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BRAWLEY 10 MW GEOTHERMAL PLANT

SOUTHERN CALIFORNIA EDISON COMPANY
AND
UNION OIL COMPANY OF CALIFORNIA

Donated By:
Herbert Rogers Jr.
Rogers Engineering Co.

PLANT MANUAL

SYSTEMS START-UP AND OPERATIONS

VOLUME II

FINAL SUBMITTAL

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**BRAWLEY
10 MW GEOTHERMAL PLANT**

**SOUTHERN CALIFORNIA EDISON COMPANY
AND
UNION OIL COMPANY OF CALIFORNIA**

**PLANT MANUAL
SYSTEMS START-UP AND OPERATIONS
VOLUME II**

ROGERS
Engineering • San Francisco

NOV 28 1980

PLANT MANUAL

Volume I Systems Descriptions

Presents each system of the facility and discusses basic features. Brief discussion of each piece of major equipment in system and design conditions.

Volume II Systems Start-up and Operations

Each system within the facility is considered from an operation viewpoint. There are five subsegments within this operation's viewpoint. Prerequisite conditions, start-up, normal operating, emergency and shutdown.

Volume III Drawings and Diagrams

The plant design drawings and diagrams are presented. A list of all drawings and an index of drawings included in the book are in Section 1. The design drawings data in this book is for general plant understanding.

Volume IV Equipment Data

This volume has technical presentations on each piece of plant equipment. It also references manufacturer's instruction books and drawing lists.

Volume V Equipment Spare Parts

This volume presents the spare parts list for each piece of equipment and references the Material Requisition on which each piece of equipment was purchased.

PLANT MANUAL
VOLUME II
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NOV 28 1980

Start-up Administration

The purpose of this section is to clearly define the responsibilities of the Start-up Engineers, Contractors, Vendors and other individuals associated with start-up. This section also proposes to define the organizational relationships required for a coordinated and comprehensive start-up program. See Start-up Organization Drawings No. A-00-006, A-00-007 and A-00-008.

All major equipment vendors and contractors are responsible for the proper installation of their respective equipment and will insure that the construction conforms to the current engineering drawings. Any deviations shall be approved by Rogers at the direction of Union Oil. The Lead Start-Up Engineer shall be notified of all changes. The installation of systems and equipment will be monitored by Construction Manager and the Lead Start-Up Engineer to insure compliance with contractors and vendors contractual obligations. All contractor and vendor drawings, instruction manuals, information bulletins and other material shall be available to the Lead Start-Up Engineer for his information and files.

Plant Start-Up is defined as that period of time between the final stages of construction and the date of firm operation.

START-UP ORGANIZATION

ROGERS ENGINEERING CO., INC.
 311 PINE STREET
 SAN FRANCISCO, CALIF. 94111
 JOB NO. S-78014

START-UP ORGANIZATION
 10 MW GEOTHERMAL PLANT
 BRAWLEY, CA. UNION #7805

DRAWING NO.	REV.
A-00-006	2
DATE: 1/30/80	

JAN 30 1980

START-UP PERIOD DETAIL

PERIOD

1

2

3

4

5

6

PERIOD DESCRIPTION

Construction

Construction &
Training & Con-
tractors Static
Tests

Start-up

Station
Operation

Station
Operation

Owner
Station
Operation

AUTHORITY LINE

1. Const. Mgr.
(C. M.)

1. C. M.
2. Lead Start-up
Eng. (L. E.)
3. Chief Operator

1. L. E.
2. Ch. Oper.
3. C. M.
4. SCE
(Monitor)

1. Ch. Oper.
2. L. E.
3. C. M.
4. SCE
(Monitor)

1. Ch. Oper.
2. L. E.
3. C. M.
4. SCE
(Monitor)

SCE
Operators
&
Sta. Sup.

ACTIVITY

Construction
Contractors
Installation

Construction
Contractor
Acceptance Tests

Operator
Training

Pre-operational
Operational Test

24 Hour Full Load
Test

Start-up
Finished After
24 Hour Full
Load Test →

Overspeed
Test

Shutdown
for Bearings
Inspection &
Inspect All
Other Equip.

Plant on Line

Equip. Accept.
Tests

Plant Firm
Operation →

Turn over
to
Union
to
SCE

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CALIF. 94111
JOB NO. S-78014

START-UP PERIOD DETAIL
10 MW GEOTHERMAL PLANT
BRAWLEY, CA. UNION #7805

DRAWING NO. REV.

A-00-007

2

DATE: 1/30/80

START-UP OVERVIEW

RESPONSIBILITY	CONSTRUCTION MANAGER	START-UP ENGINEER			OPERATION DEPARTMENT
PERSONNEL	CONTRACTORS MANUFACTURES REPS.	LEAD START-UP ENGINEER DISCIPLINE START-UP ENGINEERS CHIEF OPERATOR OPERATORS MAINTENANCE PERSONNEL CONSTRUCTION MGR. CONTRACTORS (CONSTRUCTION ASSISTANCE)			OPERATORS
ACTIVITY	COMPLIANCE WITH CONTRACTUAL OBLIGATIONS CONTRACTOR ACCEPTANCE TESTS	START-UP OPERATIONS			FIRM OPERATION
		PRE OPERATIONAL TESTING (INDIVIDUAL EQUIP & LOOP TESTS)	OPERATIONAL TESTING (INTERGRATED LOOP SYSTEM TESTS)	24 HOUR FULL LOAD TEST (FULL PLANT)	
MAIN BOUNDARIES		<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center;">A</div> </div> <div style="text-align: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center;">B</div> </div> </div>			
PERIODS	1	2 & 3			4 5 & 6

ROGERS ENGINEERING CO., INC.

111 PINE STREET

SAN FRANCISCO, CALIF. 94111

JOB NO. S 78014

Start-up Organization Scheme

10MW Geothermal Plant

Brawley Calif. UNION #7805

DRAWING NO.

A-00-008

DATE: 1/22/80

REV.

1

06-023

1.1 Personnel

The Start-Up Organization consists of a Lead Start-Up Engineer, and a number of Start-Up Engineers to supervise the initial placing in service and operation of all systems and equipment. The Project Start-Up organization will be assisted by Design Engineers and other Engineers as required to bring the start-up to a successful conclusion.

1.1.1 Construction Management

The construction of the project is under the direction and responsibility of the construction manager (CM) and his assistants. The CM supervises and coordinates the activities of the contractors and assure the compliance with the contract specification. This includes the demonstration of function and performance of the installed equipment.

1.1.2 Start-up Responsibilities

The Lead Start-up Engineer has the overall responsibility for start-up.

The Lead Start-up Engineer is responsible for start-up operations, performance tests and demonstrations and final functional check of all systems and equipment. Start-Up will begin during the final stages of construction and continue through firm operation. The

Lead Start-up Engineer's responsibility will terminate when the unit is placed on a firm operation status and when all completion (punch list) items are completed and accepted by Union Oil and Southern California Edison.

1.1.2.1 The Lead Start-Up Engineer, or his designated representative, will remain "on-site" or "on-call" continuously from the initial operation of the first system or equipment through to firm operation of the final complete unit.

1.1.2.2 The Lead Start-up Engineer and his assistant will direct all start-up operations.

These activities include, but are not necessarily limited to the following functions:

- A. Plan, coordinate and supervise all start-up operations.
- B. Schedule all start-up operations consistent with the Master Construction Schedule.
- C. Coordinate and supervise Contractor and Vendor start-up activities.
- D. Maintain a current schedule of Start-Up Engineers and Vendor Representatives to insure adequate start-up coverage.

- E. Maintain a current address and telephone list of all personnel associated with start-up.
- F. Coordinate with the Chief Operator to insure adequate operator manning requirements.
- G. Verify that all start-up activities are conducted in accordance with established and approved procedures.
- H. Maintain safe working conditions and insure strict adherence to safety rules and regulations.
- I. Monitor systems and equipment performance. Insure that all systems and equipment meet the performance design criteria.
- J. Analyze and identify equipment problem areas, compile the "completion item" list and initiate action for correction.
- K. Provide necessary maintenance for all in-service equipment to insure continuous and reliable service to firm operation. Initiate requisition to purchase service, equipment and materials.
- L. Process in-service equipment outage requests on an approved form.

- M. Prepare and distribute programs and instructions for major start-up activities.
- N. Schedule and direct all Start-up Operations Meetings; at least 24-hour notice for all start-up personnel is required.
- O. Prepare and distribute Weekly Start-up Schedules and Weekly Progress Reports and amendments as required by Union Oil and Edison.
- P. Maintain chronological diary of all start-up activities.
- Q. Conduct demonstration and performance tests, and record results on approved forms.

1.1.2.3 All Contractor Vendor Representatives associated with Start-Up will report to the Lead Start-Up Engineer for coordination and direction.

1.1.2.4 The Lead Start-Up Engineer will accept systems and equipment released for start-up from the Construction Manager (CM). All systems and equipment shall be released from Construction on an approved release form with boundaries, parameters and deficiencies defined. Released systems and equipment will be checked out by the Start-Up Engineers and if sufficiently complete will be placed in a start-up mode, after being released to Chief Operator for start-up operation and testing.

1.1.2.5 Start-up Electrical Engineer

Coordinates and directs certain electrical testing by contractors, vendors and/or Chief Operator.

1.1.2.6 Start-up Controls Engineer

Coordinates and directs all instrument and controls functional testing by contractors, vendors and/or Chief Operator personnel.

1.1.2.7 Start-Up Mechanical Engineer

Coordinates and directs initial start-up of all mechanical equipment, pre-operational cleaning of piping systems. Directs Chief Operator personnel, vendor representatives, engineers and certain craft labor in the fulfillment of start-up operations and related functions.

1.1.3 Plant Operating Personnel

The plant operating personnel will operate all permanent plant equipment under the supervision of the Chief Operator as directed by Start-up Engineers. Operation by plant personnel will begin when the system and/or equipment is released from the Lead Start-up Engineer to the plant for operation. The Chief Operator is responsible for the following:

- A. Provides sufficiently trained operating personnel to operate all permanent plant equipment for the beginning of start-up through firm operation.
- B. Accepts equipment formally released from the Lead Start-up Engineer, providing such equipment meets the standard requirements for operation.
 - 1. Posts release tags on all released systems and equipment.
 - 2. Maintains records of released equipment.
 - 3. Issues necessary clearances on released equipment and posts clearance tags.
 - 4. Maintains records of outstanding clearances.
- C. Provides competent maintenance and technical personnel to maintain, calibrate, tune and adjust equipment released for start-up operations. Such services to be provided from first date of release for start-up operations to firm operating date.

1.1.4 Vender Representatives

All vender representatives participating in the start-up program are included in this category. General responsibilities applicable to all venders include:

- A. Provide a current print file and technical support information on the equipment for which he is responsible.
- B. Provide written procedures far enough in advance of initial start of equipment to give the Lead Start-Up Engineer time for review and comment of the procedure.
- C. Provide technical personnel to meet equipment operational schedules and operator training.
- D. Adjust and tune instruments and controls from initial operation to the date of firm operation.
- E. Provide a current personnel call list to the Lead Start-up Engineer.
- F. Provide current information for the Mechanical and Instrument Data Sheets.
- G. Provide instrument set point data for controllers, transmitters, receivers, indicators and pressure switches.
- H. Originate requisitions against appropriate purchase orders for replacement parts and expedite delivery to meet Start-Up Schedules.

- I. Maintain a work item list which includes estimated material delivery date and type of outage required for the work.
- J. Be prepared to provide coverage with technical personnel as required during critical periods of operation.
- K. Attend and participate in information and planning meetings called or scheduled by the Lead Start-up Engineer.
- L. Coordinate all engineering design and "as-built" discrepancies.
- M. Assure timely release of all equipment for which they are responsible.
- N. Work in close cooperation with the Lead Start-Up Engineer and his representative.
- O. Perform mechanical equipment check out, instrument calibration, set point adjustments and electrical check out prior to operation.
- P. Provide operational supervision until it has been demonstrated that the equipment is functioning properly and that the Plant Operating Personnel are competent in its operation and control.

1.2 Chain of Command

- 1.2.1 This chain of command applies for equipment and systems while in stages between boundaries A and B on the Start-up Overview Drawing A-00-008. Start-up organization consists of a Lead Start-up Engineer, and a number of Start-Up Engineers to supervise the initial placing in service of all systems and equipment. No system and equipment can be operated by any person for any purpose without the express consent and knowledge of the Lead Start-up Engineer. Reporting directly and assisting the Lead Start-up Engineer are the discipline engineers:

Start-up mechanical engineer (see 1.1.3.4)

Start-up electrical engineer (see 1.1.3.2)

Start-up control engineer (see 1.1.3.3)

- 1.2.1.1 Lead Start-Up Engineer coordinates with the Chief Operator the assignment of adequate number of power plant operators.
- 1.2.1.2 All Contractor/Vendor Representatives associated with start-up report to the Lead Start-up Engineer for coordination and direction.
- 1.2.1.3 Any work executed under the jurisdiction of the Construction Manager during the start-up period has to be reported and cleared by the Lead Start-up Engineer.

1.2.2 The Lead Start-up Engineer can assign any of his assistants to grant clearance in the field of their competence.

1.3

Communications

Communication is essential throughout the start-up period to disseminate information, to coordinate start-up activities and to protect personnel and equipment. As start-up activities progress, formal and informal meetings will be scheduled to discuss procedures, methods and participation of groups and individuals in start-up activities.

1.3.1 Formal Meetings

Formal meetings will be scheduled by the Lead Start-Up Engineer prior to the initial start-up of any major equipment, prior to the scheduling of an event involving several manufacturers and whenever an event occurs which affects the scheduled completion of start-up activities, or when requested by Union Oil Company.

1.3.2 Informal Start-up Meetings

Informal meetings will be held daily by the Lead Start-Up Engineer, after start-up activities commence, to discuss planned operations and any details for the ensuing 24 hour period. Prior to any test or unusual operations, the details, limitations and safety precautions will be discussed with the plant Operators and Contractor Representatives.

These meetings also include a tailgate briefing to assess the daily progress and/or delays.

1.3.3 Meeting Minutes

Minutes of formal Start-Up Meetings will be maintained by the Lead Start-up Engineer. Distribution shall be determined at the first formal meeting, and in any event shall include 5 copies to Edison's start-up representative.

1.4 Records

1.4.1 Chronological Diary

The official Start-Up Diary will be maintained by the Lead Start-Up Engineer. Daily entries will be made to reflect pertinent plant start-up activity and progress. Distribution shall be as requested by Union Oil Co.

1.4.2 Mechanical Equipment Data Sheets

Individual equipment data sheets will be maintained by the Lead Start-Up Engineer. The appropriate vendor is responsible for supplying equipment nameplate data and for performance data on equipment for which he is responsible.

Distribution

- A. Lead Start-Up Engineer
- B. Chief Operator
- C. As requested by Union Oil Company and shall include 5 copies for SCE's start-up representative

1.4.3 Hydrostatic, Pneumatic and Static Test Sheets

Hydrostatic, Pneumatic and Static Test Sheets will be initiated and completed by the Construction Manager. The completed sheets will be transmitted to the Lead Start-Up Engineer who will maintain them in his files until completion of the Project. Copies of Hydrostatic, Pneumatic and Static Test Sheets should accompany equipment releases.

1.4.4 Instrument Set Point Data Sheets

Initial calibration of all plant instrumentation is the responsibility of the appropriate contractor representative. The instrument calibration/setting data will be transmitted to the Lead Start-Up Engineer on a weekly basis.

Distribution

- A. Lead Start-Up Engineer
- B. Chief Operator
- C. As requested by Union Oil Company and shall include 5 copies for SCE's start-up representative

1.4.5 Electrical Data Sheets

The Electrical Start-Up Engineer is responsible for delivering to the Lead Start-Up Engineer a Form for each circuit completed. The individual circuits to be included are itemized in the Electrical Start-Up Schedule. Two categories of construction completion are recognized: (a) that completed by the Test Crew, and (b) that completed by Construction. Form completion after testing is the responsibility of the Lead Start-Up Engineer.

Originator

Electrical Start-Up Engineer

Distribution

Lead Start-Up Engineer

Chief Operator

As requested by Union Oil Company and shall include 5 copies for SCE's start-up representative

1.4.6 Rotating Equipment Alignment Data

Construction Manager will originate the rotating equipment alignment data. A copy of the Equipment Alignment Sheet will accompany the Construction Release Sheet.

Distribution

Lead Start-up Engineer

Chief Operator

As requested by Union Oil Company and shall include 5 copies for SCE's start-up representative

1.4.7 Equipment Release Sheet (Refer to 1.6)

This document is prepared by the contractor and passed on to the Construction Manager and includes the items listed on the Master Start-Up Schedule and is accordingly numbered. All construction deficiencies shall be listed. It is transmitted to the Lead Start-up Engineer, who will checkout the released equipment or systems. Next the Lead Start-Up Engineer will pass on the release to the Chief Operator, or his representative, who will again check-out the equipment or systems, at the same time noting any deficiencies not previously listed and hanging Equipment Release Tags. Signatures of Contractor, Construction Manager, Lead Start-up Engineer and Chief Operator are required on the release form before operation of equipment or systems.

