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Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

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BULLETIN NO. 60

April, May, June 1967

(REVISED January 1971)

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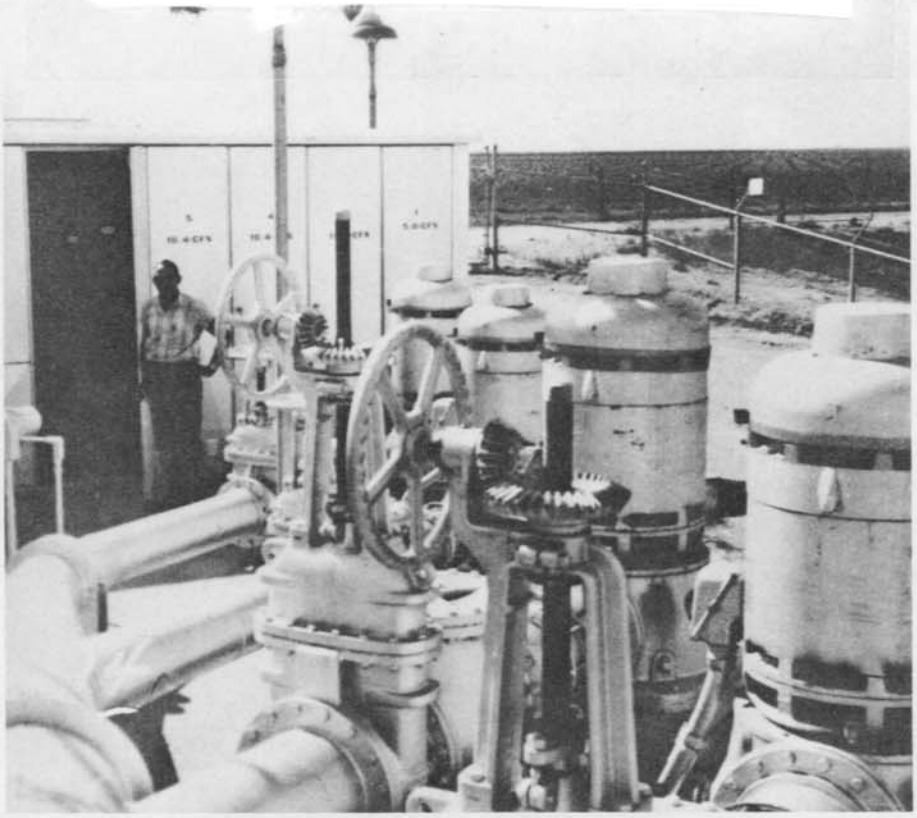

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In This Issue:

Pumping Plant Maintenance Schedules and Records

On November 6, 1979, the Bureau of Reclamation was renamed the Water and Power Resources Service in the U.S. Department of the Interior. The new name more closely identifies the agency with its principal functions—supplying water and power.

The text of this publication was prepared prior to adoption of the new name; all references to the Bureau of Reclamation or any derivative thereof are to be considered synonymous with the Water and Power Resources Service.

The Irrigation Operation and Maintenance Bulletin is published quarterly, for the benefit of irrigation project people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the material herein concerning the maintenance of pumping plant equipment and procedures, developed by the Bureau, will result in improved efficiency and reduced costs for those operators adapting these ideas to their needs.

The revisions made herein, include sectionalization, some rearrangement of material and the addition of a section on seasonal maintenance.

* * * * *

Division of Water Operation and Maintenance
Engineering and Research Center
Denver, Colorado

COVER PHOTOGRAPH:
This shows the 4 pumps of Lateral 113.7E looking west over the Delano-Earlimart Irrigation District in California. The system consists of approximately 172 miles of laterals and sublaterals utilizing precast reinforced concrete pressure pipe, and 18 pumping plants and appurtenant works. Photo PX-D-58270.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DIVISION OF WATER OPERATION AND MAINTENANCE
Denver, Colorado 80225

Irrigation Operation and Maintenance
Bulletin No. 60

April, May, June 1967

(REVISED JANUARY 1971)

PUMPING PLANT MAINTENANCE SCHEDULES AND RECORDS

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CHAPTER I - INTRODUCTION

Pumping plants on an irrigation system must be maintained in reliable operating conditions. Such maintenance is necessary to: (1) provide required service to water users, (2) reduce emergency repairs, and (3) lower maintenance costs. However, it is impossible to cover the subject of preventive maintenance in anything but a very general manner in a short publication. This bulletin will, therefore, serve only as an outline or guide for the maintenance which should be performed.

Much of the material in the bulletin has been written for pumping plant maintenance; but a great deal of it has been adapted from Power Operation and Maintenance Bulletins and where appropriate can be applied to power and pumping plants of any size.

The supervisor or foreman should take time to review the forms and inspection lists provided, add material as needed, and eliminate those items which do not pertain to his particular plant.

As indicated on the inside of the cover, this is a revision of the original Bulletin No. 60, published for April, May, and June 1967. The revision consists of sectionalizing the original Bulletin for more convenient reference, some rearrangement of material made necessary by the sectionalization, and the addition of a section on seasonal maintenance. This section contains suggestions for servicing prior to spring startup and fall shutdown of pumping plants.

1. Preventive Maintenance

Experience has proved that a continuous program of preventive maintenance, combined with equipment overhaul when required, is the best and least costly means of maintaining any plant or equipment and will best suit the needs of irrigation pumping plants. This consists of continually performing routine maintenance and adjusting the critical items of a structure or facility in a scheduled and organized manner so that special inspection and costly repairs are less necessary.

Maintenance is applied more specifically to the parts which are known to need repairs or replacement most often, the theory being that proper lubrication, adjustment, and small repairs applied often enough to the critical parts will make it less necessary to undertake complete overhaul or replacement. Breakdowns are reduced, outages shortened, and the frequency for overhaul of most facilities is lessened when preventive maintenance is a practiced procedure.

The success of preventive maintenance will depend largely on the alertness of the men who work around the equipment. They should be continually on the alert for things which need attention, such as loose bolts, vibration, leaks, wear, unusual noise, odor, etc.

2. Work Schedules

Maintenance work should be done in accordance with prearranged schedules to make the best use of available men, to coincide with favorable weather, and with periods in which outages of the equipment can best be tolerated.

Major work should be scheduled as much as possible in the nonirrigation season. Better work will be produced when employees are not compelled to work against the clock to meet immediate demands for water delivery.

3. Maintenance Record Cards

A card system should be kept for recording equipment nameplate information. It is also recommended for calling attention to the time when an inspection is due and for recording a brief description of the repair work done. A 5- by 8-inch card, shown as Form PO&M-122, "Equipment Data," Figure 1, page 3, can be used for this purpose.

The front of the card has spaces for recording the pertinent data for the equipment to which the card applies. The back of the card has spaces for recording the dates of inspections and repair work, name of the inspector, a reference to the complete inspection and repair report, and a brief description of the work done. Form PO&M-123, "Inspection and Maintenance Record," as in Figure 2, page 4, can be used as a continuation of the original card when space on that card is filled.

