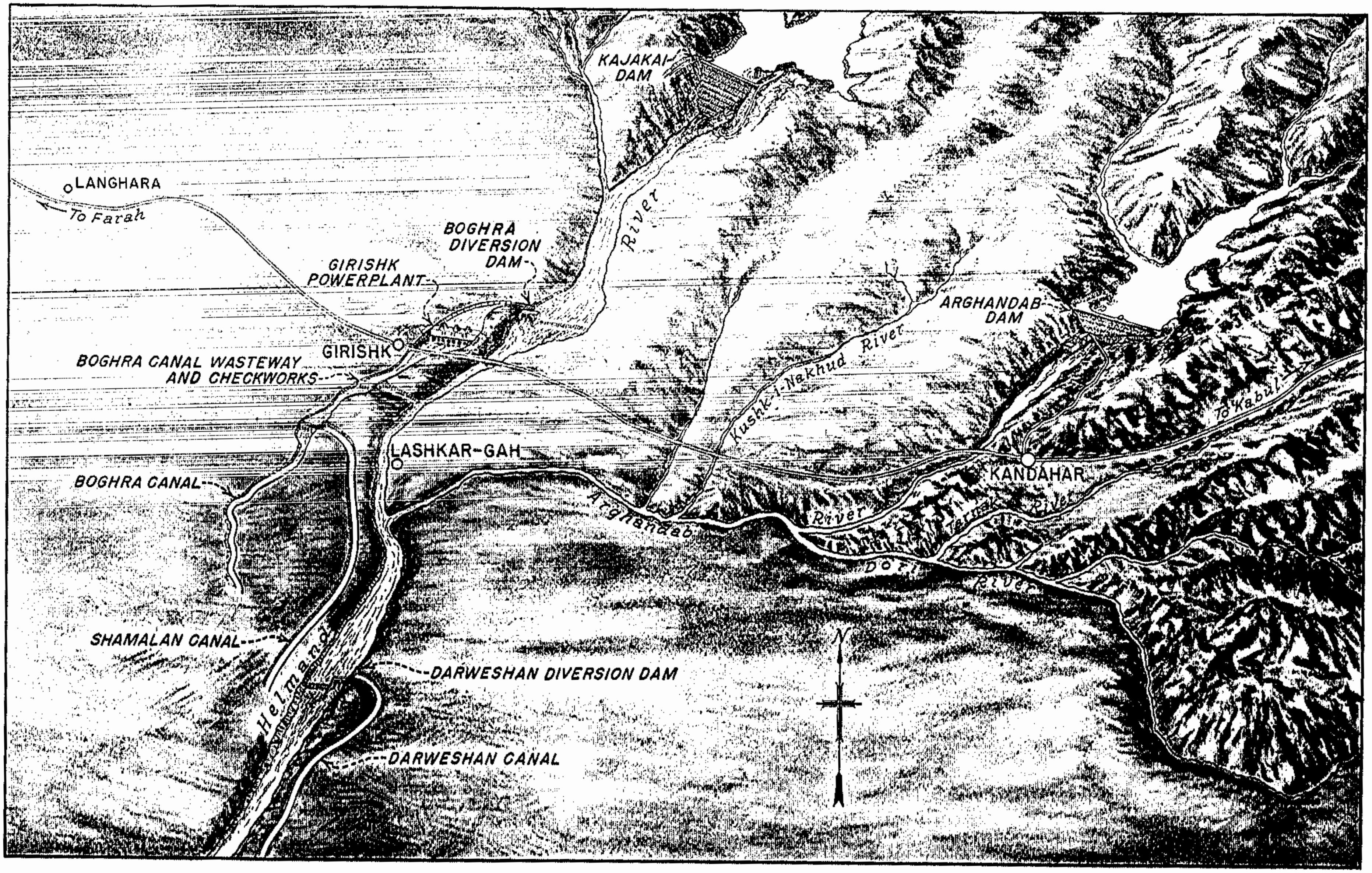
Mechanical Engineer

Office of Chief Engineer

United States Department of the Interior

Bureau of Reclamation, Denver, Colorado

May 1964



PICTORIAL MAP
HELMAND VALLEY PROJECT

C

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WASHINGTON 25, D. C.

IN REPLY REFER TO: 220

MAY 8 - 1964

Mr. William B. Macomber, Jr.
Assistant Administrator, AA/NESA
Agency for International Development
Department of State
Washington, D. C., 20523

Dear Mr. Macomber:

In accordance with Department of State Airgram to AID/W TOAID A-480, dated October 10, 1963, Subject: 306-AC-AE-1 (2) Helmand Valley Irrigation Operations and Maintenance, the Bureau of Reclamation selected E. E. Gonzales, Supervisory Mechanical Engineer, Office of Chief Engineer, Denver, Colorado, to initiate a thorough investigation of the mechanical equipment at Kajakai and Arghandab Dams, Girishk Powerplant, and other appurtenant works on the Project, to advise on correcting malfunctions of hollow-jet valves and to set up a continuing program of future periodic inspections for the Project. Mr. Gonzales departed from the United States January 16, 1964, and returned April 8, 1964.

It is my pleasure to enclose Mr. Gonzales' report on his investigation. It has my concurrence.

Sincerely yours,

Floyd E. Dominy

Commissioner

Enclosure

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INTRODUCTION

General Description

The entire Helmand Valley Development Project was designed by International Engineering Company and built by Morrison-Knudsen Afghanistan, Inc., for the Royal Government of Afghanistan. The project was built under terms of an Export-Import Bank loan and a contract directly between the Helmand Valley Authority and Morrison-Knudsen Afghanistan, Inc. This multimillion dollar project has been in existence approximately 10 years but has never been covered by a formal inspection.

The main features of the project are:

a. Kajakai Dam with a reservoir capacity of 1,495,000 acre-feet.

b. Arghandab Dam with a reservoir capacity of 388,000 acre-feet.

c. A small powerplant located near Girishk with a present nameplate capacity of 3,000 kilovolt-amperes.

d. An irrigation system with approximately 140 miles of main canals.

Authorization and Purpose

This inspection was requested by the Project Manager, Bureau of Reclamation, Helmand Valley Development Project, Lashkar Gah, Afghanistan, by wire of October 10, 1963, signed by Ambassador John M. Steeves. The purpose was to inspect the mechanical equipment on the project and to advise the Helmand Valley Operation and Maintenance Division on inspection procedures and practices.

This report covers a thorough investigation of the major mechanical equipment installed in the dams, powerplant, and canal structures and the establishment of a continuing program of future periodic inspection to assure maximum protection to the investment of the Royal Government of Afghanistan.

This report is based on 2 months of inspecting the many items of mechanical equipment on the entire project and discussing operation problems with personnel of Bureau of Reclamation and Helmand Valley Authority and with operating personnel.

Acknowledgment

I wish to express my appreciation for the help and courtesies extended by officials of the Bureau of Reclamation team in Afghanistan, by the Afghan Officials of the Helmand Valley Authority, and by the operators at the projects.

The findings and recommendations of this report are respectfully submitted.

SECTION I

Inspection Report on

KAJAKAI DAM

Helmand Valley Development Project

Afghanistan

GENERAL INFORMATION

Kajakai Dam is located on the Helmand River approximately 87 miles (140 kilometers) northeast of Lashkar Gah. The dam (Figure 1) is a rockfilled structure with an earth-filled core, and a maximum height of 320 feet (97.5 meters). The crest is at elevation 1050.00 M. An uncontrolled spillway in a rock cut is located one-half kilometer from the right abutment. When gates are installed, the maximum water surface will reach an elevation of 1045.00 M. Morrison-Knudson Afghanistan Inc., constructed the dam for the Royal Afghanistan Government. The irrigation outlet works consists of a 34-foot-diameter (10.4-meter) modified horseshoe-shaped tunnel on the left side of the canyon, an intake gate structure (Figure 2) located one-fourth mile (382 meters) upstream from the axis of the dam, a rotovalve chamber located in the tunnel, approximately 2,000 feet (602 meters) downstream from the intake gate structure, and a hollow-jet control valve house (Figure 3) located at the discharge end of the outlets 450 feet (138 meters) downstream from the rotovalves. Another 34-foot-diameter (10.4-meter) modified horseshoe-shaped tunnel, which was used for diversion during construction is located 18.3 feet (60 meters) to the right of, and parallel to, the outlet works tunnel. This tunnel has been plugged with concrete at the inlet end, and is intended for future power development. Maximum head with uncontrolled spillway is 225 feet (68.5 meters). See Drawing No. 1.

The intake gate structure is a reinforced-concrete framework tower 312 feet (95.1 meters) high with a service deck at elevation 1050.00 M, which is accessible from the bank by a steel walkway bridge. Vertical metal guides are embedded in the structure for one 7.0- by 20.0-foot (2.13- by 6.10-meter) wheel gate and one 12.5- by 34.0-foot (3.8- by 10.4-meter) steel-covered concrete bulkhead gate. Three sliding trashracks cover the entire intake portal. Behind the trashracks are two rectangular openings. One is closed by the wheel gate and the other by the bulkhead gate as shown on Drawing No. 2. An electrically operated, 200-ton capacity, bridge crane, located on top of the intake gate structure, is used to handle both gates and the trashracks. A weight actuated, mechanism, which automatically engages and releases, is connected to the crane hook and is used for lifting both gates. A separate guide beam is provided for each gate to center the lifting mechanism between guides. A 6-inch (15.2-centimeter) air vent for the tunnel is located in each downstream leg of the intake structure. A reservoir water elevation recorder is located on the deck of the intake structure.

The unlined but grouted irrigation outlet tunnel runs through limestone, and is plugged with a keyed concrete plug 75 feet (22 meters) long. A transition is formed from the tunnel to the controlled outlet works by three, 84-inch-diameter (213.4-centimeter), outlet pipes embedded side by side near the bottom of the tunnel plug. Except for expansion joints located immediately upstream from the rotovalves, the outlet pipes are embedded in 18 inches (45.7 centimeters) of concrete from the tunnel plug to the hollow-jet valve house.

Three, 84-inch (213.4-centimeter) rotovalves, one on each outlet pipe, are located near the downstream end of the tunnel-plug, and are used for normal shutoff service under balanced head. The rotovalve bodies are embedded in concrete within 1 inch (2.54 centimeters) of the top of the upper body flange as shown in Figure 4. The rotovalves are hydraulically operated, and have a working pressure of 115 pounds per square inch. Control system for the rotovalves consits of a sump tank, two electrically driven oil pumps rated for 30 gallons per minute at 500 pounds per square inch, and a control panel with pushbuttons and hydraulic selector control valves. The rotovalves were manufactured by the former S. Morgan Smith Company, York, Pennsylvania. (The S. Morgan Smith Company has been taken over by Allis-Chalmers Company, Milwaukee, Wisconsin.)

Each of the three outlet pipes has a hollow-jet valve (Drawing No. 3) on the downstream end for regulating flow. Each valve has a discharge capacity of approximately 2,100 cubic feet per second when operating fully open at 100-foot head. The valves are hydraulically operated and mechanically positioned by an electrically driven, Cutler Hammer, Type TN-3-Y Valve Operating Unit, Bulletin 817, Publication No. 8431. The valve operating unit is located near the roadway, 26.5 feet (8.1 meters), above the centerline of the hollow-jet valve. The operating unit (Figure 5) is protected by a galvanized sheet metal cover. An internal pilot valve, controlled by the positioning mechanism, regulates the

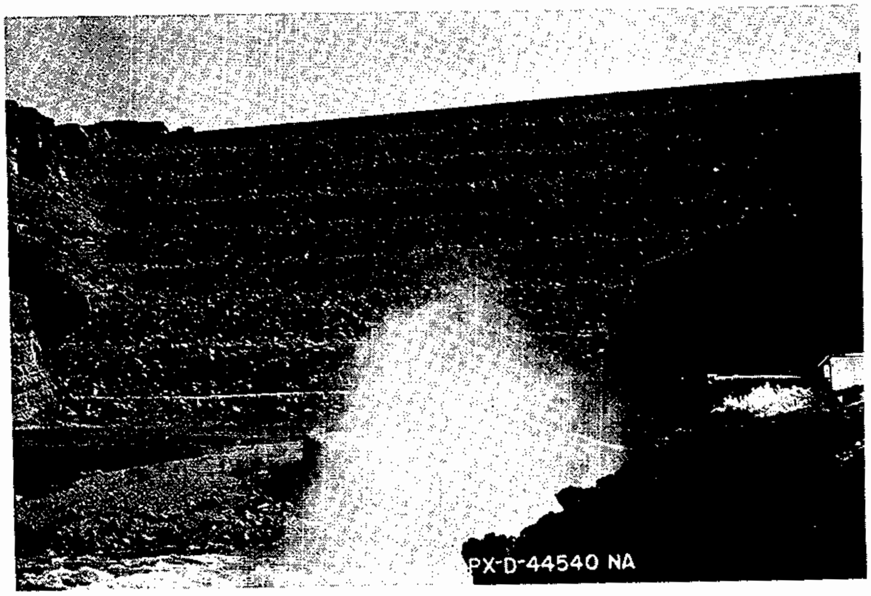


Figure 1.--Kajakai Dam. The downstream face of Kajakai Dam with the three 84-inch hollow-jet valves discharging 90 percent open.

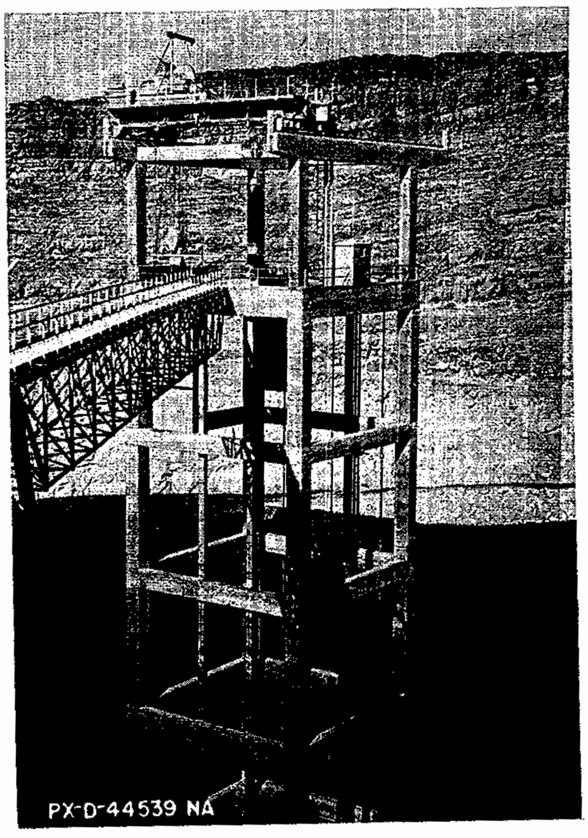
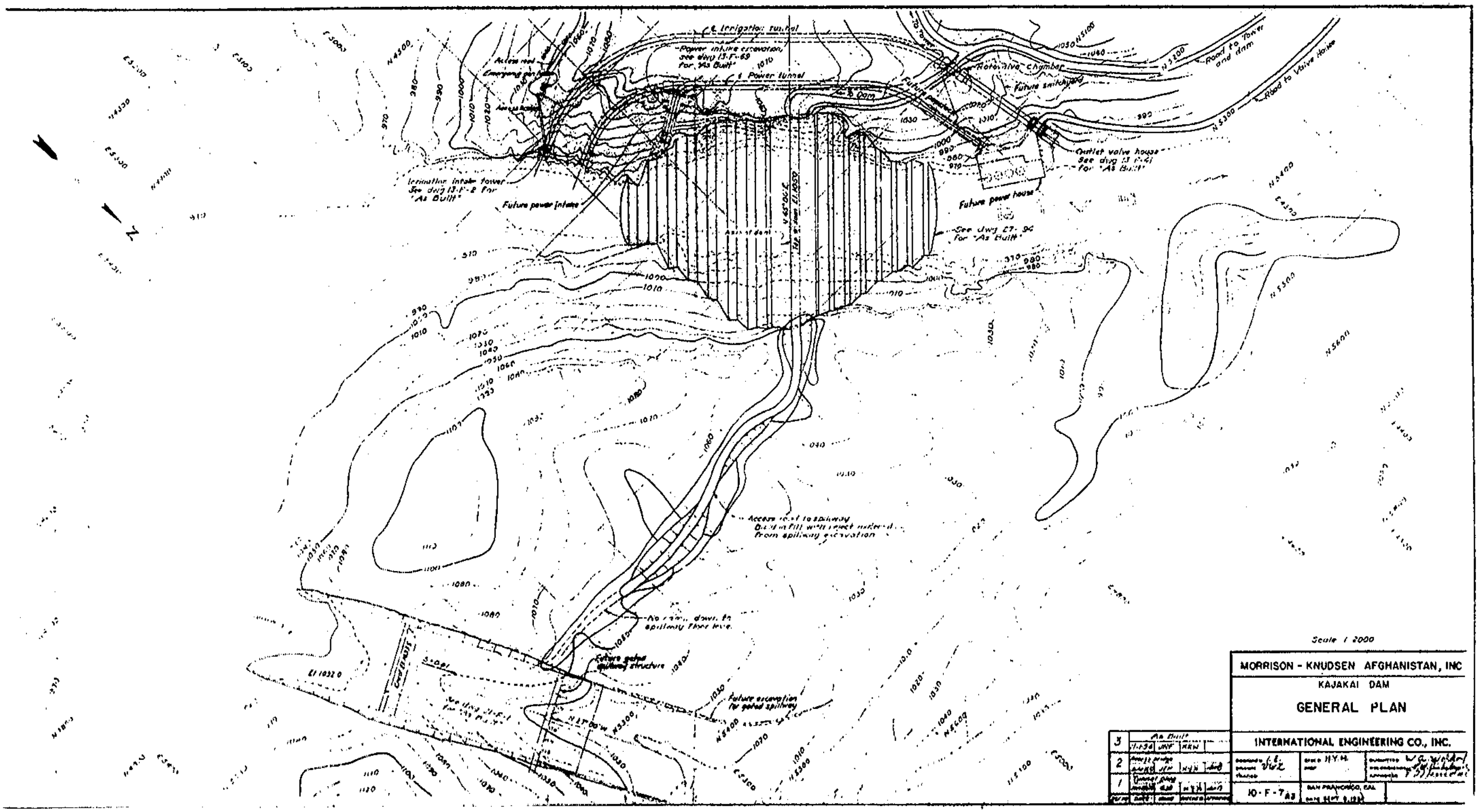


Figure 2.--Kajakai Dam. Open frame intake structure showing the walkway bridge, hoist, and intake gates in the storage position.



2-A

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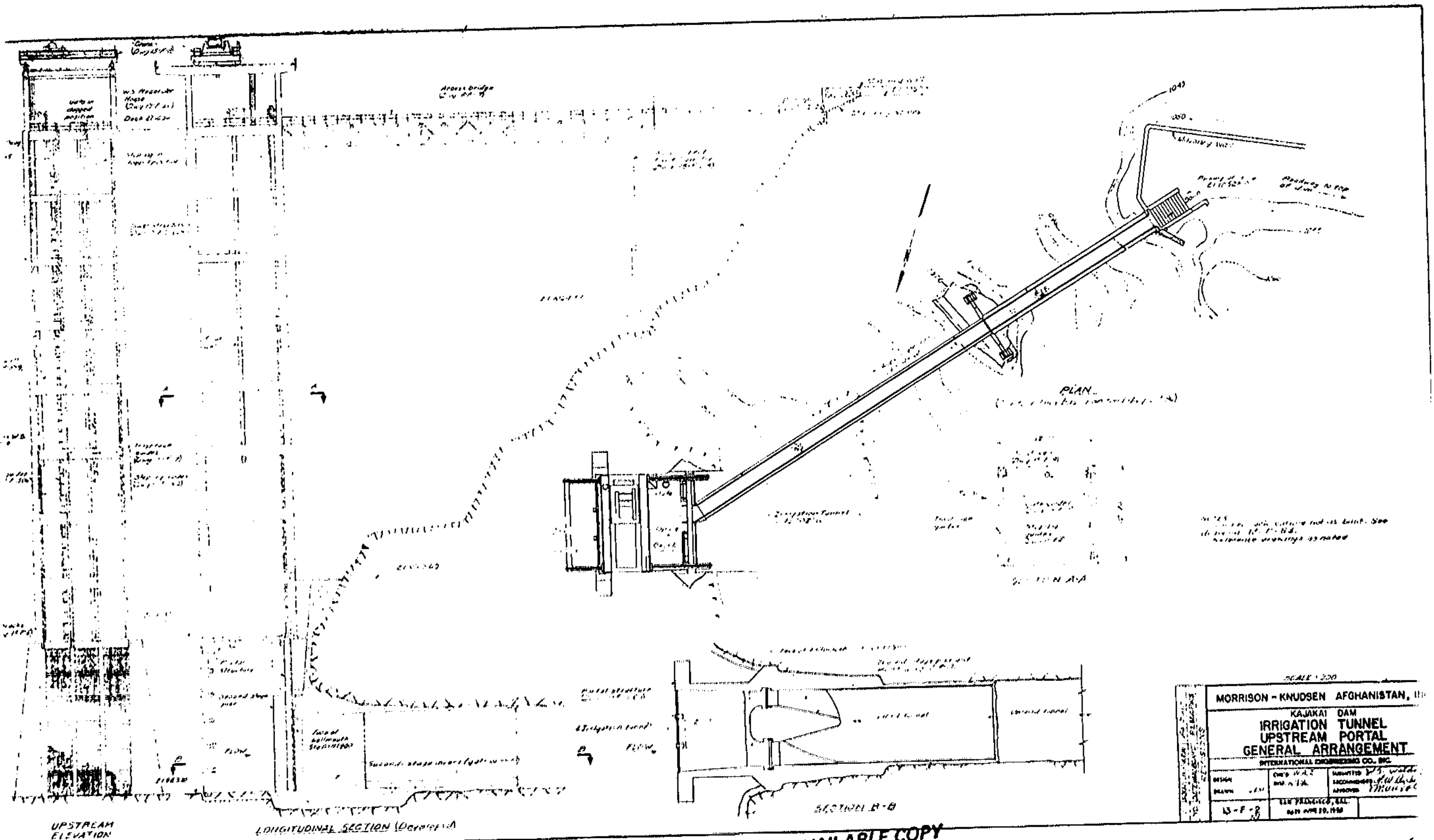
Drawing No. 2