Originator

Construction Manager

Distribution

- A. Construction Manager
- B. Lead Start-Up Engineer
- C. Chief Operator
- D. As requested by Union Oil Company and shall include 5 copies for SCE's start-up representative

1.4.8 Start-up Work Requests

All work to be performed by the Contractor after construction equipment has been released by the Construction Manager must be approved by the Lead Start-Up Engineer. This mandate starts when the Contractor delivers the "Release Sheet" to the Construction Manager.

Originator

Union Oil Company

Approval

Lead Start-up Engineer

Distribution

- A. Construction Manager
- B. Lead Start-up Engineer
- C. Project Cost Engineer
- D. File
- E. Contractor
- F. Union Oil Company and 5 copies to SCE's start-up representative

1.4.9 Final Start-Up Records

The Lead Start-Up Engineer will prepare the final Start-Up records, containing the following:

- A. Summary of start-up, including chronology of key activities and jobsite personnel
- B. Start-up schedule record
- C. System and equipment cleaning records
- D. Steam blow records
- E. Hydrostatic, Pneumatic and Static Test Records
- F. Electrical Test Records
- G. Instrument and Controls Test Records

Distribution

- A. Normal Project Distribution
- B. As requested by Union Oil Company and 5 copies to SCE's start-up representative

1.5 Schedules

1.5.1 Construction Completion

Under the leadership and jurisdiction of the Construction Manager, all major equipment vendors and contractors are responsible for the proper installation of their respective equipment and will insure that the construction conforms to the current engineering drawings.

All contractor and vendor drawings, instruction manuals, information bulletins and other materials shall be available to the Lead Start-up Engineer. This shall include all the test data and records obtained or generated by the contractor during period of his contractual obligations.

1.5.2 Initial Start-up Sequence

The start-up activities start with the take over of the overall responsibilities by the Lead Start-Up Engineer. The Lead Start-Up Engineer and his assistant will plan, coordinate, direct and supervise all start up operation.

1.5.3 Acceptance Tests Schedule

1.5.3.1 The Lead Start-Up Engineer with assistance of mechanical, electrical and control start-up engineers will conduct the Acceptance tests. This testing program consists of demonstration of proper functioning of individual loops. The integrity of interconnection of loops in systems will be tested. (See Section 5.0). After satisfactory testing, the systems are released to Chief Operator.

1.5.3.2 The unit is ready at this point for start up. All equipment is operated by plant personnel assigned by the Chief Operator. Bringing the unit on the line will follow the procedure described in Section 4.1.

1.6 Release Tags

1.6.1 General

When the construction of a system or piece of equipment is completed by the contractor sufficiently for start-up operations, a release shall be provided. The following sequence of events shall take place.

1.6.1.1 Contractor or Vendor

1. Fills out and signs an Equipment Release Sheet.
2. Enters on the release all known construction deficiencies.
3. Attaches a P&ID marked so as to clearly show the equipment or system being released and the released boundaries.
4. Attached to the equipment release form shall be copies of hydrostatic, pneumatic and static test forms, mechanical and electrical equipment data sheets and instrument calibration cards when applicable.
5. Submits the signed release and all applicable forms to the Construction Manager.

1.6.1.2 Construction Manager

1. Assures himself of the operational integrity of the system or equipment, noting any equipment or system deficiencies.
2. Checks that the P&ID accompanying the release clearly shows the release boundaries and that all applicable data sheets accompanying the release are properly filled out, and properly signed.

3. Endorses the release and passes it on to the Lead Start-Up Engineer.
4. Prepares and submits equipment clearance tags as needed to maintain safe working conditions outside of the release boundaries. The clearance tag is submitted to the Lead Start-up Engineer.

1.6.1.3 Lead Start-Up Engineer

1. Assures himself of the operational integrity of the system or equipment.
2. Checks that the P&ID accompanying the release shows the release boundaries and all applicable data sheets are correctly filled out and properly endorsed. Adds any deficiencies not previously noted. Verifies that all vessels have been closed after inspection.
3. Endorses the release and submits it to the Chief Operator accompanied by a sufficient number of "release tags" to be attached to every valve, switch and disconnect within the release boundary. The release tags shall be assigned a release number by the Lead Start-Up Engineer.
4. Retains any equipment clearance tags submitted by the Construction Manager.

1.6.1.4 Chief Operator

1. Assures himself of the operational integrity of the system or equipment.

2. Checks that the P&ID accompanying the release clearly shows the release boundaries and that all applicable data sheets are correctly filled out and that the release is properly endorsed. Adds any deficiencies not previously noted.
3. Endorses the release and returns it to the Lead Start-Up Engineer.
4. Hangs a release tag on each valve, switch and disconnect within the release boundaries.
5. Enters a release in the Controls Operator's Log. Notifies dispatcher of applicable Electrical System Releases.

1.6.2 Administration

1.6.2.1 Lead Start-Up Engineer

1. Makes copies of the release and marked up P&ID accompanying the release and distributes one copy to the Station Superintendent. The original release and marked up P&ID will be retained by the Lead Start-Up Engineer.
2. Checks over equipment clearance tags and after assuring himself they are proper, approves each one. Retains the equipment control stubs and passes the craft tag and equipment clearance stub to the Chief Operator to issue clearances as requested to the clearance requester.
3. Requests Construction Manager to close all vessels immediately after release inspections are complete.
4. Apprises Chief Operator of action to be taken on released and tagged systems and equipment.

1.6.2.2 Designated Representative

For the purpose of continuity of start-up operations and to assure smooth, continuing release of systems and equipment, the Construction Manager, the Lead Start-Up Engineer and the Chief Operator can designate certain qualified personnel as representatives to process and sign equipment releases. Qualified personnel are listed below:

1. Construction Manager
 - A. Construction Engineers
2. Lead Start-Up Engineer
 - A. Start-Up Engineers
3. Chief Operator
 - A. Operator

1.6.2.3 Deficiency or Completion Items

All deficiencies listed in releases will be entered on Deficiency List Forms and will be closely monitored until corrected.

Deficiencies or completion items will be monitored during Start-Up Meetings.

Deficiency Lists will be updated and distributed as a part of the meeting minutes.

BRAWLEY GEOTHERMAL POWER PLANT DEFICIENCY LIST

[illegible]

JAN 30 1980

EQUIPMENT RELEASE SHEET

Date _____

Brawley Geothermal Power Plant

Job Order No. _____

To Chief Operator

The following equipment has been checked and is released for operation. A Release Tag accompanies this release for placement on the equipment.

Equipment _____

Further construction work is required as noted _____

Signed _____

Construction Manager

Date _____

Signed _____

Lead Start-Up Eng.

Date _____

Signed _____

Contractor

Date _____

Signed _____

Chief Operator

Date _____

JAN 30 1980

RELEASED TO START-UP
FOR PRE-OPERATIONAL
TESTING

I.D. #

RECO

RELEASED TO START-UP
FOR PRE-OPERATIONAL
TESTING

I.D. #

RECO

JAN 30 1980

1.7

Safety

When start-up operations are initiated, equipment and systems will be transferred, as they become available, from construction to start-up operations. At this time, construction workers are accordingly restricted in their activities with respect to equipment on which they can work and must obtain a suitable equipment clearance before working on such operating equipment.

The safety procedure is designed primarily to protect personnel from injury and, secondarily to prevent damage to plant equipment after start-up operations are initiated.

1.7.1 Equipment Clearances

Equipment clearance is the permission to remove a piece of equipment or system from operating status. This permission must be obtained from the Lead Start-up Engineer.

1.7.2 Equipment Clearance Responsibilities

1.7.2.1 Lead Start-up Engineer shall:

- A. Provide a current list of personnel authorized to take operating clearances and issue equipment clearances.
- B. Administer and control the clearance procedure and insure compliance with its provisions.

- C. Take, hold and release operational clearances.
- D. Keep Chief Operator advised of equipment clearances in effect.
- E. Issue all equipment clearances required before any work is performed on the equipment or systems turned over by Construction.
- F. Direct the restoration of operational status to equipment and systems following the release of operational clearances.

1.7.2.2 Chief Operator

- A. Issues operating clearances to the Lead Start-up Engineer, and accepts their release when rendered.
- B. Maintains the official operating clearance log.
- C. Maintains a current file on all operating clearances in process and in effect.
- D. Performs all operating work required to effect operational clearances and to restore systems and equipment after clearances are released.

1.7.2.3 Equipment Clearance Request

- A. Submits clearance request to the Lead Start-Up Engineer in the form of an equipment tag properly filled in and signed. Every effort should be made to submit clearance requests to the Start-Up Group 24 hours in advance of the scheduled work.
- B. Upon receipt of the equipment clearance stub, assures safe-to-work conditions and supervises corrective work.

- C. Defines boundaries of equipment clearance to construction personnel.
- D. Inspects system and equipment at the conclusion of work and verifies operating integrity before releasing the equipment clearance.

1.7.3 Clearance Procedure

The procedural steps in taking equipment clearances are stated below:

A clearance requester submits a clearance request to the Lead Start-up Engineer in the form of an equipment clearance tag with two attached stubs properly filled out and signed. The Lead Start-up Engineer obtains equipment clearance for the work from the Chief Operator and releases an equipment clearance stub to the clearance requester. To obtain a release of the equipment clearance, the requester receives the signed equipment clearance stub from the craft performing the work, inspects the equipment for completion of work and operating integrity, and returns the equipment clearance stub to the Lead Start-up Engineer.

- 1.7.3.1 Before equipment is turned over to Chief Operator for the first time, all construction tags will be removed. The Lead Start-Up Engineer shall be responsible for obtaining clearances on valves,

switches, circuit breakers, etc., isolating all sources of energy in such a manner that untagged equipment cannot become hazardous.

1.7.3.2 Construction maintenance personnel cannot perform any work on equipment tagged with a release tag reading: "This Equipment Has Been Turned Over To Chief Operator", unless they hold an equipment clearance on the equipment. NOTE: IN SOME INSTANCES, LIMITED WORK CAN BE ACCOMPLISHED UNDER AN "APPROVAL". APPROVALS FOR WORK ARE ISSUED BY THE CHIEF OPERATOR (WITH APPROPRIATE LOG BOOK ENTRIES ACCOMPANIED BY SIGNATURES OF MAINTENANCE PERSONNEL OR VENDER REPRESENTATIVE) FOR WORK THAT IS ORDINARILY PERFORMED WHILE EQUIPMENT IS ROTATING, ENERGIZED OR PRESSURIZED. EXAMPLES: ADJUSTING PUMP PACKING. CERTAIN INSTRUMENT WORK. APPROVALS MUST BE RELEASED ON THE DAY THEY ARE GRANTED.

1.7.3.3 All clearance tags shall be filled out completely. Blank tags are not to be used and shall be considered not valid.

1.7.3.4 Contractor personnel requesting clearances shall be given the equipment clearance stubs of the tags to hold in their possession until they are ready to have the equipment released. The stub numbers shall be matched with the tag numbers before the tags are removed. Only the man originally obtaining the clearance shall release the equipment. Equipment tags shall be hung last and removed first.

- 1.7.3.5 More than one equipment clearance may be issued under one operating system clearance.
- 1.7.3.6 NO EQUIPMENT SHALL BE WORKED ON UNDER THE CLEARANCE OF ANOTHER PIECE OF EQUIPMENT.
- 1.7.3.7 No service organization or company shall work under the clearance held by another service organization or company.
- 1.7.3.8 Clearing mechanical equipment, such as motor driven pumps, shall require that the motor starter or circuit breaker be cleared by opening the disconnects of the starter or racking out the circuit breaker; also, the control circuit must be cleared by opening the control switch at the starter or breaker compartment. In every instance fuses shall be pulled where provided.
- 1.7.3.9 Under no circumstances shall there be a equipment clearance tag hung without an operational clearance tag.
- 1.7.3.10 The Lead Start-Up Engineer removing the last equipment clearance tag is responsible for releasing of the operational clearance, the operational clearance is not to be used to keep equipment out of service.

1.7.3.11 No clearance boundaries shall be altered without the approval of the Lead Start-Up Engineer.

1.7.4 Equipment & Systems Releases

1.7.4.1 When the construction of a system or equipment has been completed, a release signed by the Contractor noting all construction deficiencies will be forwarded to the Construction Manager.

The Construction Manager will transfer the system or equipment to Start-Up with a written release to the Lead Start-Up Engineer. Copies of hydrostatic, pneumatic and static test data sheets and alignment and mechanical data sheets shall accompany this release if applicable. A P&ID marked to clearly show boundaries of the release shall accompany the release.

1.7.4.2 The Construction Manager receiving a release shall check out the system or equipment to satisfy himself of its operating integrity, list any deficiencies not previously listed, endorse the release and relay it to the Lead Start-Up Engineer requesting boundary clearances as appropriate.

1.7.4.3 The Lead Start-Up Engineer will inspect the released equipment, list any deficiencies not noted previously, and if satisfied with its operational readiness, release it to Chief Operator.

1.7.4.4 Chief Operator will inspect the released equipment and, if satisfied with its operational readiness, tag the equipment with release tags reading: "This Equipment Has Been Turned Over To The Chief Operator".

1.7.4.5 Initial operation can be accomplished only when the foregoing have been completed. WARNING: BE SURE YOU ARE FAMILIAR WITH THE CLEARANCE AND TAGGING PROCEDURE. WHEN IN DOUBT, ASK!!!!!!

1.7.5 Electrical Test Clearance

After the construction forces have completed work on electrical equipment and its associated circuits and the contractors have satisfied the requirements described under Section 2.3 Electrical contract, and Section 2.6 Building Electrical contract, the testing will start. At this time testing activities must be restricted by a special clearance procedure to allow limited energization of the circuit only by the holder of the "In-Test" clearance. This procedure is designed to protect personnel from injury and to avoid damage to plant equipment while allowing for adequate and complete testing of equipment.

1.7.5.1 Preparation

A. Before any testing may be started all equipment clearances and operating clearances must be removed from the circuit to be tested.

- B. All testing will be done with circuits in the "Test Position" only, except the following:
1. Motor Operated Valves
 2. Power Receptacles
 3. Motor Heaters
 4. Solenoid Operated Valves
 5. 4kV Breakers may be tested in the racked in position under an "In-Test" clearance if the switchgear bus is de-energized.
- C. The "Test Position" is defined as follows:
1. 4 kV switchgear, 4 kV starters and 480V breakers: This is a position identified in the switchgear as the "Test Position" for testing the closing and tripping of the circuit breaker.
 2. 480V starters and equivalent devices: These are considered in the "Test Position" when the load side leads are lifted at the starter or equivalent device.

1.7.5.2 Responsibilities

- A. Lead Start-up Engineer
1. Maintains a current file on all "In-Test" clearances in process and in effect.
 2. Approves equipment in service to be placed "In-Test".
 3. Schedules and monitors all rotation check and initial operation of motors.

B. Chief Operator

1. Issues "In-Test" clearances and accepts their release when rendered.
2. Maintains the official Test Clearance Log.

C. Electrical Start-up Engineer

1. Upon request from Test Personnel (see Paragraph D.1) determines if testing can be performed.
2. Accepts or denies request for "In-Test" clearance.
3. Removes all equipment clearances and operational clearances per normal clearance procedures.
4. Defines test parameters and effects of test on Station Operations
5. Defines limitations on testing procedure to Test Personnel.
6. Is available for technical assistance to all personnel involved in testing.

D. Test Personnel

1. Test personnel are assigned to and approved by the Electrical Start-up Engineer to accomplish electrical testing during start-up.
2. Aligns the circuit by racking in circuit breakers, installing fuses, and energizing control circuits as necessary to perform tests after he has received "In-Test" stub.

3. Completes the electrical data sheets (see 1.4.5) with any data pertinent to the circuit or equipment and returns it to the Electrical Start-Up Engineer.
4. Keeps the Electrical Start-Up Engineer fully informed with respect to the status of testing, any problems that arise, and provides a written report covering faulty or inadequate components.

1.7.5.3 Electrical "In-Test" Clearance Procedures

The procedural steps in taking an "In-Test" clearance, performing electrical circuitry test, recording the results, and releasing the clearance are stated below.

- A. Test Personnel: Requests "In-Test" approval on a specific circuit. Fills out "In-Test" tag.
- B. Start-Up Engineer: After approving "In-Test" clearance, removes equipment clearances as outlined in the General Clearance Procedure.
- C. Electrical Start-up Engineer: Submits "In-Test" tag with its stub and operational clearance stub to Station Operations of the circuit to be tested, including pertinent data on the condition of the equipment, the alarms which will be initiated,

and the effects of the test on the tested equipment and on associated equipment. Releases operational clearance on the circuit to be tested.

- D. Chief Operator: Makes entries in "In-Test" log.
- E. Chief Operator: Removes the operating clearance tag and hangs the "In-Test" tag on the circuit breaker, safety switch, or control switch. Transmits "In-Test" stub to the test personnel informing him of any limiting conditions to his testing.
- F. Test Personnel: Places the circuit and equipment to be tested in the "Test Position". Performs the test. Upon completion of the test he returns the "In-Test" stub and electrical data sheets, filled in with the data of the test to the Start-Up Engineer. Yellow lines the record prints to identify the circuits or the parts of the circuitry tested.
- G. Electrical Start-up Engineer: Checks electrical data sheets (see 1.4.5) for completeness and gives to the Lead Start-up Engineer.
- H. Lead Start-up Engineer: Verifies job completeness. Turn equipment to Chief Operator.

1.7.5.4 Special Tasks During "In-Test" Clearance

A. IF MOTOR IS TO BE CHECKED FOR ROTATION AND/OR RUN:

Test Personnel: Submits "In-Test" tag and signs off log.