Entries should be made on the "Inspection and Maintenance Record" for the detailed annual inspection and repair work but not for the routine weekly, or monthly inspections, unless some repair work is performed.

A card should be used for each piece of equipment which is subject to scheduled periodic inspection and maintenance. A simple rotating file system, illustrated in Figure 3, page 5, is suggested as appropriate for pumping plants. This entire file, including the index tabs, rotates forward as time goes on, with cards removed from the front as work is done being placed in the back so that for each year (or other inspection interval) the cards come up in the same order.

PO&M - 122
(5-56)
Bureau of Reclamation

FILE NO. LJE-5-3

EQUIPMENT 115 kv OCB No. 1162

INSPECTION DUE June

PROJECT Rio Grande LOCATION Elephant Butte Powerplant INSPECTIONS ANNUALLY 1

EQUIPMENT DATA

FURNISHED ON Spec. 892, Schedule 3 DATE Initial operation June 1955
CONTRACTOR Johns Manufacturing Co.
MFR. Johns Manufacturing Co. TYPE B20-60-115D
MODEL OR STYLE NO. SERIAL NO. 5894
VOLTS 115 kv AMPS. 600
H.P. KW. KVA. P.F.
R.P.M. FREQ. 60 PHASE 3 TEMP. °C
TAPS %IMPEDANCE
INTERRUPTING RATING - KVA. 1,000,000

SAMPLE

LINE LENGTH TYPE OF CONSTRUCTION
CONDUCTOR SIZE AND KIND CONDUCTOR SPACING

GPO 840304

FRONT

INSPECTION AND MAINTENANCE RECORD

DATE	INSPECTED BY	REPORT REFERENCE	DESCRIPTION OF WORK DONE	COST LABOR	COST MATERIAL
6/9/56	AJF		Annual inspection - See report of 7/1/56		
6/18/57	AJF		" " " " " 7/11/57		
9/24/57	RWH		Replaced open circuited trip coil	7.60	4.50
6/15/58	RWH		Annual inspection - See report of 6/30/58		

SAMPLE

REAR

Figure 1

POAM-123
(10-55)
Bureau of Reclamation

FILE No.....

EQUIPMENT..... INSPECTION DUE.....

PROJECT..... LOCATION..... INSPECTIONS ANNUALLY.....

INSPECTION AND MAINTENANCE RECORD

DATE	INSPECTED BY	REPORT REFERENCE	DESCRIPTION OF WORK DONE	COST	
				LABOR	MATERIAL

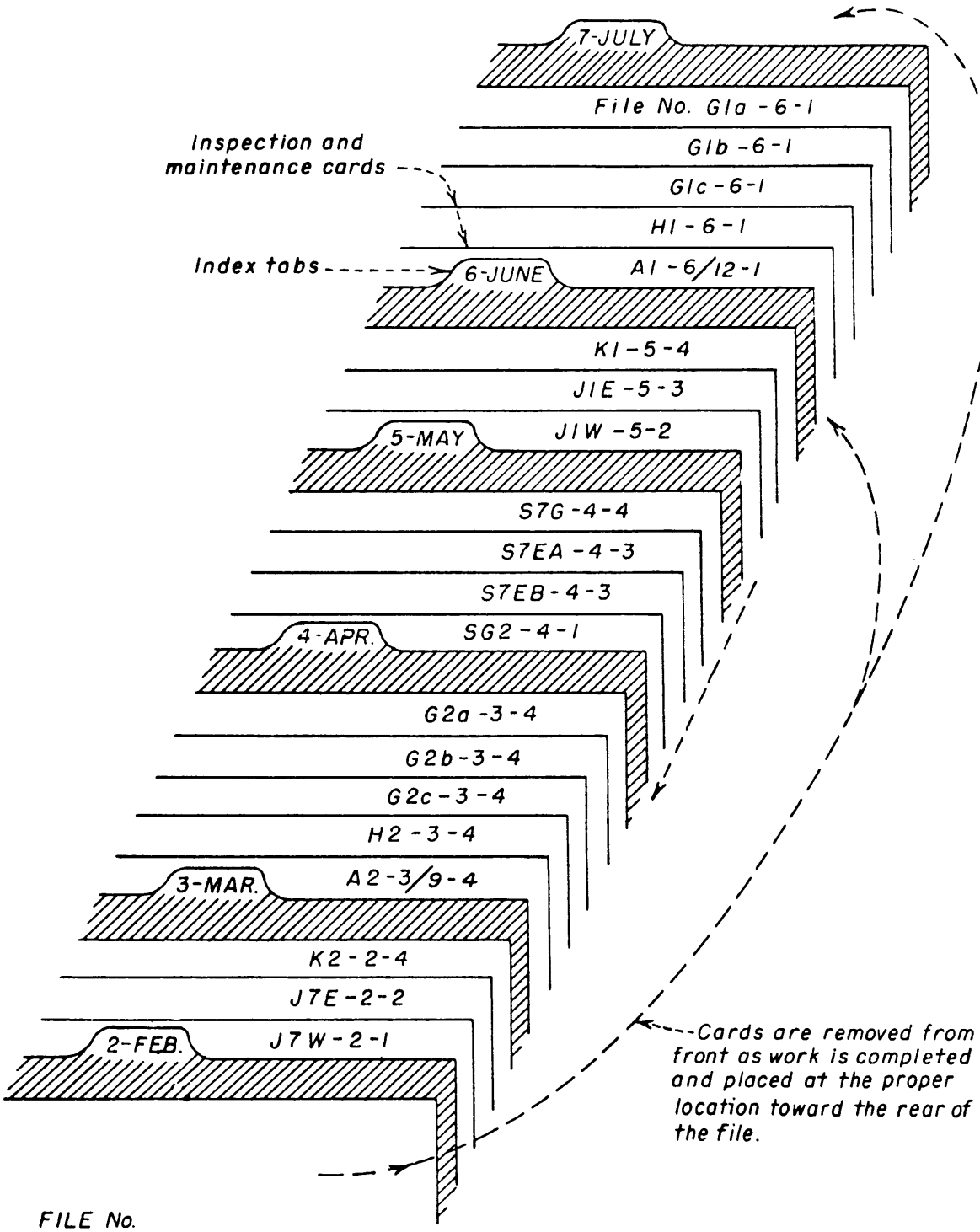
FRONT

INSPECTION AND MAINTENANCE RECORD

DATE	INSPECTED BY	REPORT REFERENCE	DESCRIPTION OF WORK DONE	COST	
				LABOR	MATERIAL

REAR

Figure 2



FILE No.

1st. Symbol group = Equipment designation symbol as established for construction purposes and shown on switching diagrams. G1a = generator No.1 . a, b, c, etc. represent parts such as exciters, etc. requiring separate cards. For old plant or equipment having no official symbol use word description such as Gen. 1, Line 1, etc.

2nd. Symbol = Month when inspection is due.

3rd. Symbol = Week when inspection is due.