2-B

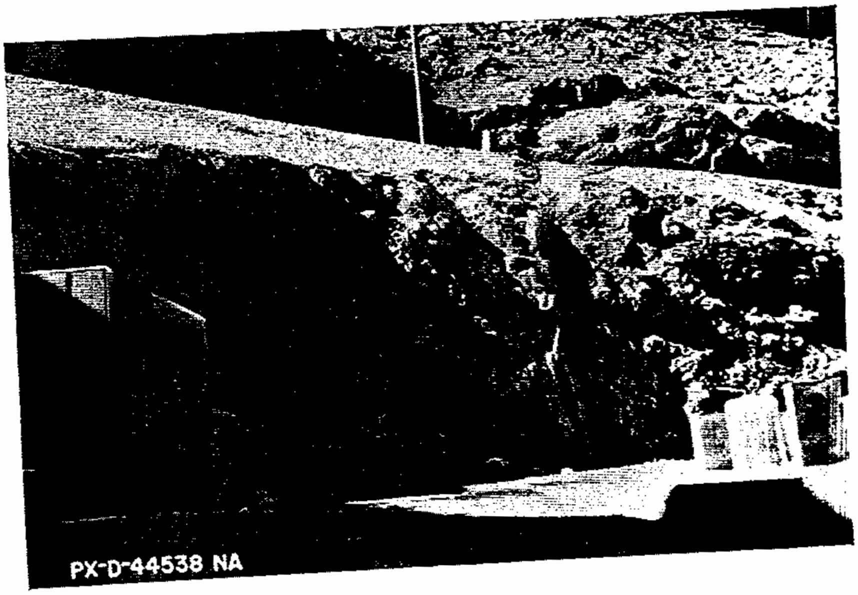
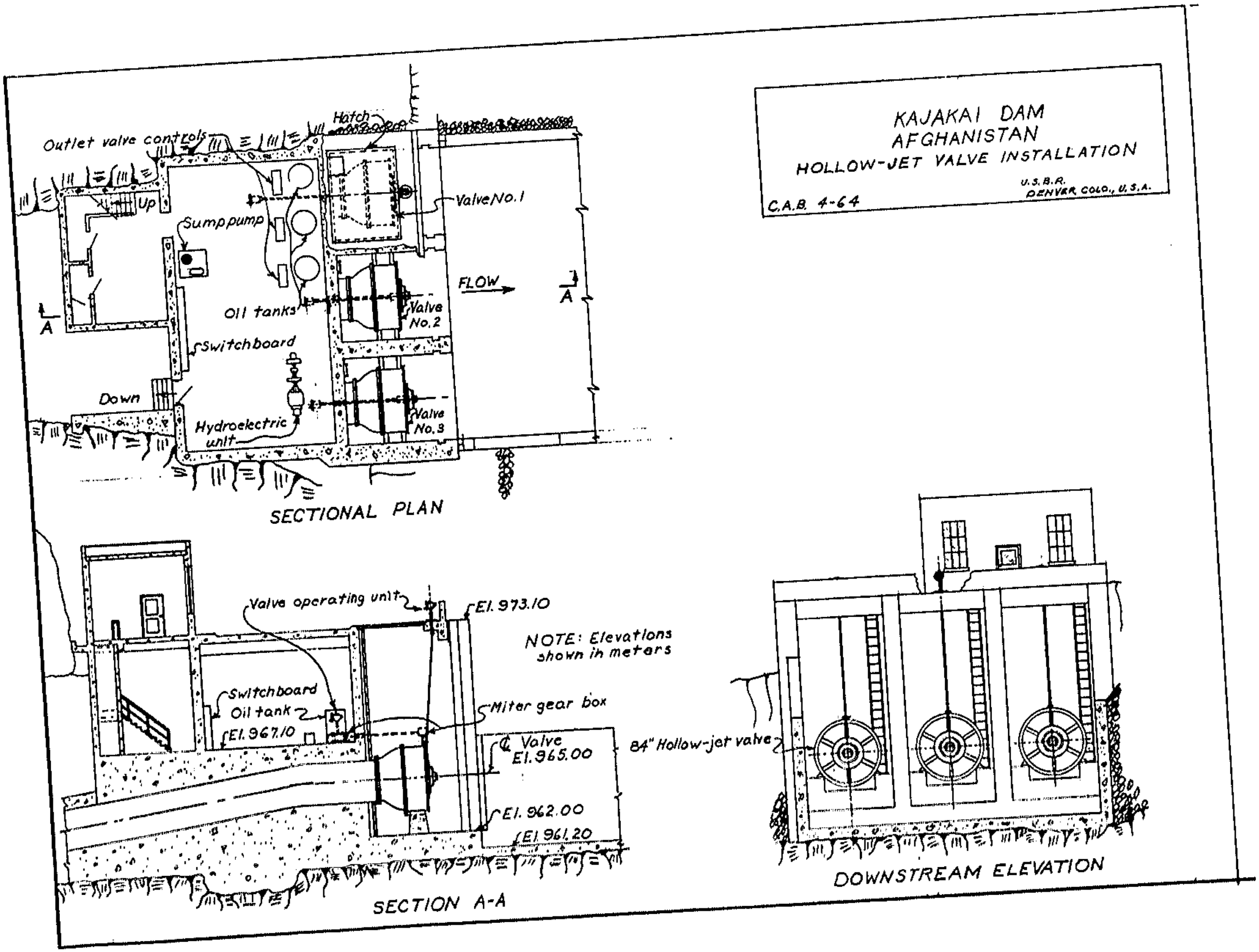


Figure 3.--Kajakai Dam. Hollow-jet valve control house and the gear unit control stands covered with ice from spray from the hollow-jet valves. January 28.

Figure 4.--Kajakai Dam. Eighty-four-inch rotovalves are shown embedded in concrete at the downstream end of the tunnel-plug.



KAJAKAI DAM
AFGHANISTAN
HOLLOW-JET VALVE INSTALLATION
U.S.B.R.
DENVER COLO., U.S.A.
C.A.B. 4-64
Outlet valve controls
Hatch
Up
Sump pump
Valve No. 1
FLOW
A
Oil tanks
Valve No. 2
Switchboard
Down
Hydroelectric unit
Valve No. 3
SECTIONAL PLAN
Valve operating unit
El. 973.10
NOTE: Elevations shown in meters
Switchboard
Oil tank
El. 967.10
Miter gear box
℄ Valve El. 965.00
84" Hollow-jet valve
El. 962.00
El. 961.20
SECTION A-A
DOWNSTREAM ELEVATION

Drawing No. 3

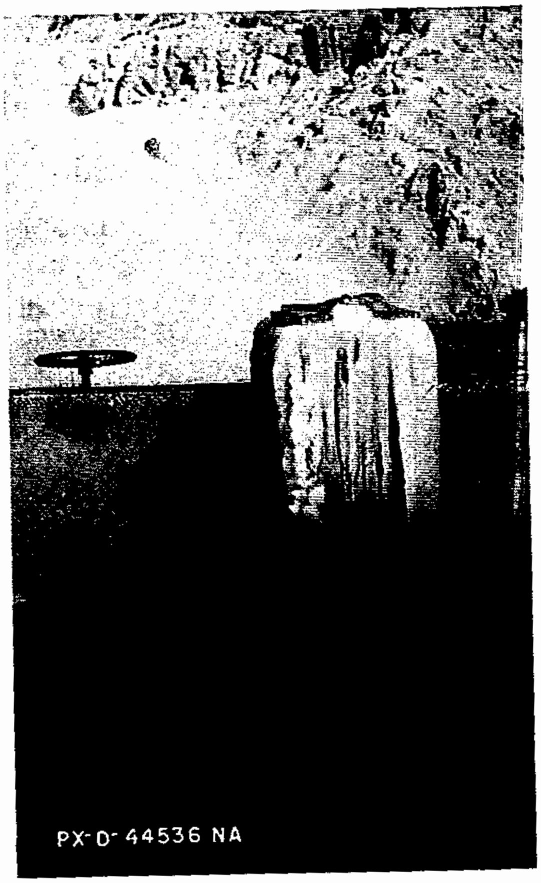


Figure 5.--Kajakai Dam. A gear control unit for hollow-jet Valve No. 1, under cover in January.

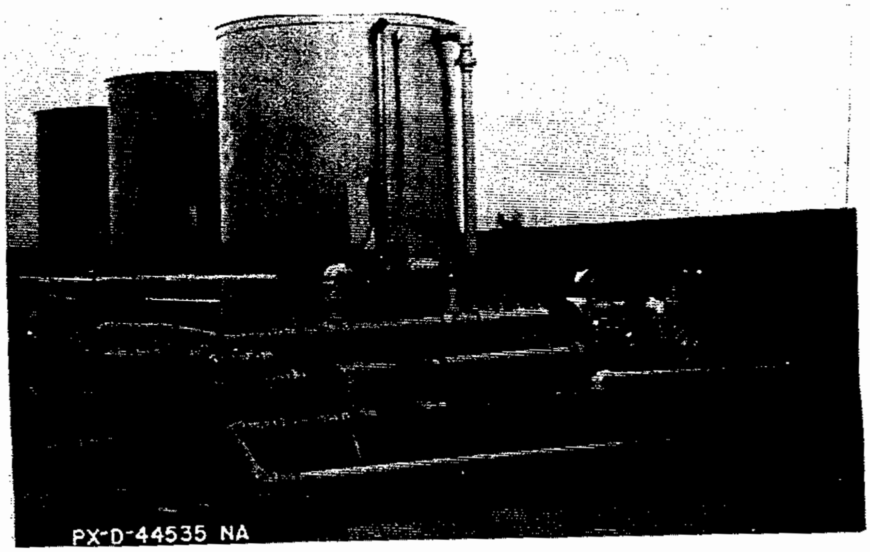


Figure 6.--Kajakai Dam. Hydraulic control units for the hollow-jet valves. Note the four-man pump handles for manual operation, and the number of hand valves on the piping system.

oil discharge from the pressure chamber to control the speed of the needle. Each valve has an individual hydraulic control system located in the control room approximately 20 feet (4.1 meters) below the roadway.

The control system consists of an electrically driven oil pump, a 600-gallon (2,274-liter) oil tank, a solenoid-controlled relief valve, a spring relief valve, a filter, and 10 handwheel control valves, as shown in Figure 6. The pushbutton stations and position indicator are located on the control panel at one end of the room and the hydraulic controls are at the opposite end.

A 93 kilovolt-ampere turbine generator station-service unit is installed in the hollow-jet valve control house and a diesel generator unit is located near the footbridge to the intake gate structure. Power for operating the gantry crane on the intake gate structure should always be furnished from the diesel unit, as the hydroelectric unit and the diesel unit cannot be run in parallel.

A piezometer cabinet is located on the left bank of the river at the downstream toe of the dam, just above the service road. The piezometer tubes are used to measure pore water in the embankment and foundation of the dam to determine the extent of saturation, percolation flow lines, and uplift pressures that affect stability.

FACILITIES INSPECTED

Intake Structure

The concrete intake structure, access bridge, gantry crane, and all miscellaneous metalwork on the structure appeared to be in excellent condition. Equipment has been kept painted and generally clean. The wheel gate and bulkhead gate are kept in storage position on the gate structure, ready for use. The bulkhead is well painted and in good operating condition. The upstream side of the wheel gate is of open construction and the beam flanges form pockets that do not have drain holes. Accumulation of dirt, bird nests, and moisture in these pockets accelerates paint deterioration and rusting. Roller bearings are used on the wheel of the wheel gate. Indications are that grease has dried and hardened through the years as the wheels could not be turned by hand. None of the equipment on the gate intake structure has been used since the dam was constructed. Neither gate has ever been closed since initial installation, the trashracks have never been taken out for inspection, and the hoist has never been used.

Mr. Assifi suggested that we close the gates and inspect the trashracks. Since it would have been necessary to close all flow in the river and depend on the automatic lifting mechanism to close and open both gates, I advised against closing the gates for testing at this time. Taking a chance of not being able to raise one of the gates from the closed position was not justified, especially when the reservoir is being lowered for spring runoff. The latching mechanism was gummed up with dry grease and dirt which made it difficult to operate even manually. The reservoir recording device does not operate when the water surface is below a certain elevation. However, an ingenious device consisting of wire, a float, and a steel tape is being used for gaging the reservoir water surface.

Outlet Tunnel

The outlet tunnel was not examined because of my advising that the intake gates should not be closed. However, the three rotovalves were closed one at a time and the three 84-inch (213.4-centimeter) outlet pipes were pumped dry and examined. Evidence in two of the pipes showed they had been coated with a very heavy application of paint similar to CA-50. All paint had disappeared on Outlet No. 1, except for one section which had patches of paint on the full circumference for a distance of 15 feet (4.6 meters). The patches of paint were located near the rotovalve, and varied in thickness from 1/16 to 1/8 inch. Outlet No. 2, has a similar section of paint adjacent to the hollow-jet valve, about 6 feet (1.8 meters) long. Outlet No. 3 had no evidence of paint.

The inside surface of the outlets showed no evidence of rusting, cavitation or erosion. A slight roughness of tiny pimples and small irregular depressions no larger than one-eighth inch across could be detected by sight, but roughness could not be felt by hand. The roughness looked like concrete crosshatching on a drawing. By scraping the pipe surface with a sharp screwdriver, a slight amount of black substance could be collected on the point. This could have been the remains of the paint or perhaps a deposit of some kind. The outlet pipes are in excellent condition and it is questionable if painting will be required in the near future.

During the time the No. 1 hollow-jet valve was closed and the rotovalve was open, leakage appeared from a hairline crack in the concrete floor of the rotovalve access tunnel. The crack was located at the left side (looking downstream) of the conduit, starting about 22 feet (6.7 meters) downstream from the rotovalve and extending for about 25 feet (7.6 meters) parallel to the pipe. Water seeped out of the crack and wet the floor for a width of 2 to 3 inches in a period of one-half hour. It is not certain if there was a continuing flow during the time the valve was closed; but, if so, it was very slow and was not readily discernible. Two sources for the water seem possible: (1) leakage from a small defect in the conduit, or (2) the squeezing of water from small clearances around the conduit, caused by expansion of the conduit under the pressure increase when the hollow-jet valve was closed.

Rotovalves

The part of the rotovalve plugs which is in contact with water when the valve is closed, apparently has been painted with the same paint used in the outlet pipes. The paint has peeled off in spots over the entire area in sizes from 1/4 inch to 6 inches in diameter and the metal is rusting quite badly where the paint is missing. Operation of the rotovalves is exceptionally smooth when opened or closed under balanced head. The No. 1 rotovalve was opened and closed with the hollow-jet valve 25 percent open and considerable vibration, not necessarily objectionable, occurred during the first 20 percent of opening. The remaining cycle was completed smoothly and quietly. The operator indicated that the rotovalves have been operated with the hollow-jet valves opened as much as 50 percent. While opening the rotovalves with the hollow-jet valves 25 percent open is not alarming in the rotovalve chamber, the thundering noise and tremendous roar heard outside near the hollow-jet valves is frightening. Filling and air vent lines were not provided for the outlets between the rotovalves and hollow-jet valves; so the rotovalves must operate under full pressure and the hollow-jet valves must be partially open to vent air. Rotovalves No. 1, and No. 2, were closed and opened with the hollow-jet valves 5 percent open with no apparent vibration. The standard practice in the past has been to open and close the rotovalves with the hollow-jet valves 15 percent open. When the flow is shut off during normal operation, the outlet pipe between the rotovalve and hollow-jet valve remains full except for the incline up to the hollow-jet valve. The hollow-jet valves are installed slightly over one pipe diameter above the rotovalves. The three rotovalves are absolutely droptight when in the closed position. A small amount of water leaked past the packing on the plug stem during opening of all three valves, but this is not believed to be serious. All rotovalves and related equipment are well painted on exterior surfaces, greased, clean, and are in excellent working condition.

Hollow-jet Valves

The hollow-jet valves operate very quietly at any opening with practically no vibration. No vibration could be detected by standing on a valve while it was being operated from fully open to fully closed position. While the outer surface of all jets appeared somewhat irregular as they left the periphery of the valve, the jets were uniform and made, what would be considered a normal and orderly discharge into the river regardless of how many or which valves were opened. The tailwater with two valves discharging was above the valve pit floor, but somewhat lower than the bottom of the hollow-jet valves. One was able to work inside the valves without getting splashed. The hollow-jet valves were closed one at a time, the rotovalve closed, and the outlet pipe pumped dry for inspection. An examination was made of each valve from inside of the outlet pipes as well as from the downstream side.

Seal replacements and cavitation repairs were made on the hollow-jet valves approximately 2 years ago. The upstream edges of the splitter, which had been cavitated and damaged by solid objects passing through the valves, and cavitated areas on the valve bodies have been repaired by stainless steel welding. The repaired area appeared satisfactory except that most welding was not ground smooth. Some areas were ground smooth but were not finished to the original contour of the fluidway. The original fluidway contour of the valve body has some very irregular protruding areas which should be ground to the intended contour as shown on the manufacturer's Drawing No. SV-1J-167. The rubber seal that was installed in Valve No. 1, was still intact except for about a 2-foot length, at the seal joint, located at 10:30 o'clock when looking downstream. This portion had been torn out of the groove and was still hanging loose in the fluidway. At the same location where the rubber seal was missing, there is a moon-shaped opening 2 feet long and 1-inch-maximum width between the needle and the valve with the valve in the closed position. The rubber seal that was intact projected 3/16 inch above the needle surface. Valves No. 2, and No. 3, had no rubber seals.

No cavitation was found on the needle of Valve No. 1; however, the body was cavitated about halfway around. Pitting started 8 to 14 inches (20.3 to 35.6 centimeters) downstream from the seal seat and extended downstream 6 to 24 inches (15.2 to 61.0 centimeters). Splitter surfaces were cavitated in a similar manner, but not as extensively. Pitting was more severe at the upstream end and tapered to a smooth surface toward the downstream end. Severe pitting (up to 1/8-inch depth) was localized in small areas, 3 inches wide, 8 inches long, most of which were on the valve body and about 10 inches (25 centimeters) downstream from the valve seat. The bodies of all three valves were cavitated much the same way. While the needles of Valves No. 1, and No. 2, were in good condition, the needle of Valve No. 3, was cavitated severely upstream from the seal groove for a distance of 10 inches (25 centimeters) around the entire needle. Cavitation was most severe about an inch from the seal groove and tapered to a smooth surface 10 inches (25 centimeters) upstream.

All hollow-jet valves operate satisfactorily in either direction as long as there is a hydraulic head on the needle. Valve No. 1 was opened with a dry outlet pipe once, but the operator was not able to close it until the rotovalve was opened and reservoir pressure was applied on the needle. This rotovalve was opened with the hollow-jet 25 percent open. Hollow-jet Valves No. 2 and No. 3 were closed to the 5 percent open position before closing the rotovalves for inspection because of inability to operate them with no reservoir head. Except for the Valve No. 1 that opened the one time without reservoir head, no other movement could be obtained hydraulically from any valve no matter what combinations of control settings were used. However, once the reservoir head was applied on the needles the operator could operate the valves in either direction. The operator said they could operate the valves manually when there was no reservoir head and they did move the needle on one valve slightly. However, it is my belief that the needle was moved by brute force on the handwheel of the valve gear unit and not hydraulically as intended. The valve gear unit is not designed to move the needle.

The hollow-jet valve controls will function satisfactorily with pressure in the outlet pipes, but only when a skilled operator is at the controls. Synchronization of the needle travel and speed of the pilot valve screw is dependent on the pilot valve which is a built-in feature of the hollow-jet valve. The oil pump motor and the gear unit motor are started by a common pushbutton, but the gear unit motor has a time delay relay to give the pump motor time to get up to speed before the valve actually starts moving. Oil is bypassed while the pump is getting up to speed. The operator has to press the start button and run across the room to close the bypass valve by the time the delay relay starts gear unit.

The operator has no indication as to when to close the bypass valve except by instinct gained from experience. The gear unit is equipped with interlocked limit switches, which stop both motors at the open and close limits of the hollow-jet valve travel, and with a thrust switch that stops both motors if the pilot screw should bind when the needle travels too fast or too slow. If the operator does not close the bypass valve to start the needle moving at the exact moment the gear unit motor starts, the thrust switch shuts off the control system and the operator has to start the cycle over again. Once the hollow-jet valve control has been properly set for the opening or closing cycle, the valve will complete the cycle without further adjustment. The operators are skilled and can always operate the hollow-jet valves satisfactorily with the present control system providing there is water pressure in the outlet pipes.

Theoretically the valves should open and close with dry outlet pipes, but the operation is dependent on very delicately balanced oil pressures, including negative pressure, which are practically impossible to obtain in this control system. The force required to move the needle under its own weight governs the oil pressures required. Since friction factors are indeterminate, any valve setting on this system will not remain workable for more than one operation, and no operator is able to master a system of valve settings that is dependable.

Since part of the hydraulic control system is designed into a major part of the hollow-jet valve mechanism, it is impossible to modify the control system for better operation without major changes being made to the valve.

Turbine Generator Unit

The governor motor had burned out, apparently from a "short," a day before my inspection of February 20, 1964. The turbine generator unit being shut down presented an opportunity to inspect the turbine. Inspection covers were removed and except for some leakage around the wicket gate shafts and very minor cavitation and chipped edges on some of the runner vanes the unit was in good condition. After the burned-out motor is repaired or replaced, the unit should be serviceable for many years.

Diesel Generator Unit

The diesel generator unit was used to operate the equipment while the turbine generator unit was out for repairs. Considerable trouble was experienced in starting the unit and minor repairs had to be made before it could be started. The unit appeared to be in need of general servicing and cleaning to bring it up to maintenance standards equal to other equipment on the project. No attempt was made to check for worn parts, compression or efficiency. In general the motor appeared to operate satisfactorily.

SUMMARY AND COMMENTS

Equipment on the intake structure looks good and is well painted and clean. The bulkhead and wheel gate, which are in the storage position, are in good condition except that the wheel gate needs drain holes, cleaning, and the wheels need servicing. Neither gate has been used, nor have the trashracks been inspected since construction was completed. Gates were not closed because the latching mechanism was not considered dependable.

Outlet pipes appear to have been painted, but practically all paint has disappeared. There is no evidence of deterioration in the outlet pipes and it is questionable if painting will be required in the near future.

Paint on the surface of the rotovalve plug, which is in contact with water when the valve is closed, is badly deteriorated and the plug is rusting. Rotovalves operate exceptionally smooth under balanced head and are droptight when closed. Rotovalves have been opened normally with the hollow-jet valves 15 percent open. No bypass lines or air vents are provided for filling the outlet pipes for balancing the pressure for opening the rotovalves. There is some leakage on the rotovalve stem packings. Valves are clean and in excellent operating condition.

Hollow-jet valves operate smoothly at all openings and cause very little disturbance in the river stilling basin. All valves are cavitated extensively in the body and on the splitters. One valve has severe cavitation damage on the needle. One valve still has the rubber seal intact except for about 2 feet which has been torn loose. With the present control system it is impossible to make adjustments or reasonable modification to improve the operation of the valves when a hydraulic head is not acting on the valve needle; however, a skilled operator can satisfactorily operate the valves when the outlet pipes are full and under pressure.

The station-service turbine generator unit was shut down because of a burned-out governor motor. All inspection plates were removed, and except for minor repairs such as gaskets and bushings in wicket gate linkage, the unit is in good condition. The governor motor burned out apparently from a "short" which occurred from normal usage. It will be repaired locally.

The diesel generator appeared to be the most neglected piece of equipment on the project and is in need of servicing, cleaning and painting.

RECOMMENDATIONS

Category II (To prevent or reduce further damage)

1. One- to two-inch drain holes should be drilled or burned on the centerline of the web of the wheel gate crossbeams to prevent collection of water.

2. The bearings on the wheels of the wheel gate at the intake structure should be examined for rust, cleaned, greased, and maintained in first-class condition for emergency use. The gate may not close under emergency conditions if the wheel bearings are not in good operating condition.

3. The automatic latching device which is used with the 200-ton crane for handling the gates on the intake structure should be thoroughly cleaned and maintained in good operating condition for emergency use at all times. The mechanism should not be lubricated except prior to being used.

4. Further tests should be made to determine the source of leakage over the No. 1 outlet in the rotovalve tunnel. Close the No. 1 hollow-jet valve for several hours. If the leakage through the crack reaches a limit and the water stops flowing, it may be assumed that the leakage is caused by squeezing of water from small clearances around the pipe. The squeezing would be caused by the pipe expansion when the hollow-jet valve is closed and such leakage is not considered serious. Continued leakage after the valve has been closed for several hours will be an indication that the outlet pipe is leaking.