Start-up Engineer: Monitors all motor bumping and initial running. Completes motor running data and logs on electrical data sheets.

B. IF THE CIRCUIT AND EQUIPMENT IS TO BE RETURNED TO FULL

CLEARANCE STATUS:

Lead Start-up Engineer: Requests a clearance from Chief Operator.

Chief Operator: Issues new clearance on the equipment, hangs clearance tag and checks that the equipment is in the cleared condition. If "In-Test" tag has not been removed, Chief Operator should remove "In-Test" tag when the clearance tag is hung.

C. IF THE CIRCUIT AND EQUIPMENT IS READY FOR SERVICE:

Chief Operator: Remove "In-Test" tag. Leaves circuits energized. Returns tag to Electrical Start-Up Engineer and signs off log.

Test Personnel: Returns completed SCE Form 142 to Electrical Start-up Engineer.

Electrical Start-up Engineer: Checks the yellow lined record print. Signs the electrical data sheets and indicates its distribution. WARNING: BE SURE YOU ARE FAMILIAR WITH THE CLEARANCE AND TAGGING PROCEDURE. WHEN IN DOUBT, ASK!!!!!!

D. TEST PERSONNEL INCLUDES: ELECTRICAL START-UP ENGINEER, TEST TECHNICIANS, TEST SUPERVISORS, INSTRUMENT TECHNICIANS AND VENDOR REPRESENTATIVES APPROVED FOR TAKING CLEARANCES.

1.7.6 Emergency Clearance Release

In the unusual instance that a clearance must be released when the clearance holder is unavailable the following procedures will be followed:

1.7.6.1 If the clearance holder is a contractor:

1. The Electrical Start-up Engineer will provide notice of equipment clearance release to the next higher level of contractor supervision on site, or at the emergency phone number provided by the contractor.
2. The supervisor notified will assume all the responsibilities of the original clearance holder. That is, he will be responsible for notifying the original clearance holder and equipment

personnel that the clearance has been released. This information must be communicated by the contractor to the equipment personnel before work resumes the following day.

3. After the contractor has been notified, the Electrical Start-up Engineer will release the clearance.
4. Barrier tape and a sign labeled: "Emergency Release Has Been Made On This Equipment - Check With Control Operator Before Resuming Work" will be placed on the equipment by Chief Operator.

1.7.6.2 If the clearance holder is from the Maintenance Group:

1. The Lead Start-Up Engineer initiating an emergency release will make every effort to call the clearance holder. If this is unsuccessful, he will notify the Chief Operator who will assume the responsibilities of the clearance holder.
2. After this notice has been completed, Steps 3 and 4 from paragraph 1.7.6.1 will apply.

1.7.7 Exceptions

When a new or unusual situation that is not provided for in the Clearance Procedure Section arises, the Chief Operator, Start-up

Engineer and Clearance Requester must work out a reasonable and safe method for getting the task accomplished. This rule applies to operating and "In-Test" clearances. The objective is to place the plant in service with minimum delay while maintaining control and personnel safety.

1.8 Design Changes

1.8.1 Requests

Design change requests originated in the field will be processed on Construction Form and will be routed in the following manner:

Step 1: Originator (Discipline Start-Up Engineer or Vendor Representative) submits Construction Engineering Field Report to the Lead Start-Up Engineer.

Step 2: The Lead Start-Up Engineer assigns a number and recommends for or against approval. Files original in Field Report file and sends copy with recommendation to Construction Manager.

Step 3: Construction Manager approves or disapproves. If disapproved, feeds back to Lead Start-Up Engineer. If approved, passes on to Construction Discipline Engineer.

Step 4: Construction Discipline Engineer recommends method of correction or design change and passes recommendation with sketch(s) to Construction Manager. If revision is a RUSH design change, it should be submitted to the Lead Start-Up Engineer for immediate action.

1.8.2 Construction Problems

The Lead Start-Up Engineer will communicate construction problems directly to construction.

Construction Contractor Acceptances

All major equipment vendors and contractors are responsible for the proper installation of their respective equipment and that the construction conforms to the current engineering drawings. The Construction Manager supervises and approves the installation of systems and equipment and ensures compliance of vendors and contractors with their contractual obligations.

2.1 Personnel

2.1.1 All major equipment vendors and contractors are responsible for the proper installation of their respective equipment and will insure that the construction conforms to the current engineering drawings. All deviations shall be approved by the respective engineering department. The Lead Start-up Engineer shall be notified of all changes. The installation of systems and equipment will be monitored by Construction Manager and the Lead Start-up Engineer to insure compliance with contractors and vendors contractual obligations. All contract and vendor drawings, instruction manuals, information bulletins and any other materials pertinent to the equipment shall be available to the Lead Start-up Engineer.

2.1.1 The Construction Manager ascertains that the contractor and/or vendor:

1. Fills out and signs an Equipment Release Sheet
2. Enters on the release all known construction deficiencies
3. Attaches a P&ID marked to clearly show the equipment or system being released and the released boundaries.

2.1.3 The Lead Start-up Engineer assures himself of the operational integrity of the system or equipment released by the contractors through the Construction Manager. Checks that the P&ID accompanying the release shows the release boundaries and all applicable data sheets

are correctly filled out and properly endorsed. Adds any deficiencies not previously noted. Endorses the release and submits it to the Chief Operator. (See also Section 1.6 and 1.7)

2.2 Mechanical Contract (Spec.41-001)

The following is a summary of the requirements specified to be completed by the mechanical contractor:

2.2.1 (Division 15D) Pumps, compressors, blowers, turbines, fans and mixers

- a. Equipment grouted
- b. Final alignment and certification
- c. Piping hydrotest
- d. Install temporary strainers and certify
- e. Lubricate equipment
- f. Coupling made up
- g. Main steam pipe blown through
- h. Turbine oil system flushed
- i. Pipe welds radiographed

Note: The following is not included in the above contract:

- k. Equipment dowel installation
- l. Overspeed trips
- m. Relief valve set point check
- n. Turbine governor set point
- o. Turbine steam cleaning

2.2.2 (Division 15F) Field Pressure Testing of piping systems

- a. All plant piping and pressure vessels will be pressure tested to comply with ANSI B.31.1 Section 137 or ASME Boiler & Pressure Vessel Code to pressures shown on the Line Summary Sheets

or vessel plate with Code Stamp as appropriate but not less than 15 psig except as listed below:

- b. Vacuum lines minimum test pressure 15 psig
- c. Instrument process piping beyond the first block valve will not be pressure tested.
- d. Pumps, turbines and compressors will not be pressure tested
- e. Pressure safety valves, and rupture discs will not be pressure tested
- f. Connected equipment will not be pressure tested
- g. Piping components such as displacement meters, expansion joints, strainers etc., maximum test pressure per manufacturers standard
- h. Special items may be pneumatically pressure tested to 110% of design pressure up to 100 psig subject to approval of the Construction Manager.

2.2.3 A permanent record of each test shall be provided to the Construction Manager.

2.3 Electrical Contract (Spec. 17-003)

The following is a summary of test and check out requirements required under the electrical contract:

2.3.1 Ground rod resistance measurement (switchyard only - ground rods around building installed under separate contract).

2.3.2 Main and Auxiliary Transformers

- a. Insulation resistance measurement
- b. Oil dielectric test
- c. Functional test of transformer alarms and relays
- d. Functional test cooling fan operation
- e. Functional test, no-load tap changers and measurement of voltages.

2.3.3 Wire and cable

- a. Insulation resistance measurement all power and control wires
- b. High potential test, 5 kV cable.

2.3.4 Switchgear and Motor Control Center

- a. Inspection for conformity to specifications
- b. Insulation resistance measurement
- c. Contact alignment
- d. Functional test, controls and indicating lights, circuit breakers, motor starters and automatic transfer switch.

- e. 4 kV switchgear bus ground test (actuates relay 50B)
- f. 480V motor control center bus ground test for both the normal bus and the critical load bus (actuates ground detector on each bus)

2.3.5 Substation

- a. Functional test, switches and recloser (de-energized)
- b. Verification of phasing for incoming lines

2.3.6 Relays and protective devices

- a. Set relays
- b. Check motor overload heaters against motor nameplate currents.

2.3.7 Motor and Generators

- a. Insulation resistance measurement
- b. Inspect for alignment, adequate ventilation and alignment
- c. Motor test run one-half hour (uncoupled from load) check for correct rotation and temperature rise measure speed and current.

2.3.8 High resistance ground unit

- a. Test for operation including actual ground-fault.

2.3.9 Lighting System

- a. Test for operation
- b. Verify positioning of floodlight beams of correct illumination.

2.3.10 System Operations

- a. Test each alarm circuit and where feasible by simulating alarm condition
- b. Perform operational check all instrument circuits
- c. Run operating test of all control circuits

2.3.11 A permanent record of each test shall be provided to the Chief Operator.

2.3.12 Energizing circuits shall be made only with the permission of the Chief Operator.

2.4 Instrumentation Contracts (Spec. 40-001)

2.4.1 Instrument Installation Contract

The installation contractor is required to make a complete and working installation as approved by the Construction Manager. Instrument calibration is not included in this contract.

2.4.2 Instrument Calibration Contract (except vibration instrumentation)

The calibration contractor is required to calibrate all instruments, except the turbine vibration instruments, under the direction of the Construction Manager.

2.4.3 Vibration Instrument Calibration Contract

The vibration instrument calibration contractor is required to calibrate all of the turbine vibration instruments, under the direction of the Construction Manager.

2.5 Cooling Tower Contract (Spec. 12-102)

2.5.1 The contract covers the furnishing, erection and field testing of the cooling tower.

2.5.2 The cooling tower basin contract is a separate contract.

2.5.3 After completion of structure and prior to introducing water into the cooling tower basin the supplier will clean and remove all dirt, wood, sawdust and other debris from the interior of the cooling tower and basin.

2.5.4 The distribution nozzle and piping within the tower will be installed and cleaned by another contract.

2.5.5 Noise levels measured 3 feet in any direction of the equipment furnished in this contract shall be less than 90 dBA.

2.5.6 The cooling towers shall be subject to testing in accordance with the most recent edition of Cooling Tower Insitute (CTI) standard ATP-105 except that the wet bulb temperature shall be measured 100 feet upstream per ASME Power Test Code. The expense of this test is not included in the cooling tower contract.

2.6 Control House Building and Turbine-Generator Building Contract
 (Spec. S-80-001)

The following is a summary of the requirements specified to be completed by the prefabricated steel buildings contractor.

2.6.1 Two prefabricated steel buildings complete, inclusive of:

- a. Heating, Ventilation, and Air Conditioning System
- b. Electrical Power and Lighting Systems
- c. Plumbing System

NOTE: The following is not included in the above contract:

- e. Rough Grading and Site Preparation
- f. Concrete Work (Slabs and Foundations)
- g. Furnishing and Installing of the 15 Ton Crane in the Turbine-Generator Building
- h. All Equipment and Appurtenances in Both Buildings Used in Generating Power.

2.6.2 Control Building

The Contractor is required to verify complete compliance with the specifications for the building; i.e., Divisions 5, 7, 8, 9, 10, 15 and 16 as follows:

2.6.2.1 Division 5

- a. Steel Framing
- b. Insulated Steel Wall and Roof Panels.
- c. Roof Screens and Canopy
- d. Woven Wire Partition and Gate

2.6.2.2 Division 7

- a. Caulking and Sealants

2.6.2.3 Division 8

- a. Windows, Exterior and Interior
- b. Wood Doors
- c. Metal Doors and Frames
- d. Glass and Glazing

2.6.2.4 Division 9

- a. Metal Studs and Gypsum Wallboard
- b. Painting
- c. Acoustical Ceilings
- d. Resilient Floor Coverings
- e. Ceramic Tile

2.6.2.5 Division 10

- a. Finish Hardware. Provide keys, as follows: 3 keys per lock; 6 master keys for each master key set.
- b. Metal Toilet Partitions
- c. Toilet Room Accessories
- d. Shower Stalls and Doors
- e. Lockers

2.6.2.6 Division 15 (Mechanical)

Contractor is to perform the following tests and verifications as required by the specification.

2.6.2.6.1 Tests for Plumbing Systems

- a. Soil, Waste, and Vent Systems
- b. Water Piping System Hydraulic Pressure Test
- c. Flush valves and automatic control devices shall be adjusted for proper operation.
- d. Check compliance of access panels for concealed valves, and items with requirements for inspection or maintenance.

2.6.2.6.2 Tests for Heating, Ventilation and Air Conditioning

- a. The Contractor shall test the system as a whole to ensure that all items perform as an integral part of the system, and that

temperatures and conditions are evenly controlled throughout the building.

- b. Verify for compliance with California OSHA requirements for properly enclosing or guarding belts, pulleys, projecting setscrews, keys, and any rotating parts located in close proximity to personnel.
- c. Perform tests and provide certified test data for the balancing and testing operation pursuant to the Associated Air Balance Council National Standards for Field Measurements and Instrumentation, Total Balance System, for the following items:
 - a. Fans - Size, type, speed in revolutions per minute, static pressure in inches of water, air quantity in cubic feet per minute, and motor load in amperes.
 - b. Air Balance - Coils: Size, face velocity in feet for minute, air conditioning on-and-off unit wet bulb and dry bulb temperature in °F.
 - c. Ducts: Size, velocity in feet per minute, and air quantity in cubic feet per minute.
 - d. Air Outlets and Inlets: Size, velocity in feet per minute, and air quantity in cubic feet per minute.

- e. Air Conditioner Capacity: Size and type of unit, air quantity, air condition on-and-off unit, wet bulb and dry bulb °F, condensing temperature.

2.6.2.7 Division 16 (Electrical)

The Contractor is required to perform tests which shall include the following:

- a. All main secondary feeder cables, with a 500 volt "megger".
- b. Each individual lighting and power circuit shall be tested at the panelboard for proper operation with the lighting or power equipment connected.

2.6.3 Turbine-Generator Building

Contractor shall verify for compliance with Divisions 5 and 16 as follows:

2.6.3.1 Division 5

- a. Steel Framing
- b. Steel Roofing
- c. Crane Rails
- d. Steel Ladder, Platform and Safety Cage
- e. Steel Railings

- e. Air Conditioner Capacity: Size and type of unit, air quantity, air condition on-and-off unit, wet bult and dry bulb °F, condensing temperature.

2.6.2.7 Division 16 (Electrical)

The Contractor is required to perform tests which shall include the following:

- a. All main secondary feeder cables, with a 500 volt "megger".
- b. Each individual lighting and power circuit shall be tested at the panelboard for proper operation with the lighting or power equipment connected.

2.6.3 Generator Building

Contractor shall verify for compliance with Divisions 5 and 16 as follows:

2.6.3.1 Division 5

- a. Steel Framing
- b. Steel Roofing
- c. Crane Rails
- d. Steel Ladder, Platform and Safety Cage
- e. Steel Railings

2.6.3.2 Division 16 (Electrical)

The Contractor is required to perform tests which shall include the following:

- a. All main secondary feeder cables, with a 500 volt "megger".
- b. Each individual lighting and power circuit shall be tested at the panelboard for proper operation with the lighting or power equipment connected.

2.6.4 Guarantee

Contractor shall provide the certified warranties, in terms of the specifications, including:

- a. Wall and roof panels
- b. Water Heater

Acceptance Tests

Under the jurisdiction of the Lead Start-up Engineer, the Owner ascertains the operating integrity of the unit. This is performed through tests described in subsequent sections. The Chief Operator's personnel conduct these tests including the release of the unit for commercial operation.

The equipment manufacturers operation manuals form an integral part of the "Systems Start-up and Operations", Volume II, and all operating personnel should be familiar with their contents prior to start-up of the power plant.

3.1 Personnel

3.1.1 The plant operating personnel will operate all released equipment under supervision of the Chief Operator as directed by Start-up Engineers. Operation by plant personnel will begin when the system and/or equipment is released from the Lead Start-up Engineer to the plant for operation. The Chief Operator provides competent maintenance and technical personnel to maintain, calibrate, time and adjust equipment released for start-up and testing operations. Such services to be obtained for the Lead Start-up Engineer from the Construction Manager and to be provided from first date of release in start-up operation to plant firm operating date.

3.1.2 Start-up Mechanical Engineer

Prepare the scope and write-up of the pre-operational tests. Directs and coordinates all testing and initial start-up of all mechanical equipment. Directs the operating personnel, vendor representatives, (see Section 1.1.4) and certain craft labor in fulfillment of start-up operations and testing functions.

3.1.3 Start-up Electrical Engineer

Coordinates and directs electrical testing by contractors, vendor and/or operating personnel.

3.1.4 Start-up Controls Engineer

Coordinates and directs all instrument and controls functional testing by contractors, vendor representatives and/or operator personnel.

3.1.5 Vendors' Representatives

All Vendors' Representatives participating in the start-up and testing program are included in this category (see Section 1.1.4). This group provides operational supervision until it has been demonstrated that the equipment and/or loop is functioning properly and that Plant Operating Personnel are competent in its operation and control.

3.2 Pre-operation Tests

3.2.1 General

The purpose of this section is to outline the testing and checking requirements to prepare the mechanical equipment such as pumps, compressors, tanks, pressure vessels and piping systems.

No equipment shall be installed, tested or operated in such a manner as to void the manufacturer's warranty or guarantee. Should any test values or procedures, as indicated in this section, exceed the values or overrule the procedures recommended by the manufacturer for the equipment involved, the manufacturer's recommendation shall take precedence.