Figure 3

ROTATING CARD FILE SYSTEM FOR MAINTENANCE SCHEDULES

The file should be consulted frequently to see what work is due. After the work is completed, the card should be filled in, signed by the man responsible for maintenance, and placed at the back of the file.

Keeping records of the inspection, repairs, and tests is an important part of preventive maintenance. It provides a means of recognizing chronic troubles and finding their causes. It also serves as a basis for estimating what spare parts should be kept on hand and how often repairs will be necessary.

The PO&M-123 cards described on page 2, when used in the rotating file system, are intended to serve primarily as an index and tickler system to assist in scheduling inspections. At each inspection, it may be desirable to record a more complete report showing briefly what was found and what was done. The work involved in making such reports can be greatly simplified by using forms made out for the purpose.

4. Inspection Checklist

Each piece of equipment should be inspected at specified intervals. Scheduling of such inspections (and repairs) will be facilitated by careful recordkeeping.

The inspection checklists on the following pages should be used as a guide to proper maintenance by the operators and maintenance men. The time intervals shown represent the average intervals which the particular item should go without inspection. More or less frequent inspections may be necessary as operating experience or accessibility for maintenance dictates.

The lists are intended to cover all types of equipment, including the most complex. If the particular equipment is not provided with all the features listed under "Items of Inspection," these items on the checklist should be disregarded.

The routine inspections are those which normally should be made by a roving maintenance man, a ditchrider or other responsible employee not necessarily in constant attendance of the plant equipment. These routine checks and inspections should be of a visual nature not requiring the use of tools or equipment, and are intended to detect troubles in their early stages so that corrective measures can be applied before serious trouble develops. Anything unusual should be promptly reported to personnel responsible for maintenance for proper action.

The indexed paragraphs following the checklists are intended to give pertinent instructions on what to look for and what to do. However, it is not intended to supersede other specific instructions already covered in detail in other bulletins, manufacturers' instruction books, or other available publications, particularly Designers' Operating Criteria or Standing Operating Procedures, if such have been prepared.

5. Reference Material

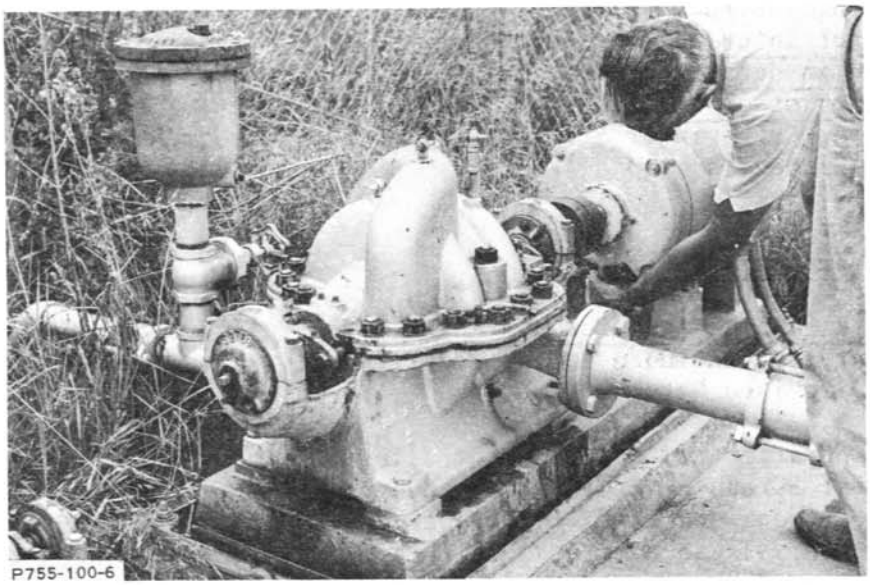
This Irrigation Operation and Maintenance Bulletin has been prepared from material included in the Power Operation and Maintenance Bulletin No. 19, revised October 1965.

Power Operation and Maintenance Bulletins are prepared primarily to assist Bureau of Reclamation power operating personnel in establishing Bureau standards for proper and safe operation of power facilities. These booklets are referred to in many places in this publication as reference material and a complete set consists of 27 bulletins.

The above bulletins are available for sale from our Publications and Film Management Unit, for $25.40 a set. Requests should be directed to:

U.S. Department of the Interior
Bureau of Reclamation
Engineering and Research Center
Building 67
Denver Federal Center
Denver, Colorado 80225

Bureau of Reclamation requisitions should also be sent to the above address.



1. Inspection Checklist

Items of inspection	Inspection interval	
Pumps and Turbines		
Runner or impeller		A
Seal rings	NS	A
Scrollcase or pump casing		A
Wicket gates	NS	A
Curb plates		A
Thrust collars		A
Gate linkage	W	A
Draft tube		A
Shaft and coupling	W	A
Shift ring and bearing surfaces		NS
Bearings	D A	NS
Servomotor cylinder, piston, and rod	D	NS
Packing glands	D	NS
Lubrication	D	A
Thermometers and gages	D	A
Controls and indicators	W	A
Linkage and pins	W	A
Pump inspection report	NS	A

D - Routine daily inspection when in service.
W - Routine weekly inspection when in service.
A - Annual inspection.
NS - Not scheduled, frequency as required to maintain equipment and assure its function.

References

Power O&M Bulletin No. 21, Lubrication of Powerplant Equipment
Power O&M Bulletin No. 24, Welding Repair to Hydraulic Equipment
Bureau Paint Manual and Field Painting of Metalwork

2. Runner or Impeller

Annual inspection. - Examine runners for cavitation pitting, sand, or other forms of erosion, and cracked vanes, blades, or crowns. Repair pitted areas, cleaning damaged area with a gouging rod and building up steel runners with mild steel welding rod, bronze runners with bronze rod, cast iron runners with "Ferroweld" rod, and stainless steel runners with stainless steel rod. Other approved type rods may also be used. Bronze and stainless steel runners should be built up to the original surface and ground smooth. Cast iron and cast steel runners should be built up and ground to a surface about 1/8 inch low to the original. Then 18-8 stainless steel should be used as a final coating over the mild steel inlay on steel runners and should be 1/8 inch thick. 25-12 stainless steel should be used over "Ferroweld" inlays on cast iron runners.

In grinding the stainless steel coatings, a high-speed grinder should be used, and a permanent bar magnet or a commercial copper sulphate solution should be used to check the thickness of the stainless. Stainless steel is nonmagnetic and too much pull on the magnet indicates that the stainless has been ground away or applied too thinly. Some work has been done with metallizing surfaces subject to cavitation with stainless steel, but until further information as gathered from experience is available, it is advisable to continue to weld or braze. See Power O&M Bulletin No. 24 for details on welding. After assembly, check vibration of unit with vibrometer and balance if necessary.

3. Seal Rings

Annual inspection. - Check the seal ring clearances. Check to see that seal ring cooling waterlines are clear.

Not scheduled. - Remove the runner, replace or build up with suitable material and machine seal rings to original clearances as listed on manufacturer's blueprints.