To search for leaks, drain the outlet pipe and sandblast all welded joints surrounding the leaking area to a clean and dry surface. Apply a dye penetrant, similar to Spotcheck (obtainable from Magnaflux Corporation, Chicago 31, Illinois), to check for cracks or small pinholes in the welds on the pipe wall. A small crack or pinhole may be repaired by welding: Provided, That the pipe is kept sufficiently cool to prevent steam pressure between the concrete and the pipe wall. Small repairs may also be made by drilling, tapping and plugging with a steel pipe plug and grinding flush.

If other than minor welding is required, a section of plate containg the fault should be removed by air-arc or chipping. The concrete should be removed from underneath the area to be repaired, to a depth of 2 inches. The new section of plate should be drilled and tapped for grouting before welding in place. After welding has been completed, the welding should be tested for cracks with dye penetrant.

After all testing has been completed, grout between the pipe and concrete, plug the grouting hole with a steel pipe plug, and grind flush with the interior surface of the pipe.

5. The portion of the rotovalve plug which is exposed to water on the downstream side should be cleaned and painted with a good grade of water resistant paint such as CA-50. The upstream side should also be painted when the tunnel is dewatered.

6. Cavitated areas on the hollow-jet valves should be repaired by filling with stainless steel weld metal. The fluidway surfaces should be ground to the contour shown on the manufacturer's drawings. Offsets or irregularities in the fluidway should be ground smooth and should not have a slope greater than 1 to 20. Since it is not necessary to close the hollow-jet valve tight, cavitation will be minimized if the rubber gaskets are eliminated and the gasket grooves filled with weld metal and overlayed with one-fourth inch of stainless steel.

7. The diesel generator unit should be completely serviced, all packings, damaged oil lines, fuel lines and fittings should be replaced, and the motor should be cleaned and painted.

Category III (Beneficial repairs)

1. Ordinarily trashracks on submerged intakes are not inspected; however, since inspection facilities have been provided, the trashracks should be removed, inspected and repaired when the tunnel gates are closed for other purposes.

2. The packing glands on the rotovalve stems should be tightened. If leakage continues, packings should be replaced when the tunnel is dewatered.

3. The electric control instruments (Figure 7) including the pushbuttons, selector switch, indicating lights and indicator for each hollow-jet valve should be moved from the present control board to a small panel located on the wall adjacent to the hydraulic controls. This will give the operator a more convenient control system. The installation of an ammeter on the control panel for the gear unit motor would aid the operator in the operation of the hollow-jet valves. To give the operator better access to the hollow-jet valve controls, the valve operating unit should be moved into the control house. The shaft could be passed through a packing gland in a sleeve through the wall of the control house. Shaft connections between the hollow-jet valve and valve operating unit could be made with two sets of miter gear as shown on Drawing No. 3.

4. Since the interior surfaces of the outlet pipes are in excellent condition after 10 years of service, painting is not recommended at this time; however, the interior surface of the pipes should be examined at 6-month intervals for several years. Should damage occur in the slightest degree, the pipes should be painted with a good grade of coal-tar enamel.

5. When the hollow-jet valves are repaired, they should be painted all over with vinyl-resin paint Type VR6.

Date of inspection

January 28, February 19 and 20, 1964

Structure completed

1953

Operation status at time of inspection

Reservoir water surface--Elevation 1006 M
Maximum water surface--Elevation 1033.5 M
Reservoir releases--On January 28, all three hollow-jet valves were discharging at 90 percent open. The temperature was 30° F. and the entire area in front of the valve house including the valve operating unit, for the hollow-jet valves, was covered with ice.

On February 19, all three valves were discharging at 100 percent open. Temperature 50° cloudy and showers.

Inspection party

January 28, 1964 M. H. Parwana--Assistant Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan
Carroll Wilcomb--Chief, Operations and Maintenance Division, Bureau of Reclamation
Dale Curtis--Irrigation Operations Advisor, Bureau of Reclamation
Thomas Dewhurst--Construction Management Engineer, Bureau of Reclamation

February 19, 1964	A. Tawab Assifi--Director General, Operation and Maintenance, Helmand Valley Authority, Afghanistan M. H. Parwana--Assistant Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan Carroll Wilcomb--Chief, Operations and Maintenance Division, Bureau of Reclamation Thomas Dewhurst--Construction Management Engineer, Bureau of Reclamation

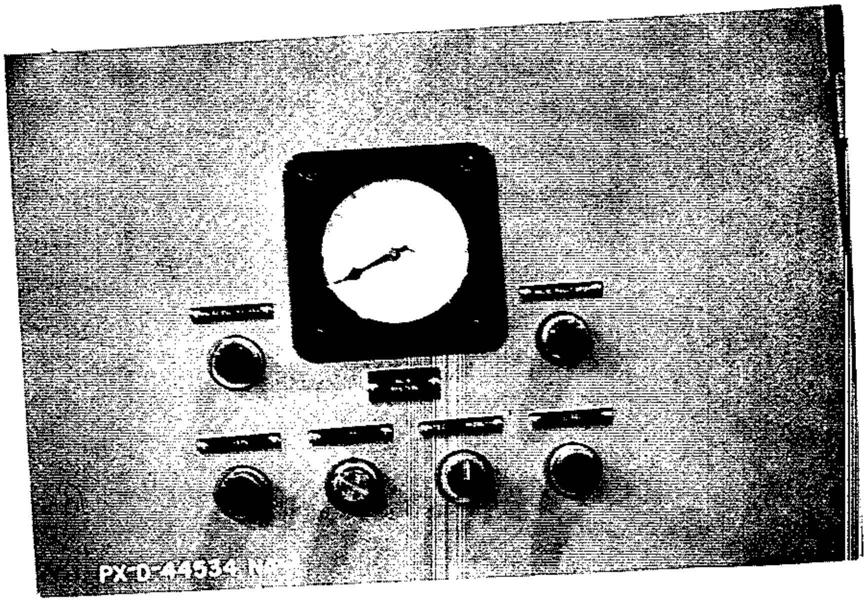


Figure 7.--Kajakai Dam. Control panel showing indicator, indicating lights, and pushbutton station for one hollow-jet valve.

Figure 8.--Stuck in the Mud. A 2-hour delay between Lashkar Gah and Kajakai Dam. One of the hazards of auto travel in Afghanistan.

SECTION II

Inspection Report on

ARGHANDAB DAM

Helmand Valley Development Project
Afghanistan

GENERAL INFORMATION

Arghandab Dam is located approximately 21 miles (34 kilometers) northeast of Kandahar on the Arghandab River. The dam (Figure 9) is an earthfill structure riprapped on the upstream side, and is 160 feet (49 meters) high with the crest at elevation 1115.00 M. Morrison-Knudsen, Afghanistan, Inc., constructed the dam for the Royal Government of Afghanistan. The outlet works consist of one 15-foot-diameter (4.60-meter) tunnel with the intake portal and trashrack structure located at the right abutment, an octagonal concrete intake guard gate structure located 160 feet (49 meters) upstream from the axis of the dam, and an outlet control valve house which is located on the right abutment at the downstream toe of the dam as shown on Drawing No. 4. The tunnel is concrete lined except for 54 feet (16.5 meters) at the downstream end which is steel lined, and from which two 48-inch-diameter (122-centimeter) pipes branch into the valve house for the outlet works. The 15-foot (4.60-meter) steel penstock, which is intended for future power development, extends past the valve house and is closed off with a steel bulkhead (Figure 10).

Two 9.67- by 41-foot (2.0- by 12.5-meter) steel trashrack panels with 8-inch bar spacing are located on a 45° slope on the trashrack structure. No provisions have been made for a trash rake; however, the trashrack panels may be hoisted to the upper portion of the inclined structure for maintenance.

An 11.7- by 15.43-foot (3- by 4.7-meter) wheel gate with rubber seals is provided in the intake structure for maintenance of the tunnel and ring-follower gates, and for emergency closure. A service deck is provided at elevation 1111.0 M for maintenance of the wheel gate. The wheel gate is operated at 6 feet per minute by a 71-ton, electrically driven wire rope hoist which is located above the gate on an open deck at elevation 1119.00 M. Approximately 1 hour and 15 minutes is required to open, or close the gate from the storage position. The hoist has a travel of approximately 15 feet (4.6 meters) for normal operation of the wheel gate, and a maximum travel of 162 feet (49.5 meters) for maintenance. The present policy is to keep the gate in storage position unless it is closed. A 24-inch-diameter (61-centimeter) air vent for the tunnel is located in the wheel gate structure.

Two 48-inch (122-centimeter) ring-follower gates and two 48-inch (122-centimeter) Howell-Bunger valves are located in the valve house. The ring-follower gates are hydraulically operated and are closed under essentially no flow conditions to shut off the river outlets when the Howell-Bunger valves are not in use. The gates may also be used for emergency closure under full flow conditions if the Howell-Bunger valves should become inoperable. The mechanically operated Howell-Bunger valves, located at the discharge end of the outlet pipes, have a maximum discharge capacity of 920 cubic feet per second at full reservoir head, and are used for regulation. The Howell-Bunger valves discharge into a steel-lined concrete chamber, approximately 25 feet (8 meters) square, which converges the water into the river (Figure 11). The ring-follower gates were manufactured by Pacific Coast Engineering Company, Alameda, California, and the Howell-Bunger valves were manufactured by the former S. Morgan Smith Company, York, Pennsylvania. (S. Morgan Smith Company has been taken over by the Allis-Chalmers Company, Milwaukee, Wisconsin.)

A hydroelectric station-service unit, consisting of a Leffel Company turbine, belt-driven Woodward governor and a 75-kilowatt, 50-cycle, 440-volt Fairbanks Morse generator, is located in the valve house. A diesel generator unit is housed in a small concrete structure located at the top of the right abutment near the intake gate structure. The hydroelectric unit and diesel generator unit cannot be operated parallel.

FACILITIES INSPECTED

With the ring-follower gate open and the tunnel intake gate closed, the Howell-Bunger valves were opened to drain the tunnel. About half the tunnel drained through the Howell-Bunger valves, and the remaining water was drained by removing a 16-inch-diameter (41-centimeter) cover from the penstock bulkhead. The 48-inch-diameter (122-centimeter) outlet pipes were in excellent condition; there was no evidence of cavitation, erosion or

Figure 9. --Arghandab Dam. A view of the downstream face of Arghandab Dam.

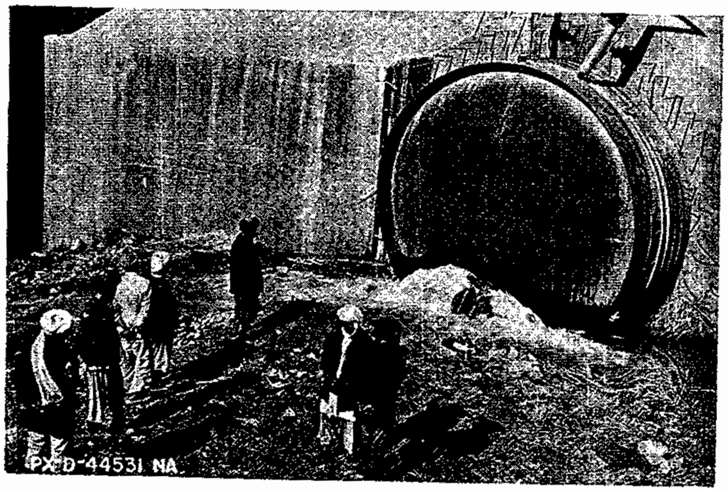


Figure 10. --Arghandab Dam penstock bulkhead. Draining the tunnel through a 16-inch-diameter manhole cover.

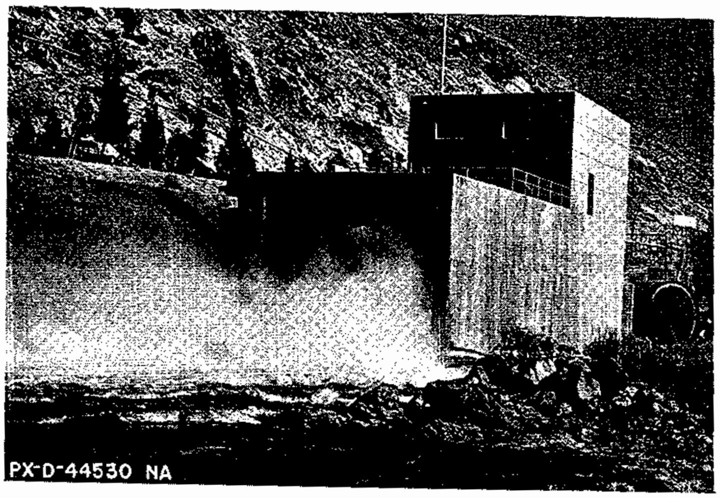
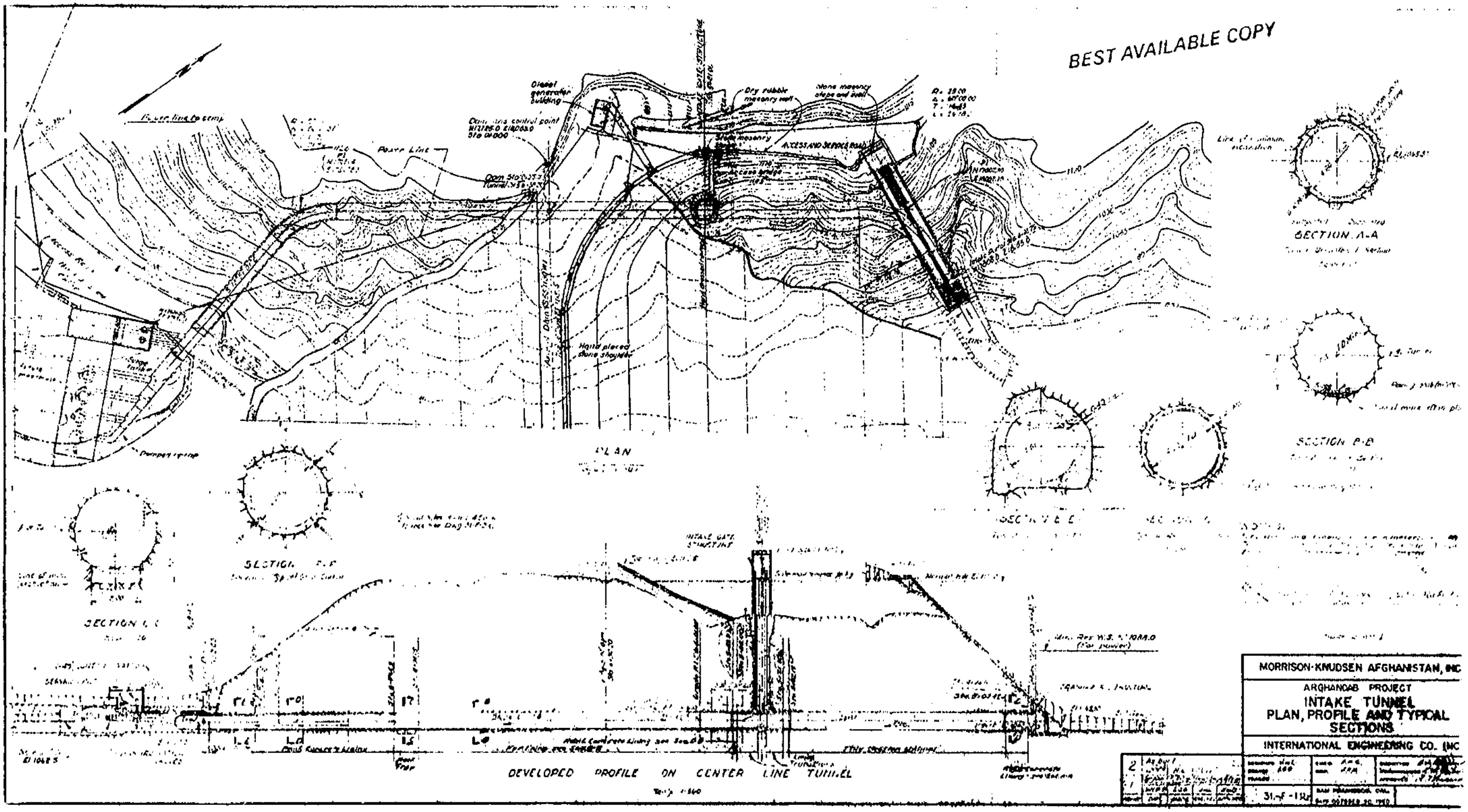


Figure 11. --Arghandab Dam. The valve house with the Howell-Bunger valves discharging at 30 percent opening.



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rusting inside the pipes. The inside of the pipes was uniformly coated with what appeared to be a white brittle deposit approximately 1/32 inch thick. The coating scraped off easily with the point of a screwdriver to a bright metal. The follower opening of the ring-follower gate matched almost perfectly with the diameter of the pipe. Facilities were not available for entering the 15-foot-diameter (4.6-meter) tunnel, so it was not examined except for the part that could be seen from the junction of the 48-inch-diameter (122-centimeter) outlet pipes. Leakage from the tunnel, with the intake wheel gate closed, was approximately one-half cubic foot per second. I was informed that most of this leakage was from the walls of the unlined tunnel.

Tunnel Inlet Wheel Gate

The wheel gate is in excellent condition. The seals are all in good condition; holes have been burned in all the beam webs so water will drain as the gate is raised above the water. Wheels were well greased and could be turned easily by hand, and the gate had a heavy coat of paint. The rope hoist is also in excellent working condition and has been kept well painted and greased. The wire rope was also well greased. Limit switches are provided to stop the gate in the closed and storage positions. The limit switch for the open position, with the gate just above the tunnel opening, has been disconnected as the present policy of operation is to keep the gate in the storage position when it is not closed. Since there is no powerplant at present, this is good practice.

The hoist control mechanism is also equipped with a limit switch and time delay relay to stop the gate at a 6-inch (15-centimeter) opening during the opening cycle for filling the tunnel. The time delay relay prevents the opening cycle from operating for 30 minutes. After 30 minutes the OPEN button has to be pressed to complete the opening cycle. I was informed that on several occasions the gate stopped and went through the 30-minute waiting period several times during the opening cycle. On my first visit, time did not permit checking of this malfunction, but on my second trip Mr. Victor Terzariol, an electrician, went along to check the wiring system. The gate was operated through a complete closing and opening cycle and everything worked perfectly. His explanation of the erratic operation was that the diesel generator unit was probably not operating at the proper voltage when the time delay relay did not function properly. Mr. Terzariol had adjusted the diesel generator for proper voltage before testing the gate controls.

Ring-follower Gates

The ring-follower gates were not operated, as no trouble has ever been experienced in their operation. The gates are hydraulically operated and the control system consists of an oil tank, electrically driven oil pump rated for 6.4 gallons per minute at 750 pounds per square inch, pushbuttons and hydraulic control valves. A semiautomatic hanger holds each gate in the open position. A number of break studs have been broken from time to time because of failure to unlatch the hanger before the closing cycle was initiated. The bonnet cover on Gate No. 1 has cracked twice in different places since installation but has been satisfactorily repaired by welding. Cracks were apparently caused from faults or internal stresses in the castings that appeared after the gate had been in operation for some time. Water was leaking from the packing gland of Gate No. 2. No oil leaks were found, and the gates are well painted and clean. There are no air vents in the control system nor is a surge snubber provided on the pressure gageline. The gage needle is badly bent from surges causing it to strike the peg at the end of the scale.

Howell-Bunger Valves

A Howell-Bunger valve consists of a cylindrical body with radial ribs extending beyond the cylindrical shell through the valve ports to a cone-shaped head, a cylindrical sleeve which slides upstream over the body to open and downstream over the radial ribs to close, and a gear and screw mechanism on the valve body to operate the valve. The exterior of the valves and operating mechanism, are in good condition. All moving parts were well greased and exterior surfaces well painted. The interior surface of the discharge end of the cylindrical sleeves are cavitated around the circumference from the edge of the seal to approximately 4 inches (10 centimeters) upstream. Some of this surface has been repaired by building up with stainless steel weld metal, but is still in serious need of repair. The cones are severely cavitated with pits more then 1/8 inch deep, for an area around the circumference at the discharge end and from edge of the seal to a distance of 10 inches (25 centimeters) upstream (Figure 12).

The stainless steel seal surfaces on the cones are in excellent condition. Neither Howell-Bunger valve seals very tight, mainly because the closing limit switch stops the valve approximately 1/16 inch before the seal seats. The gear reduction motor units for both valves are well painted and are in excellent operating condition. One oil seal in Unit 2 has a minor leak.

Turbine Generator Unit

The turbine generator unit was shut down for repairs. Linkage from the governor to the wicket gates had jammed; and in an effort to release it, the hole in the linkage for a handle to manually shift the wicket gates was ripped out. This part of the linkage is of cast iron and cannot be repaired, so it should be replaced with a new part. The wicket gates have been painted with epoxy for over 18 months and are in excellent condition. There is no evidence of cavitation and the wicket gates are still perfectly smooth. The leading edges of the runner vanes are badly cavitated. The control cabinet for the turbine generator unit (Figure 13) has the back cover removed and makeshift connections have been made to install a disconnect switch for interchanging operation of the turbine unit and diesel unit. The open connections are unsightly and are dangerous to an operator. The pointers on the ampere and voltage dials on the control panel are bent and are not adjusted to read accurately.

Diesel Generator Unit

The diesel generator unit is in fair condition; however, the oil and fuel lines leak enough so that drip pans are used to keep the oil from running across the floor. Fuel pump packings were also leaking badly. The diesel engine was started but no investigation was made for worn parts, compression or efficiency of the unit.

SUMMARY AND COMMENTS

The tunnel was drained and the outlet pipes were examined and found to be in excellent condition. The tunnel was not examined except for what could be seen from junction of the 48-inch-diameter (122-centimeter) branch. Leakage from the tunnel and the wheel gate combined was approximately one-half cubic foot per second.

The tunnel intake wheel gate, hoist, and all appurtenant equipment is in excellent working condition. Limit switches are provided at the closed position, 6 inches (15 centimeters) from closed position with a 30-minute time delay relay for filling the tunnel, and at the fully raised storage position. The gate is kept in the storage position except when it is closed.

Ring-follower gates were not operated as no trouble has been experienced in their operation except breaking of hanger studs because of failure to unlatch the hanger before initiating the closing cycle. Two cracks have been repaired in the bonnet cover. There are no air vents in the hydraulic control system or snubbers on the line to the oil pressure gage.

The exterior surfaces of the Howell-Bunger valves and operating mechanisms are in excellent condition, but the inside surfaces are severely cavitated at the discharge end of the valves. Limit switches are not set so the valve will seal tight; therefore, leakage is greater than is desirable. The gear operating unit is in good condition.