Accordingly, general procedures for inspection, check and testing are contained in this section. Should changes be required, these will be approved by the Lead Start-up Engineer.

3.2.2 Pumps

3.2.2.1 Inspection

- A. Verify by documentation review that the pump assembly, including driver and all accessory equipment, is installed in accordance with drawings, erection instructions, and construction

procedures, related piping has had the hydrostatic test performed, and the pump assembly is ready for preliminary operational test.

B. Inspect the items below as applicable:

1. Debris removed from motor windings, pump base, drains and the general vicinity of the equipment.
2. All equipment piping is connected, including primary, balancing, equalizing bearing, cooling, smothering, gland sealing, warming, recirculating and lubricating oil piping as applicable.
3. Relief valves as specified are installed.
4. Instruments and controls are installed or available, and properly isolated or protected from damage during tests.
5. Lubrication of all bearings has been completed in strict accordance with manufacturer's instruction book, and lubrication tag attached. Grease lubricated bearings are not overlubricated and vent plug is removed as specified for run-in. Oil lubricated bearings are cleaned, lubricated, and oil rings are free to rotate. Forced lubrication systems are filled and ready for operation.

6. Electric wiring, switchgear overload protection and interlock connections, and motors are installed, tested, and inspected, and power is available to equipment terminals.
7. Main piping and supports are installed.
8. Suction strainers are clean and/or temporary strainers are installed if required, properly instrumented and identified in the Chief Operator's Temporary Strainer Log.
9. Verify documentation alignment of motor to driven equipment is completed, check that:
 - a. Equipment and motor when rotated by hand, are found free to turn without rubbing or binding.
10. Shaft packing is in place and not binding on shaft.
11. Coupling guards are installed when specified.
12. Verify keys are tight and locked.

3.2.2.2 Preliminary Operational Test

- A. Inspection in Section 3.2.2.1 above shall be completed and piping, mechanical and electrical equipment is ready for preliminary operational test.

- B. Where required, or if deemed necessary by the Lead Start-up Engineer, manufacturer's service representative shall be present and shall satisfy himself that equipment is ready to proceed with preliminary operational test.
- C. Piping and mechanical equipment shall have been flushed clean, unless flushing is being performed within line equipment, primed and valves arranged according to actual or simulated service conditions. Seal and cooling water, etc. shall be turned on if required.
- D. Start pump in accordance with manufacturer's starting and run-in instructions.
 - 1. During run-in period, equipment shall be attended and observed constantly for any malfunctions. Run-in shall continue and adjustments shall be made as indicated until proper operation is established to the satisfaction of Start-up Engineer. Run-in data to include baseline vibration level indication.
- E. Temporary and permanent strainers shall be cleaned as often as required by predetermining maximum differential pressure, during run-in and subsequent preliminary operation.

3.2.3 Compressors

3.2.3.1 Inspection

- A. Verify by documentation review that compressors, including driver and accessory equipment, is installed in accordance with drawings and erection instructions, related piping has had the hydrostatic test performed, and that the compressor is ready for preliminary operational test:
- B. Inspection shall include items listed below as applicable:
 - 1. Debris is removed from motor windings, baseplates, drains and general vicinity of equipment.
 - 2. All auxiliary piping is connected, including bearing, jacket, and gland cooling water, vents, drains and lubrication piping as applicable.
 - 3. Relief valves, as specified, are installed and have been tested. Vent piping is complete and unobstructed.
 - 4. Instruments are properly isolated or protected from damage during tests.

C. Lubrication of all points has been completed in accordance with manufacturer's instruction book.

1. All gear cases not lubricated at the factory are flushed and relubricated, breather vents are clear.
2. Crankcase, cross head guides and cylinders are thoroughly cleaned and relubricated as specified.
3. Bearings are correctly lubricated as specified.
4. Automatic lubrication system, if provided, is correctly filled, primed and delivering oil to all parts.

D. Electric wiring, switchgear, overload protection, interlock connections, motor, are all checked and tested; and power is available to equipment terminals.

E. Suction piping and supports are installed and inspected. Suction strainer or filter in place. All loose scale and debris between strainer or filter and intake valves are removed.

F. Suction and discharge valve assemblies are correctly adjusted.

- G. Discharge piping and supports (including receivers) is inspected and ready for preliminary operational test.
- H. Valve unloader piping and control system, if specified, are properly tested.
- I. Verify by documentation alignment of motor to driven equipment is correct and is in compliance with manufacturer's requirements.
 - 1. Equipment and motor when rotated by hand are found free to turn without rubbing or binding.
- J. Verify keys are tight and locked.
- K. Coupling and/or belt guards are installed as specified.

3.2.3.2 Preliminary Operational Test

- A. Inspection of Section 3.2.3.1 above shall be completed and compressor and related piping and electrical equipment released for preliminary operational test.
- B. Where required, or deemed necessary by the Lead Start-up Engineer, manufacturer's service representative shall be present and shall satisfy himself that equipment is ready for preliminary operational test.

- C. Piping and equipment in liquid service shall have been flushed clean, unless permanent in-line equipment is being used for flushing, primed and vented, and valves arranged according to actual (or simulated) service conditions.
- D. Start equipment in accordance with manufacturer's starting instructions. During run-in period, equipment shall be attended and observed constantly for any malfunction, including vibration monitoring. Run-in shall continue and adjustments shall be made as indicated until proper operation is established.
- E. Clean strainers as often as required, by predetermined maximum differential pressure, during run-in and subsequent preliminary operation.

3.2.4 Piping, Pressure Vessels, Tanks and Heat Exchangers

Verify by documentation, that all pipes, valves, fittings and pressure vessels have been provided in accordance with material standards outlined in specifications and on drawings.

Hydrostatic tests as required will be performed after piping erection in accordance with approved test procedures. Flushing of all piping, pressure vessels, tanks and systems shall be in accordance

with flushing test procedures or approved special procedures. Construction to perform hydrostatic tests that do not require plant equipment operation.

3.2.4.1 Piping Inspection

A. Verify by visual inspection and documentation that piping system is complete and that system is ready for filling. This inspection shall include:

1. Piping is clean - free from debris.
2. All joints are properly made - flange joints complete with gaskets and bolts are properly tightened. Welded joints are completely welded.
3. All terminations are made up and all unused openings are closed.
4. Valves are correctly located, packed and operable, and identified. Hand operation, if applicable, shall be verified.
5. Motor operated valves are operable, and torque limit, and interlock switches are set. Valves must be clean, stems

properly lubricated and free of foreign material, and stem covers/position indicators installed. In addition, the grease plug should be removed and the grease level checked.

6. Relief valves are correctly set.
7. Power operated control valves are correctly connected and operated smoothly with power available.
8. Instruments are properly isolated or protected during test.
9. Code and/or State inspections are made as specified.
10. Determine that all hangers and restraints are in position and that spring hangers and snubbers are operable, verify all lock-pins have been removed from hangers after hydrostatic test.

3.2.4.2 Preliminary Operational Test

- A. Inspection shall be complete, all required leak testing and flushing completed and equipment released for preliminary operations.

- B. Temporary strainers are in place and logged in Start-up Department Temporary Strainer Log Book, and gauges are ready for service to measure pressure across the strainers.
- C. During the initial preliminary operational test, adjust all packing glands as required.
- D. Operate equipment, valves, pressure vessels, tanks, etc., in piping to demonstrate satisfactory operation.
- E. Check for unusual vibration of the piping system.

3.2.4.3 Pressure Vessel and Heat Exchangers

- A. Verify by inspection and documentation that vessels are complete, clean internally and ready for filling. This inspection shall include:
 - 1. Code and/or State inspections made as specified.
 - 2. All appurtenance (trim) items - safety valves, level controls, vents and drains are properly piped and connected and are complete.
 - 3. Interior of vessel is clean and free of all loose scale, sand or debris.

4. All internals are installed.
5. All manhole covers and flanged joints are made up complete with gaskets and bolts which are tightened.
6. All unused openings are closed.
7. Protective linings are installed and are undamaged.
8. Instruments are properly isolated or protected from damage during test.
9. All personnel are out before closing manholes.

3.2.4.4 Preliminary Operational Tests

- A. Inspection shall be completed and equipment released for preliminary operational test.

3.2.4.5 Tanks

- A. Verify by inspection and documentation that tanks are complete and that tanks are ready for filling. This inspection shall include:

1. All appurtenances (trim) items, level gauges, valves, etc., are properly piped and connected.
2. Flushing has been completed and interior of tank is clean and free of all loose scale, sand or debris.
3. Interior of lined tanks inspected and found to be undamaged.
4. All unused openings are closed.
5. All manhole covers and flanged joints are made up complete with gaskets and bolts.
6. All personnel are out before closing manholes.
7. Tanks used for pre-operational testing and flushing of piping have been recleaned and suitable for preliminary operational use.
8. Code and/or State inspections are made as specified.

3.2.5 Fans

3.2.5.1 Inspection

- A. Verify by documentation review that fans, including driver and accessory equipment, are installed in accordance with drawings

and erection instructions and that the fan is ready for preliminary operational test.

B. Inspection shall include items listed below as applicable:

1. Debris is removed from baseplates, drains, and general vicinity of the equipment.

C. Lubrication of all points has been completed in accordance with manufacturer's instruction book and lubrication tag attached.

1. Bearings are correctly lubricated as specified.

2. Automatic lubrication system, if provided, is correctly filled, primed and delivering oil to all parts.

D. Electrical wiring, contractors, overload protection interlock connections, motors, are all checked and tested; power is available to equipment terminals.

3.2.5.2 Preliminary Operational Tests

A. Inspection of Section 3.2.5.1 above shall be completed. Electrical equipment released for preliminary operational test.

B. Verify alignment of motor to driven equipment is correct.

- C. Check back draft dampers are free to operate properly.
- D. Start equipment in accordance with manufacturer's starting instructions. Run-in shall continue and adjustments shall be made as specified until proper operation is established.

3.2.6 Electrical Testing

- A. The Electrical Start-up Engineer is responsible for testing all circuits and devices, except those tested by the vendor, necessary to insure reliable protection and control.
- B. Test Technicians will maintain records of all circuits and devices tested and forward those records to the Electrical Start-up Engineer. Those records include:
 - 1. Electrical Circuit Test Record and Equipment Data Sheet.
 - 2. A complete set of Elementary Diagrams for each unit shall be furnished as check-off records. The Test Technician shall yellow-line each circuit on this elementary as it is checked.
 - 3. When drawings have been revised to the extent that it is not practical to yellow-line on the existing drawing,

yellow-lined information shall be transferred to a new drawing and checking procedures will be followed on the new drawing.

4. The Test Technicians shall keep a record of annunciator alarms by using the Annunciator Window Engraving drawing as a check-off print. He shall yellow line each initiating device for each window as it is tested.
 5. All check off prints shall be kept at a mutually agreed upon location available to personnel concerned.
- C. The Test Technicians will insure that all circuit modifications have been accomplished before releasing circuits and equipment to Start-up. The circuit will conform with the latest Schematic, Elementary and Connection Diagram.
- D. The Electrical Start-up Engineer shall schedule and arrange for high potential tests when equipment to be given such tests is ready.
- E. Advise the Lead Start-up Engineer of discrepancies or problems on circuitry, devices or equipment failures.

3.2.7 Records

Electrical Start-up Schedule

The Electrical Start-up Engineer shall develop this schedule as soon as practicable. He shall include all of the electrical items which will be tested. Revisions to this schedule will be reflected weekly.

Equipment Release Sheet

The Lead Start-up Engineer shall endorse the Equipment Release Sheet on each major item of electrical equipment after it has been tested for construction integrity and is ready for operation. Electrical equipment which is a part of, or is directly connected with, a mechanical piece of equipment shall be released with and on the same release form as the mechanical equipment with which it is associated. Equipment releases will be initiated by the Construction Manager.

3.2.8 Electrical Circuit Test Record and Equipment Data

An individual record of each circuit shall be maintained. This record is the "Electrical Circuit Test Record and Equipment Data" and will be initiated by the Test Technicians.

After (and only after) this information is entered on the Data Sheets, the forms will be returned to the Electrical Start-up Engi-

neer for further processing. The Electrical Circuit Test Record and Equipment Data form for a circuit will be put into the "completed" file kept by the Electrical Start-up Engineer when the circuit has been completely tested.

When testing has been completed the circuit will be released for operation. If testing cannot be completed, the reasons shall be noted on the Electrical Circuit Test Record and Equipment Data form and shall be put into the "incomplete" file maintained by the Electrical Start-up Engineer.

When a circuit is changed after the original test work is completed, the revised circuit will be tested and the test results will be entered as a revision on the Electrical Circuit Test Record and Equipment Data form of the original circuit.

3.2.9 Outline of Electrical Tests

3.2.9.1 Electrical Start-up Engineer

The general outline of tests to be performed by the Test Technicians is as follows:

A. Transformers

1. Test control circuits of cooling fans and pumps.
2. Test protective device circuits.

3. Test annunciator circuits.
4. Monitor for combustibles after energizing.
5. Make settings on all protection devices.
6. Check ratio and polarity of all instrument transformers.
7. Check and set tap changers.
8. Check transformers while in service.
9. Make oil hi-pot test after filling.

B. Switchgear

1. Test all air circuit breakers in accordance with, but not limited to the following:
 - a. On 480V breakers, check calibration and set trip points of solid-state trip devices, and check minimum trip currents.
2. Test all bus metering circuits and label all devices in accordance with the Elementary Diagrams.
3. Test all control circuits, and label all devices in accordance with the Elementary Diagrams.
4. Check ratio and polarity of all current transformers and potential transformers.

5. Perform saturation tests on current transformers.
6. Set the bus tie protection and transfer relays for the reserve auxiliary transformer and the auxiliary transformer.
7. Perform functional operation of the transfer circuits from auxiliary transformers to reserve auxiliary transformer.
8. Set all overcurrent and trip relays of the 4.16kV circuit breakers. Also undervoltage and ground relays.
9. Set all trip relays associated with the 480V tie and main circuit breakers.
10. Test all control circuits on 4kV and 480V tie and main circuit breakers.

C. Generators

1. Test ground detector relays and circuits.
2. Check ratio and polarity of current and potential transformers.
3. See that phasing is correct.

4. Set all protective relays and metering.
5. Test all protective relay circuits.
6. Perform high potential test.
7. Perform high potential test on 4kV bus.
8. Functionally trip test all protective relays before energizing machine.

D. Excitation Switchgear (To be accomplished in collaboration with Apparatus Personnel)

1. Set and adjust all protect relays.
2. Megger exciter.
3. Functionally test generator voltage regulators and check response.
4. Functionally test exciter and exciter DC system.
5. Check exciter for proper voltage build up.
6. Check mechanical condition of all devices.

7. Check control circuits and perform operational test of the field breaker.
8. Check wiring of all control circuits.
9. Perform operational check of all control circuits.
10. Make polarity check.

E. Switchyard

1. Test dielectric strength of recloser.
2. Test recloser control circuits.
3. Check ratio and polarity of current transformers.
4. Verify that relays are set.
5. Verify operation of all manually operated switches.

F. Miscellaneous

1. Set all trip relays on relay board.
2. Test oscillographs.

3. Test synchronizing circuits.
4. Check chemical control circuits and chemical instrumentation.

G. Steam Turbine

1. Test all protective devices and protective relay circuits.
2. Trip test all protective devices before initial roll as witnessed and directed by the Lead Start-up Engineer.
3. Check control wiring.
4. Check thermocouples and temperature recorders.
5. Check and set all turbine supervisory instruments.
6. Test and prove all annunciator circuits.

3.2.9.2 Vendor, Contractors, and Construction

- A. Individual vendors and contractors are responsible for testing, calibrating and setting up electrical equipment that is within the scope of their contracts. This work includes initiating and entering test and calibration information on appropriate forms. Vendors and contractors are responsible to the Lead

Start-up Engineer in the performance of testing as set down in this manual.

- B. Work listed in this item 3.2.9.2 includes (but is not necessarily limited to) electrical testing, calibrating, and setting up that which will be performed by MHI personnel on equipment that is within the scope of their contracts. MHI will perform all electrical functions listed here on equipment within their contractural jurisdiction.

3.3 Initial Start-up

3.3.1 After the pre-operation tests described in Section 3.2 are successfully completed the initial start-up commences.

3.3.2 The following systems will be checked for functional continuity:

- A. Cooling water system (see P&ID Dwg. E-03-004, Rev. 5)
- B. Condensate System (see P&ID Dwg. E-03-003, Rev. 5)
- C. Steam System (see P&ID Dwg. E-03-002, Rev. 5)
- D. Compressed Air and Air Compressor cooling water systems (see P&ID Dwg. E-03-006, Rev. 5)
- E. Canal water filtration and fire water systems (see P&ID Dwg. E-03-008, Rev. 5)

3.3.3 The discipline engineer will have a system start-up program in compliance with the master start-up program (see Section 1.1.2.2). All activities of the system initial start-up have to be approved by the Lead Start-up Engineer. The results of this activity have to be reported to the Lead Start-up Engineer who in turn releases the system to the Chief Operator.

3.3.4 The conduct of the system start-up has to comply with the provisions of Tags and Releases (Section 1.6) and Safety (Section 1.7).