4. Scrollcase or Pump Casing

Annual inspection. - Examine surface for corrosion and failure of paint. Check rivets for tightness. Inspect for leaks. Calk leaks

and rivets as necessary. Prepare surfaces and paint with a recommended material. Inspect manhole door gaskets and bolts, and renew as necessary. Smooth up seating surfaces on door and case.

5. Wicket Gates

Annual inspection. - Measure clearance between gates when nearly closed. Adjust openings as necessary. Examine body of gates for pitting. Examine sealing surfaces and grind or file rough or wire-drawn portions to a smooth surface. Check clearance at stem bushings by jacking.

Not scheduled. - Raise cover plate and inspect stem bushings, journals, and shaft sleeve at packing gland for scoring, improper lubrication, and corrosion. Clean all hard grease from grooves and pockets. Refit bushings as necessary. Build up stem at packing gland and at journal areas using stainless steel if they are mild steel or repair is needed. At this time, also inspect baffle plates for deterioration and tightness. Clean and paint baffle plates and underside of cover plate.

6. Curb Plates

Annual inspection. - Examine facing plates for scoring and corrosion. Check clearance between facing and wicket gates. See that the facing plates are tight to the head cover and bottom ring.

7. Thrust Collars

Annual inspection. - Examine three or four thrust collars and plates as examples for scoring, corrosion, and proper lubrication, taking different ones each year until all are examined. If excessive scoring or corrosion is noted, examine the remainder and repair as necessary. Obtain proper clearances between wicket gates and upper and lower curb plates with the thrust collars, placing or removing shims as needed.

8. Gate Linkage

Weekly inspection. - Note linkage for excessive backlash.

Annual inspection. - Measure the backlash in linkage and refit pins and bushings as needed.

9. Draft Tube

Annual inspection. - Inspect metal liner for cavitation pitting. Weld and grind as necessary. Inspect concrete for failure and repair as necessary. Test for voids between liner and concrete by striking the liner with a hammer. A "drummy" sound indicates a void at that point. Grout if necessary. Inspect manhole door gaskets and bolts. Replace where needed. Smooth up seating surfaces on door and case. Prepare bare or corroded surfaces and paint with suitable material.

10. Shaft and Coupling

Weekly inspection. - Check shaft visually and by hand for wobble or runout. Note coupling for apparent misalinement or signs of loose coupling bolts.

Annual inspection. - Check shaft with oscillograph or dial indicator for excessive runout. Check coupling for runout. Check alinement of shaft at coupling and inspect coupling bolts for tightness. Inspect shaft sleeve at packing gland. Replace or build up and machine as necessary.

11. Shift Ring

Not scheduled. - Lift shift ring and inspect bearing surfaces for wear and proper lubrication. Check scoring and for out-of-round condition. If fitted, inspect patch bolts on cover plate bearing surface for tightness. Smooth up or build up and machine bearing surfaces as needed. Replace bearing plates on cover plates if needed.

12. Bearings

Daily inspection. - Check bearings for overheating and to see that an ample supply of lubrication is being furnished.

Not scheduled. - Inspect babbit or bronze bushings for wiping or scoring. Inspect journals for scoring, wear, and discoloration which may be due to excessive heat, acidity of the oil, or shaft current.

Annual inspection. - Refit or rebabbitt and machine bearings as necessary. See that all oil or grease grooves are clear. Check oil for dirt, sludge, and acidity, and filter or replace as necessary. See that bearing temperature bulbs and alarms are functioning properly.

13. Servomotor

Daily inspection. - Note glands for leakage. Adjust as necessary. Listen for "groaning" noises indicating misalinement.

Not scheduled. - Examine plunger, rings, and cylinder for scoring. If scored, examine for possibility of misalinement and realine if needed. Repair by reboring or polishing cylinder, renewing rings, or machining piston. Inspect packing and repack as necessary.

14. Packing Glands

Daily inspection. - Check packing gland and seals for excessive heat and see that a slight flow of water is coming from between the gland and the shaft or the gland and stuffing box. Adjust gland as necessary.

Not scheduled. - Inspect packing rings for wear. See that lantern ring is in proper place and cooling waterlines are clear. Repack as necessary, staggering adjacent rings so that the points where ends meet do not coincide. See that the lantern ring is in its proper place and that the cooling waterlines and drains are not obstructed. The gland should be adjusted so that a slight leak occurs rather than complete stoppage of waterflow. A gland too tight to allow a flow of water will wear the shaft sleeve unduly. The purpose of a gland is to control the flow rather than to stop it.

15. Lubrication

Routine inspection. - Lubricate underwater fittings once daily where the unit regulates frequently or every other day where load is constant. Cycle gates to distribute grease if load is constant. Abovewater fittings should be lubricated twice weekly where the unit regulates frequently or once weekly otherwise. On pumps or turbines which are fitted with babbitted bearings which are submerged in water containing abrasive material, it may be necessary to lubricate every 5 minutes or less with a solenoid-operated grease gun or similar equipment. Replenish oil in reservoirs as necessary. Check automatic greasing system to see that all fittings are receiving grease and that system is functioning properly. See Power O&M Bulletin No. 21.

Annual inspection. - Clean and flush out all fittings with fresh grease. Check each fitting for adequate grease quantity where automatic greasing system is used. Test oil in large bearings for acidity prior to overhaul. If neutralization number is within limit

specified by oil manufacturer, and has not taken a sudden increase since the last test, centrifuge and filter oil and clean out all bearing reservoirs and sumps. If neutralization number is above limits set by manufacturer, discard and refill system with new oil. In small bearings where the cost of testing is approximately equal to or more than the cost of new oil to refill the system, the oil should be drained and the system refilled with fresh oil.

16. Thermometers and Gages

Daily inspection. - See that gages and thermometers have no visible signs of breakage. See that all dial-type needles are free to move by tapping the case gently with the fingers.

Annual inspection. - Remove all gages and thermometers and calibrate. Reinstall.

17. Controls and Indicators

Weekly inspection. - Note daily operation of all controls and indicators. Investigate any unusual conditions. Lubricate moving parts.

Annual inspection. - Check pointers on indicators for correct setting. Check control moving parts for wear. Check remote controls for proper indication. Repair or renew as necessary. Calibrate gages.

18. Linkage and Pins

Weekly inspection. - Note linking arms and pivot pins for excessive backlash due to wear and vibration. Lubricate as necessary.

Annual inspection. - Refit or replace bushings and pins as needed.

At each inspection, it may be desirable that a more complete report be made showing briefly what was found and what was done. A form similar to Form O&M-154, Figure 4, pages 14 and 15, may be used for this purpose.

19. Pump Inspection Report

A suggested form for reporting the condition of a pump and repairs made is given on pages 14 and 15. Copies of this form, O&M-154 (10-56) can be furnished.