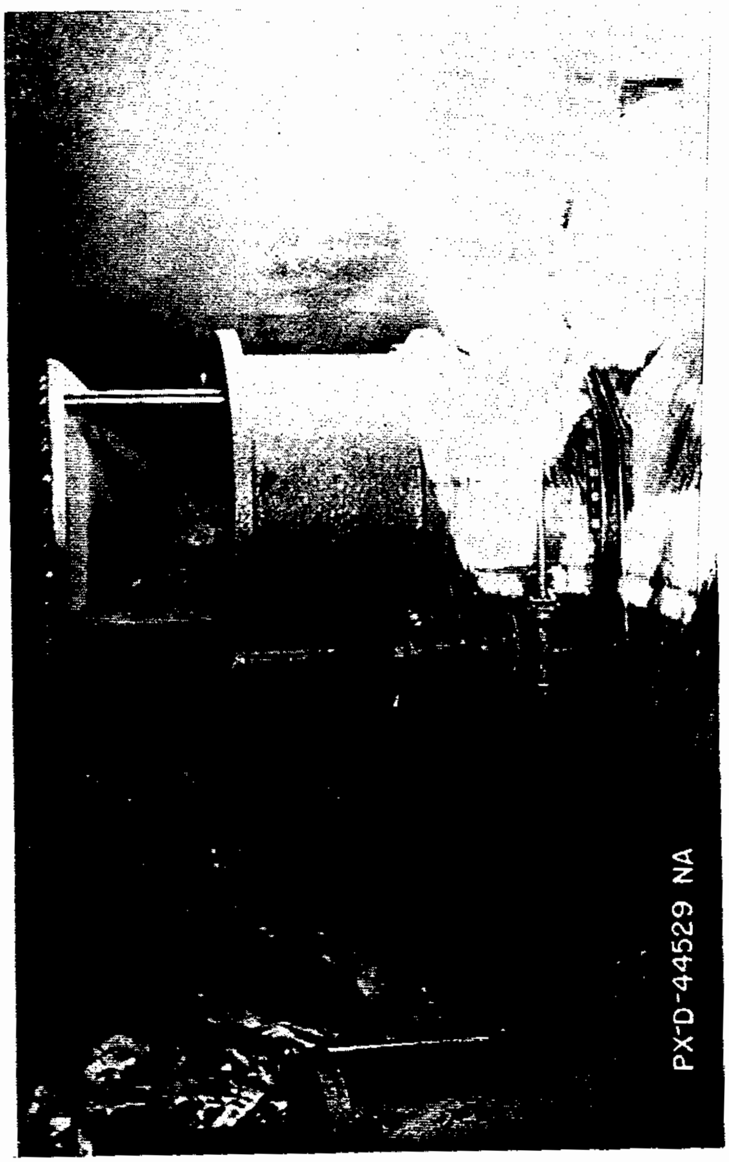


Figure 12.--Arghandab Dam. The 48-inch Howell-Bunger valves are in the fully open position for inspection. Note that the stainless steel seat at the downstream of the cones is in perfect condition, but the metal upstream from the seal seat is severely cavitated.

The turbine generator had been shut down for repairs, and wicket gate linkage adjustments. Part of the linkage used for hand operation has been damaged by too much force applied on a manual operating handle. The runner vanes are cavitated and need to be repaired. The back cover of the generator control cabinet is missing, and exposed switches and wiring are dangerous. Panel gages are damaged and out of adjustment.

The diesel generator is in need of servicing and repairing of all the leaking lines, packings and fittings.

The cracks that developed on the bonnet cover of the ring-follower gate appear to have been satisfactorily repaired and in all probability no more cracks will develop. However, if other cracks should develop in the future it is advisable to again repair them by welding, rather than replacing the bonnet cover.

RECOMMENDATIONS

Category I (Matter of great importance)

1. Arrangements should be made to remove the Howell-Bunger valves and repair the cavitated areas to prevent progressively greater damage. The valves are severely damaged and should be removed so that first-class welding and finishing can be done.

Category II (To prevent or reduce further damage)

1. The water packing on the stem of ring-follower Gate No. 2 should be tightened, shimmed or replaced if necessary to stop the leakage.

2. The oil seal between the motor and gear unit for Howell-Bunger Valve No. 2 should be repaired or replaced.

3. A standard switch box should be installed on the side of the control cabinet of the turbine generator unit, similar to, and above the one already there, to enclose the switch that is now attached on the back of the cabinet with makeshift wiring.

4. After the switch and loose wiring has been removed from the back of the control cabinet of the turbine generator unit, the back cover should be replaced to enclose the cabinet.

5. The dials on the panel of the control cabinet, for the turbine generator unit, should have the pointers straightened and adjusted to read correctly.

6. The vanes of the station-service turbine runner should be repaired with a low carbon stainless steel weld rod.

7. The broken turbine wicket gate link which holds the handle for manual operation of the wicket gates should be replaced.

Category III (Beneficial repairs)

1. Adjust the limit switch, for the closing cycle of the motor gear units of both Howell-Bunger valves, so that the seals will seat as the gear unit stops.

2. Air vent valves should be installed at the high point on the oil lines of the hydraulic control system for the ring-follower gates. These valves are necessary to keep the air bled out of the hydraulic system. For convenience it would be desirable to connect the bleed valves with a line back into the oil tank to prevent the spilling of oil.

3. An oil line snubber should be installed in the line to the pressure gage of the hydraulic control system for the ring-follower gates. A snubber does not hamper accurate gage reading and will prevent damage to the gage from oil pressure surges.

4. Since the interior surface of the steel tunnel and outlet pipes is in excellent condition after 10 years of service, painting is not recommended at this time; however, the interior surfaces of the pipes should be examined at 6-month intervals for several years. Should damage start to occur, the pipes should be painted with a good grade of coal-tar enamel.

5. The diesel generator unit should be completely serviced, all damaged oil and fuel tubing, fittings and packings should be replaced or repaired and the motor cleaned and painted.

Date of inspection

January 23, 1964 and February 25, 1964

Structure completed

1952

Operation status at time of inspection

Reservoir water surface--Elevation 1104.5 M
Maximum water surface--Elevation 1110.00 M
Reservoir releases--Both Howell-Bunger valves were closed, ring-follower gates were open and the wheel gate at the intake was closed. The temperature was 40° F.

Inspection party

January 23, 1964	M. H. Parwana--Assistant Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan
	Carroll Wilcomb--Chief, Operations and Maintenance Division, Bureau of Reclamation, Lashkar Gah, Afghanistan
	Dale Curtis--Irrigation Operations Advisor, Bureau of Reclamation, Kandahar, Afghanistan
	Mohamid Nasim--Camp Manager and Operator, Arghandab Dam
February 25, 1964	A. Tawab Assifi--Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan
	Carroll Wilcomb--Chief, Operations and Maintenance Division, Bureau of Reclamation, Lashkar Gah, Afghanistan
	Thomas Dewhurst--Construction Management Engineer, Bureau of Reclamation, Lashkar Gah, Afghanistan
	Dale Curtis--Irrigation Operations Advisor, Bureau of Reclamation, Kandahar, Afghanistan
	Orville Mowery--Operations and Maintenance Technician, Bureau of Reclamation, Lashkar Gah, Afghanistan
	Victor Terzariol--Refrigeration/Auto Mechanic, Afghanistan Construction Unit, Chah-i-Anjir, Afghanistan
	Mohamid Nasim--Camp Manager and Operator, Arghandab Dam

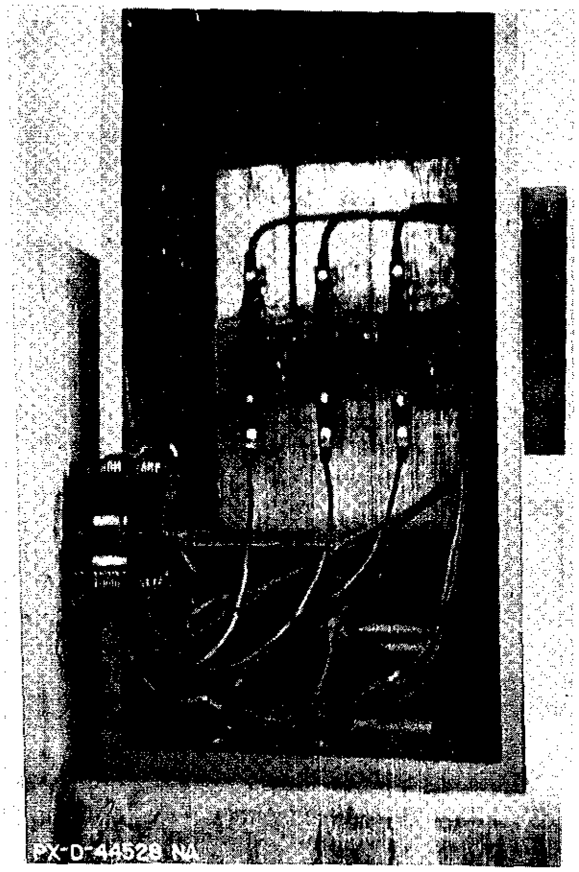


Figure 13. --Arghandab Dam. The back cover of the turbine generator unit control cabinet has been removed for convenience of additional wiring.

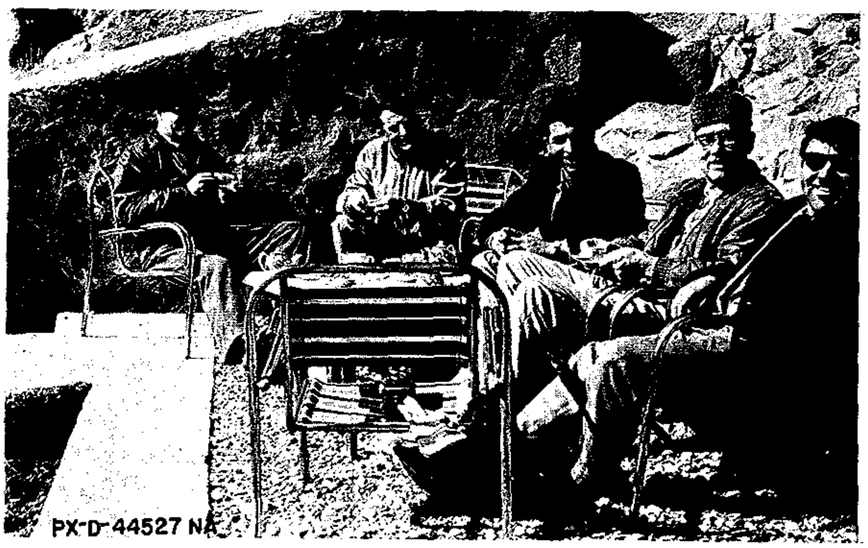


Figure 14. --Arghandab Dam. Superb hospitality was unavoidable at Arghandab. Left to right are E. E. Gonzales, Dale Curtis, M. H. Parwana, Carroll Wilcomb and Mohamid Nasim, the Camp Manager, who was never too busy to extend his courtesies and dine you on the best of Afghan delicacies.

SECTION III

Inspection Report on

GIRISHK POWERPLANT

Helmand Valley Development Project

Afghanistan

22a

GENERAL INFORMATION

Powerplant

The Girishk Powerplant is the only source of power in the Helmand Valley Area, and the town of Lashkar Gah is completely dependent on this plant for power. The powerplant is located near the town of Girishk approximately 37.5 miles (60 kilometers) northeast of Lashkar Gah. The powerplant (Figure 15) is a three-unit, outdoor-type installation with open-flume turbines. The plant was designed by the International Engineering Company, Inc., San Francisco, California, and constructed by Morrison-Knudsen Afghanistan, Inc., for the Royal Government of Afghanistan. Water for the powerplant is diverted from the Helmand River by the Boghra Canal Diversion Dam which is located approximately 2.5 miles (4 kilometers) upstream from the powerplant. Two bypasses are provided, one at each end of the powerplant, to bypass water past the powerplant when irrigation demands are greater than what is being passed through the turbines. Flow through the bypasses is regulated by manually operated tainter gates. Tailwater elevation is maintained by a check structure and automatically operated wasteway facilities which are located approximately 3.1 miles (5 kilometers) downstream. Excess water is diverted back into the Helmand River.

Only Units 1 and 2 are installed at present. There are provisions for future installation of Unit 3. The generators are housed in individual steel casings while the remainder of the plant equipment is housed in a concrete structure (Drawing No. 5) below the surface of the canal banks. The structure provides approximately a 19.8-foot (6-meter) hydraulic drop in the canal bottom which supplies the head for power generation.

Generators

The generators (Figure 16) are of the outdoor-enclosed vertical type with a rated capacity of 1,500 kilovolt-amperes each, 80-percent power factor, 3 phase, 50 cycles at 187.5 revolutions per minute. The generators were furnished by Westinghouse Electric Corporation.

Turbines

The turbines (Figure 17) are Kaplan fixed-blade propeller type, vertical, and rated at 2,200 horsepower when operating under a net head of 25 feet at 187.5 revolutions per minute, with an estimated discharge of 870 cubic feet per second. The turbines have a conical steel plate draft tube, submerged gate operating mechanism, and submerged guide bearing, runner, stay and discharge rings, and wicket gates. The wicket gate ring is set on top of the turbine distributor housing and is attached to each of the 20 wicket gates by individual safety links. Each turbine shaft is composed of two sections, 11-inch (0.279-meter) minimum diameter, (bearing journal is 11.875-inch diameter) and is connected to the generator rotor shaft by bolted flanges. The lower shaft section is 8.2 feet (2.50 meters) long, extends through the turbine bearing, and supports the runner. The upper shaft is 13.45 feet (4.10 meters) long and connects the lower section to the generator. The turbines were furnished by James Leffel and Company, Springfield, Ohio.

Gantry Crane

A hand-propelled traveling gantry crane with a 16-ton chain hoist is provided on top of the powerplant. The hoist has a 53-foot (16.17-meter) lift and a lifting rate of less than 8 feet (2.4 meters) per hour, which is extremely slow for powerplant use, (1,400 meters of hand chain travel required for 1 meter of hook travel). The crane is used to open and close the bay headgates and tailgates, and to handle other powerplant equipment.

Diesel Generator Unit

A 25-kilowatt, diesel engine generator set has been provided for emergency operation of station-service only.

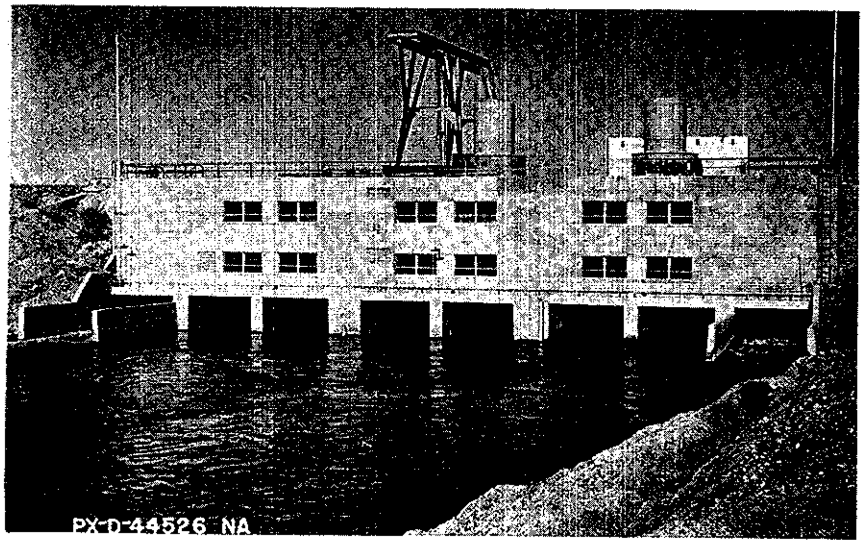


Figure 15.--Girishk Powerplant. A downstream view of the powerplant.

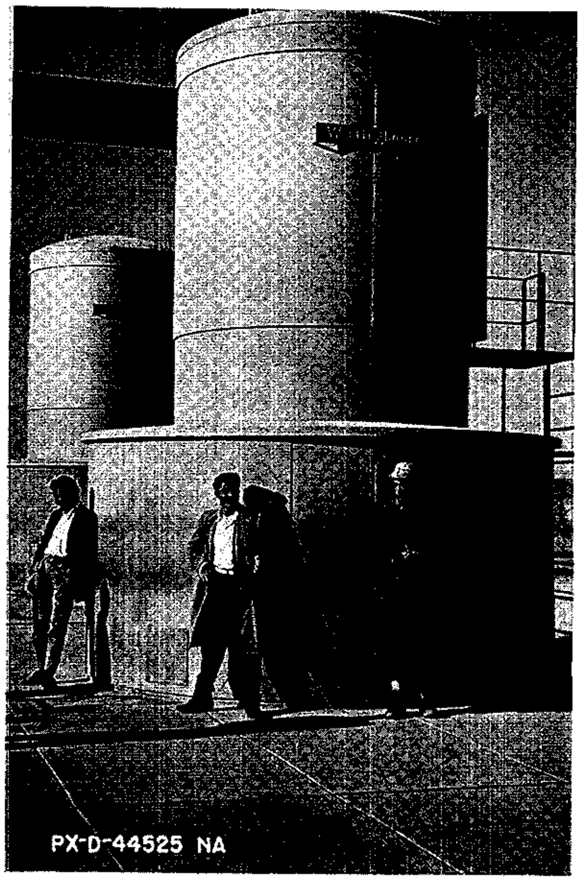
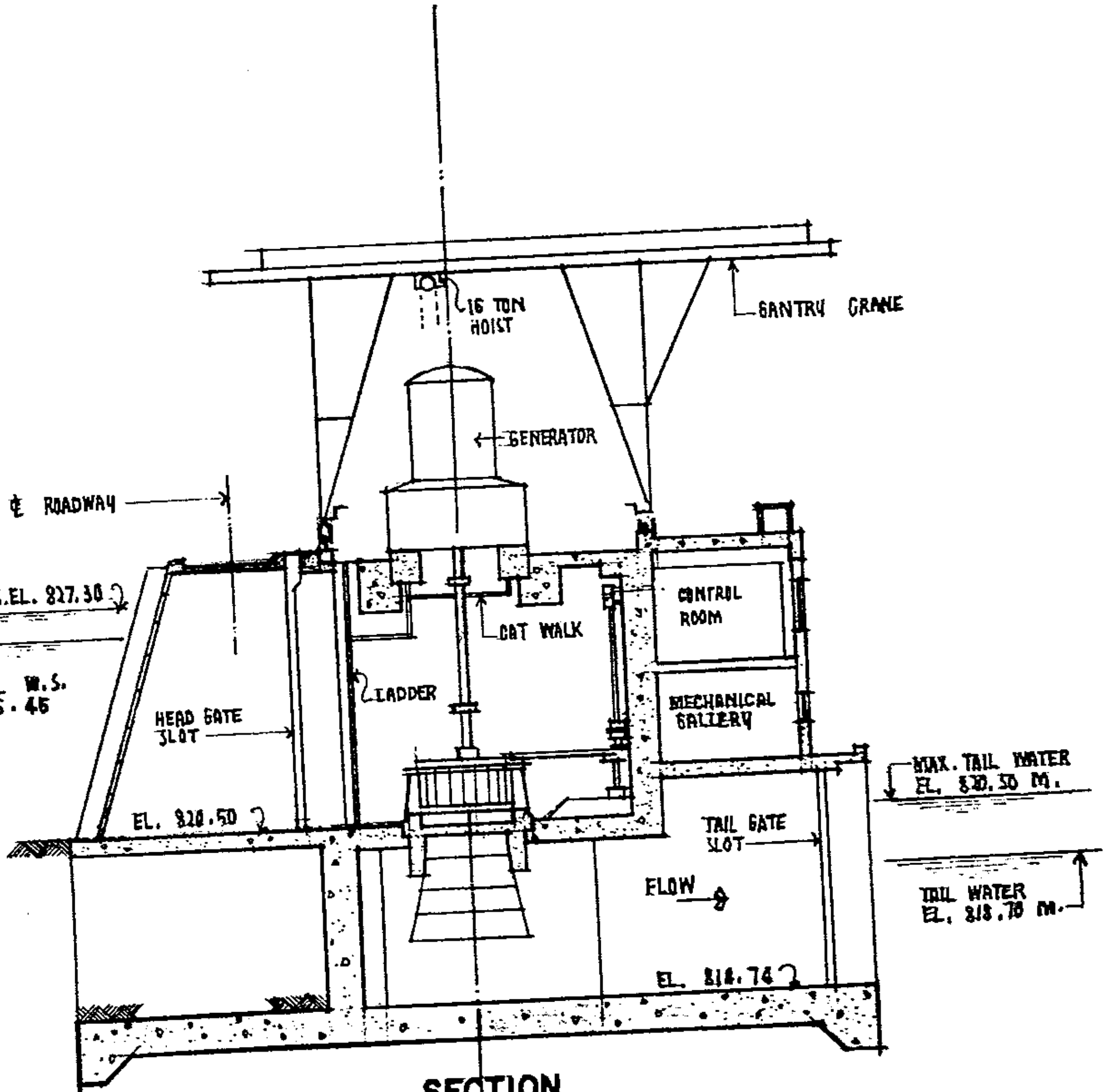


Figure 16.--Girishk Powerplant Generators. Outdoor enclosed-type 1,500-kilovolt-ampere generators.



SECTION
GIRISHK POWER PLANT

FACILITIES INSPECTED - UNIT 2

Turbines

The Harza Engineering Company has a contract with U. S. Agency for International Development to make a study of the Girishk Powerplant and to make recommendations for restoring the powerplant to satisfactory service. Since there is no other source of power in the area, efficient operation and dependability of this plant is extremely important.

Mr. E. H. Richardson, Resident Engineer, the Harza representative, drove me to the plant where we met Mr. Isenberg, Electrical Engineer for ACU (Afghanistan Construction Unit). The No. 2 Unit had been out of service for sometime and the turbine bearing was partically disassembled for examination and for checking alinement of the shaft. Mr. Richardson explained where measurements had been taken and the method used in taking them. Since all alinement measurements had been very carefully taken with a micrometer, to within 0.001 of an inch, from a vertical piano wire, 0.033 inch in diameter, with a 20-pound vaned weight suspended in oil, I was confident that his measurements could be accepted without question and remeasuring would not be necessary.

The generator shaft was found to be plumb. The turbine shaft had been partially reassembled and would have required disassembly to take accurate measurements. However, measurements were taken of the clearance between the turbine shaft and guide-bearing housing (with the bearing out) with a 12-inch-long feeler gage. These measurements disclose an offset of the bearing bracket in relation to the turbine shaft of approximately 0.022 inch. Evidence shows that an effort had been made to aline the shaft by machining the guide-bearing bracket and shifting it to correct for alinement. Measurements that are possible to take without a complete disassembly show that the shaft still remains approximately .008 inch out of alinement. As a result of the guide-bearing bracket being shifted in the turbine housing, the runner blades (Figure 18) show evidence of dragging on the lower crown ring.

Outside edges of the rotor blades (Figure 19) have worn flat and the edges have curled out beyond the thickness of the blades. The turbine shaft (Figure 20) and turbine shaft bearing were found badly grooved and worn. The lower crown ring was found 0.4 inch (1 centimeter) out of level. The shaft coupling had been shimmed with wedge-shaped shims so that the bolts could be tightened without leaving a gap at the coupling joint. The two shaft flanges do not appear to be parallel. The space between the turbine wicket gates, in the closed position, varied from .002 to .110 inch from top to bottom on some of the gates. Enough water leaked past the wicket gates to prevent the turbine from stopping without heavy application of the brake. The governor shaft that extends below the generator and operates the wicket gates was approximately 1.5 inches out of plumb and a support bracket was found broken. A new bracket has been installed and alinement has been corrected. The turbine is designed for a wicket gate opening of 10.5 inches (26.7 centimeters). The maximum opening that can be obtained with the present linkage on the governor shaft is 9.125 inches (23.2 centimeters).

As soon as temporary repairs can be made on Unit 2, it will be restored to service while Unit 1 is taken off the line and examined to determine what repairs are required to maintain dependable operation.

Headgates

The turbine bay inlet is closed off by two 14-foot, 4.75-inch by 23-foot, 4-inch structural steel headgates equipped with music note rubber seal all around. The seals were holding tight except at the bottom of the gate. With the bay drain open, the floor of the bay would not drain to less than 4 inches of water. Both gates were leaking extensively near the center, apparently from damaged floor sealplates or damaged concrete around the sealplates. Roughness could be felt on the concrete floor by sliding your foot along the downstream edge of the gates. Further examination could not be made because of the 4 inches of water on the floor.