3.3.5 The availability of the system for testing depends on the progress of the construction program. The decision will be made by the Lead Start-up Engineer with input from the Construction Manager and Chief Operator.

3.4 Release to Operation

The term "Release to Operation" in context of acceptance tests means to release the pre-operation tested and satisfactory start-up systems to Chief Operator for station operation.

3.4.1 The Chief Operator is responsible for providing sufficiently trained operating personnel to operate all permanent plant equipment. Accepts equipment formally released systems from the Lead Start-up Engineer, providing such systems meet the standard requirements for operation. (See 1.1.3, 4.0 and 5.0)

3.4.2 IMPORTANT NOTE: The operation of any equipment at anytime during the initial start-up under the jurisdiction of the Lead Start-up Engineer can be operated only by competent operating personnel.

3.5 Firm Operation

- 3.5.1 The total plant will be commissioned in steps observing all the conditions described in Sections 4.1 and 5.0.
- 3.5.2 After the plant has been brought up to synchronous speed and paralleled with IID's system the unit will be loaded in increments up to maximum load. Holding this load for 24 hours and satisfying all safe operating conditions, the unit is declared as being in firm operation and turned over to the Chief Operator.
- 3.5.3 An overspeed test and bearing inspection follow the full load test. The bearing inspection shall be performed in accordance with the requirements of the equipment manufacturer.
- 3.5.4 The clean-up items compiled during the start-up operation will be executed after the unit is in firm operation.

Normal Plant Operation

This section in the start-up program describes the plant operation step-by-step from the time when the integrated system becomes operational. The Chief Operator will have a master start-up schedule. This schedule will identify all the operating milestones for the normal start-up of the generator and all support systems from initial system start, through power supply to the utility, and including normal shutdown sequence and procedures.

Normal Sequence to Start Plant

The starting of each operating system includes prestart requirements which must be implemented prior to attempting the initial coordinated start-up of the entire power plant.

To accomplish a safe and reliable start-up, the systems should be started in accordance with the following normal sequence:

Step 1

Establish electric power supply to makeup water pumps. (Section 5.6)

Step 2

Establish that electric power is available for all electrical distribution and control systems. (Section 5.11 thru 5.14)

Step 3

Establish makeup water flow, start filling sanitary service water system and cooling tower basin. When above two sections are filled with water, start-up auxiliary cooling water pump and sanitary service water pump. Firstly establish flow through building air conditioner condenser and start-up building air conditioner and ventilation systems. Follow up by filling of all exchangers and completing the cooling water and sanitary water system start-ups. (Sections 5.6, 5.5)

Step 4

Check out and start-up H₂S monitoring systems. (Section 5.9)

Step 5

Start commissioning the compressed air system. Because the start-up of this system may take up to two-three days to achieve dry air flow through all control loops, work in the next two steps may be accomplished concurrently. (Section 5.8)

Step 6

Check out and commission the fire water system, the carbon dioxide systems and the safety shower (chemical treatment area). (Section 5.7 and 5.6)

Step 7

Check over turbine-generator and associated equipment and insure that this system is ready for start-up. (Sections 5.2, 5.10, 5.16)

Step 8

Initiate steam flow into the steam supply system and complete warm-up and raise full steam pressure. (Section 5.1)

Step 9

Complete all items required to commission the condensate system. (Section 5.3)

Step 10

Initiate pull down to vacuum and complete check out of condenser noncondensable gas removal system. (Section 5.4)

Step 11

Check that all main control and electrical systems are ready. In accordance with the sequence shown in Section 5.2.2 complete initial start-up of main cooling water pumps, turbine generator, and cooling water treatment systems.

Step 12

Make final adjustments to turbine generator, request permission from IID to parallel the system, synchronize and load.

Step 13

Start cooling tower fan in accordance with procedure shown in Section 5.5.2 H. When required by load, start second fan.

Normal Sequence to Shutdown Plant

To accomplish a safe and orderly plant shutdown, the systems should be shutdown with the following normal sequence:

Step 1

Notify IID of impending station outage, and expected time and duration.

Step 2

Notify steam supplier of impending station outage, and expected time and duration.

Step 3

Reduce turbine generator load in accordance with Section 5.2.4 and 5.10.4. When load reaches zero, trip generator breaker and trip turbine stop valves.

Step 4

Shutdown noncondensable gas system in accordance with Section 5.2.4 and 5.4.4.

Step 5

Start auxiliary cooling water pump, shutdown the main cooling water pumps and close off these pump discharge valves in order to close off the cooling water flow out of the main and intercondensers in accordance with Section 5.2.4 and 5.5.4.

Step 6

Shutdown cooling tower fans. See Section 5.5.4 B. Shutdown chlorine addition to cooling water system per cooling water system operating orders.

Step 7

Within one hour after turbine shutdown, stop the following:

- A. Vacuum Compressor Seal Water Pump
- B. Condensate Pump
- C. Generator Air Blower

At this stage of the shutdown the following systems (or equipment) will be operating:

- A. Auxiliary cooling water pump which is recirculating cooling water through instrument air cooling system heat exchangers, vacuum compressor seal water cooler, generator air cooler, lube oil cooler and building air conditioner condenser.
- B. Cooling water treatment chemical metering pumps.
- C. Cooling water makeup pump (intermittent).
- D. Silt pocket pumps and associated auxiliaries.
- E. Back wash sump pump and waste water sump pump (intermittent).
- F. Sanitary service water pump (intermittent).
- G. Jockey pump (intermittent).
- H. Fire Pump (available)
- I. Instrument air compressors and associated auxiliaries.
- J. Steam system, associated drains, traps, flash drain tank ejector and noncondensable vent stack purge steam.
- K. Building ventilation system.
- L. Purifier
- M. Lubricating oil reservoir vapor extractor (See 5.5.2)

- N. Auxiliary Oil Pump
- O. Centrifuge

If the shutdown duration is less than twenty-four hours the systems may be left as noted above in a "ready for restart" condition.

Should the shutdown be of longer duration, auxiliary power savings may be desirable. The systems can be curtailed to reduce auxiliary electric power requirements by using the following normal sequence:

Step 9

Reduce the following pumps to intermittent operation

- A. Cooling water makeup
- B. Shutdown silt pocket filtration system

For shutdown to minimum standby, use the following normal procedure:

Step 10

- A. Block off main steam line valve HV902 using HS902, open bypass valve.
- B. Close off all auxiliary steam users, flash drain tank ejector, close noncondensable gas stack purge. Leave all steam drains cracked open.
- C. Shutdown cooling water chemical treatment metering pumps.
- D. Continue to turn auxiliary oil pump and lube oil centrifuge.
- E. Turn turbine on turning gear for 5 to 10 minutes daily.

For shutdown to cold condition with no personnel in attendance use the following normal sequence:

Step 11

- A. Block off discharge valves on instrument air compressor receivers and shutdown entire instrument air system (including air compressor cooling water systems).
- B. Shutdown building ventilating system.
- C. Shutdown auxiliary cooling water pump.
- D. Close bypass valve around HV902 (main steam system) and close all main and auxiliary steam drains.
- E. Shut down centrifuge and auxiliary lube oil pump.

At this time the following systems (or equipment) will be operating.

- D. Jockey pump (intermittent)
- E. Fire Pump (available)
- F. Waste water sump pump (intermittant)
- G. Sanitary service water pump (intermittent)
- H. Battery Charger
- I. Transformers
- J. Switchyard

A running check of plant will be required to be sure that the following items are covered:

- K. Check cooling tower basin level.
- L. Check sanitary water tank level. Refill to operating levels as required by restarting makeup water pumps.
- M. Check back wash sump and pump out sump as required.

- N. Check waste water sump to be sure sump pump is operable and waste water is being transferred to holding tank. Check waste water holding tank and arrange for disposal as required.
- O. Install H₂S dose monitoring cards in switchgear and control rooms, fire pump control building, instrument air shed and chemical treatment shed. Inspect cards weekly.

Systems Operations

A detailed knowledge of every piece of equipment and mode of operation is essential. The information is available in the Manufacturer's Instruction Book. During the training period of the operators, special attention must be given to these instructions. The manufacturer's instructions should be strictly observed and are not to be violated. The descriptions in this book of the different systems and conditions are in principle. The final authority follows the manufacturer's instructions.

All individual systems are addressed by procedures and conditions in the following sequence:

Prerequisite Conditions

Start-up Operation

Normal Operation

Shutdown Operation

Emergency Shutdown Operation

These systems constitute the individual parts and loops. The overall coordination of the plant is contained in Section 4 of this manual.

5.1 Steam Supply System

Because the steam supplier needs to avoid having a large change in steam flow it is desirable that once start-up is initiated that the steam flows be stabilized to near design as soon as practical.

5.1.1 Prerequisite Conditions

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and circuitry verified and tested per drawings.	_____	_____
B. Cooling water available and flows established through the heat exchangers.	_____	_____
C. Instruments and controls calibrated before start-up.	_____	_____
D. Check all steam piping and steam drain piping to ensure equipment and piping is installed per P&IDs' E-03-002 and E-03-011.	_____	_____
E. Check all valves to ensure that they are positioned and locked as shown on P&ID E-03-002 and E-03-011	_____	_____

INITIAL DATE

- F. All drain valves must be open before steam is admitted to any pipeline

5.1.2 Start-up Procedure for Steam System

- A. Reverse blind down stream of main steam block valve HV-902.

- B. Open valve in auxiliary steam line feeding through restrictive orifice and FE-103 into line ES-4 going to noncondensable gas vent stack.

- C. Open flash drain tank vent valve to condenser and lock open.

- D. Open flash drain tank bypass valve between upper and lower section of tank.

- E. Open 2 inch bypass at HV-902 and start warming and pressuring up all lines. Throttle atmospheric drains as necessary to insure proper steam line drainage without excessive free blow.

INITIAL DATE

F. Open block valve on discharge of drain
 ejector 15-4 lock open and start steam flow
 to 15-4.

G. Commission LIC-703 and LV-703, all steam
 traps and crack all low point drains.

H. Check all pressure gauges. A consistant
 pressure near 90 psig should show through-
 out the system.

I. With main steam line temperature 285°F
 minimum open main steam block valve HV-902.
 Close 2 inch bypass valve at HV-902.

The steam lines and equipment should now be warm
and ready for turbine and ejector start-up.

5.1.3 Normal Operation

A. Periodically check steam traps (Geothermal
 steam deposits out easily causing blocked
 traps)

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INITIAL DATE

B. Check condensate level in steam separator 10-2 and check dump cycle of LIC 703 and LV 703.

C. Periodically check main steam strainer pressure differential using PI-305 and PV-305. Log pressures _____

D. Check for absense of condensate in Flash Drain Tank LG-1A and LG-1B. Log. _____

5.1.4 Shutdown Procedure

- A. Inform steam supplier that the steam system will be shutdown and that the main steam block valve HV-902 will be closed.
- B. Check that steam ejectors are shutdown.
- C. Check turbine main stop valves closed.
- D. Check drain ejector steam admission valve closed.
- E. Close main steam block valve HV-902.
- F. Open valve in auxiliary steam line feeding through restrictive orifice and FE-103 into line ES-4 to noncondensable gas vent stack.

- G. Open all low point drains.
- H. If steam line is to be kept warm, regulate HV-902 2" bypass and steam line drain valves to maintain 3 psi by flowing steam through the turbine Y-strainer trap bypass valve.
- I. If steam line is not to be kept warm, close all drain valves and traps. Secure vacuum compressor circulating water and the seal water cooler.

It is important to keep air out of all lines which have been exposed to geothermal steam to avoid corrosion. The lines should not be opened up except in emergency.

5.1.5 Emergency Conditions

A. Turbine outage

When turbine trips the main steam bypass valve will open and discharge the excess steam into the rock muffler provided by the steam supplier. If this bypass valve fails to open the steam pressure will rise and the plant PSV's (313A, B, C) will operate.

If a PSV sticks open on overpressure inform the steam supplier and coordinate joint corrective action.

- B. The steam separator (10-2) high water level trips the turbine and closes HV-902.

In the event of priming water from the steam supplier's flash vessel entering the steam separator (10-2), shut off the drain to the seal water separator (10-1) to prevent contamination of the Nash vacuum compressor.

5.2 Turbine and Associated Equipment

5.2.1 Prerequisite Conditions

- A. Check that the turbine and all associated valves, control valves, piping, lube oil system, and instruments have been released of clearances.
- B. Check to see that the following have been released of clearances and that the required electric power is available for auxiliaries

Generator

Condensers

Condensate System

Noncondensable Gas Ejector System

Cooling Water System

Cooling Tower and Basin (Water in Basin)

Generator Cooling System

Turbine Lube Oil Cooling System

Instrument and Control Air System

High Voltage Switchgear

Main Steam Supply System (including steam supplier's system operational)

Drain Tank Ejector

- C. Check that air conditioning system is working

- D. Check instrument and control air system operating (Section 5.8)
- E. Energize all instrumentation for turbine and other systems.
- F. Verify all trip cutout switches closed or under temporary operating memorandum.
- G. Check lube oil reservoir - oil level above normal. Lube oil temperature at least 77°F. If the oil is at a lower temperature turn on lube oil heater.

5.2.2 Start-up

NOTE: All turbine speed and load changes shall comply with the rates shown on the Table in Section 5.2.4 V.

- A. Verify main stop valves closed.
- B. Open drain valves on main steam strainer.
- C. Open drain valves on main stop valves.
- D. Open drain valves on turbine.
- E. Verify auxiliary oil pump and centrifuge are running.
- F. Start vapor extractor.
- G. Test D. C. emergency oil pump. Leave switch in auto position.
- H. Check that lube oil is flowing through all bearings.
- I. Put turbine on turning gear with auxiliary oil pump running.
(Lube oil temperature at least 77°F)
- J. Perform stem free test procedures.
- K. Open main and auxiliary steam line drains.

- L. Open main steam isolation valve bypass valve (HV-902). Warm up main and auxiliary steam lines (Section 5.1). When lines are warm put line drains on to their respective traps.
- M. Open main steam isolation valve (HV-902) and close bypass valve.
- N. Check cooling tower basin for normal water level and availability of makeup water pumps and system (5.6). Check that auxiliary cooling water pump is running to supply cooling water to instrument air cooling system heat exchanger and building air conditioner.
- O. Start main cooling water pump and establish water flow through main condenser, inter-condenser, lube oil cooler, generator air cooler, and vacuum compressor seal water cooler (Section 5.5).
- P. Shutdown auxiliary cooling water circulating pump (Section 5.5).
- Q. Open vacuum breaker valve.
- R. Open gland steam control valve slowly and set downstream pressure at 3 psig.
- S. Open drain ejector.
- T. Open second stage ejector gas valves and establish gas flow through first stage gas path from main condenser with gas bypass valves closed (Section 5.4).
- U. Close vacuum breaker valve.
- V. Raise gland seal steam to 5 psig.
- W. Set low vacuum trip (raise lever to upper position).
- X. Open steam to second stage ejector and raise vacuum (Section 5.4).

- Y. Push turbine reset button and hold in until both turbine control valves are fully open.
- Z. Push the turbine trip button and check that both control valves move to the fully closed position.
- AA. Push turbine reset button and hold in until both turbine control valves are fully open.
- BB. With main condenser vacuum 10 inch Hg absolute (or lower pressure) crack open one of the two turbine main stop valves by turning the handwheel. The turbine should be on turning gear for one hour previously.
- CC. The turbine rotor will start to speed up and the turning gear is disengaged automatically. Allow 5 minutes to reach 500 rpm and close the main stop valve by turning the handwheel. Lock the knob on the turning gear in the "off" position. Check turbine with sound rod and check oil temperature to bearings at least 77°F.
- DD. Re-open one main stop valve to maintain 500 rpm for warm up for 20 minutes.

Start one condensate pump (Section 5.3) and establish flow. After this warm up period increase turbine speed to rated speed in 20 minutes. Increase speed quickly when crossing the first critical speed 1,800 to 2,200 rpm.

- EE. At 3,300 rpm the main oil pump pressure should be over 120 psi. This pressure will increase with turbine speed to 150 psi at 3,600 rpm.

- FF. With the main oil pump working to the above pressures, trip the auxiliary oil pump and set the auxiliary oil pump switch in "auto" position.
- GG. At 3,300 the Woodward speed governor starts to control. Check this operation and if the governor is taking over control open the main stop valve fully and close handwheel one quarter turn.
- HH. At initial commission and every 6 months overspeed trip test the turbine by manual operation of the Woodward governor speed control knob. The turbine speed should be slowly increased to the trip speed of 3,960 to 3,996 rpm (overspeed alarm 3,924 rpm). After turbine trip the speed should drop back to 3,300 rpm at which speed the trip weight will have reset. Close the main stop valve handwheels and set the manual reset button to the reset position. Open main stop valve carefully and as the turbine speed increases check that the Woodward governor is taking over control. Open the main stop valve fully by the handwheel and close handwheel one quarter turn. Set the turbine speed to 3,600 rpm by manual operation of the Woodward speed control knob.
- II. Observe the lube oil cooler oil "out" temperature (approximately 104°F). This temperature is controlled by the "Waxtat" valve. (This valve is factory set and is located inside the lube oil reservoir).
- JJ. Start-up the first stage jet ejector (Section 5.4) and raise full vacuum.