O & M 154
(10-56)
Bureau of Reclamation

PUMP INSPECTION REPORT

PROJECT: Colo-Big Thompson PUMPING PLANT: Granby UNIT NO.: 1 DATE: 3-12-56

MANUFACTURER: N.N. Shipbuilding & Dry Dock Co. MODEL NO.: None

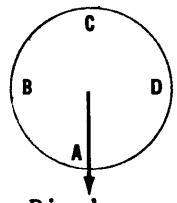
TYPE: Centrifugal Vertical Pump SERIAL NO.: 10

CAPACITY: 200 cfs HEAD: 186 feet

CLEARANCES				
	POSITION**			
PART	A	B	C	D
WEARING RING, MOTOR END	.015	.014	.014	.015
WEARING RING, PUMP END	.014	.015	.015	.014
PUMP GUIDE BEARING, MOTOR END	.016	.017	.015	.017
PUMP GUIDE BEARING, INTERMEDIATE	.018	.016	.017	.016
PUMP GUIDE BEARING, PUMP END	.014	.016	.015	.015
*IMPELLER				
*OTHER CLEARANCES				

*EXPLAIN AND GIVE REFERENCE POINTS IN REMARKS IF NECESSARY.

**SHOW SKETCH



CONDITION OF:

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

CASING: CA50 paint condition good except for small chipped areas covering approximately 5 square feet in area.

DISCHARGE PIPE: Short metal section good - Concrete section good.

IMPELLER, DIFFUSER: Bronze impeller not painted. Some cavitation on shrowd band. Cracks occurring in previous welded vanes. (See impeller report 4-5-56.)

SUCTION PIPE: Did not check.

SEAL AND WEARING RINGS: Slight scoring of wearing ring motor end considered satisfactory for further operation. Wearing ring pump end OK.

Figure 4

CONDITION OF:

OIL PUMP: D.C. Pump OK - A.C. Pump noisy bearing.

GAGES: OK Checked and calibrated 2-5-56.

INTAKE GATE:

LEAKAGE, 20 GPM, DESCRIPTION OF LEAKAGE: Leakage right hand bottom side

DISCHARGE GATE:

LEAKAGE, 25 GPM, DESCRIPTION OF LEAKAGE: Leakage along center at top

SHAFT PACKING:

LEAKAGE, 0 GPM, TYPE Garlock G44, NEED REPACKING? No

GLANDS AND LANTERN RING: Condition good

SHAFT SLEEVE: Slight scoring serviceable after filing.

PUMP BEARINGS:

MOTOR END: Surface OK

INTERMEDIATE: Surface OK

PUMP END: Slight wiping in center of bearing. Bearing OK after scraping.

JOURNALS: OK

OTHER ITEMS:

NAME, MANUFACTURER AND VISCOSITY OF OIL USED: Standard Oil Stan - Oil 31

NAME, MANUFACTURER AND GRADE OF GREASES USED: Texaco No. 1

DATE LAST OVERHAUL: 2-5-55

REPAIRS MADE: Impeller removed and reconditioned. See Unit 1 overhaul report 3-6-55.

REMARKS AND RECOMMENDATIONS:

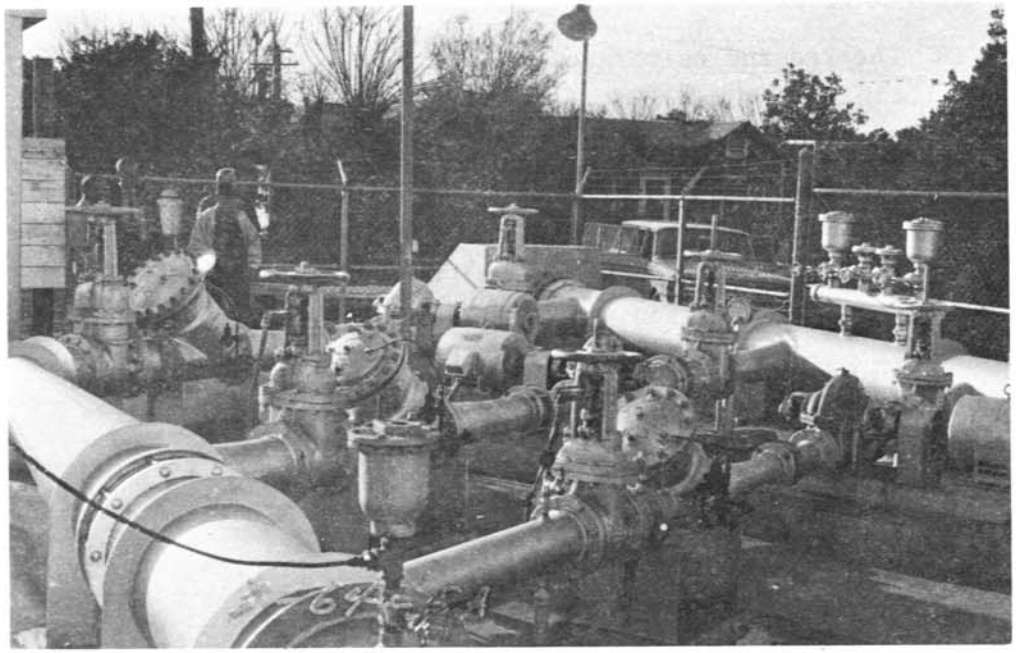
Repair damage paint area in pump casing.

Investigate repair of cracked runner vanes by chain lock method.

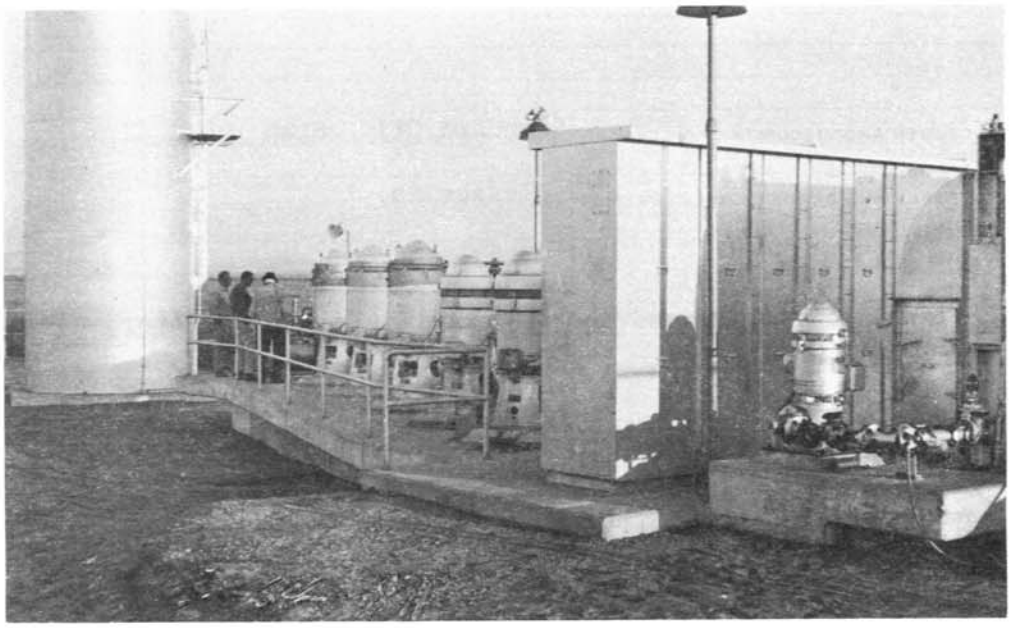
Replace A.C. oil pump bearing.