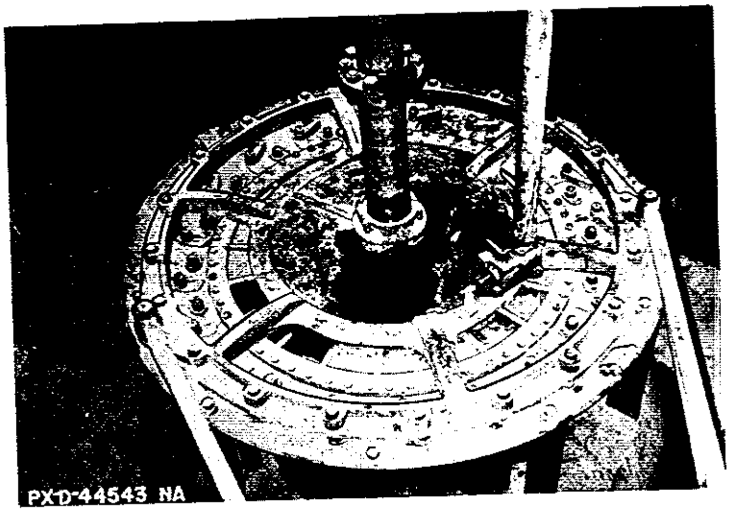


Figure 17.--Girishk Powerplant Unit 2. Top view of turbine showing the speed ring, turbine shaft and lower shaft coupling.

Figure 18.--Girishk Powerplant Unit 2 turbine runner. Edges of blades show wear from dragging on the lower crown ring.

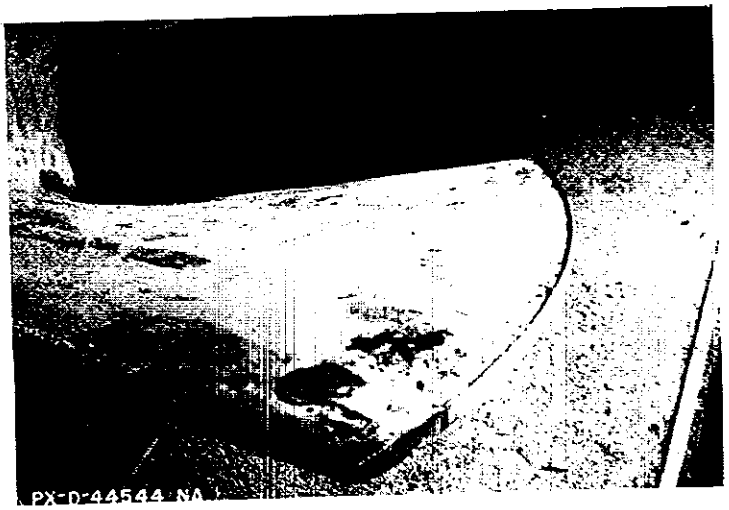


Figure 19.--Girishk Powerplant Unit 2. Turbine runner blade shows evidence of severe dragging between the edge of the blade and lower crown ring.

Figure 20.--Girishk Powerplant Unit 2. An enlarged view of the turbine shaft showing the bearing surface bodily grooved and worn. Pencil points to area that was in contact with oil packing. Lower oil packing wore similar grooves.

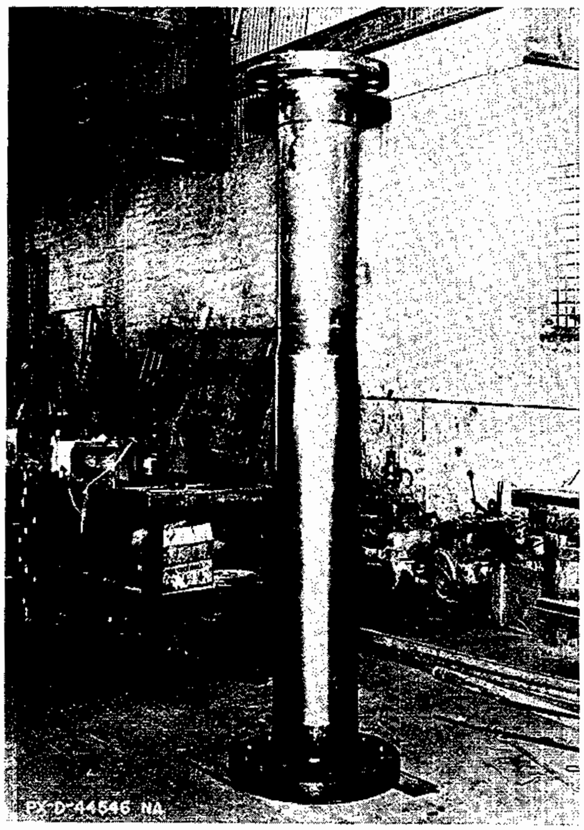


Figure 21.--Girishk Powerplant Unit 2. Turbine shaft after machining undersize to eliminate grooving. Shaft will be used temporarily while Unit 1 is shut down for examination.

Trashracks

Trashracks on the power bay intakes collect a considerable amount of debris which has to be removed frequently to keep from obstructing the inlet. Debris is removed manually with a hand rake from the powerplant roadway parapet or by a man riding a small raft which is propelled by two men on the bank pulling on guide ropes. This method of cleaning the trashracks is dangerous, inefficient, and it is possible to clean only the top 1.75 meters. (Length of hand rake.)

SUMMARY AND COMMENTS

The Girishk Powerplant was visited to examine Unit 2, for malfunctioning and to determine possible causes of vibration, and to examine other major mechanical features.

The turbine had been partially disassembled and was being examined by Mr. Richardson. Observations were made and measurements for turbine shaft alinement taken by Mr. Richardson were accepted.

Turbine shaft was found out of alinement and the lower crown ring out of level. The turbine bearings were found rough and scored. The bearing bracket has been shifted from the center of the turbine.

Turbine runner showed evidence of scraping the lower crown ring and wearing the propeller edges flat.

Wicket gates do not close tight enough to stop the turbine.

The governor shaft was out of plumb and a support bracket was broken. Repairs have been made and the shaft realined.

The wicket gates are designed for a 10.5-inch (26.7-centimeter) opening and would open only 9.125 inches (23.2 centimeters); apparently because of improper linkage on the governor shaft.

Both headgates leak excessively under the bottom seal. Water stands about 4 inches deep in the bay with the drain open.

Trashracks are cleaned by hand with small rakes from the powerplant roadway or from a small barge which is dangerous and ineffective.

The gantry crane is hand operated and it requires considerable time to handle powerplant equipment.

When suitable equipment is properly installed and maintained, a plant of this type should serve for approximately 20 years with no more than minor repairs.

RECOMMENDATIONS

Category I (Matters of great importance)

1. Alinement of the turbine shaft is extremely critical for satisfactory operation and long service of the unit. To be assured that a satisfactory installation will result, all second-stage concrete should be removed and the turbine reset to correct alinement.

2. The damaged bearing area on the turbine shaft should be repaired by building the shaft up with weld metal and refinishing, or the shaft should be replaced.

3. The turbine bearing bracket should be replaced or built up with weld metal, refinished to original dimensions and redoweled to the turbine case.

4. Repairing the wicket gates so they will close tight is not absolutely necessary; however, it would be desirable to build them up with weld metal and refinish by grinding in the event releveling of turbine does not allow closure adjustment with eccentric shear link pins.

Category II (To prevent or reduce further damage)

1. The apparent reason for the wicket gates not opening to 10.5 inches (26.7 centimeters) is that the lever on the governor shaft that operates the wicket gate ring on top of the turbine is short or linkage is not in proper adjustment. Full opening of the wickets can be obtained by linkage adjustment or supplying a governor shaft lever arm of proper length. Maximum turbine efficiency cannot be obtained unless the wicket gates open fully.

2. Headgate leakage should be repaired at the first opportunity. It will be necessary to dry the Boghra Canal upstream from the powerplant which will require shutting down the plant.

3. A mechanically operated trash rake should be constructed, or procured commercially, that can be guided on two or more of the present trashrack bars or by adding new guides to the trashracks. To be effective the rake should reach to within 6 inches of the bottom of the trashrack. With the present method of hand cleaning, it is almost impossible to prevent the lower portion of the trashracks from becoming obstructed with debris. Clean trashracks are important to maintain maximum efficiency.

4. This plant is the only source of power at the present time, and will continue to be so for sometime in the future. When the plant is shut down for repairs it is urgent that equipment be handled rapidly to get the plant back on the line as soon as possible. The present chain hoist operates extremely slow; therefore, an electric motor should be incorporated into the present 16-ton gantry crane hoist or a new electric hoist should be procured.

Date of inspection

January 27, 1964

Structure completed

Unit 1--February 1958

Unit 2--March 1958

Operation status at time of inspection

Approximately 800 cubic feet passing through the plant and approximately 400 cubic feet are being discharged through the left bypass. Unit 1 was in service and Unit 2 was shut down.

Authorization and purpose of inspection

This investigation was requested by the Project Manager of the Bureau of Reclamation, Helmand Valley Development Project, Lashkar Gah, Afghanistan, by cablegram to the Commissioner. Telephone conversation from the Commissioner's Office to the Technical and Foreign Services Branch, Denver, January 2, 1964, requested that engineer detailed to Afghanistan be qualified to examine the 1,500-kilovolt-ampere turbines at Girishk Powerplant for misalinement and causes of vibration.

Inspection party

H. E. Richardson, Resident Engineer, Harza Engineering Company, International

R. B. Isenberg, Electrical Engineer, ACU (Afghanistan Construction Unit)

Excellent cooperation was received from the above-mentioned personnel, which was appreciated very much.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
HELMAND VALLEY DEVELOPMENT PROJECT
LASHKAR GAH, AFGHANISTAN

March 9, 1964

Address reply:
USOM/KABUL/LASHKAR GAH
STATE DEPARTMENT MAIL ROOM
WASHINGTON 25, D. C.

TO: Mr. F. Gordon Whitaker, Project Manager

FROM: E. E. Gonzales, Mechanical Engineer
Bureau of Reclamation, Denver, Colorado

SUBJECT: Report on Unit No. 1 - Appendix I to Section III of Report on Girishk Powerplant

On March 4, 1964 I accompanied Mr. H. E. Richardson, representative of the Harza Engineering Co. International, to examine the turbine shaft and bearing of Unit No. 1 of the Girishk Powerplant. The turbine pit had been dried before our arrival and workmen were disassembling the turbine bearing.

Findings:

1. The top bearing packing was badly worn and a section of approximately four inches was missing. The lower bearing packing was missing completely with no evidence whatsoever that packing had ever been installed; however, I was assured that packing had been installed. The packing grooves are 3/4 inches wide and 1 1/2 inches deep and receive three 3/4 inch X 3/4 inch packing rings each. The packing found in the upper groove was a hard woven fabric, compression type gasket which appeared to be very durable.

   Shimming in sizes up to 3/8 inch was found under the legs of the turbine bearing bracket (Figure 22) and the holes for the bolts that fasten the bearing bracket to the turbine were enlarged from 1 9/16 inch, as shown on the drawing, to 2 1/8 inch as shown in Figure 23. The space between the 1 1/2 inch bolt and the hole had been filled with lead.

2. The upper packing gland and lower guide bushing showed evidence of severe wear. The inside surfaces were grooved and wire edging curled over the flange as shown on Drawing No. 6. This was caused from extreme eccentric pressure of the turbine shaft.

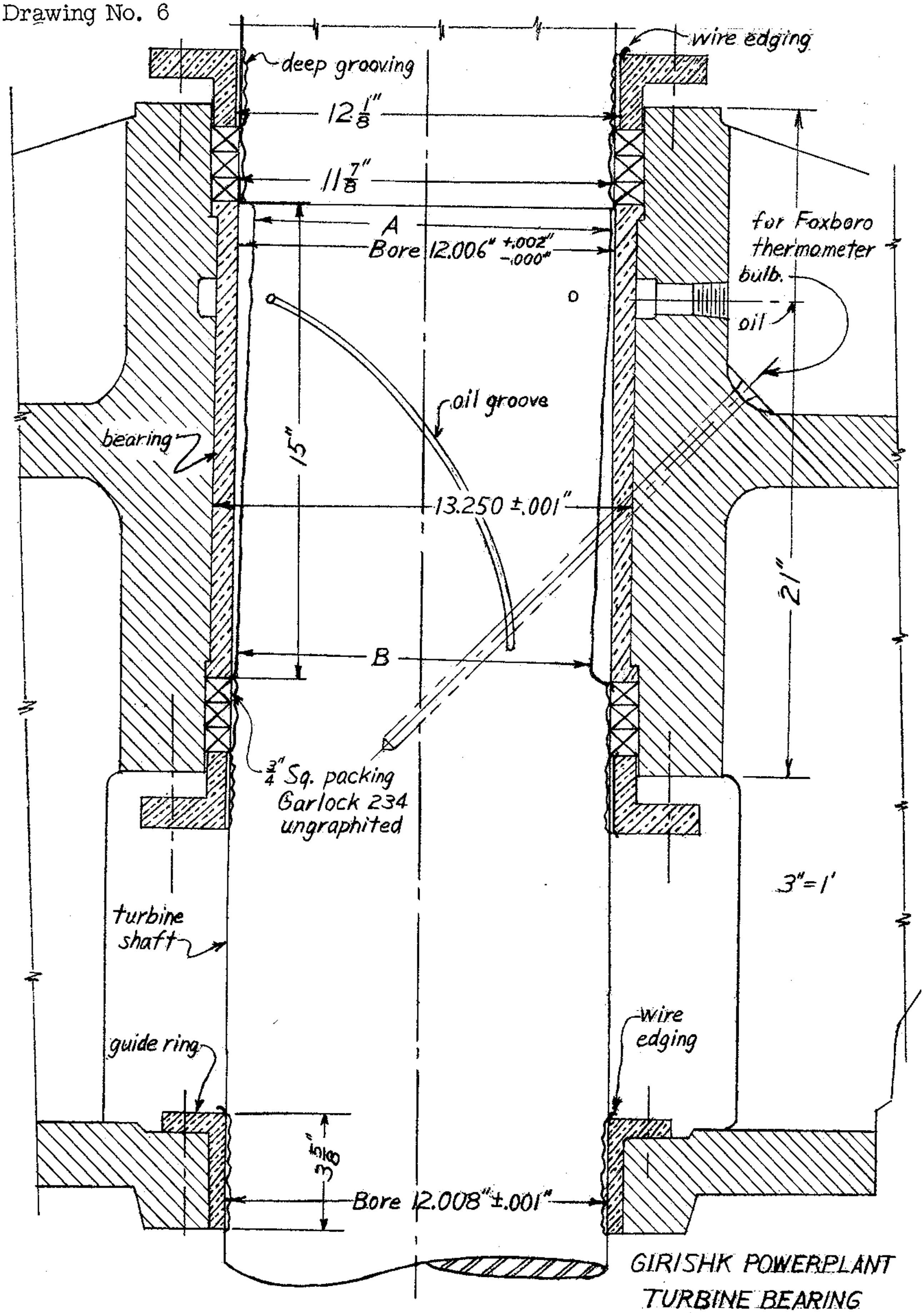
3. Feeler gauges were inserted between the turbine shaft and the bearing a 180° apart. One side had a clearance of .063 inch and the other side had more than .083 inch clearance.

4. The shaft bearing was fairly smooth and showed considerable evidence of wear and wire edging on the bottom flange. The most severe evidence of recent wear was on the upper packing gland and lower guide bushing. At these two bearing points, the turbine shaft showed deep grooving that was plainly visible to the eye.

5. A visual inspection of the shaft showed severe wear over the entire bearing area. Apparently, most of the wearing had been done before the present bearing was installed as the bearing showed little wear. The turbine shaft measured 0.120 inch flat at Point A - (Drawing No. 6). From Point A, the shaft tapers at an angle to the centerline 0.124 inch to Point B. This makes the shaft a total of 0.244 inch undersize at Point B.

6. The lower crown ring showed grooving all the way around where the tips of the turbine runner have been scraping. Clearance between the runner tips and the lower crown ring varied from 1/8 to 1/2 inch with the turbine bearing out and the shaft hanging free from the generator thrust bearing (shaft floating).

Drawing No. 6



GIRISHK POWERPLANT
TURBINE BEARING

Figure 22.--Girishk Powerplant Unit 1. The turbine shaft bearing bracket assembled on the floor to measure the bearing diameter.

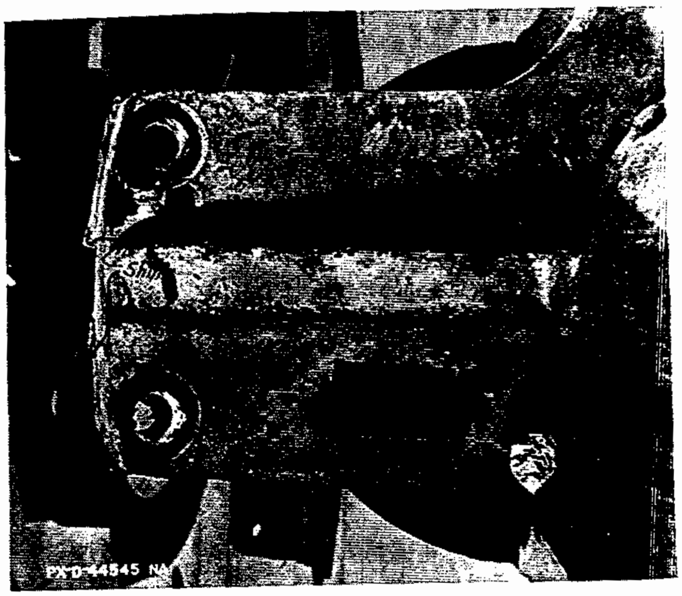


Figure 23.--Girishk Powerplant Unit 1. One leg of bearing bracket showing boltholes drilled oversize and filled with lead, and shimming to compensate for turbine misalinement.

7. With the governor in the maximum closed position, all the wicket gates remained approximately 1/4 to 3/8 inches open.

   With the governor in the maximum opened position, the wicket gates opened a maximum of 8 3/4 inches instead of the intended design opening of 10 1/2 inches. (Leffel Drawing 48642)

8. The governor shaft and wicket gate linkage does not appear to be set properly to obtain the design opening intended for the wicket gates. The crank arm on the governor shaft, that actuates the long connecting linkage to the wicket gate shift ring, is approximately perpendicular to the linkage centerline (Drawing No. 7). When the wicket gates are opened, the governor shaft crank arm is turned to the extreme right as shown by the dotted line - (Drawing No. 7). This condition, along with loose fitting linkage connection bushings, account for the wicket gates not opening the full 10 1/2 inches. Maximum wicket gate opening is obtainable when the governor shaft crank arm is set so that it is perpendicular to the linkage centerline when the wicket gates are midpoint of opening.

   The turbine shaft of Unit No. 1 is so badly worn that putting it back into service in its present condition would be risking serious damage of the generator and thrust bearing. Extensive repairs are needed on the turbine shaft and bearing before the unit can be used even for temporary service.

   The Girishk Powerplant design is of such nature that redesigns or changes other than minor improvements would, in all probability involve major reconstruction of the plant and exorbitant cost.

Recommendations

It is my opinion that the Girishk Powerplant can be satisfactorily rehabilitated for many years of dependable service by aligning, repairing and adjusting the present equipment.

1. The turbine shafts will have to be repaired by welding or replacing and accurately aligning the shaft and bearing, and centerlines of turbine and generator of each unit.

2. It will be necessary to properly fit, align and assemble the shaft bearing including the packings, packing glands and lower guide ring.

3. The turbine runners should be balanced and centered in the lower crown ring of the turbine.

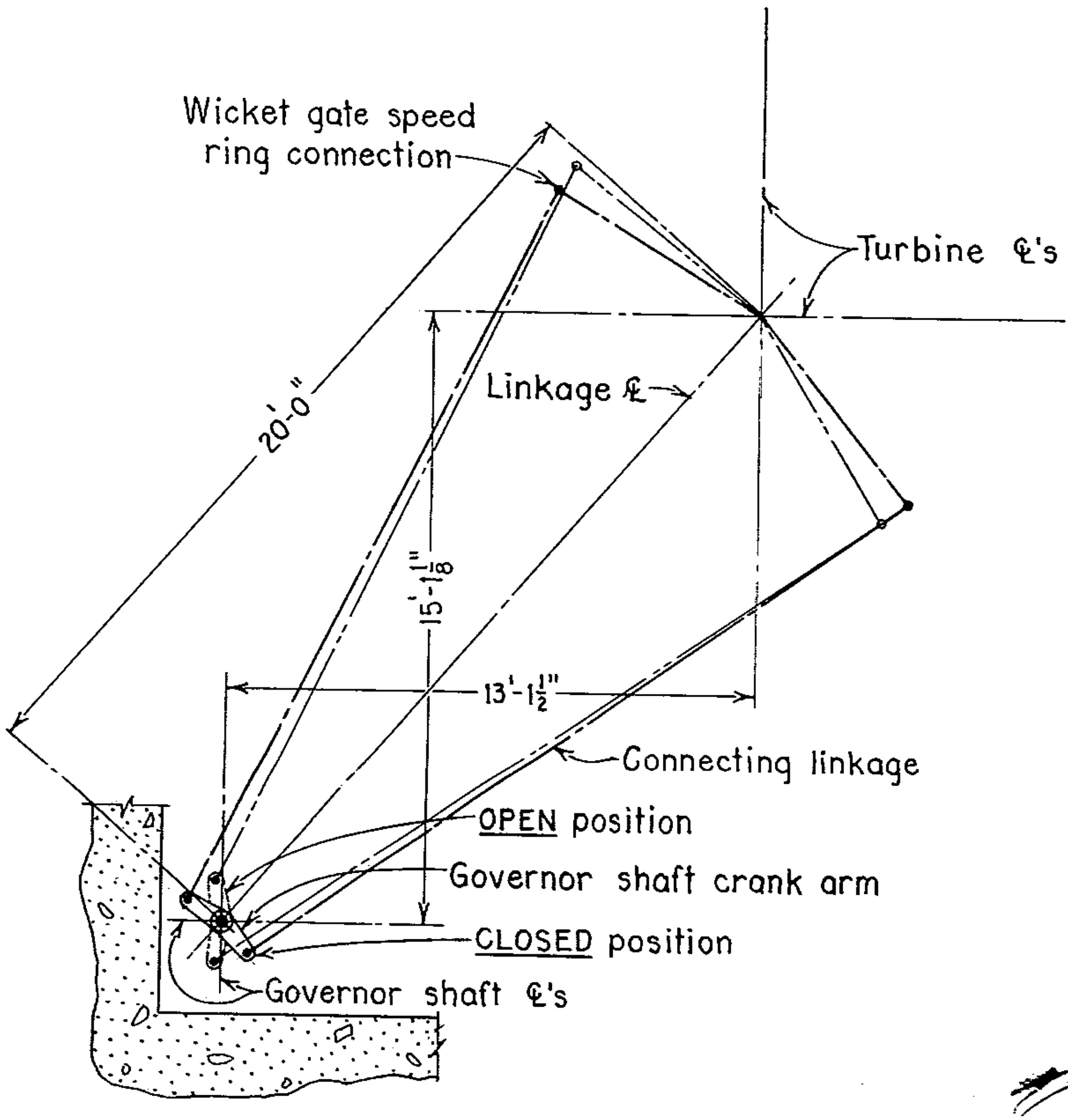
4. To accurately align the turbine shaft with the generator shaft, the turbine should be removed from the concrete and reembedded properly aligned and leveled so that the runner will be centered in the lower crown ring and the shaft will be accurately aligned with the generator shaft and bearing.