- KK. Open the second main stop valve slowly and watch the control valves change position to maintain constant turbine speed. Open this main stop valve fully by the handwheel and close the handwheel one quarter turn.
- LL. Synchronize the generator in accordance with Section 5.10.2 and load unit to 0.5 to 1 MW for 10 to 20 minutes.
- MM. Increase load to 2 MW at the rate of 0.2 MW/min.
- NN. Start one cooling tower fan when the cooling temperature circulating through the cooling tower reaches design conditions (116°F) and start the second cooling tower fan as required to maintain condenser vacuum (Section 5.5.2 H.).
- OO. Close the main steam strainer drain, the main stop valve drains and the steam chamber drain.
- PP. Increase load to 10 MW at the rate of 0.2 MW/min. Start up the second main cooling water pump at 5 MW load or as condenser vacuum conditions indicate.
- QQ. Start-up the vacuum compressor and check out. Open noncondensable gas inlet valve. Close gas inlet valve to second stage gas ejector. Close steam to second stage ejector (Section 5.4).
- RR. Set cooling water flows by adjusting trim valves to generator air coolers, and vacuum compressor seal water cooler. Lube oil inlet and outlet valves to be fully open.
- SS. The lube oil centrifuge should be run at least 12 hours per day and as required to keep the turbine lube oil in good condition.

TT. Start oil purifier and run when turbine is running. Oil temperature to purifier should be at least 90°F. The oil purifier serves as a back up for the centrifuge when the latter is not available.

5.2.3 Normal Operation (Turbine)

- A. Turbine exhaust steam temperature should not exceed 175°F for continuous operation or 250°F for short periods.
- B. The turbine should not be operated with an abnormally low steam temperature. If the temperature is low, the load should be decreased and the cause investigated. The maximum moisture content in the steam for short periods should not exceed 1% and the cause of this excessive moisture should be investigated.
- C. The steam delivered through one turbine main inlet valve must be within 25°F temperature of the steam delivered simultaneously through the other turbine main inlet valve.

5.2.4 Shutdown Procedure (turbine)

NOTE: All turbine speed and load changes shall comply with the rates shown on the Table in item V. below.

- A. Coordinate shutdown with generator in accordance with Section 5.10.4 Reduce load at the rate of 0.5 MW/min. to 2 MW load.

Shutdown second cooling water pump at 5 MW load.

- B. At 2.0 MW load - crack open all steam line and turbine drains, open turbine high pressure drain valve, secure the turbine Y-strainer trap and open the Y-strainer trap bypass half turn.
- C. At 1 MW load - hand trip the turbine. Observe that the generator circuit breaker and generator field circuit breaker open after turbine stop valves close.
- D. Check auxiliary oil pump cut in when bearing oil pressure drops to about 11.4 psig.
- E. Return turbine stop valve handwheels to close position. Insure trip latch lever moves freely-valve handwheel in fully closed position.
- F. Shutdown first stage ejector and close root valve when turbine turns at 500 rpm. (Section 5.4)
- G. Shutdown one main cooling water pump (if two pumps are running) and one cooling tower fan (if both fans are running). Shutdown the second fan when cooling water return temperature drops below 116°F and is decreasing.
- H. When turbine speed has decreased to 350 rpm, open the vacuum breaker valve.

- I. When the turbine has stopped turning, shutdown second stage ejector/vacuum compressor (Section 5.4). Close ejector/compressor gas manual valves.
- J. When the main condenser vacuum has dropped to atmosphere, shut off the gland sealing steam.
- K. Place on turning gear for a minimum four hours.
- L. Shutdown drain tank eductor, and gland seal root valve.
- M. Close HV-902.
- N. If steam line is to be kept warm, regulate HV-902 2" bypass and steam line drain valves to maintain 3 psi by flowing steam through the turbine Y-strainer trap bypass valve.
- O. If steam line is not to be kept warm, close all drain valves and traps. Shutdown vacuum compressor circulating water and the seal water cooler.
- P. Close inlet valve to FI-111.
- Q. Shutdown condensate pump. (Section 5.3)

- R. Open MVR and AVR circuit breakers in excitation panel.
- S. When waxstat exit temperature is below 104°F, shutdown the cooling water outlet valve and the lube oil cooler.
- T. Shutdown the outlet valves of the generator air coolers.
- U. When the main condenser has cooled (1 hour after turbine shutdown) shutdown the main cooling water pump and observe that the auxiliary cooling water pump starts automatically through pressure switch. (Section 5.5)
- V. Four hours after turbine shutdown - shutdown the vapor extractor.
- W. After turning gear shutdown - shutdown the auxiliary oil pump.
- X. The lube oil centrifuge should be run at least 12 hours per day and as required to keep the turbine lube oil in good condition.
- Y. After auxiliary oil pump shutdown - shutdown cooling water to lube oil cooler and generator air cooler (Section 5.5).
- Z. Shutdown oil purifier.
- AA. Turbine Load Change Rates

Turbine Load Change Rates

	<u>After More Than 24 Hours Shutdown</u>	<u>After 10 hours Shutdown</u>	<u>After Less Than 10 Hours Shutdown</u>
Turning	At Least 60 Min.	Continuous or Not Less than 60 Min.	Continuous Turning
Low Speed Warming (at 500 rpm)	10 - 20 Min.	10 Min.	5 Min.
Speed Up (500 rpm to rated speed)	20 Min.	15 Min.	10 Min.
Initial Load	0.5 to 1 MW	1 MW	1-2 MW
Initial Load Holding Time	10 to 20 Min.	10 Min.	5 Min.
Load Up Rate 1 - 10 MW	0.2 MW/Min.	0.3 MW/Min.	0.5 MW/Min.
Load Down Rate	0.5 MW/Min.	0.5 MW/Min.	0.5 MW/Min.

The above operation is subject to vibration readings not exceeding
0.003 inch peak to peak at shaft.

5.2.5 Emergency Conditions Turbine and Associated Equipment

Vibration Alarm - .005 inch peak to peak at shaft.

If continuous - descale and rebalance.

Vibration Trip - .01 inch

If continuous - descale and rebalance.

Speed 3,924 rpm - alarm

Speed 3,960 to 3,996 rpm - trip (Set at 3,948 rpm)

Vacuum Trip Setting - 18 inch Hg. To help maintain vacuum reduce load and check for abnormal conditions in cooling water system, gland steam or noncondensable gas systems.

Thrust bearing trip device - nozzle type which trips the turbine by oil pressure change to the emergency pilot valve; an alarm will also be initiated on pressure greater than 38 psig.

Turning gear shut off - oil pressure to bearings less than 7.1 psig.

Low bearing pressure trip - 8.5 psig.

Drain tank level extra high - trip

33.4 inch above tank bottom

Turbine casing drain water level high-trip.

Main condenser high water level trip 69" H₂O.

Main condenser low water level trip 14.5" H₂O.

Steam separator (10-2) high water level trip - top of sight glass.

Bearing temperature high trip (170°-turbine)
(180°F-generator)

Cooling tower forebay level low trip - 30" H₂O.

5.3

Condensate system

After the cooling water, compressed air, fire water and steam systems have been started condensate will start to accumulate in the main condenser hot well and in the vacuum compressor seal water separator 10-1. Because the accumulation rate will be less than 3 gpm it will be necessary to add water to fill these two points of accumulation prior to system start-up (after a complete system drain). A truck (with pump) load of at least 800 gallons of "deionized water" should be available to add into the system at the vacuum compressor seal water separator.

5.3.1

Prerequisite Conditions

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and circuitry verified and tested per drawings.	_____	_____
B. Instruments and controls calibrated before start-up.	_____	_____
C. System and equipment installed per P&ID E-03-003.	_____	_____
D. Instrument air, cooling water and steam available.	_____	_____

E. Fill water is available per general section 5.3. _____

F. Seal water recirculation pump 14-5 and condensate pumps 14-4A and 14-4B pre-checked for rotation and ready to use. _____

G. Check that seal water recycle to vacuum compressor is blocked off. _____

5.3.2 Startup Procedure

A. Start adding fill water into fill and drain connection on seal water separator 10-1. When level appears high in LG 740, stop fill from truck and commission LIC-722, LV-722 and open block valve into main condenser hot well. _____

B. Open suction valve to seal water recirculation pump 14-5. Start pump and check that LIC-722 and LV-722 operate to hold level. Restart water from truck and slowly complete the system fill until the LSH-710 and LAH-710 are activated. Stop input of fill water and shut down pump 14-5. _____

- C. Open suction valves and all recycle line block valves on each condensate pump 14-4A and 14-4B. _____
- D. Select 14-4A as prime pump and start pump. Commission LIC-710 and set to just pull the level down below the LSH-710 and LAH set point. Open LV-710A and check that flow is registered on FT-110, and that when set point is reached LV-710A closes and LV-710B opens to recycle pump 14-4A. _____
- E. Place pump 14-4B into auto start position. Stop pump 14-4A and check pump 14-4B auto starts and that LV-710C opens. _____
- Reset LV-710 to a slightly lower level and check that flow registers on FT-110. _____
- F. Place pump 14-4A on auto. Stop pump 14-4B and see that pump 14-4A auto starts and that LV-710B opens. _____
- G. Reset LIC-710 until LSL-710 and LAL-710 are activated. _____

H. Shut down both pumps 14-4A and 14-4B. _____

I. Periodically check LG-740 and LG-712 and restart pumps 14-5 or 14-4A and/or 14-4B to pump out any accumulation of condensate prior to completion of the start-up of the noncondensable gas system and the turbo generator. _____

J. After the start-up of these latter two sections commission LIC-720 and LV-720 and open flow through AIR-952. _____

5.3.3 Normal Operation

A. Periodically check that the setting on F1-112 is per operating order. Log readings on T1-511 and T1-513 and measure dp across seal water cooler 12-4 using P1-325 and PV-325 and log. _____

B. Similarly check F1-111 and log. _____

- C. Check AIR-952 and log. If conductivity increases and quality of steam is unchanged problem is probably due to leakage of cooling water into system from either exchanger 12-2, 12-3 or 12-4. (Must be confirmed by chemical analysis)
-

5.3.4 Shutdown Procedure

- A. If the condensate systems shutdown is for a lengthy period, the turbine-generator and the jet ejectors should be shutdown.
- B. Shutdown the seal water recirculation pump 14-5.
- C. Shutdown the running condensate pump by pushing the auto off button, and push the auto-off button on the standby pump.
- D. Verify the condensate pump discharge valves closed. Each discharge valve closes automatically when the associated condensate pump motor is off.

5.3.5 Emergency Conditions

The following alarms and trips are provided:

- A. Condensate no-flow alarm with a pump motor energized.

- B. Condenser high or low level signal trips turbine and alarms.
- C. Condenser low level stops condensate pump(s) and alarms.
- D. Condensate pump low pressure starts standby pump and alarms.
- E. Seal water recirculation pump low flow - alarm
- F. Seal water no flow - trips vacuum compressor
Manual trip seal water recirculation pump.
- G. Loss of instrument and control air pressure causes the condensate pump(s) discharge valve(s) to close.

5.4

Condenser Noncondensable Gas Removal System

After all other auxiliaries have been started and or tested and the turbine-generator is ready to start the noncondensable gas system can be started up.

5.4.1

Prerequisite Conditions

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and all circuitry verified and tested per drawings.	_____	_____
B. Instruments and controls calibrated before start-up.	_____	_____
C. System and equipment installed per P&IDs' E-03-005 and E-03-003.	_____	_____
D. Condensate system in standby ready to restart.	_____	_____
E. Instrument air, cooling water and steam available.	_____	_____

The initial pull down of the system to the required vacuum (low absolute pressures) specified in operating order will be accomplished using the first stage and second stage steam ejectors. When the specified vacuum level has been established in the main condenser, the second stage ejector will be shut down and the vacuum compressor may be started up.

5.4.2 Start-up Procedure

- A. Open block valve in line NC-4 into second stage ejector 15-2 and start motive steam flow to ejector. _____

- B. Check that cooling water is flowing through intercondenser 12-3 and start motive steam to first stage ejector 15-1, by operating HIC-901 in main control panel. _____

- C. While the system is pulling down to vacuum line up the flow of recirculating seal

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water into vacuum compressor as follows:

Start seal water recirculation pump 14-5
and open recycle water injection block
valves at all points feeding vacuum com-
pressor. Observe FI-112 on each setting so
that the set flow will be as noted in oper-
ating order and log.

Check that cooling water is flowing through
seal water cooler 12-4.

Start one condensate pump 14-4A as prime
and place pump 14-4B on auto. Set flow of
condensate recycle through FI-111 per
operating order.

- D. When the vacuum approaches values in
operating order it may be required to crack
HV-940 and HV-941 by operating the HIC in
the main control room if surging occurs at
start-up. After steam is flowing to tur-
bine reset these valves to maintain desired
vacuum.

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E. To place vacuum compressor into operation check that PIC-362 (anti surge controller) is at set point marked on the instrument and open vacuum compressor suction block valve, start compressor and check suction valve PV-364 opens automatically.

F. Close suction valve in line NC-4 into second jet 15-2 suction. Shut off motive steam to second jet and close gas outlet block valve in line ES-3.

5.4.3 Normal Operation

A. Periodically check value of signal air pressure to control valve PV-362 and flow on FR-130 and log.

Over a period of time at the same FR-130 reading a further closing of PV-362 would indicate a loss of compressor efficiency.

B. Refer to Section 5.3.3 A and B for checks on seal water cooler.

5.4.4 Shutdown Procedure

Vacuum Compressor

The compressor motor can be shutdown at the motor control center and the local control station. Similarly, the seal water pump may be shutdown at both locations.

- A. Shutdown vacuum compressor motor. Check that noncondensable gas inlet valves and bypass valve (if open) close automatically. Shutdown seal water pump ten (10) minutes after vacuum compressor shutdown.
- B. If shutdown is for extended period close cooling water inlet valve to seal water cooler.

First Stage Ejector

- C. Close motive steam valve to first stage ejector 15-1, by operating HIC-901 on main control panel.
- D. If shutdown is for an extended period shutdown the cooling water flows to the main condenser and intercondenser by starting the auxiliary cooling water pump and stopping the main

cooling water pump(s). If the main cooling water pumps stop the auxiliary cooling water pump starts up automatically. The discharge valves operate automatically.

5.4.5 Emergency Conditions

- A. The motive steam to the first stage ejector is shut off automatically in the event the turbine trips for any cause.
- B. The vacuum compressor is shutdown automatically in the event the turbine trips for any cause. The seal water pump will continue to run.
- C. The vacuum compressor is shutdown automatically on loss of seal water.
- D. High seal water temperature initiates an alarm in the annunciator panel.

5.5 Cooling Water System

5.5.1 Prerequisite Conditions

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and circuitry verified and tested per drawing.	_____	_____
B. Instruments and controls calibrated before start-up	_____	_____
C. Check equipment and piping installed per P&ID E-03-004	_____	_____
D. Cooling tower basin full of water	_____	_____
E. Following equipment available for water circulation:		
Main Condenser	_____	_____
Intercondenser	_____	_____
Lube Oil Cooler	_____	_____
Generator Air Coolers	_____	_____
Instrument Air Cooling System Heat Exchangers	_____	_____

	<u>INITIAL</u>	<u>DATE</u>
Vacuum Compressor Seal Water Cooler	_____	_____
Building Air Conditioning Condenser	_____	_____
 F. Cooling Tower Fan Drive Motors Available	 _____	 _____
 G. Water Treatment System with Chemicals Available	 _____	 _____
 5.5.2 Start-up Procedure		
A. With drive motors <u>uncoupled</u> on cooling		
water pumps 14-1A, 14-1B and 14-2, bump		
motors for rotation check. Take inrush and		
running current readings. Record informa-		
tion on applicable data sheets. Heat run		
motors for 3 hours.		
Cooling Water Circulating Pump 14-1A	_____	_____
Cooling Water Circulating Pump 14-1B	_____	_____
Auxiliary Cooling Water Circulating Pump		
14-2	_____	_____
 B. With drive motors <u>uncoupled</u> on cooling		
tower fans, bump motors for rotation check.		
Take inrush readings and running current.		
Record information on applicable data		
sheets. Heat run motors for 3 hours.		
Cell No. 1 Fan	_____	_____
Cell No. 2 Fan	_____	_____

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Manipulate vibration switch on each
fan and note that motor stops.

Cell No. 1 XS 930-1

Cell No. 2 XS 930-2

- C. Line up sulfuric acid from tank 11-2 into
day tank 10-4. Partially fill day tank
10-4. Start acid metering pump 14-9 and
establish flow through discharge line. As
soon as sulfuric acid starts into cooling
tower basin, shut down pump 14-9 and check
that the acid pump back pressure valve
reseats.

Pump 14-9

- D. Line up corrosion stabilizer from tank 11-5
into inhibitor metering pump 14-10. Start
pump 14-10 and establish flow through dis-
charge line. As soon as corrosion stabilizer
starts into the cooling tower basin, shutdown
pump 14-10 and check that the corrosion
stabilizer pump back pressure valve reseats.

Pump 14-10

	<u>INITIAL</u>	<u>DATE</u>
E. When the cooling tower basin is full check that LSH 732 and LAH 732 operate.	_____	_____
Close manual bypass valve around LV 730 and check that FR 121 drops to zero.	_____	_____
F. Couple cooling tower fan motors, cooling water circulating pump motors and auxiliary cooling water pump motor. Record alignment data on mechanical equipment data sheets.		
Cell No. 1 Fan	_____	_____
Cell No. 2 Fan	_____	_____
Cooling Water Circulation Pump 14-1A	_____	_____
Cooling Water Circulation Pump 14-1B	_____	_____
Auxiliary Cooling Water Circulation Pump 14-2	_____	_____
G. Start-up auxiliary cooling water pump 14-2 and fill circulating water line and activate all heat exchange equipment in accordance with the following sequence. For each heat exchanger crack inlet valve and let air out vent until water appears then crack return water valve and open inlet water valve wide.		