INSPECTION MADE BY John Rose

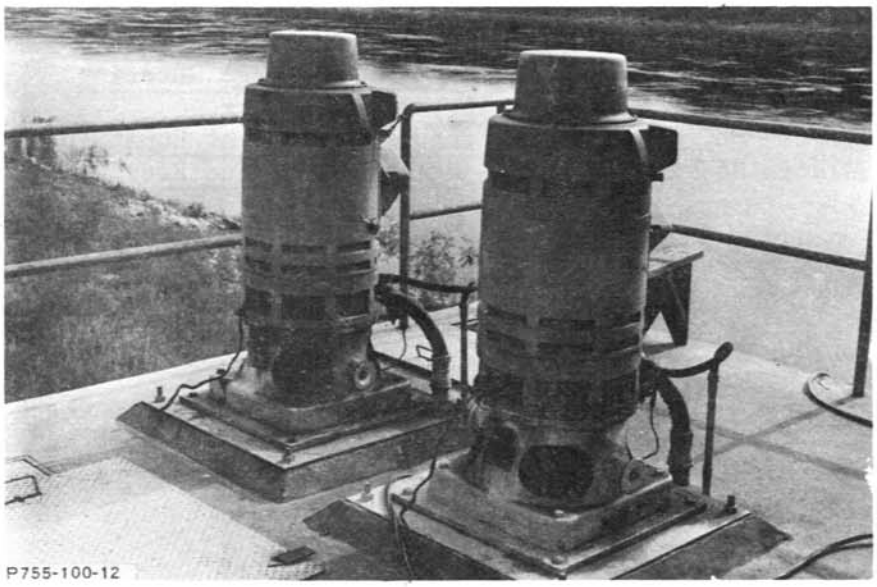
Form O & M 154 12-1-51 (Back



Tea Pot Dome Irrigation District. General view of Pumping Plant T-3, Lateral 99.4. Friant Division, Porterville, California. Photo P214-D-58274



Tea Pot Dome Irrigation District. T-1 Pumping Plant control board, pumps, and air chamber. Friant Division, Porterville, California. Photo P214-D-58275



1. Inspection Checklist

Items of inspection	Inspection interval	
Foundation, base, or support	M	A
Frame		A
Laminations and pole pieces		A
Armature or rotor		A
Airgap		A
Air fans		A
Windings	M	A
Banding and lashing		A
Slot wedges		A
Commutator or collector rings	W	
Brushes		A
Shaft and bearings	D	A
Couplings, gears, and pulleys		A
Cooling coils and air coolers	D	A
Temperature indicators and relays		A

D - Routine daily inspection by operators when in service.
W - Routine weekly inspection when in service.
M - Routine monthly inspection when in service.
A - Annual inspection.

References

Power O&M Bulletin No. 3, Testing Solid Insulation of Electrical Equipment
Power O&M Bulletin No. 9, Keeping Motor Windings Dry
Power O&M Bulletin No. 13A, Field Balancing of Large Rotating Machinery
Power O&M Bulletin No. 21, Lubrication of Powerplant Equipment
Power O&M Bulletin No. 23, Fire--Fighting, Cause and Prevention

2. Base

Monthly inspection. - Visual inspection to see that machine foundation, base, or support is in good condition.

Annual inspection. - Check concrete foundation for cracks. Check base or support for broken, loose, or weakened parts. Check and tighten anchor bolts. Check sound-absorbing base for adequacy.

3. Frame

Annual inspection. - Check for cracks, loose, or broken parts. Clean and repaint as necessary. Check frame ground connection.

4. Laminations and Pole Pieces

Annual inspection. - Check for loose laminations and tighten clamping bolts. If laminations vibrate and cannot be stopped by tightening clamping bolts, force some quick-drying varnish or shellac between the loose laminations while the machine is out of service. Check for damaged laminations at airgap due to rubbing or objects caught in airgap. Check and tighten field pole piece clamping bolts.

5. Armature or Rotor

Annual inspection. - Check induction motor squirrel-cage rotor bars or synchronous motor amortisseur windings for loose or broken bars or end connections. Check synchronous motor field circuit connections and tighten if necessary. Check voltage drop across each synchronous motor field pole by applying alternating current at the collector rings and then measuring the voltage across each pole winding with a voltmeter. This will show up a turn-to-turn short better than direct current. After this test it may be necessary to "flash the field" to restore the proper residual field polarity. Flashing the field may be performed by momentarily connecting a 6- or 12-volt battery, with the proper polarity, across the slip rings. Check pole keys for tightness. Rebalance armature or rotor if vibration is objectionable. (See Power O&M Bulletin No. 13A.)

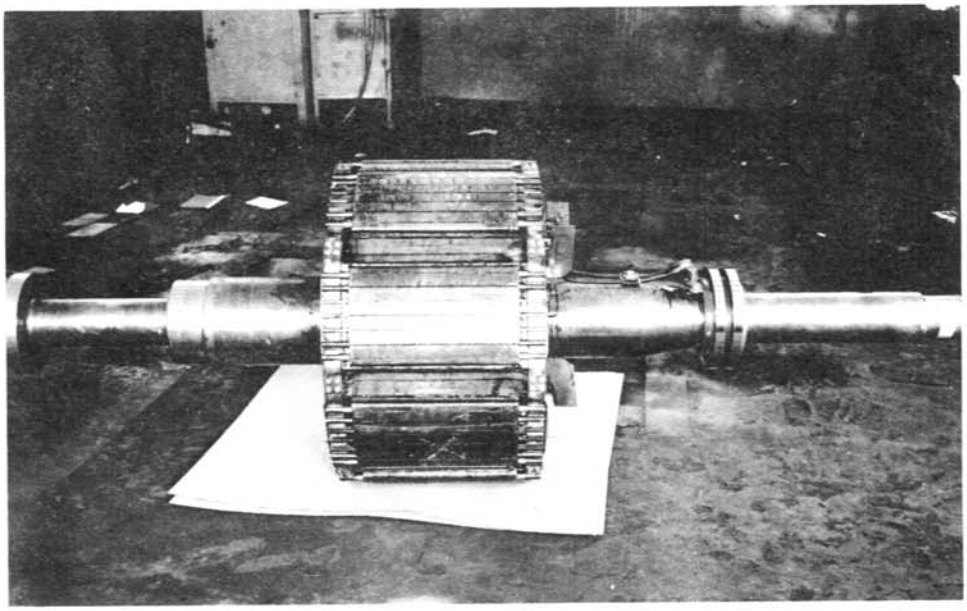


Photo PX-D-68176NA

6. Airgap

Annual inspection. - Check airgap at four quadrature positions and re-center rotor if necessary. On horizontal machines, the bearings may need replacing if the bottom airgap is appreciably smaller than the top.

7. Air Fans

Annual inspection. - Check rotor air fans for fatigue cracks. Check and tighten holding bolts or screws.