   Accurate alignment of the turbine and generator, and balancing of the runner is essential for dependable operation and long service of any powerplant.

5. All governor linkage should be checked for loose fitting and alignment, and repaired, aligned and adjusted as necessary to obtain tight closure and 10 1/2 inch opening of the wicket gates.

In view of the fact that Mr. Richardson is well acquainted with the problems of the Girishk Powerplant, and is well qualified to do a first-class job of restoring the plant to satisfactory operating conditions and dependable service, I recommend that arrangements be made for Mr. Richardson to supervise rehabilitation of the Girishk Powerplant to completion.

E E Gonzales



GOVERNOR SHAFT LINKAGE

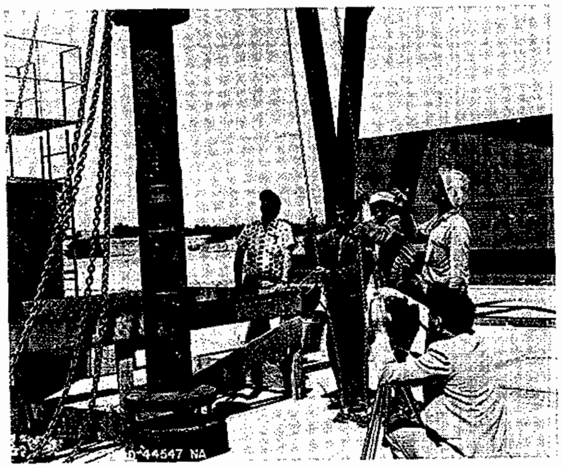


Figure 24.--Girishk Powerplant Unit 1. Workmen raising the turbine shaft to the surface deck of the powerplant. Shaft is 8.2 feet long and 12 inches in diameter at the bearing area.

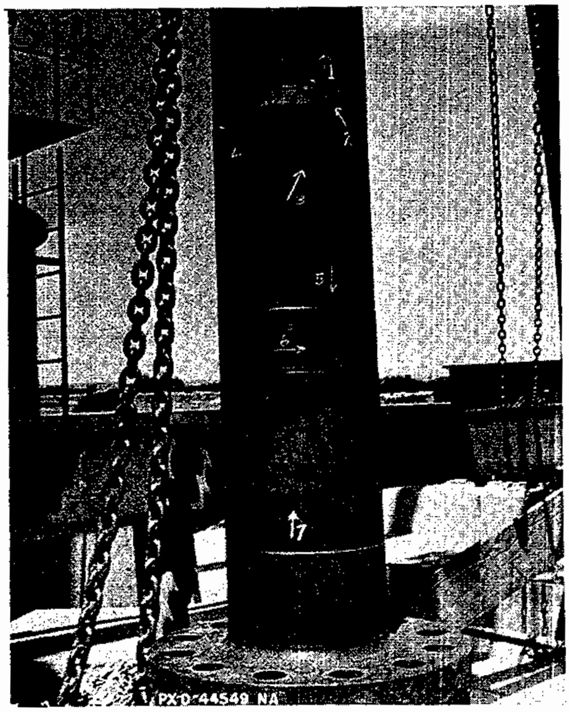


Figure 25.--Girishk Powerplant Unit 1. Turbine shaft bearing area showing severe worn surfaces. Area between 2 and 5 is the main bearing area.

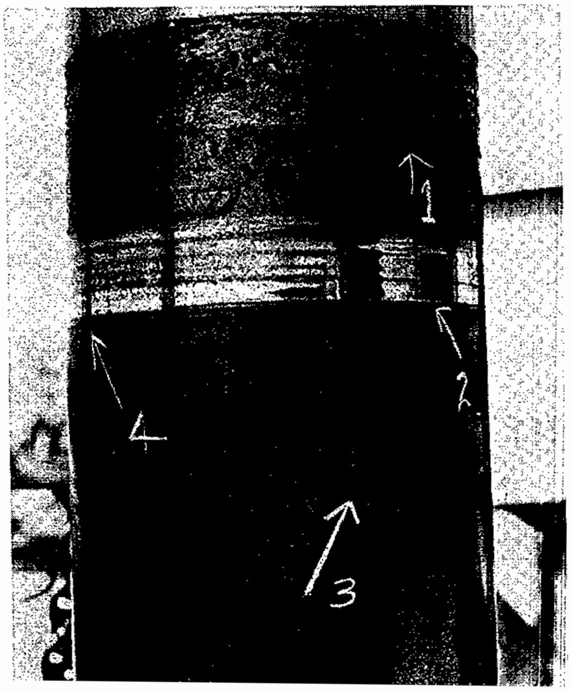


Figure 26.--Girishk Powerplant Unit 1. Turbine shaft--Area 1 is upper packing gland surface. Area between 1 and 2 is upper packing surface. Note pitting in bearing Area 3. Note eccentric wearing at points 2 and 4. This is likely caused by shifting of the shaft center as wear occurs on the shaft and bearing.

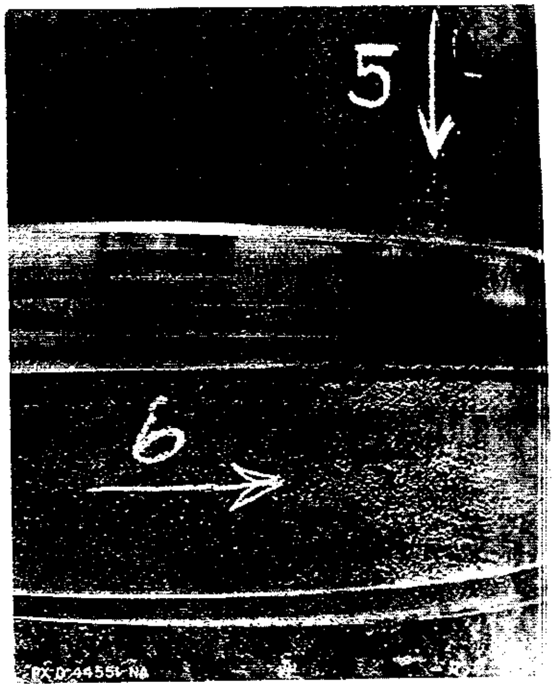


Figure 27.--Girishk Powerplant Unit 1. Turbine shaft showing severe wear. Groove between 5 and 6 was caused by the lower packing which was missing completely at time of disassembly. Area 6 shows galling under the packing gland.

Figure 28.--Girishk Powerplant Unit 1. Turbine shaft--Note eccentric grooving at Area 6. This was caused by the shaft shifting from a forced position after the packing disappeared and wear took place. Double grooving was caused by the packing gland being tightened after packing had disappeared.

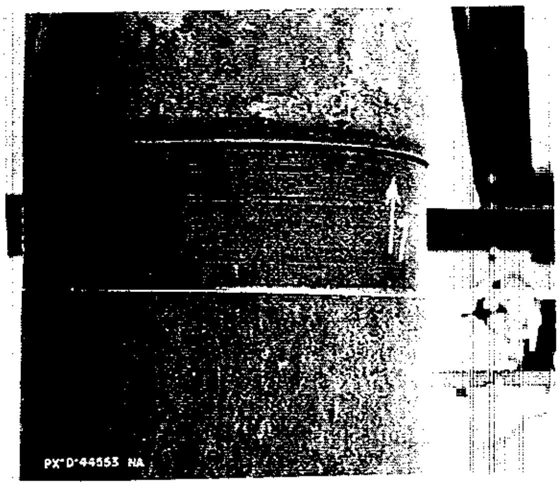


Figure 29.--Girishk Powerplant Unit 1. Turbine shaft. Area 7 shows the extent of wear at the lower guide ring.

SECTION IV

Inspection Report on

BOGHRA, SHAMALAN AND DARWESHAN CANAL SYSTEM

Helmand Valley Development Project

Afghanistan

GENERAL INFORMATION

Boghra, Shamalan and Darweshan (Drawing No. 8) are the main canals in the irrigation system and are located along the Helmand River Valley. The Boghra Canal headworks is located at the Boghra Diversion Dam on the Helmand River 40 miles (64 kilometers) northeast of Lashkar Gah and extends 47 miles (75 kilometers) in a southwesterly direction. The Boghra Canal has a capacity of 2,600 cubic feet per second; supplies water for the Girishk Powerplant, Shamalan Canal, and furnishes irrigation water for the Nad-i-Ali and Marja areas. The Shamalan Canal branches off the Boghra Canal 10 miles (16 kilometers) north of Lashkar Gah and extends south a distance of 44 miles (70 kilometers) parallel to the river.

The Darweshan Canal has a capacity of 1,000 cubic feet per second, has headworks at the Darweshan Diversion Dam on the Helmand River approximately 36 miles (58 kilometers) south of Lashkar Gah, and extends south a distance of 47 miles (75 kilometers) parallel to the river. At the present time there is a total of approximately 66,000 acres of irrigated land served by the entire canal system. Water is stabilized for power and irrigation by Kajakai Dam which is located on the Helmand River, 88 miles (140 kilometers) northeast of Lashkar Gah.

Dimensions given in this report denote approximate sizes of structures and are not intended to be exact. Distances are approximate.

FACILITIES INSPECTED

Boghra Diversion Dam

The Boghra Diversion Dam (Figure 30) consists of a concrete spillway, 590 feet (180 meters) long and a maximum height of 8 feet (2.40 meters) with the sluice gate structure and diversion works located on the right bank of the river. The sluice gate structure has three gate openings with three 20- by 10-foot sluice gates, that regulate river flow adjacent to canal inlet. One extra gate has been provided for maintenance. The sluice gates are controlled by a gantry crane that travels on top of the sluice gate structure, and a semiautomatic lifting beam. The canal inlet structure is regulated by four 22- by 7-foot manually operated top seal tainter gates. The operator reported that the lifting beam did not work. This is not an unusual complaint, as semiautomatic or self-latching lifting beams frequently give trouble. In this particular case, a man is able to reach the gates to latch and unlatch the hooks for handling, so it does not present a serious problem.

Boghra Canal Wasteway and Checkworks (Sta. 10+917.00)

The Boghra Canal Wasteway and checkworks structure is located 3.1 miles (5 kilometers) downstream from the Girishk Powerplant and consists of four 21- by 10-foot manually operated tainter gates across the Main Canal, and two 18- by 10-foot tainter gates that regulate the wasteway which is located on the left bank of the canal. The wasteway gates are equipped with both manual and automatic controls. Automatic controls are of the weir floatwell and counterweight type. The gates have individual counterweights but are controlled by a common floatwell. The primary purpose of this structure is to maintain constant tailwater elevation for the Girishk Powerplant by automatically checking, or diverting excess water back into the river.

On the first visit, one wasteway gate was being controlled automatically and the other manually. It was reported that the downstream gate did not operate properly and that it lagged approximately a foot behind the other. On the second visit both gates had been shifted to automatic controls and the downstream gate was not functioning. An examination disclosed that the float cables were completely slacked and the counterweight would

Figure 30. --Boghra Diversion Dam. Sluice gate structure shown in foreground is adjacent to the Boghra Canal Intake.

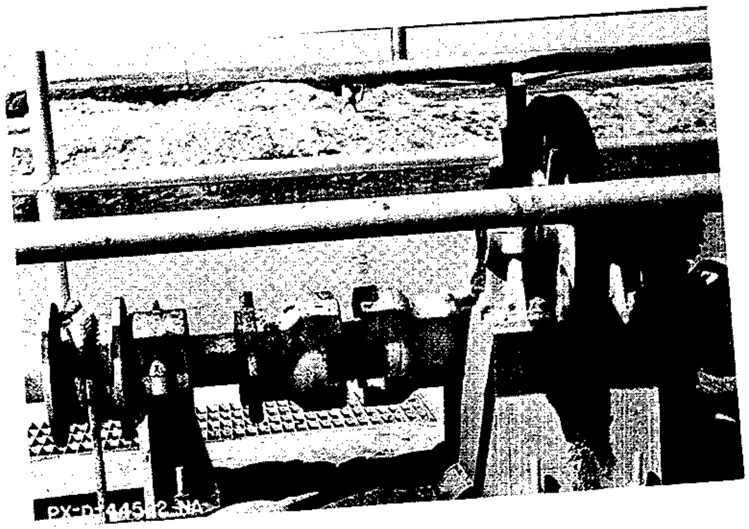


Figure 31. --Boghra Canal Wasteway. The notch-type clutch is used to change from manual to automatic control of the wasteway gates.

Figure 32. --Boghra Canal Checkgate. Wire rope on one checkgate was rusted through.

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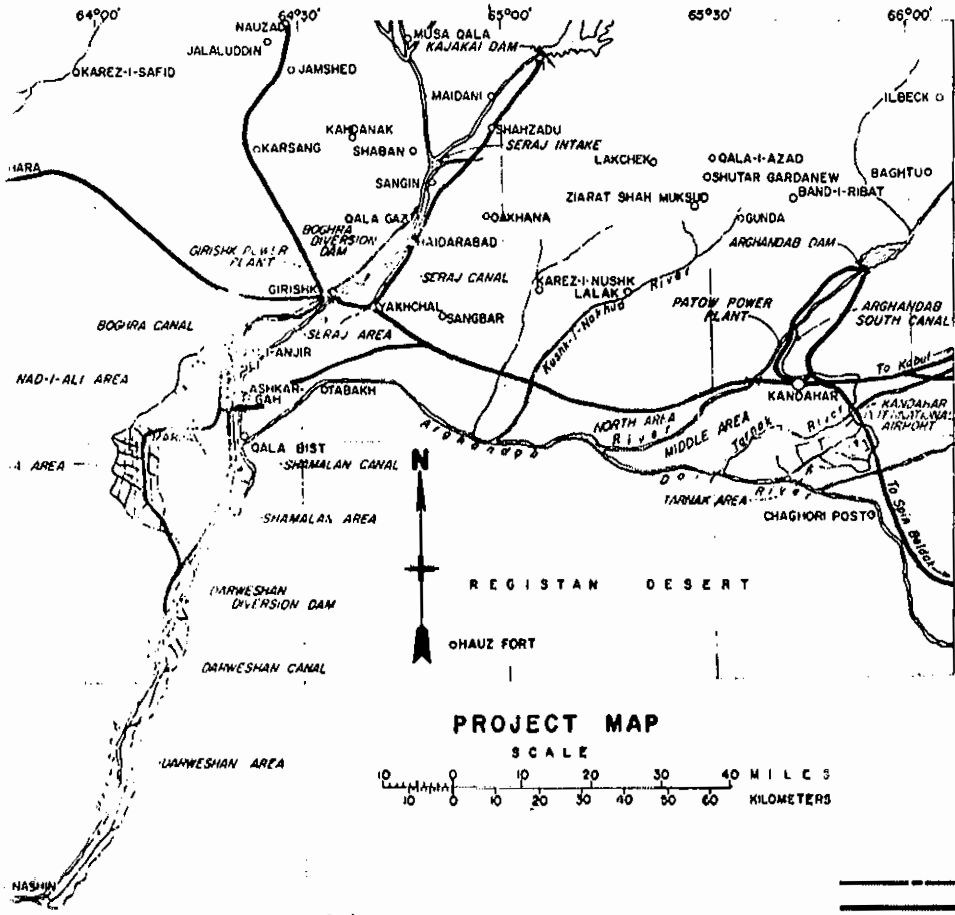
Drawin

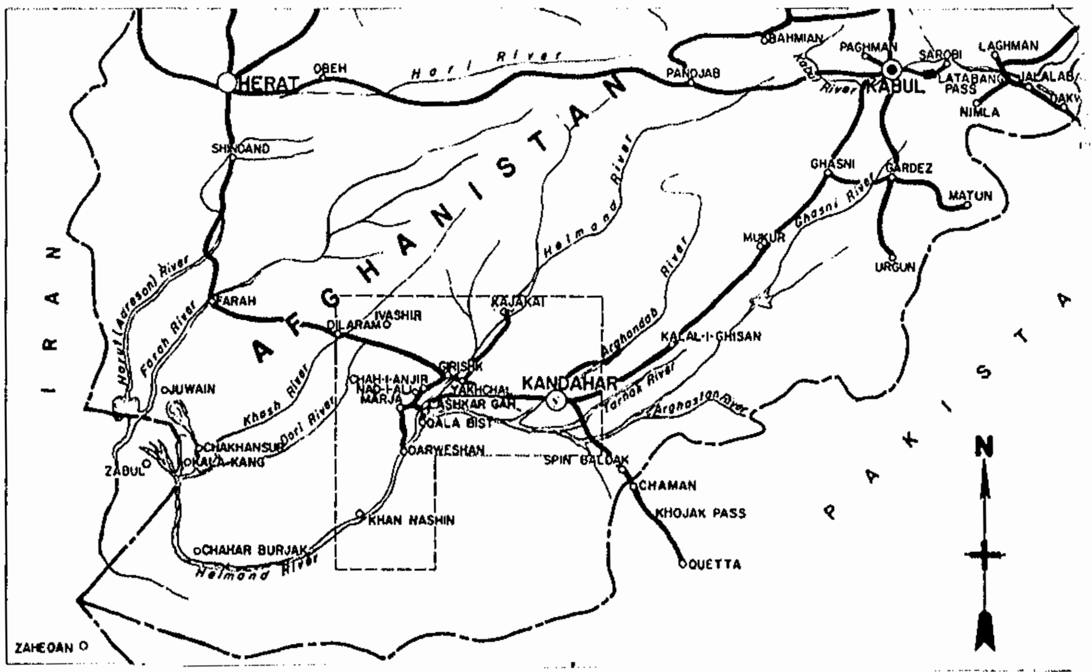


PROJECT MAP

SCALE

10 0 10 20 30 40 MILES

10 0 10 20 30 40 50 60 KILOMETERS



KEY MAP

SCALE

100 0 100 200 MILES

100 0 100 200 300 KILOMETERS

LEGEND:

- INTERNATIONAL BOUNDARY LINE
- ROAD
- CANAL AND LATERAL
- OUTLET DRAIN AND WASTEWAY
- RIVER
- CREEK
- BRIDGE

HELMAND VALLEY AUTHOR[ITY]	
AFGHAN CONSTRUCTION	
LOCATION OF PROJECTS -	
DRAWN BY jose's dondo, jr	CHECKED BY
DATE march 14, 1962	APPROVED
DRAWING NO MC-107	CONCURRED BUREC

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not go down. After prying the weight loose from the guides and dislodging the rope drum shaft from its bearings with a bar, the automatic mechanism began to work, but very sluggishly. The clutch (Figure 31) on the end of the rope drum shaft which should slide freely by hand could not be shifted even by forcing it with a bar. In examining the shaft it was found that lack of greasing and accumulation of dirt, grit and hardened grease had bound the bearings to the shaft so tight that it required tremendous force to turn it.

It was reported that the Main Canal tainter gates vibrated violently at certain openings. An examination of the gates disclosed that one hoist rope (Figure 32) was completely rusted through, others badly rusted and frayed, rope clamps were loose and some clamp nuts missing, shaft bearings were dry, and grease fittings were missing. The hoist rope anchors (Figure 33) on the drums are arranged so that the loose end of the rope lies across the bottom of the drum and the rope winds over it at random. In some cases the rope has been purposely wound over the loose end to prevent it from slipping. In any case, these conditions are damaging to the ropes, and will cause unequal tension, which is likely to increase the tendency to vibrate. Grease that has been used on open gears of the rope hoist has combined with sand and hardened, so that it becomes more harmful to gears than no grease at all.

The concrete approaches at both ends of the concrete bridge over the gate structure have separated 2 to 4 inches (Figure 34) at the joint of the first pier on both sides of the canal. This appears to have occurred from settling of the canal bank as the main structure does not show any faults or cracks.

Although this structure is of major importance in supplying continuous service from the Girishk Powerplant, which is the only source of power in the area, no provisions were made for stoplog guides or any other convenient means of repairing or servicing the gates without shutting down the powerplant. However, it is possible to replace cables or service the gates, one at a time, by using a specially constructed A-frame on top of the structure to lift the gates out of the water. Special scaffolding will be needed to reach the gates for servicing and painting.

Sheila Lui Manda Wasteway (Sta. 29+865·00)

The Sheila Lui Manda Wasteway structure consists of two 18- by 11.5-foot tainter check gates across the Main Canal, and one 26- by 9.5-foot manually operated and one 6- by 7.5-foot automatically operated tainter wasteway gate. It was reported that the automatic mechanism has never worked. The gate is small, constructed very light, lifted by one rope and the inlet into the floatwell was found covered with mud. Due to surrounding developments, future use of the automatically controlled gate will likely never be required. However, if the gate is to remain on the structure, it should be maintained; if not it should be removed and the opening permanently blocked with concrete. Gates in the Main Canal have been painted recently and are in excellent condition.

Darweshan Diversion Dam

The Darweshan Diversion Dam is one of the most recently constructed structures on the canal system and is decidedly one of the best. It appears to be in excellent condition.

A secondary structure is provided about 1.2 miles (2 kilometers) downstream from the diversion dam. This structure is provided with three wooden gates for the purpose of shutting off flows which could overtop and damage the canal downstream. The canal upstream from the structure, however, is not protected, as no wasteway has been provided to discharge flood water which would be intercepted from the hillside on which the canal is located.

The wooden gates are controlled by a hand operated wire rope hoist but, the gates are wedged so tight in the slots that none could be moved.

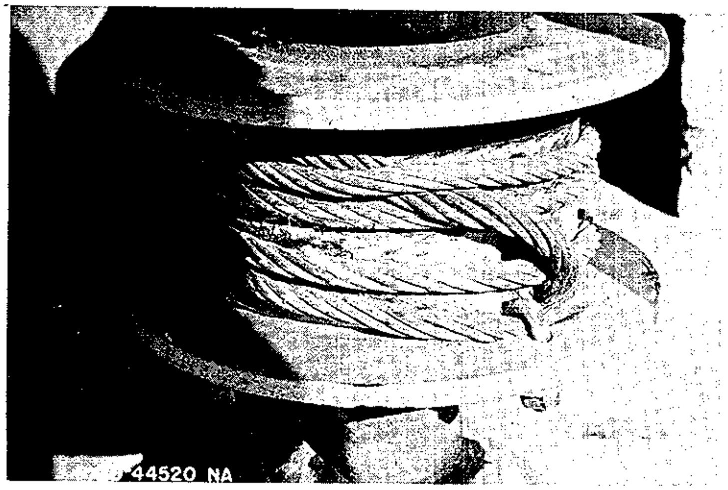


Figure 33.--Boghra Canal Wasteway. Wire rope drum shows type of anchorage and rope winding over loose end.

Figure 34.--Boghra Canal Wasteway. Approach to gate structure bridge has separated 2 to 4 inches at the joint on the first pier.

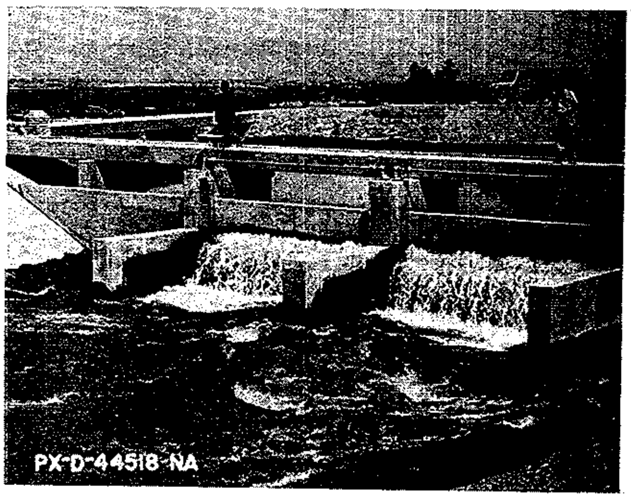


Figure 35.--Canal checkgates. Water flowing through a partially opened top-seal tainter gate which has a corrugated skinplate.