	<u>INITIAL</u>	<u>DATE</u>
Building air conditioner condenser	_____	_____
Generator air coolers	_____	_____
Lube oil coolers	_____	_____
Instrument air cooling system	_____	_____
Vacuum compressor seal water cooler	_____	_____
Intercondenser	_____	_____
Main condenser	_____	_____

- H. Initiate flow of circulating water through AE 950 and AE 951. Check that FS 123 is activated. These devices are associated with the chemical treatment and blowdown system for the cooling water system.
- _____

When the turbine generator is ready to start, the cooling water recirculating pumps 14-1A and 14-1B should be brought into service with lines full of water per paragraph G and the auxiliary cooling water circulation pump should be shut down. Start-up one main cooling water pump and do no start the second main cooling water pump until the first one has established

normal flow conditions (say one minute)-
per flow and pressure gauges.

NOTE: Each main cooling water pump has 60%
system flow capacity when running alone.
As heat loads build up the flow of cooling
water must be rebalanced. The temperature
rise across each exchanger developed for
the design is listed below, Item I, for
assistance in the balancing of the system.

When the cooling water temperature circu-
lating through the cooling tower reaches
design conditions (116°F) start one cool-
ing tower fan by operating the pushbutton
station local to the fan motor or in the
main control panel. Check for vibration.

Under design ambient conditions and with
the turbine-generator at half load or
greater start the second cooling tower fan.
Check for vibration.

I. Design Temperature Rise for Heat Exchangers

Generator air coolers--6.7°F rise.

Lube oil cooler--4.0°F rise.

Instrument air cooling system--3.2°F
rise.

Intercondenser--30°F rise.

Main condenser--30°F rise.

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J. Final Adjustment

Initiate operation of ARC 950 and ARC 951
and place metering pumps 14-9 and 14-10
into auto control mode. Activate LV 730
and AV 950. Recheck that FR 121 and FR 122
are operating.

Check that LT 730 and LIC 730 are operating

Activate addition of chlorine into cooling
water recirculation line.

Manually add required dosage of chemical
biocide into cooling tower forebay.

Check that FI 120 is operating.

Refer to Section 5.6 for operation of the
silt pocket filtration system.

- K. Operation of building air conditioner condenser, when cooling tower is down for maintenance above the basin. Open valve in bypass line CW-26-2 located at rear of tower which bypasses the warm condenser water into the cooling tower basin.

5.5.3 Normal Operation

During normal operation the pressure drop across each exchanger should be logged and the system rebalanced to maintain individual temperature rises near design.

5.5.4 Shutdown Procedure

A. Main and Auxiliary Cooling Water Pumps

Push the stop button for the main cooling water pumps. This button is located on the main control panel.

When both main cooling water pumps are stopped observe that the auxiliary cooling water pump starts up in automatic control.

To stop the auxiliary cooling water pump push the off button.

B. Cooling Tower Fans

Stop cooling tower fans at pushbutton station local to fan motors or at main control panel.

C. If the turbine-generator outage extends over 8 hours the chlorine dosage should be reduced.

5.5.5 Emergency Conditions

A. The cooling water circulating pumps are stopped automatically in the event the cooling tower forebay reached its low, low level setting.

B. The cooling tower chemical treatment system is shutdown automatically in the event of low flow through the analysis sensing elements AE-950 and AE-951.

C. A shutdown or failure of the cooling tower chemical treatment system will initiate an alarm in the annunciator at the main control panel.

D. A high level in the cooling tower basin will initiate an alarm in the annunciator.

- E. The cooling tower fan motor vibration switch will shutdown the fan. Any fan motor failure will initiate an annunciator alarm.
- F. A low water level in the cooling tower forebay will initiate an alarm in the annunciator.
- G. Any cooling water pump failure will initiate an alarm on the annunciator. Turbine-generator load must be reduced to keep an acceptable vacuum within the condenser.
- H. Failure of both cooling water pumps will automatically start the auxiliary cooling water pump on loss of cooling water pressure, and close main condenser and intercondenser valves. Turbine will trip on loss of vacuum.

SECTION 5.6

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5.6

Makeup and Waste Water System and Blowdown System

The cooling water makeup is obtained from two alternative canal locations, namely, from Spruce lateral and Stanley lateral. At each location there is an inlet structure, a set of trash screens and a wet pump pit. Once make-up water flow is established the cooling tower basin will be filled so that the cooling water system can be activated.

The waste water system removes the silt and other non-dissolved solids which are in the cooling system and arise from the canal water.

The dissolved solids concentration is controlled by a blowdown system.

5.6.1

Prerequisite Conditions (Cooling Water Makeup)

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and circuitry verified and tested per drawings.	_____	_____
B. Instruments and controls calibrated before start-up.	_____	_____

INITIAL DATE

- C. Check each wet pit installation and make-up water line into the cooling water tower to ensure equipment and piping is installed per P&ID E-03-004.

During initial operation the make-up water will be first used to activate the sanitary water system filtration section. Refer to Sections 5.6.16 through 5.6.19 for operation of this system.

- D. Check that the sanitary water system equipment and piping is installed per P&ID E-03-008.

5.6.2 Start-up Procedure (Cooling Water Makeup System)

- A. With drive motors uncoupled on make-up water pumps 14-7 and 14-8, bump motors for rotation check. Take inrush and running current readings. Record information on applicable electrical and mechanical equipment data sheets. Heat run motors for 3 hours.

Cooling Water Make-Up Pump 14-7

Cooling Water Make-Up Pump 14-8

	<u>INITIAL</u>	<u>DATE</u>
B. Mechanically manipulate low level shutdown float switch and check motor shutdown.		
LSL 733	_____	_____
LSL 734	_____	_____
C. Couple make-up water pumps. Record alignment data on mechanical equipment data sheets.		
Cooling Water Make-Up Pump 14-7	_____	_____
Cooling Water Make-Up Pump 14-8	_____	_____
D. Crack isolation valve in line CW-18-2, start one make-up water pump and set rate into sanitary water filter 19-3 (3 gpm) After rate is established, manipulate level float on filter 19-3 to shut off flow. Check that FS 124 in make-up water line deactivates and shuts down pump. Reopen valve at filter 19-3, restart pump and recheck FS 124.		
Shut down first make-up water pump and start-up alternative make-up water pump. Check again to see that FS 124 operates properly, same procedure as above.	_____	_____

E. Open manual bypass valve around LV-730 in make-up water line CW-19-6 and set flow into cooling tower basin at a rate of 600 gpm as shown on FR 121. While the cooling tower basin is filling initiate preparation for start-up of cooling water system.

5.6.3 Normal Operation (Cooling Water Makeup System)

One makeup pump running (14-7 or 14-8). The Spruce Lateral (14-7) is nearer the plant and will require less power to run. Availability of both pumps is dependent upon the canal cleaning program of the IID.

The main control panel contains a red and green indicating light for each pump operating condition. A recorder and integrating flow meter located in the main control panel show the flow conditions in the common makeup line at the plant.

The rate of flow of water into the cooling tower to maintain water level is controlled by a level controller and flow throttling valve.

5.6.4 Shutdown (Cooling Water Makeup System)

To stop a running makeup water pump push the stop button on the main control panel. A green light will be illuminated to confirm the action.

The cooling water makeup low pressure alarm will be indicated on the annunciator on the main control panel.

5.6.5 Emergency Conditions (Cooling Water Makeup System)

The following alarms and trips are provided:

- A. Low level in sump of the cooling water makeup pump, causes the pump to stop by a signal from a low level switch, and the appropriate green light will be illuminated on the main control panel. The loss of pressure in the discharge line will cause an alarm on the annunciator on the main control panel.

- B. An illuminated red light on the main control panel indicating a running makeup water pump and a low or no flow on the flow meter indicates a broken line or a blocked pump suction.
- C. A low level in the cooling tower forebay will initiate an alarm on the annunciator on the main control panel. The low level (LSL-730) control is set to alarm at a water level 50 1/2 inches above the bottom of the forebay. The pumps will trip out at a water level of 46 1/2 inches above the bottom of the forebay.
- D. A gradual blockage of the trash screen between the cooling tower basin and the forebay will cause an increasing level in the basin, since the makeup water is delivered to the cooling tower basin and the level signal is from the forebay. The high water alarm in the basin is set at 72 inches above the bottom of the basin.
- E. The steam supplier facility may receive water from this system via a 1 inch line. This water is metered.

5.6.6 Prerequisite Conditions (Silt Pocket Filtration)

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and all circuitry tested and verified per current drawings.	_____	_____
B. Instruments and controls calibrated for start-up.	_____	_____
C. Check out each subsystem to ensure that equipment and piping is installed per P&ID E-03-008.	_____	_____
D. Silt Pocket Pump 14-13, backwash pump 14-14, and air scour blower 16-3 are all pre-checked for rotation.	_____	_____

5.6.7 Start-up Procedure Automatic Sand Filler for
Silt Pocket

- A. Open 1/2 inch valve from cooling water system and check that self priming backwash sump pump 14-14 is fully primed as shown by flow

from suction line into backwash sump.

Reset 1/2 inch valve to provide a continuous low flow of priming water.

- B. Open cooling tower screen wash down hose wide and add one foot of water to backwash sump. Shut hose off.
- C. Open all blocked off valves in backwash sump pump 14-14 discharge line and manipulate level switch LS 764 and start-up pump 14-14 and check that pump out continues to low level in sump and pump 14-14 shuts down.
- _____
- D. Open one silt pocket valve and suction valve for silt pocket pump 14-13. Crack pump 14-13 discharge to 20% open. Use sand filter cycle controller to start automatic filtration cycle. Check that silt pocket pump starts, feed valve opens and backwash valve is closed. When compartment is full

and clearwell level starts to rise, open pump 14-13 discharge valve wide. Follow cycle through backwash cycle. During backwash set backwash control valve (flow) per manufacturers instructions, so that backwash sump does not overflow during cycle. Check that air scour blower goes through start-stop cycle and that silt pocket pump goes through stop-restart cycle.

- E. Periodically check cycle time for each step and log on proper record sheets.

- F. Switch suction at silt pockets from one to the other daily.

5.6.9 Normal Operation (Silt Pocket Filtration)

(Refer to Sand Filter Sketch and Sequence Diagram (Figure 1) shown on page 5-53) See also Ecodyne Drawing No. 23203.

- A. Pump 14-13 running
Valve "A" open
Valve "W" Open
Valves "U" & "C" Closed

Dial Reading:	3-20	21-38	38-58	58-75	75-85
Seconds/Operation:	5.1	5.4	6.0	5.1	3.0

NORMAL RUN	DRAINDOWN	AIR SCOUR	SETTLE BED	BACKWASH	SETTLE BED
A Open	A Closed	A Closed	A Closed	A Closed	A Closed
C Closed	C Open	C Open	C Open	C Open	C Open
W Open	W Closed	W Closed	W Closed	W Open	W Closed
U Closed	U Open	U Closed	U Closed	U Closed	U Closed
Blower Off	Blower Off	Blower On	Blower Off	Blower Off	Blower Off
Pump 14-13 Run	Pump 14-13 Shuts Down Automatically

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CALIF. 94111

JOB NO. S-78014

AUTOMATIC SAND FILTER FOR
COOLING TOWER EQUIP. NO. 19-4

5-53

DRAWING NO.

REV.

FIGURE 1

SHEET

OF

DG-023

NOV 6 1950

Water flows under cone and downward through the anthracite and is polished by fine sand at the bottom.

Water flows to top of the filter tank (above cone) through the valve "W". The water flows through the outlet pipe to the cooling tower basin.

Backflushing of the filter occurs when the flow resistance through the filter increases and sets off a pressure switch which starts the automatic backwash cycle.

Backwash (Refer to Sand Filter sketch on page 5-53).

Check tabulated list for sequence of valve operations.

The pressure switch initiates operation of a 30 minute timer which controls the valves and starts a blower in the following sequence:

Step 1 - Drain Down

Silt pocket pump (41-13) is automatically shutdown and valve "A" is closed to isolate the inlet water from the silt pocket pump (14-13).

Valve "C" opens to allow backwash discharge to the backwash sump.

Concurrently valve "U" opens to drain the water underneath the cone to the backwash sump. The valve closes after approximately 5 minutes.

Valve "W" closes to isolate bottom of filter from top of tank.

Step 2 - Air Scour

Valve "U" is closed and the blower is started to feed air upward from the bottom of the filter media. The air loosens up the encrusted silt. The blower operates for approximately 5 minutes.

Step 3 - Settle Bed

Blower is stopped.

Step 4 - Backwash

Backwash inlet valve "W" opens to provide backwash water which enters the bottom of the filter to flush the filter. The backwash water leaves the top of the filter and out the top of the cone and is dumped through valve "C" into the backwash sump.

Backwash occurs for approximately 5 minutes.

Step 5 - Settle Bed

Valve "W" is closed.

A period of 3 minutes is allowed for the bed to settle.

Step 6 - Return to Normal Running

Valves "A" and "W" open and valves "U" and "C" close. Silt pocket pump 14-13 starts.

Operation of the backwash cycle may be initiated manually by pushing the filter backwash start button on the panel at the filter.

Pump 14-13 shuts down automatically during the entire backwash cycle (from draindown through bet settlement).

- B. The backwash sump is pumped out by the backwash sump pump 14-14 which discharges through the blowdown line to the Spruce Drainage ditch. The pump is controlled by a level switch in the backwash sump.

In addition to the sand filter backwash water the sump receives drains by gravity from the neutralizer sump, the acid drain sump, safety shower drain and the cooling tower screen wash.

5.6.10 Shutdown Procedure (Silt Pocket Filtration)

The system is fully automatic and there is no special shutdown procedure required.

5.6.11 Emergency Operation (Silt Pocket Filtration)

The silt level in the silt pockets will rise if the silt pocket pump fails to remove the deposits faster than the deposition rate. The silt from a full pocket would eventually find its way into the forebay and could damage the pumps.

The automatic sand filter may become choked if the backwash system does not function properly. The interval of time between backflush cycles should be noted. Should the interval shorten significantly either the amount of silt being pumped into the plant is increasing or the backwash/filter condition is deteriorating. The filter bed may be renewed by removal of the filter cover and cone.

5.6.12 Start-up Procedure (Oily Waste Water System)

<u>INITIAL</u>	<u>DATE</u>
----------------	-------------

A.	Open 1/2 inch valve from auxiliary cooling water line and check that self-priming waste water sump pump 14-6 is fully primed as shown by flow from suction line into

waste water sump. Reset 1/2 inch valve to provide a continuous low flow of priming water.

- B. Wash down area and partially fill waste water sump. Manipulate level switch and check that sump pump 14-6 auto starts and empties sump.
- _____

5.6.13 Normal Operation (Oily Waste Water System)

With the sump pump (14-6) set in auto-control, the level switch starts and stops the pump as necessary to keep the sump empty. The oily water is piped to a holding tank. The holding tank is emptied periodically by tank truck.

Level switch (LS-765) starts the pump when the liquid level is 18-inches above the bottom of the sump and shuts off when the liquid level is 3 inches above the bottom of the sump.

5.6.14 Shutdown Procedure (Oily Waste Water System)

The sump is emptied by a pump normally operated in automatic control. Shutdown of this pump is accomplished by turning the control switch to "OFF".

5.6.15 Emergency Conditions (Oily Waste Water System)

In the event the pump does not run turn the control switch to hand position. If the pump runs check the level switch (LS-765). If the pump runs and fails to lower the water level check the priming of the pump. If the pump still does not pump it should be opened up to determine the reason for failure to pump.

The oily water must not be permitted to enter the water table.

5.6.16 Start-up Procedure (Sanitary Service Water System)

NOTE: Refer to Section 5.6.2 D wherein water flow was started into sand filter 19-3.

INITIAL DATE

A. With the inlet flow to the sand filter set at 3 gpm the Sanitary Water Storage Tank 11-1 will normally be filled during the night. When 11-1 approaches high level, the float controlled canal water feed valve will shut off.

B. Once the filtered water is above the level shutdown switch LSL 762 the sanitary service water pump 14-15, should be started. Open pump discharge block valve 2 turns

and fill service lines and check that the pump stops when PS-395 is activated. Start using sanitary service water at safety shower and building sanitary facilities and check that service water pump auto starts and stops to maintain service water pressure.

5.6.17 Normal Operation (Sanitary Service Water)

In normal operation the sand filter vessel (19-3) will be kept full by the cooling water makeup system, the sanitary water storage tank will be kept full by gravity flow from the sand filter. The hydro-pneumatic tank and sanitary service system will be kept pressurized by the sanitary service pump (14-15).

5.6.18 Shutdown Procedure (Sanitary Service Water)

Close isolation valve ahead of FQ-150 in line CW-18-2. This valve isolates the incoming water from the cooling water makeup system.

Shutdown the sanitary service pump (14-15).

5.6.19 Emergency Conditions (Sanitary Service Water)

In the event the sanitary service pump (14-15) does not run, turn the control switch to hand position. If the pump runs check the level switch (LSL-762).