8. Windings

Monthly inspection. - Visual inspection for damaged insulation and dirt, oil, or moisture on winding.

Annual inspection. - Blow out dust with clean dry air at pressure not exceeding 40 pounds per square inch. Clean exposed parts of windings thoroughly with a noninflammable solvent, using suitable brushes for inaccessible places. The use of carbon tetrachloride is not recommended because of the toxic hazard. A number of good commercial solvents such as "Turco-Solv" are satisfactory. Check for insulation deterioration such as tape separation, cracking, brittleness, or evidence of corona. Check insulation with Megger or high-voltage direct-current method. (See Power O&M Bulletins No. 3 and 9.)

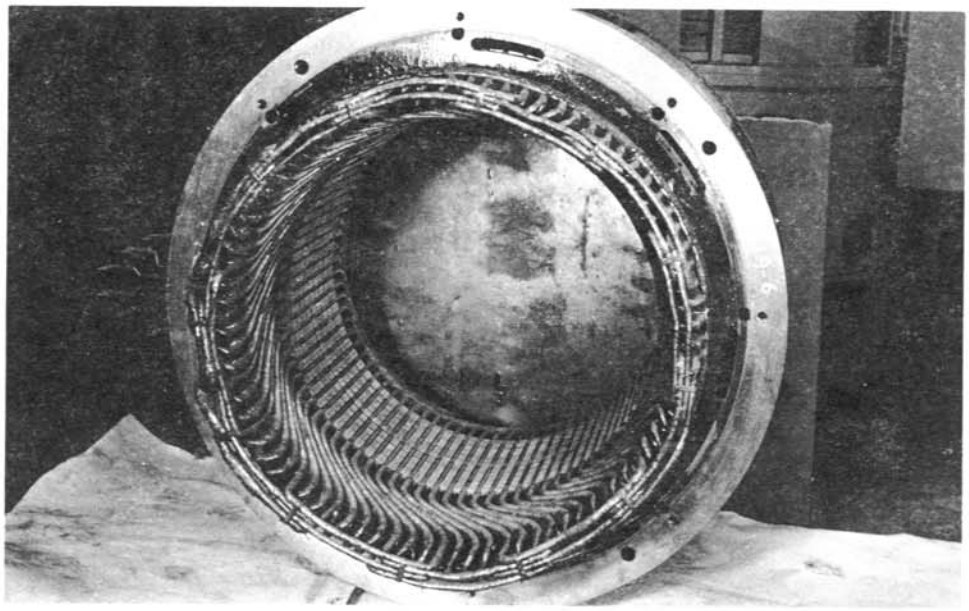


Photo PX-D-68175NA

9. Banding and Lashing

Annual inspection. - Check wire and string banding on direct-current armature windings. Check end-turn lashing of alternating-current stator coils. Apply lashing if end turns vibrate excessively.

10. Slot Wedges

Annual inspection. - Check slot wedges and replace loose ones. Tighten coils in slots by rewedging if necessary.

11. Commutator or Collector Rings on Synchronous Motors

Weekly inspection. - Check commutation or collector ring and brush operation. Wipe commutator or rings if needed. Have brushes replaced if worn too short.

12. Brushes on Synchronous Motors

Annual inspection. - Turn down, stone, or polish commutator or colector rings if grooved, rough, or eccentric. Undercut mica if high. If commutator or rings have a good polish, they should not be disturbed. Check brush spring tension and brush fit. Tighten bolts, screws, and connections. Reset brush holders if not properly spaced. Check brush neutral position. Replace and sand in new brushes if needed. Clean up carbon or metallic dust.

13. Shaft and Bearings

Daily inspection. - Check bearing temperature, lubrication and oil level. (See Power O&M Bulletin No. 21.)

Annual inspection. - Check bearing clearances. Check oil for dirt, sludge, and acidity, and filter or replace as necessary. Check end play on horizontal machines. Replace or refinish rough bearings. Inspect bearing oil piping and cooling water piping for leaks. Check shaft for wobble and alinement. Check for shaft currents through bearings on large machines. Check insulation of insulated bearings. Check oil film resistance occasionally with machine in operation with ohmmeter of 6 volts or less on thrust bearings provided with test terminals.

14. Couplings

Annual inspection. - See that keys, setscrews, and coupling bolts are tight. Check parts of flexible couplings for wear or fatigue. Adjust belt or silent chain tension. Flush out and renew grease in gearboxes. Inspect belts, chains, or gears. Check alinement between driving and driven machine.

15. Cooling Coils on Water Cooled Units

Daily inspection. - Check for water leaks in bearing cooling coils and surface air coolers. Check cooling waterflow.

Annual inspection. - Check external supply and drain piping for leaks. Flush out cooling coils with air and water. Test bearing cooling coils for leaks by applying air pressure to coils and observe for air bubbles rising in oil and drop in air pressure with supply valve closed, or use hydrostatic pressure test. Use hydrostatic pressure test on air coolers. If water scale is present, circulate a solution of 25 percent hydrochloric acid and water through the coils until clean. Then flush out thoroughly. Clean external surfaces of coils if practical. A pressure of 75 pounds per square inch is recommended.

16. Temperature Indicators

Annual inspection. - Check bearing and stator temperature indicators and relays for sticking, dirty contacts, etc. Check calibration if in doubt. Check water and oil flow or pressure gages and relays for proper operation.

At each inspection, it may be desirable that a more complete report be made showing briefly what was found and what was done. A form similar to Form O&M-150, Figure 5, pages 22 and 23, may be used for this purpose.

O. & M.-150
(9-56)
Bureau of Reclamation

MOTOR OR GENERATOR INSPECTION REPORT

LOCATION Black Canyon Pr. Pl. DATE OF INSPECTION 5-18-67
PURPOSE OF UNIT Main Unit UNIT No. 3
MFR. OF UNIT
RATING:
VOLTS 6600 AMPS. 436 PHASE 3 FREQ. 60
H.P. KW. 4000 KVA. P.F. %
R.P.M. 225 TYPE
FRAME SIZE SERIAL No.
FIELD ~~OR SEC.~~ AMPS. 96 VOLTS 250
KIND OF BEARINGS

MAIN EXCITER: KW. 35 VOLTS 250 AMPS. 140
TYPE SERIAL No. 119500
PILOT EXCITER: None KW. VOLTS AMPS.
TYPE SERIAL No.