Other Structures

Other similar small structures, such as canal checks, branch canal outlets, and wasteways were examined on the canal system. Many of the small tainter gates (Figure 35) in check structures were top-seal types with corrugated galvanized skinplate. When these gates operate at any intermediate opening, extensive leakage occurs at the top seal because the seal is tight only in the closed position. The amount of leakage is of no consequence, but the continuous flow of water over the back side of the gate is causing considerable deterioration of paint and corrosion of the galvanized skinplates. Many of the hoisting mechanisms have been damaged by heavy traffic passing on narrow bridges over the structures. Small parts of hoisting mechanisms such as nuts, bolts, clamps, and grease fittings are missing.

Canals

Canals in general are being kept in satisfactory serviceable condition. Heavy equipment such as draglines and a Gradall (Figure 36) is being used in the cleaning and repair work of canals. An objectionable feature of the cleaning operation of canals is that large, tall and irregular piles of material are left on canal banks. This condition is not only unsightly but leaves material where it can easily wash or blow back into the canal. The material also forms mudholes which are destructive to the canal banks and roadways (Figure 37). Some canals have been lined with compacted earth and other portions are being lined with compacted earth for more efficient irrigation operations. Most canal banks have fair roads on at least one side and are used for public traffic (Figure 38). Roads on the main canals are gravelled and in good condition.

SUMMARY AND COMMENTS

The Boghra, Shamalan and Darweshan Canals systems were visited to examine all facilities and determine what repairs and maintenance are needed to sustain dependable service in the future, and to establish an inspection program.

Tainter gates, sluice gates, hoisting equipment, and gantry crane were examined at the Boghra Canal Diversion Dam. The operator commented on the unsatisfactory service of the lifting beam used to handle the sluice gates.

Concrete structure, tainter gates, hoisting equipment and automatic controls were examined at Station 10+917.00 wasteway and check gate structure. Automatic controls do not operate satisfactorily, the wire rope drum shaft was binding in bearings, the counterweight was sticking, and the clutch jaw was bound tight to the shaft and could not be shifted on the wasteway gates. It was reported that the check gates vibrated violently. One hoist rope was rusted through, other ropes are badly rusted, anchorage of hoist ropes is unsatisfactory, and hoist gears are covered with hardened grease and dirt which is harmful to gears. The footbridge over the structure has separated at the joint on top of first pier on both sides of canal. Provisions were not made for convenient maintenance of gates on this structure without shutting down the powerplant.

Automatic wasteway facilities do not work at the Sheila Lui Manda Wasteway structure. It is possible that it may never be used, but it should be serviced or salvaged for another location. Other facilities were in good condition.

The Darweshan Diversion Dam was in excellent condition. The secondary structure, downstream from the diversion dam, which is intended for flood protection, has wooden gates which are completely inoperable. If the gates should be closed, no provisions have been made for spilling floodwater on the upstream side of the structure to prevent overtopping the canal banks.

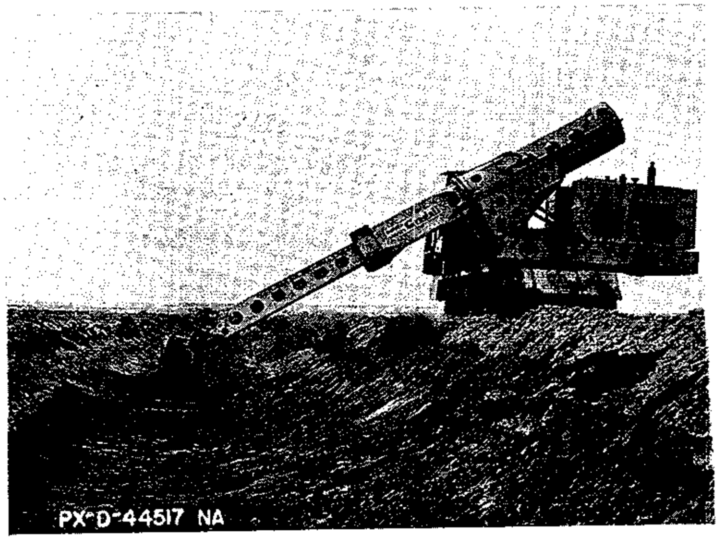


Figure 36. --Canal cleaning. A Gradall being used to clean a canal.

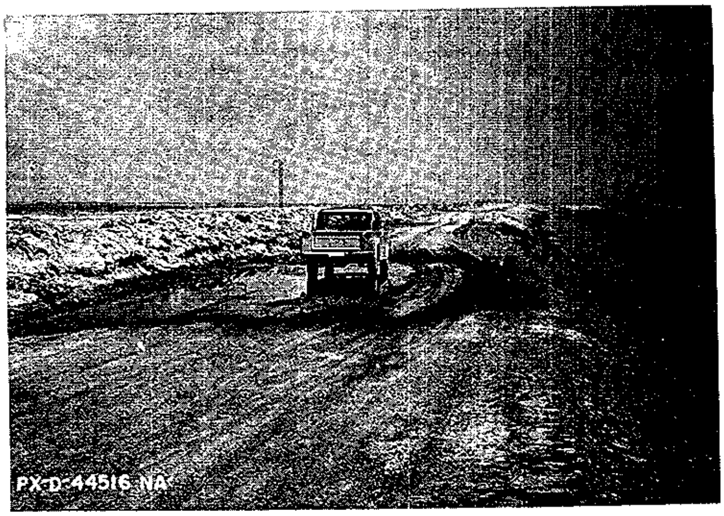


Figure 37. --Canal bank. Mudhole formed on canal roadway by blocking drainage with material removed from canal when cleaning.

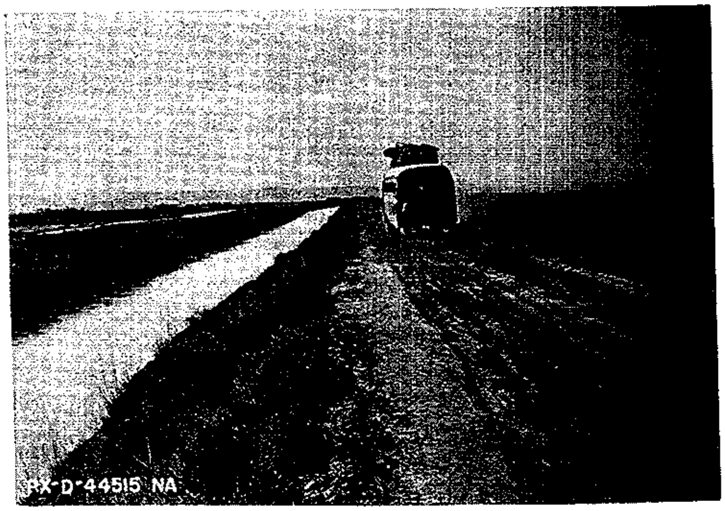


Figure 38. --Canal roadway. Narrow road on the bank of a small canal used for a public highway.

Many other small structures such as canal checks, branch outlets and wasteway outlets of the same nature were examined. Small, top seal tainter gates with corrugated galvanized skinplate were badly corroded and rusted. Hoisting facilities have been damaged by heavy traffic on canal banks, and many small parts such as nuts, bolts and grease fittings are missing.

In general all canals are in good condition. Heavy equipment such as draglines and a Gradall is being used for cleaning and repairing canals.

RECOMMENDATIONS

Category I (Matters of great importance)

1. Remove all bearing covers from the wire rope drum shafts, clean bearings and shaft bearing surface with kerosene or some suitable solvent that will remove the dried grease and dirt. Smooth bearing surfaces, if necessary, and reassemble.

2. Check to see that all grease holes in bearings are open, replace missing grease fittings, and grease all shaft bearings once a month during irrigation season.

3. Make sure that wire ropes on each gate have equal tension and are securely anchored both on the gate, and on the drum.

4. Clean all open gears of hoist mechanism and operate gears dry. Grease when mixed with sand is more harmful to gear than no grease at all.

5. All tainter gates and metalwork should be examined once a year for deteriorated or damaged paint. Paint repairs or repainting, if needed, should be done immediately.

BOGHRA DIVERSION DAM

Category I

1. Wheels on the stoplogs and bearings on the rope drum shafts on this structure should be greased once a month the year around.

BOGHRA CANAL WASTEWAY AND CHECK GATES

Category I

1. The weir well, floatwell and counterweight wells should be cleaned of all silt and debris, and all metalwork and weir well equipment should be painted once a year.

2. Replace all ropes on this structure with stainless steel wire ropes.

3. A special design of A-frame should be made that will rest on top of the check gate structure to raise tainter gates one at a time, above water for replacing wire ropes or servicing the gates. The A-frame should be made so that it can be moved from one gate to the other.

Category II (To prevent or reduce further damage)

1. Modify the wire rope drums by drilling a hole through the drum flange so that the loose end of the rope can be clamped from both sides with the U-bolt to prevent slippage. This provision will prevent the objectionable condition, which presently exists, of winding the wire rope over the projecting loose end beyond the U-bolt.

2. Vibration of tainter gates results from fluctuating pressures under the bottom seals and beams when the tailwater is above the lower beam. Fluctuating pressures can result when music note seals or closed beams are used across the bottom of the gate as shown in Detail B2, Drawing No. 9.

Vibration may be minimized or eliminated by replacing the music note seals with a flat rubber seal, by cutting holes through the web of the lower beam, and by cutting off the lower half of the downstream flange of the bottom beam. See Detail B1, Drawing No. 9, noting flange reinforcement.

3. The approaches on the footbridge across the structure should be broken loose at the canal bank and moved back into position at the joint of the first pier on both sides of the canal. The space left at each canal bank should be backfilled with concrete.

SHEILA LUI MANDA WASTEWAY

Category II

1. The 6- by 7.5-foot automatically operated wasteway gate should be completely rehabilitated and maintained if it is to remain in service. It is believed that the gate will operate satisfactorily if the operating mechanism is cleaned, painted and properly balanced and adjusted. The gate is small and light; so care must be taken to be sure the gate is accurately alined and operates freely without binding.

DARWESHAN CANAL

Category II

1. The wooden gates on the secondary control structure, which is located downstream from the Darweshan Diversion Dam, should be repaired and maintained in an operable condition for emergency use. It is believed that the present wooden gates can be made serviceable by dislodging the gates and properly fitting them in the slots. The gates should be operated by the rope hoist the same as other gates and the block method of suspension should be completely eliminated.

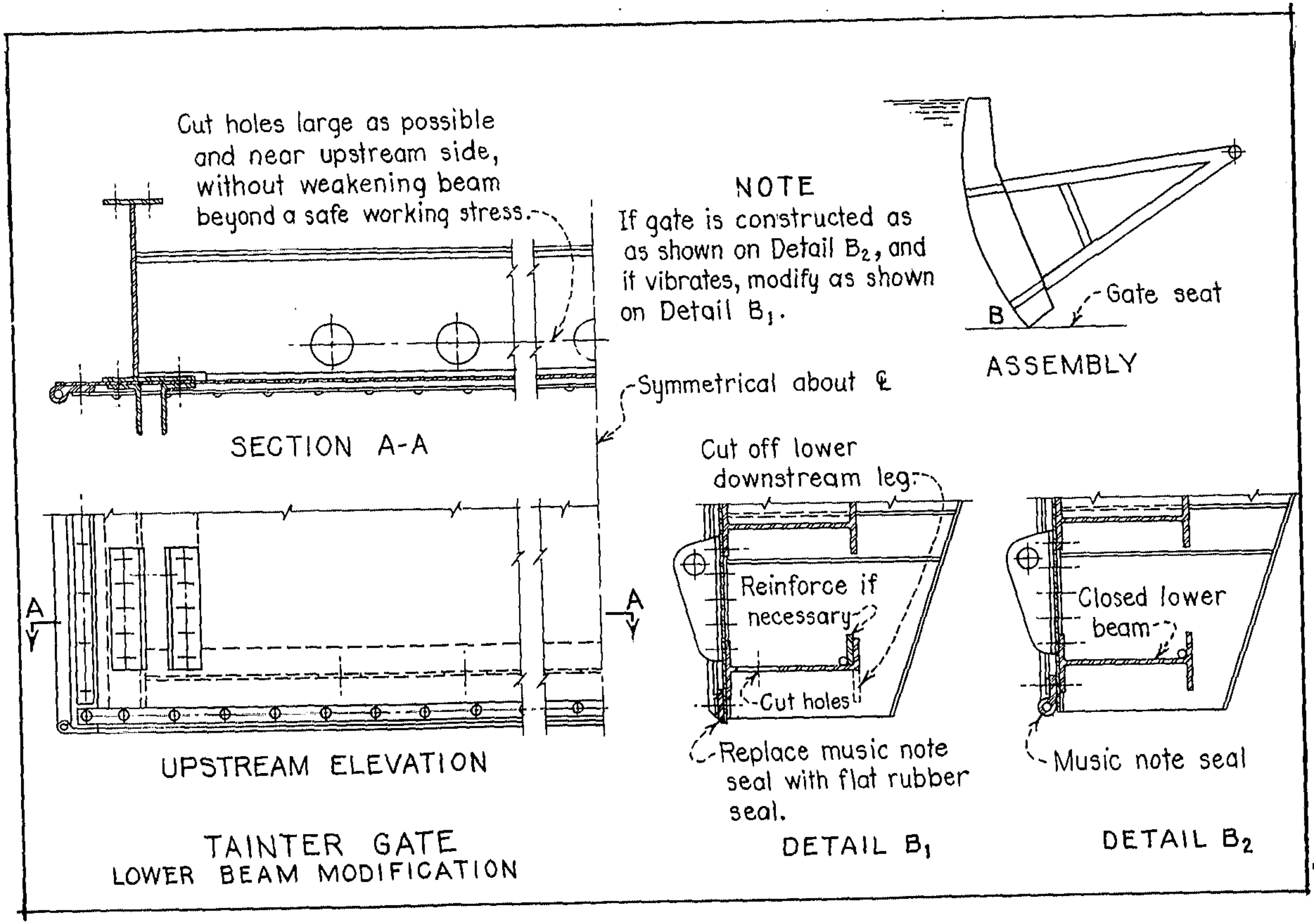
2. The secondary structure, 1.2 miles (2 kilometers) downstream from the Darweshan Diversion Dam, is of an important nature and it should be restored to serviceable condition. A wasteway weir should be constructed to discharge excess floodwater to prevent overflowing the canal banks.

Dates of inspection

January 30, February 4, 5, and 6, 1964

Operation status at time of inspection

Approximately 1,900 cubic feet of water were flowing in the Boghra Canal past the Girishk Powerplant and was being diverted back to the river at the Boghra Canal Wasteway. The rest of the canal system was dry except where small quantities of water were required for domestic purposes.


Cut holes large as possible and near upstream side, without weakening beam beyond a safe working stress.
SECTION A-A
NOTE
If gate is constructed as as shown on Detail B₂, and it vibrates, modify as shown on Detail B₁.
Gate seat
B
ASSEMBLY
Symmetrical about ℄
A
A
UPSTREAM ELEVATION
Cut off lower downstream leg.
Reinforce if necessary
Cut holes
Replace music note seal with flat rubber seal.
DETAIL B₁
Closed lower beam
Music note seal
DETAIL B₂
TAINTER GATE
LOWER BEAM MODIFICATION

Drawing No. 9

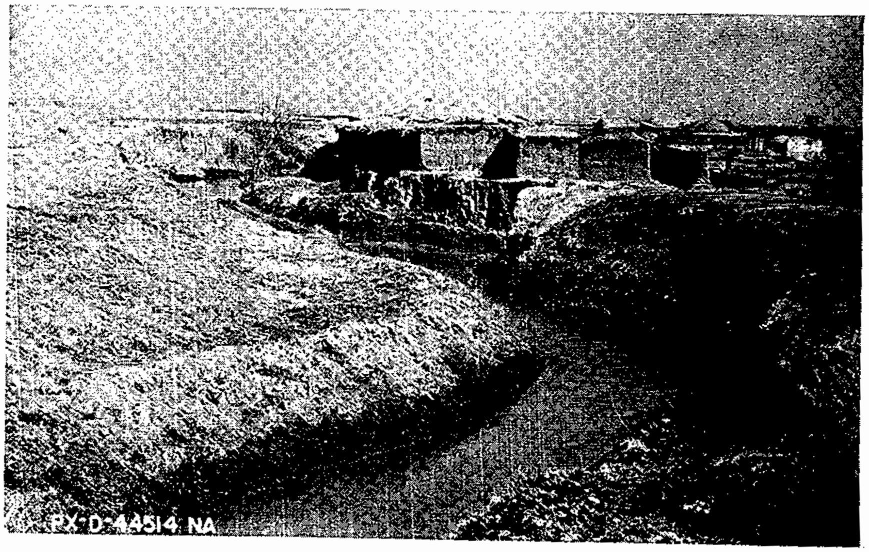


Figure 39.--Ancient Canal. Type of irrigation canals used prior to the Helmand Valley Development Project.

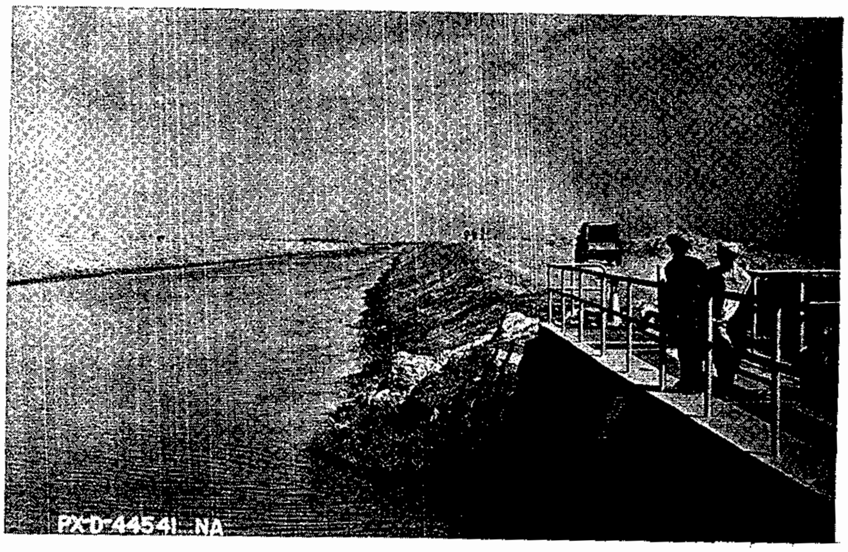


Figure 40.--Modern Canal. A view of a 2, 600-cubic-feet-per-second canal now being used for agriculture development in the Helmand Valley.

Inspection party

January 30, 1964	M. H. Parwana--Assistant Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan Carroll Wilcomb--Chief, Operations and Maintenance Division, Bureau of Reclamation
February 4, 1964	A. Tawab Assifi--Director General, Operations and Maintenance, Helmand Valley Authority, Afghanistan Abdul Shuja--Director of Irrigation, Helmand Valley Authority, Afghanistan Thomas Dewhurst--Construction Management Engineer, Bureau of Reclamation
February 5, 6, 1964	Same as for February 4, except Mr. Shuja was not included.

SECTION V

Recommendations For Field Examination on HELMAND VALLEY DEVELOPMENT PROJECT

Afghanistan

RECOMMENDATIONS FOR FIELD INSPECTIONS

OF

DAMS, POWERPLANTS

AND

IRRIGATION DISTRIBUTION SYSTEMS

Helmand Valley Authority

These recommendations require that field inspections be made of all irrigation facilities in the Helmand Valley that are under the jurisdiction of the O&M Division. These inspections are to assure protection of the RGA (Royal Government of Afghanistan) investment in such facilities, and the responsibility for the supervision of these inspections is assigned to the Division of Irrigation Operations. It is required that major structures of these irrigation facilities be inspected at 1-year intervals and other project facilities as may be deemed necessary.

Major structures on the Main Canal Systems are to be inspected by representatives of the Irrigation Operations Division Office. Project facilities outside of the Main Canal Systems are to be inspected by the corresponding Project Watermaster Offices who will in turn submit their reports to the Director of Irrigation.

Objective

The objective of these recommendations is to strengthen the maintenance program by developing procedures for and approaches to the inspections, bring about greater uniformity and avoid unnecessary difficulties and duplication. Toward this end, representatives of the Operation and Maintenance Division should consider these objectives in field inspections.

Preparation for Field Review

The Division of Irrigation Operations has on file copies of all inspection reports prepared by previous inspection teams. A summary of all recommendations made by previous inspection teams is also maintained by the division. This information will be supplied to the representatives who will make the inspections, and should be reviewed by them before making inspections. If it is believed other features on a particular project should be inspected during the scheduled field review, this should be called to the attention of the inspection team.

Before proceeding to the field, the selected inspection team should meet with the President of the Operation and Maintenance Division to further discuss the field review. This meeting should be arranged about 3 weeks prior to the time the representatives are to proceed to the field so there will be time for additional preparations if necessary.

Field Inspection

The following are suggested as guides and requirements for the inspection teams:

1. Review the reports made of previous inspections by Watermasters and Irrigation Operations Division personnel and the recommendations made as a result of previous inspections.

2. Consider problems raised by other Divisions of the Helmand Valley Authority.

3. The O&M Division should arrange, where appropriate, for participation in the inspections by responsible members of other divisions of the Helmand Valley Authority.

4. Discuss proposed recommendations with the General Director of Operations or his representatives before submitting a report. Agreement should be reached with responsible officials on all important recommendations before a report is submitted to the President of the O&M Division for approval.

5. In preparing reports on individual structures, remember that the report will be carefully studied and may serve as a guide in treating future project problems.

Recommendations

The numerous unusual and abnormal conditions encountered in the inspection of a project necessitate considerable flexibility in the types of recommendations that should be made by the inspection teams. It is advisable to recognize, however, certain categories of recommendations which take into consideration the importance of the problem in question. Most situations, it is believed, can be covered by three categories outlined below and inspection teams are requested to classify all recommendations by categories.

Category I

Recommendations in this category involve matters of great importance and set forth remedial action to be completed in a prescribed period, usually 3 months or less, to insure structural safety or to avoid serious malfunctioning of a facility. When an inspection report, including such a recommendation is approved by the President of O&M, it will constitute definite instructions to appropriate divisions to take action. The Division of Irrigation Operations will follow up recommendations in this category, requesting written reports from the responsible division at 3-month intervals on the status of the work recommended.

Category II

Recommendations in this category cover a wide range of important matters where action is needed to prevent or reduce further damage or preclude operational failure. The remedial measures prescribed and the timing may be indefinite, depending on the circumstances involved, but are generally expected to be programed and completed as a part of the project's normal maintenance program. Careful attention should be given to all such recommendations, and the responsible division will be requested to follow up yearly to assure reasonable progress.

Category III

Recommendations in this category will cover matters of less importance which the inspection team believes to be sound and beneficial to the project or project feature. No follow-up records will be kept, and mention of progress in future reports will not be required as long as the recommendation remains in this category. Recommendations in this category may, at some later date, be placed in a higher category to emphasize the need for corrective work.

From the above, it will be seen that Category I recommendations will be used very infrequently. Few conditions calling for such rigorous measures are likely to be encountered by most inspection teams. More recommendations will fall in Category II. However, care should be taken to include only problems of considerable importance. Minor matters can be placed in Category III, covered by general comments in the report, or by discussions in the field at the discretion of the field inspection team.

The Inspection Report

Reports should be brief and to the point, with detail only given on those conditions requiring attention. Reports should include the date of the inspection, a list of those participating in the inspections, features inspected, reference drawings, and conditions under which the structure is being operated at the time of inspection, such as water surface elevations, amount of water being discharged, and so forth. Reference can be made to previous reports or other documents for general descriptions of the structures and facilities, and only those matters essential to an understanding of conditions discussed need be included in the report.

Review of the report will be greatly facilitated if the writers will comment on the progress made in acting on the recommendations of previous reports. All previous recommendations that have not been acted upon should be discussed. They should be repeated in the new report if the action taken has not corrected the deficiency, if no action has been taken, or if they can be deleted because changing conditions so dictate. If a condition has worsened and earlier corrective action is needed, the recommendations can be changed to a higher category.

The use of photographs to illustrate conditions will reduce the description necessary, shortening the report. Photographs taken from the same position as those of previous reports will also add materially in showing the additional deterioration or progress in maintenance. However, photographs should be limited to only those essential to a better understanding of the problems encountered.

A reference to drawings can serve a similar purpose in the inspection report, but should only be included when the problem cannot be otherwise adequately described or when instructions to the field forces are necessary. Major repairs, involving preparation of detailed instructions and drawings should be handled by a separate report.

It has been suggested that uniform terms be used in describing the operability of equipment and the structural sufficiency of the facilities. Terms suggested are:

1. Excellent, no work required.
2. Satisfactory, only minor deficiencies (Category III).
3. Fair, maintenance needed (Category II).
4. Poor, major repairs needed (Category I).
5. Inoperable, replacement needed (Category I).

SAMPLE FORMS
FOR
INSPECTION REPORTS

The following sample forms cover a list of items that should be inspected during a periodic inspection of the following features of irrigation and power projects:

1. Dams and powerplants.
2. Diversion dams and headworks.
3. Major wasteway structures.
4. Irrigation distribution system.

These forms are furnished only as guides and may be combined, simplified or revised to suit any specific condition required. Forms of this type will provide the inspector with a check list which will be helpful in preventing oversights during inspection and will save considerable inspection time.

INSPECTION

OF

DAMS AND POWERPLANTS

NAME OF DAM ______________________

PROJECT ______________________

DATE OF INSPECTION ______________________

STRUCTURE COMPLETED--YEAR ______________________

OPERATIONAL STATUS AT TIME OF INSPECTION ______________________

RESERVOIR WATER SURFACE ____________ ELEVATION ____________

WATER IN STORAGE ____________ ACRE FEET ____________ (APPROX.)

RESERVOIR RELEASES ______________________

____

INSPECTION PARTY

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

FACILITIES INSPECTED

1. DAM ______________________
2. SPILLWAY ______________________
3. GANTRY CRANE ______________________
4. OUTLET WORKS ______________________
5. POWERPLANT ______________________
6. BUILDINGS ______________________
7. WORKSHOPS ______________________
8. ROADS ______________________
9. OTHER ______________________

REFERENCE DRAWINGS

NO. ______________________

NO. ______________________

NO. ______________________

NO. ______________________

PREVIOUS INSPECTIONS

GENERAL INFORMATION

DAM

LOCATION ______

KIND ______

HEIGHT ______ STRUCTURAL ______ HYDRAULIC ______

WIDTH TOP ______ BASE ______

CREST LENGTH ______ ELEVATION ______

SPILLWAY

LOCATION ______

SIZE ______

CREST LENGTH ______ ELEVATION ______

CONTROL ______

MAX. CAPACITY ______

GANTRY CRANE

CAPACITY ______

OUTLET WORKS

NUMBER OF OUTLETS ______

SIZE OF OUTLETS ______

EMERGENCY CONTROLS ______

SERVICE CONTROLS ______

CAPACITY OF OUTLET WORKS ______

POWERPLANT

NUMBER OF UNITS ______

CAPACITY OF UNITS ______

KIND OF UNITS ______

INSPECTION

DAM

1. UPSTREAM FACE ______
2. DOWNSTREAM FACE ______
3. ABUTMENTS ______
4. EROSION ______
5. ROADWAY ______
6. PARAPETS ______
7. DETERIORATION OF CONCRETE ______
8. DRAINS ______

9. GENERAL APPEARANCE ____________________

10. COMMENTS MADE BY OPERATING PERSONNEL ____________________

____

____

____

____

SPILLWAY

1. APRON ____________________
2. CREST ____________________
3. WALLS ____________________
4. PIERS ____________________
5. STILLING BASIN ____________________
6. GATES ____________________
7. GATE HOISTS ____________________
8. BRIDGE ____________________
9. OPERATION OF CONTROLS; TYPE, CONDITION, ETC. ____________________

____

____

____

____

10. PAINT ON GATES, BRIDGE, AND METALWORK ____________________

____

____

____

____

11. GENERAL APPEARANCE ____________________

____

____

____

____

12. COMMENTS MADE BY OPERATING PERSONNEL ____________________

____

____

____

____

GANTRY CRANE

1. MOTORS ____________________
2. CONTROLS ____________________
3. BRAKES ____________________
4. CABLE ____________________

5. PAINT ____________________

6. GENERAL APPEARANCE ____________________

OUTLET WORKS

1. UNWATERED ? ____________________

2. CONDUIT ____________________

3. EMERGENCY GATES:

   a. OPERATING FREQUENCY ____________________

   b. CONTROL ____________________

   c. OPERATING CHARACTERISTICS ____________________

   d. SEALING EFFICIENCY ____________________

   e. CAVITATION ____________________

   f. EROSION ____________________

   g. PAINT ____________________

   h. COMMENTS MADE BY OPERATING PERSONNEL ____________________

4. REGULATING VALVES

   a. OPERATING FREQUENCY ____________________

   b. CONTROLS ____________________

   c. OPERATING CHARACTERISTICS ____________________

   d. SEALING EFFICIENCY ____________________

   e. CAVITATION ____________________

   f. EROSION ____________________

   g. PAINT ____________________

   h. COMMENTS MADE BY OPERATING PERSONNEL ____________________

5. INTAKE STRUCTURE ____________________

Powerplant

1. *Motor Generator*

LOCATION __________ DATE OF INSPECTION __________
PURPOSE OF UNIT __________ UNIT No. __________
MFR. OF UNIT __________
RATING:
VOLTS __________ AMPS __________ PHASE __________ FREQ. __________
H.P. __________ KW __________ KVA. __________ P.F. __________ %
R.P.M. __________ TYPE __________
FRAME SIZE __________ SERIAL No. __________
FIELD OR SEC. AMPS __________ VOLTS __________
KIND OF BEARINGS __________
____
MAIN EXCITER: KW __________ VOLTS __________ AMPS __________
TYPE __________ SERIAL No. __________
PILOT EXCITER: KW __________ VOLTS __________ AMPS __________
TYPE __________ SERIAL No. __________

CONDITION OF UNIT AND AUXILIARY DEVICES:
COIL INSULATION __________
FIELD COIL RESISTANCE __________ OHMS AT __________ °C.
MAIN EXCITER FIELD COIL RESISTANCE __________ OHMS AT __________ °C.
PILOT EXCITER FIELD COIL RESISTANCE __________ OHMS AT __________ C.
FRAME AND ROTOR __________
STATOR AND ROTOR LAMINATIONS __________
SHAFT __________
COUPLING __________
BEARINGS __________
ANY OIL LEAKS? __________
BEARING OIL __________
COLLECTOR RINGS __________
COMMUTATOR __________
BRUSHES __________
COLLECTOR RING OPERATION __________
COMMUTATION __________
IF TROUBLE IS EXPERIENCED GIVE:
BRUSH GRADE __________ SIZE __________ NUMBER __________
COLLECTOR-RING MATERIAL __________ MAX. AMPS __________
SPRING PRESSURE __________ LBS. RING OR COM. DIA. __________ IN.
MISALINEMENT OR VIBRATION? __________
DOES END PLAY FLOAT FREELY? __________
BEARING THERMOMETERS OR THERMOSTATS __________
BEARING OIL GAGE OR SWITCH __________
BEARING COOLING-WATER PRESSURE GAGE OR SWITCH __________
STATOR TEMP. INDICATOR OR THERMOSTAT __________
FIRE PROTECTIVE EQUIPMENT __________

AIR GAP CLEARANCE (INCH)	TOP NORTH	RIGHT EAST	BOTTOM SOUTH	LEFT WEST
MAIN UNIT				
MAIN EXCITER				
PILOT EXCITER				

(MEASURE OPPOSITE SAME SPOT ON ROTOR FOR EACH POSITION IF PRACTICAL)

WAS INSULATION RESISTANCE MEASURED?

(REPORT DATA ON FORM O&M 109)

MAXIMUM LOADING AND TEMPERATURES OF UNIT (FROM LOG SHEETS OR TEST)

DATE					
HOUR					
A.C. AMPS.					
A.C. KV.					
KW.					
KVAR. P.F.					
FIELD AMPS.					
FIELD VOLTS					
PILOT EXCITER AMPS.					
PILOT EXCITER VOLTS					
TURBINE GATE OPENING					
TURBINE NET HEAD					
STATOR TEMP. °C.					
INLET AIR TEMP. °C.					
THRUST BRG. TEMP. °C.					
UPPER GUIDE BRG. TEMP. °C.					
LOWER GUIDE BRG. TEMP. °C.					
TURBINE GUIDE BRG. TEMP. °C.					
COOLING WATER TEMP. °C.					
AMBIENT TEMP. °C.					

REPAIRS OR CHANGES MADE AT TIME OF THIS INSPECTION

OTHER REPAIRS OR CHANGES RECOMMENDED

INSPECTION MADE BY:

NOTE: CROSS OUT ALL ITEMS WHICH DO NOT APPLY TO THE UNIT COVERED BY THIS INSPECTION.

2. Turbine

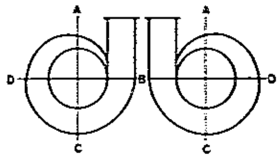
PROJECT________________ POWERPLANT________________ UNIT NO ________ DATE________

CLEARANCES BETWEEN UPPER AND LOWER CURB PLATES AND WICKET GATES			CLEARANCES BETWEEN WICKET GATES, CLOSED POSITION WITH PRESSURE RELEASED *			CLEARANCES BETWEEN UPPER AND LOWER CURB PLATES AND WICKET GATES			CLEARANCES BETWEEN WICKET GATES, CLOSED POSITION WITH PRESSURE RELEASED *		
GATE	UPPER	LOWER	TOP	MIDDLE	BOTTOM	GATE	UPPER	LOWER	TOP	MIDDLE	BOTTOM
1						13					
2						14					
3						15					
4						16					
5						17					
6						18					
7						19					
8						20					
9						21					
10						22					
11						23					
12						24					

* CONSIDER CLEARANCE BETWEEN GATES NO. 1 AND 2 AS NO. 1, ETC.

CLEARANCES				
	POSITION			
PART	A	B	C	D
UPPER WEARING RING				
LOWER WEARING RING				
TURBINE GUIDE BEARING, LOWER END				
TURBINE GUIDE BEARING, UPPER END				
POSITION ** OF CROWN AND CURB PLATE				
POSITION ** OF BAND AND CURB PLATE				

** HIGH OR LOW WITH RESPECT TO CURB PLATE



CONDITIONS OF:

PAINT AND KIND, OR IF BARE, METAL SURFACES OF, INCLUDING LOCATION OF PITTING AND EROSION AREAS AND SIZE AND DEPTH OF DAMAGED AREAS

SCROLL CASE:________________________________

____

____

PENSTOCK:________________________________

____

____

SPEED RING, WICKET GATES, CURB PLATES:________________________________

____

____

DRAFT TUBE:________________________________

____

____

____

____

RUNNER:________________________________

____

____

____

____

CONDITION OF:

OIL PUMP:

GAGES:

SHAFT PACKING:

LEAKAGE,........GPM, TYPE..,NEED REPACKING?

GATE STEM PACKING:

LEAKAGE,.......GPM, TYPE..,NEED REPACKING?

HEAD GATE:

LEAKAGE,.......GPM, LOCATION.., TYPE

GLANDS AND LANTERN RING:

SHAFT AT GLAND:

SHIFTING MECHANISM:

THRUST COLLARS:

PINS AND JOURNALS:

GATE STEMS AND BUSHINGS:

LIST ALL BUSHINGS WITH EXCESSIVE CLEARANCE:

SHIFT RING:

TURBINE GUIDE BEARING:

BEARING:

JOURNAL:

OTHER ITEMS:

NAME, MANUFACTURER AND VISCOSITY OF OIL USED:

NAME, MANUFACTURER AND GRADE OF GREASES USED:

REMARKS AND RECOMMENDATIONS:

INSPECTION MADE BY

3. Transformer

LOCATION ________ DATE OF INSPECTION ________

PURPOSE OF BANK ________ BANK No. ________

MFR. OF TRANSFORMERS ________

RATING:

HIGH VOLTAGE ________

MEDIUM VOLTAGE ________

LOW VOLTAGE ________

(UNDERLINE TAP OR VOLTAGE USED)

KVA PER TANK ________

PERCENT IMPEDANCE ________

TYPE ________ COOLING ________

FREQ. ________ CYCLES. PHASE ________ TEMP. ________ °C ________

SERIAL NUMBERS ________

BUSHINGS:	TYPE	MFR.	C.T. RATIOS	P.D. RATIOS
H.V.				
M.V.				
L.V.				

(UNDERLINE RATIO USED)

CONDITIONS OF TRANSFORMERS AND AUXILIARY DEVICES:

TANK AND RADIATORS ________

ANY OIL LEAKS? ________

____

____

COOLING FANS ________

BUSHINGS ________

GROUND CONNECTIONS ________

GROUND RESISTANCE ________

ARE TRANSFORMERS NOISY? ________

THERMOMETERS ________

TEMPERATURE RELAYS ________

OIL-LEVEL GAGES ________

OIL-LEVEL ALARM RELAYS ________

COOLING WATER SIGHT FLOW ________

TAP CHANGERS ________

AUTO-LOAD RATIO CONTROL ________

IS PRESENT RANGE ADEQUATE? ________

NITROGEN PURITY, % OXYGEN ________

NITROGEN PRES. IN TRANSFORMER ________

NITROGEN TANK PRES. ________

PRESSURE RELIEF ________

CONSERVATOR ________

CORE ________

ARE ALL CLAMPING BOLTS TIGHT? ________

COIL INSULATION ________

COOLING COILS ________

CONDITION OF INSULATING OIL ____________________

WAS OIL TESTED? ____________________

WAS INSULATION RESISTANCE TESTED? ____________________

(RECORD OIL AND INSULATION DATA ON FORM O&M 109)

MAXIMUM LOADING AND TEMPERATURES OF TRANSFORMERS (FROM LOG SHEETS OR TESTS)

DATE					
HOUR					
AMPS.					
KV.					
KW.					
KVAR. P.F.					
KVA.					
ΦA OIL TEMP. °C.					
ΦA RTD TEMP. °C.					
ΦB OIL TEMP. °C.					
ΦB RTD TEMP. °C.					
ΦC OIL TEMP. °C.					
ΦC RTD TEMP. °C.					
AMBIENT TEMP. °C.					
COOLING WATER IN - TEMP. °C.					
COOLING WATER OUT - TEMP. °C.					

REPAIRS OR CHANGES MADE AT TIME OF THIS INSPECTION ____________________

OTHER REPAIRS OR CHANGES RECOMMENDED ____________________

INSPECTION MADE BY: ____________________

NOTE: CROSS OUT ALL ITEMS WHICH DO NOT APPLY TO THE TRANSFORMERS COVERED BY THIS INSPECTION.

4. Powerplant Crane

a. MOTORS ____________________

b. CONTROLS ____________________

c. BRAKES ____________________

d. CABLE ____________________

e. PAINT ____________________

f. GENERAL APPEARANCE ____________________

____

RECOMMENDATIONS	CATEGORY	DATE COMPLETED

INSPECTION
OF
DIVERSION DAMS AND HEADWORKS

NAME OF DIVERSION DAM ______

DATE OF INSPECTION ______

STRUCTURE COMPLETED--YEAR ______

OPERATIONAL STATUS AT TIME OF INSPECTION ______

RIVER W.S. ELEVATION ______ DISCHARGE ______

CANAL W.S. ELEVATION ______ DISCHARGE ______

INSPECTION PARTY

NAME ______ TITLE ______

NAME ______ TITLE ______

NAME ______ TITLE ______

NAME ______ TITLE ______

NAME ______ TITLE ______

REFERENCE DRAWINGS

NO. ______

NO. ______

NO. ______

NO. ______

NO. ______

PREVIOUS INSPECTIONS

GENERAL INFORMATION

DAM

LOCATION ______

KIND ______

HEIGHT ______

TOP WIDTH ______ BASE WIDTH ______

CONCRETE CREST LENGTH ______ ELEVATION ______

DIKE LENGTH ______ ELEVATION ______

SLUICEWAY

NUMBER OF SLUICEWAYS ______

SIZE OF OUTLETS ______

TYPE OF GATES ______

TYPE OF CONTROLS ______

HEADWORKS

NUMBER OF OUTLETS________ MAXIMUM CAPACITY________

TYPE OF GATES________ NUMBER________ SIZE________

TYPE OF HOISTS________

INSPECTION

DAM

1. UPSTREAM CONDITION________
2. DOWNSTREAM CONDITION________
3. EROSION________
4. ABUTMENTS________
5. CREST________
6. DIKES________
7. DETERIORATION OF CONCRETE________
8. GENERAL APPEARANCE________
9. COMMENTS MADE BY OPERATING PERSONNEL________

SLUICEWAY

1. WALLS________
2. PIERS________
3. GATES________
4. GATE HOIST________
5. OPERATION OF HOIST; TYPE, CONDITION, ETC.________
6. PAINT ON GATES, HOIST, AND METALWORK________
7. GENERAL APPEARANCE________
8. COMMENTS MADE BY OPERATING PERSONNEL________

CANAL HEADWORKS

1. UNWATERED ?__________ IF NOT; DISCHARGE__________
2. CONCRETE STRUCTURE __________
3. GATES__________

   CABLES__________ SEALS__________ METALWORK __________
4. GATE HOISTS__________
5. OPERATION OF HOISTS; TYPE, CONDITION, ETC. __________
6. PAINT ON GATES, HOISTS, METALWORK __________
7. GENERAL APPEARANCE __________
8. COMMENTS MADE BY OPERATING PERSONNEL __________

RECOMMENDATIONS	CATEGORY	DATE COMPLETED

INSPECTION

OF

MAJOR WASTEWAY STRUCTURES

NAME OF WASTEWAY ____________________

DATE OF INSPECTION ____________________

STRUCTURE COMPLETED ____________________

OPERATIONAL STATUS AT TIME OF INSPECTION ____________________

UNWATERED ? ____________________

IF NOT; CANAL W.S. ELEVATION ____________________

CANAL DISCHARGE ____________________

WASTEWAY DISCHARGE ____________________

INSPECTION PARTY

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

NAME ____________ TITLE ____________

REFERENCE DRAWINGS

NO. ____________________

NO. ____________________

NO. ____________________

PREVIOUS INSPECTIONS

____

____

____

____

GENERAL INFORMATION

CANAL CHECK STRUCTURE

LOCATION ____________________

KIND ____________________

TYPE OF GATES ____________ NUMBER ____________ SIZE ____________

TYPE OF HOISTS ____________________

CAPACITY OF CANAL ____________________ CFS

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WASTEWAY STRUCTURE

KIND ________________

TYPE OF GATES ________ NUMBER ________ SIZE ________

TYPE OF CONTROLS ________________

CAPACITY OF WASTEWAY ________________ CFS

INSPECTION

CANAL CHECK STRUCTURE

1. UNWATERED ? ________ IF NOT, DISCHARGE ________
2. CONCRETE STRUCTURE ________________
3. GATES ________________
   CABLES ________________
   SEALS ________________
   METALWORK ________________
4. GATE HOISTS ________________
5. PAINT ON GATES, HOISTS, AND METALWORK ________________
6. GENERAL APPEARANCE ________________
7. COMMENTS MADE BY OPERATING PERSONNEL ________________

WASTEWAY STRUCTURE

1. UNWATERED ? ________ IF NOT, DISCHARGE ________
2. CONCRETE STRUCTURE ________________
3. GATES ________________
   CABLES ________________
   SEALS ________________
   METALWORK ________________
4. OPERATION OF CONTROLS; TYPE, CONDITION, ETC. ________________

5. PAINT ON GATES, CONTROLS, AND METALWORK ____________________

6. GENERAL APPEARANCE ____________________

7. COMMENTS MADE BY OPERATING PERSONNEL ____________________

RECOMMENDATIONS	CATEGORY	DATE COMPLETED

INSPECTION

OF

IRRIGATION DISTRIBUTION SYSTEMS

NAME OF SYSTEM ____________________

DATE OF INSPECTION ____________________

INSPECTION PARTY

NAME ____________________ TITLE ____________________

NAME ____________________ TITLE ____________________

NAME ____________________ TITLE ____________________

NAME ____________________ TITLE ____________________

NAME ____________________ TITLE ____________________

GENERAL INFORMATION

1. ACRES IRRIGATED BY COMPLETED FACILITIES ____________________
2. KILOMETERS OF CANALS ____________________
3. KILOMETERS OF LATERALS ____________________
4. KILOMETERS OF DRAIN AND WASTEWAY CHANNELS ____________________
5. ACRE-FEET OF WATER DELIVERED PER ACRE LAST SEASON ____________________

STATUS OF PREVIOUS INSPECTION RECOMMENDATIONS

A. ____________________

B. ____________________

C. ____________________

D. ____________________

FACILITIES INSPECTED

1. CANALS
   a. ____________________
   b. ____________________
   c. ____________________
2. LATERALS
   a. ____________________
   b. ____________________
   c. ____________________
3. SIPHONS
   a. ____________________
   b. ____________________
   c. ____________________
4. STRUCTURES
   a. ____________________
   b. ____________________
   c. ____________________

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CONCLUSIONS:

RECOMMENDATIONS	CATEGORY	DATE COMPLETED

APPENDIX I

Conversion factors--English to metric system of measurement:

Quantity	English unit	Multiply by	To get metric equivalent
Length	inches	2.54*	centimeters
	feet	30.48*	centimeters
		0.3048*	meters
		0.0003048	kilometers
	yards	0.9144*	meters
	miles	1,609.3	meters
		1.6093	kilometers
Area	square inches	6.4516*	square centimeters
	square feet	929.03	square centimeters
	square yards	0.83613	square meters
	acres	0.40469	hectares
		4,046.9	square meters
		0.0040469	square kilometers
	square miles	2.5898	square kilometers
Volume	gallons	3,785.4	cubic centimeters
		0.0037854	cubic meters
		3.7854	liters
	acre-feet	1,233.5	cubic meters
		1,233,500.	liters
	cubic inches	16.387	cubic centimeters
	cubic feet	0.028317	cubic meters
	cubic yards	0.76455	cubic meters
		764.55	liters
Velocity	feet/second	0.3048*	meters/second
	miles/hour	1.6093	kilometers/hour
Acceleration	feet/second x second	0.3048*	meters/second x second
Discharge	cubic feet/second or second-feet	0.028317	cubic meters/second
Weight	pounds	0.45359	kilograms
	tons (2,000 pounds)	0.90718	tons (metric)

*Exact value.

GPO 842-845