CONDITION OF UNIT AND AUXILIARY DEVICES:
COIL INSULATION Clean OK
FIELD COIL RESISTANCE 1.90 OHMS AT 21 °C.
MAIN EXCITER FIELD COIL RESISTANCE 25.0 OHMS AT 21 °C.
PILOT EXCITER FIELD COIL RESISTANCE OHMS AT °C.
FRAME AND ROTOR Good
STATOR AND ROTOR LAMINATIONS Good
SHAFT "
COUPLING "
BEARINGS "
ANY OIL LEAKS? No
BEARING OIL OK
COLLECTOR RINGS OK
COMMUTATOR Exciter commutator slightly grooved
BRUSHES OK
COLLECTOR RING OPERATION OK
COMMUTATION OK
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? Slight
DOES END PLAY FLOAT FREELY?
BEARING THERMOMETERS OR ~~THERMOSTATS~~ OK
BEARING OIL GAGE ~~OR SWITCH~~ OK
BEARING COOLING-WATER PRESSURE GAGE OR SWITCH None
STATOR TEMP. INDICATOR OR THERMOSTAT RTDs on swbd indicator OK
FIRE PROTECTIVE EQUIPMENT None

Figure 5

AIR GAP CLEARANCE (INCH)	~~XXX~~ NORTH	~~XXXX~~ EAST	~~XXXXX~~ SOUTH	~~XXXX~~ WEST
MAIN UNIT	.42	.44	.46	.45
MAIN EXCITER	.15	.18	.16	.14
PILOT EXCITER				

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

WAS INSULATION RESISTANCE MEASURED? See Form O&M-109

(REPORT DATA ON FORM O&M 109)

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

DATE	5/18		5/18		5/18
HOUR	3P		11P		1A
A.C. AMPS.	410		272		80
A.C. KV.	6600		6600		6600
KW.	4900		3510		1600
KVAR. P.F.	99/aq		95/aq		95/aq
FIELD AMPS.	70		55		40
FIELD VOLTS	133		120		100
PILOT EXCITER AMPS.					
PILOT EXCITER VOLTS					
TURBINE GATE OPENING	.8		.6		.3
TURBINE NET HEAD	92		92		92
STATOR TEMP. °C.	78.5 by RTD		71 by RTD		65 by RTD
INLET AIR TEMP. °C.	30		22		20
THRUST BRG. TEMP. °C.	56		50		50
UPPER GUIDE BRG. TEMP. °C.	50		45		45
LOWER GUIDE BRG. TEMP. °C.	49		45		45
TURBINE GUIDE BRG. TEMP. °C.	44		40		40
COOLING WATER TEMP. °C.					
AMBIENT TEMP. °C.	30		22		20

REPAIRS OR CHANGES MADE AT TIME OF THIS INSPECTION

None

OTHER REPAIRS OR CHANGES RECOMMENDED

Respace exiter brushes and stone commutator.

INSPECTION MADE BY: John Jones

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

1. Inspection Checklist

Items of inspection	Inspection interval	
Discharge Lines		
Foundation	Q	A
Sliding supports	Q	A
Expansion joints	Q	A
Welds, rivets, and bolts	Q	A
Exterior paint and surface		A
Interior paint and surface		A

Q - Quarterly inspection.
A - Annual inspection.

Reference

Bureau Paint Manual and Field Painting of Metalwork

2. Foundation

Quarterly inspection. - Visual inspection for cracks, settling, and spalling.

Annual inspection. - Make careful check on alinement of pipe and foundation. Settlement or breakage of the foundation may stress the joints beyond their breaking points.

3. Sliding Supports

Quarterly inspection. - Visual inspection for lubrication and for obstructions.

Annual inspection. - Check lubrication. Clean all exposed bearing surfaces of rust, scale, paint, or other material. See that sliding members are not obstructed.

4. Expansion Joints

Quarterly inspection. - Visual inspection for leaks and corrosion. Tighten adjusting bolts as necessary and clean sliding surface.

Annual inspection. - Repack as necessary. Clean and lubricate sliding surface. See that line is not obstructed and is free to move at slip joint.

5. Welds, Rivets and Bolts

Quarterly inspection. - Visual inspection of all welds, rivets, and bolted flanges for leaks and corrosion.

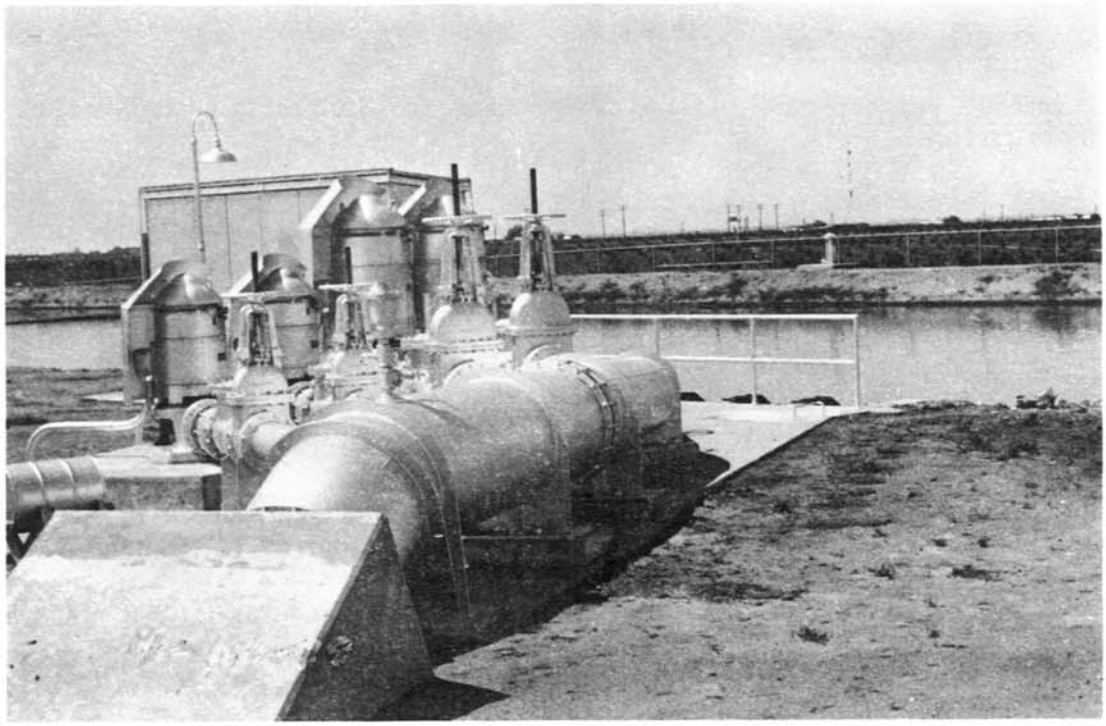
Annual inspection. - Make careful visual examination of all welds, rivets, and bolts for leaks and corrosion. Calk rivets or replace where necessary, spotweld leaky welds with line drained. Tighten or renew bolts and studs where necessary.

6. Exterior Paint and Surface

Examine paint for cracking, chalking, or other deterioration. Examine surface for corrosion, paying particular attention to welded joints, rivet heads, and bolts and nuts at flanged joints. Prepare corroded or deteriorated surfaces with sandblasting or other recommended methods and repaint with suitable materials.

7. Interior Paint and Surface

Inspect for deterioration of the paint in the form of scales, looseness, tubercles, dissolution, cracks, etc. Pay particular attention to rivet heads and welded and flanged joints. Prepare surfaces where paint has failed by sandblasting or other recommended means and repaint with suitable paint.



Southern San Joaquin Municipal Utility District - Central Valley Project, Pumping Plant S9, Lateral 127.7E. Photo P214-D-58276