Low water in sanitary water storage tank (11-1) may be caused by a shutdown of the cooling water makeup pumps (14-7 and 14-8). Thus shutdown will occur when the flow requirement is lower than the minimum design flow rate of the pumps. This condition would occur when the turbine-generator is shutdown.

Check to see that when the water level in the sand filter is higher than the water level in the sanitary storage tank, and water flows at the correct rate through the sand filter. If not, the filter will need cleaning. Remove the top layer of silt and replace with clean sand of the correct fineness.

INITIAL DATE

5.7 Fire Protection System

(See Figure 2 following Page 5-65)

5.7.1 Prerequisite Conditions (Fire Water System)

A. Electric power available and circuitry
verified and tested per drawings.

B. Instruments and controls calibrated
before start-up

C. Check equipment and piping installed per
P&ID E-03-008

D. Cooling tower basin full of water

5.7.2 Start-up Procedures

A. With drive motors uncoupled on jockey and
fire pumps 14-11 and 14-12 bump motors for
rotation check. Take inrush and running
current readings. Record information on
applicable electrical and mechanical equip-
ment data sheets. Heat run motor for 3
hours.

Jockey Pump 14-11

Fire Pump 14-12

	<u>INITIAL</u>	<u>DATE</u>
B. Check that cooling tower is at operating level (full).	_____	_____
C. Couple motors to pumps. Record alignment data on mechanical equipment data sheets.		
Jockey Pump 14-11	_____	_____
Fire Pump 14-12	_____	_____
<p>Open suction valve to Jockey Pump 14-11 and crack discharge valve 20% open and fill all lines. Crack valve open ahead of FE-151 and establish low flow recycle through FE-151 and check that flow (low) is returning to forebay. Vent air from each hydrant, hose reel and other off take-off point.</p>		
	_____	_____
D. Open suction valve to fire pump 14-12 and discharge block valve and hand start pump and check that PSV 401 opens.	_____	_____
(PSV 401 provides a low flow recycle for the fire pump.)		

E. Stop fire pump by stop button. Increase flow through FE 151 slowly. Read flow and pressure when fire pump starts automatically. Continue flow increase up to 1,000 gpm and read pressure. Record test data in fire pump test record sheets.

F. Reduce flow through FE-151 to low flow recycle and stop fire pump. Fire pump should now be placed in standby on "auto start" status.

5.7.3 Normal Operation

- A. Jockey pump 14-11 operates under control of a pressure switch to maintain normal pressure on the system and supply required flow to waste water sump pump and backwash sump pump.
- B. Power "ON" light on fire pump 14-12 to indicate power availability.
- C. The jockey pump and fire pump operation is controlled by pressure switches; the sequence of operation is as follows:

1. Jockey pump "ON" 60 psi
2. Jockey pump "OFF" 80 psi
3. Fire pump "ON" 50 psi
4. Fire pump "OFF" 95 psi

5.7.4 Shutdown Procedure

The fire water protection system is required to be in service at all times.

- A. In the event a shutdown becomes mandatory the motor drive is shutdown as follows:

Fire Pump - Open breaker at fire pump controller

Jockey Pump - Open breaker at MCC

- B. Bleed off water pressure from the system by cracking open the valve ahead of FE-151. When pressure is atmospheric close this valve.

5.7.5 Emergency Conditions

Since the firewater protection system is required to be in service at all times a backup fire pumper, from the fire department will be required when the firewater system is inoperative.

The fire pumper would pump water from Spruce Lateral if a supply of water is not available from the cooling tower basin. The fire pumper water hose may be coupled to the firewater system at the 4 inch blind flange close to the fire pump. Verify integrity of firewater system.

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JOB NO. S-78014
DG-023

FIRE PROTECTION WATER SYSTEM

DRAWING NO.		REV.
FIGURE	2	
SHEET	OF	

NOV 28 1960

FIRE PROTECTION WATER SYSTEM

5.7.6 Carbon Dioxide Fire Protection System

This system is provided for purging the generator. High pressure gas bottles (quantity 2) are used as the source of carbon dioxide gas, and are located along the wall outside the Control Room.

The system is actuated automatically by high temperature sensor installed in the generator.

5.8

Compressed Air System

The compressed air system should be operated at all times. In addition to supplying the instrument and control air system, compressed air is used to purge electrical cabinets to prevent the intrusion of H₂S from the atmosphere.

5.8.1

Prerequisite Conditions

	<u>INITIAL</u>	<u>DATE</u>
A. Electric power available and all circuitry tested and verified per current drawings.	_____	_____
B. Instruments and controls calibrated for start-up.	_____	_____
C. System and equipment installed per P&ID E-03-006.	_____	_____
D. Recirculating water system make-up water surge tank 11-3 filled with deionized water with oxygen inhibitor to approximately 26 inch level on LG 750.	_____	_____

INITIAL DATE

E. Air compressor and air compressor cooling
water pump motors pre-checked for proper
rotation and ready for start-up.

F. All instrument air header block valves
closed and supply tubing runs disconnected.

G. Cooling water system operating with either
auxiliary or main cooling water pump running.
(Refer to Section 5.5)

5.8.2 Start-up Procedure

A. Add corrosion inhibitor and scale disper-
sant dosages into make-up water surge tank
11-3 and mix with wooden paddle.

B. Open suction and discharge valves on air
compressor cooling water pumps 14-16A
and 14-16B. Open valve bypassing both
compressor after coolers and cylinders, 2
turns.

	<u>INITIAL</u>	<u>DATE</u>
C. Open inlet valves 2 turns to both heat exchangers 12-5A and 12-5B. Start-up one air compressor cooling water pump.	_____	_____
D. Place "B" pump control on automatic. Turn pump "A" control to off and check that pump 14-16B auto starts. Place pump 14-16A on auto, stop pump 14-16B and check that pump 14-16A auto starts.	_____	_____
E. Remove blind flanges at the end of each instrument air distribution header. Line up air flow for start-up of air compressor 16-1A, through dryer 19-1A, air receiver 10-3 and one instrument air after filter 19-6. Open inlet to after filter wide and crack discharge valve 3 turns.	_____	_____
F. Fill compressor after cooler and jacket water circuit with deionized water. Open water supply valve and start flow of water through system. Open vent valve, close after air is vented. Check that water flow is returned to the make-up water tank 11-3. Add deionized water if required to hold level near 25 inches on LG 750.	_____	_____

<u>INITIAL</u>	<u>DATE</u>
----------------	-------------

- G. Close off water inlet valve to heat exchanger
12-5B.

- H. Turn compressor by hand to see that machine is free and ready to start. Check lube oil level. Place selector switch on UNLOAD, open receiver drain valve and start compressor 16-1A by turning On-Off selector switch to "ON". Check lube oil pressure.

Run 1/2 hour unloaded, check that there is no overheating, oil pressure stabilizes and no unusual noise develops.

- I. Place selector switch on CONST. and transfer switch on 1.

Close drain on receiver and adjust after filter discharge valve to raise pressure to 25PSIG. Run 1/2 hour and increase pressure to 40PSIG. Run 1/2 hour and increase pressure to 60PSIG. Run 1/2 hour and increase pressure to 85PSIG and note that unit "unloads." Open receiver drain valve and

note that compressor "loads." Check cooling water flow. Adjust to desired temperature of 110°F (in loaded operation) at TI566.

Shutdown compressor 16-1A and repeat procedure H and I to run in compressor 16-1B and obtain final adjustment of water temperature at TI569. For this step place transfer switch on 2.

Once the compressors are run in either unit may be used to start-up the air dryers.

J. Start-up one air compressor and adjust after filter discharge valve so that compressed air flow is near design i.e. compressor unloads for minor part of cycle.

K. Send air flow through dryer 19-1A, turn on cycle controller and check purge rate for regeneration air flow, set at 600 SCFH.

Operate dryer until outlet air reaches design dew point of minus 40°F adjusted to 80 psig. Check with dewpoint instrument.

- L. Close discharge valve on dryer 19-1A and send air flow through dryer 19-1B and repeat procedure K.
- M. Continue to run dryer 19-1B and dry out all instrument air headers. When header is dry block off air supply block valves and blind off end of each header and reopen supply. Sequentially connect up supply tubing, open tube run block valve and dry out all supply tubing, control tubing and all air user equipment. (This operation may take up to 120 hours depending on the moisture retained). Check dryness at extremities of system at minus 40°F using dewpoint instrument. _____
- N. Log check off each subsystem as dry by test. _____

INITIAL DATE

5.8.3 Normal Operation

A. Line up one heat exchanger (12-5A or 12-5B)
as prime and the other as standby.

B. Line up one pump (14-16A or 14-16B) as
prime and the other as standby.

C. Line up one compressor (16-1A or 16-1B) as
prime and the other on auto start standby.
Turn transfer switch to select prime com-
pressor.

Maintain routine equipment checks per
manufacturers operation manual.

D. Line up one air dryer unit (19-1A or 19-1B)
as prime and the other standby and ready
for use. Dryer changeover is by manual
initiation.

E. Line up one after filter as prime.

F. Take pressure differential measurements
across critical equipment of system on a
routine basis. Log readings from P1-370,
P1-372, P1-373, P1-374 and P1-378.

INITIAL DATE

- G. Check dewpoint at remote end of system weekly. If dewpoint not satisfactory check at dryer discharge.
- _____

5.8.4 Shutdown Procedure

Normally only one compressor, dryer, filter, cooling water pump, or cooling system heat exchanger should be shutdown at any time.

Proceed as follows:

A. Air Compressor

Turn ON-OFF switch to off. Open breaker feeding compressor.

B. Dryer

Turn off electric power to dryer. Close inlet and discharge block valve. Crack bleed valves and vent air slowly.

C. Filter

Close block valves on each side of filter. Crack bleed valve and vent air slowly.

D. Cooling Water Pump

Turn pump control switch to off and open breaker. Close suction and discharge valves.

E. Cooling System Heat Exchanger

Close heated side inlet valve. Close cold side inlet and outlet valves.

5.8.5 Emergency Conditions

Failure of one air compressor cooling water pump or air compressor will start up the standby pump automatically.

Should an air dryer transfer valve fail to operate the standby air dryer should be operated.

In the event of low air pressure (less than 60 psig) an alarm will sound in the Control Room and an annunciator drop will light and indicate low instrument air pressure.

The design of the compressed air system is "fail safe", that is, in the event of loss of air pressure the plant will shutdown safely.

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- 5.9.3 Normal Operations
- 5.9.4 Shutdown Procedure
- 5.9.5 Emergency Conditions

NOTE: The emergency stack and the H₂S monitoring system are the only parts of this section that are installed.

5.9 H₂S System

5.9.1 Prerequisite Conditions

- A. Electric power available and circuitry
 verified and tested per drawings
- B. Instrument air available and instruments
 and controls calibrated before start-up.

INITIAL DATE

INITIAL

DATE

- C. Check all piping to ensure equipment and piping are installed per P&ID Drawing E-03-007

- D. Verify that cooling water temperatures are at or higher than design operating conditions. (See Section 5.5.2 H)

5.9.2 Start-up Procedure

- A. Check that hand block valves are closed at gas dispersal line to each cooling tower fan plenum. Have safety blinds changed from closed to open position at each of the above block valves.

- B. Check that block valve is closed in line to emergency vent stack at steam producers area. Have safety blind changed from closed to open at this location. Open block valve and check test automatic valve "open" and "closed". Check that automatic valve returns to open position on "auto" setting.

The steam supplier can now proceed to establish steam production with the steam supplier's noncondensable gas stream routed to the emergency vent stack.

- C. Open hand block valve at each cooling tower fan plenum noncondensable vent gas control valve station.

- D. Start-up one cooling tower fan. The "auto" valve control should initiate the opening of the fan plenum valve to vent the steam supplier's noncondensable vent gas to the fan plenum and at the same time close the emergency vent stack gas control valve. Check that the valve position lights on the fan plenum valve and the emergency vent valve both show "blue" _____

- E. Start-up second cooling tower fan. Check that "auto" valve control opens that fan plenum control valve, and position light shows "blue". _____

INITIAL DATE

F. With both cooling tower fans in operation it is permissible to "test close" the vent valve at each fan plenum. Test one valve and then the other. Do not test simultaneously.

G. Activate H₂S monitoring units by turning power supply to "ON". Check that low alarm is set for 10 ppm and that high alarm is set for 30 ppm. Check that scan is progressing at 1 second per channel

5.9.3 Normal Operations

A. Provided both cooling tower fans are running, proceed to periodically "test close" the vent valve at each plenum. Test one valve and then the other. Do not test simultaneously. Log test time.

B. Periodically "test open" the emergency vent stack valve. Log test time.

C. Log time of any low or high H₂S alarms.

5.9.4 Shutdown Procedure

- A. In case of mechanical failure or need for maintenance on one cooling tower fan, the shutdown of that fan will "auto" initiate the closing of the gas vent valve at that fan plenum. Check that "auto" valve closes. _____

To prepare for maintenance, tag fan electrical breaker off. Close hand block valve at "auto" valve station and have blind installed for maintenance work. Log fan No. and activity. _____

5.9.5 Emergency Conditions

- A. When one cooling tower fan is down and is not readily available for restart, the failure of the second fan will "auto" initiate the opening of the emergency gas vent valve. When the emergency gas vent valve is proven open, then that fan plenum valve will be automatically closed.

INITIAL DATE

Check that fan plenum "auto" valve is closed.

Close off hand block valve and tag fan
electrical breaker off. Log fan No. and
activity.

- B. With both cooling tower fans off check that
emergency vent stack "auto" valve is open.
Do not "test close" this valve.

- C. If the H₂S monitoring equipment starts to
register high alarms (30 ppm), coordinate
problem with steam supplier. If corrective
action does not reduce high alarms notify
steam supplier that a unit outage is
required.

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5.10.3	Normal Operation
5.10.4	To Shutdown Generator
5.10.5	Emergency Conditions
5.10.1	Prerequisite Conditions for Placing Generator In Service

Initial Date

A. Inspect generator to determine that interior is clean of all tools and material and that all access doors are closed. Use manufacturers suggested check list-see manufacturers instruction manual.

B. Verify that generator cooling water system is in operation.

C. Verify that control circuits have been tested.

	<u>INITIAL</u>	<u>DATE</u>
D. Verify that all protective relays are set and operational.	_____	_____
E. Verify that generator insulation resistance readings are acceptable and have been consistent.	_____	_____
F. Check for rotor ground	_____	_____
G. Verify that manual and automatic voltage regulators are operational.	_____	_____
H. Verify that field breaker is open.	_____	_____
I. Verify that voltage regulator control switch is set for manual operation.	_____	_____
J. Verify that annunciator system is operational.	_____	_____
K. Verify that instrumentation is cali- brated properly and zero'd.	_____	_____
L. Start generator makeup fan	_____	_____

INITIAL DATE

- M. During speed run-up of turbine, check generator for excessive noise and vibration (in conjunction with turbine).

5.10.2 To Place Generator In Service

NOTE: The turbine-generator will be brought up to 3,600 rpm at the local control station at which time control will be transferred to the Main Control Panel.

- A. Bring generator to 60 Hertz
- B. Place voltage regulator in manual position thru control switch CS-90E (white indicating light is on)
- C. Close field circuit breaker
- D. Increase generator voltage slowly thru control switch CS-70E to 4 kV.

INITIAL DATE

E. To transfer to automatic voltage regulator turn control switch CS-90R until balance meter reads zero.

F. Transfer to automatic regulation thru switch CS-90E (orange light on)

G. Run unloaded (in conjunction with turbine). Inspect generator for water flow and temperature, oil temperature, vibration, and winding temperature.

H. Check phase rotation.

I. Obtain clearance from Imperial Irrigation District to parallel generator with system.

J. To parallel with IID close synchronizing switch. Match voltage and frequency. Close 4 kV generator circuit breaker.

(Note: Synchronizing circuit has a synchronizing check relay to prevent closing unless frequency and voltages are within acceptable limits.)

K. Pick up approximately 500 kW of load
and 200-300 kVAR of reactive load to
stabilize turbine generator.

L. Advise IID that generator is paral-
leled. Request permission to take
load. The turbine-generator shall
be loaded in accordance with loading
rates shown in Section 5.2.4.V.

5.10.3 Normal Operation

A. The following control panel meter readings will be indicated at
generator design load:

Wattmeter:	10 MW
Varmeter:	11.76 MVAR
Ammeter:	1.62 kA
Voltmeter:	4.16 kV
Field Ammeter:	4A
Balance Meter:	0
Temperature Meter:	
Stator Windings:	Less than 100°C
Inlet Air:	40°C Maximum
Outlet Air:	Less than 100°C

B. During normal operation at rated conditions:

Inlet Cooling Water:	31.7°C (89°F)
Temperature Rise Across	
Coolers:	4°C (7.2°F)
Bearing Oil Discharge	
Temperature:	Less than 60°C (140°F)

C. Limitations:

Voltage:	± 5% or 4,370 Maximum
Frequency:	± 5% or 57 to 63 Hertz
Current:	Various - See Fig. 5.2 (Manufacturer's instruction book)

D. Minimum kVAR output shall supply station auxiliary and steam gathering system. Check IID incoming varhour meter. When meter stops generator is supplying minimum vars. Unless otherwise instructed increase var output to increase bus voltage to 4,350 volts.

E. For operation at other loads see manufacturer's instruction book for Figure 5-1, reactive capability curve, which indicates permissible loading with different power factors and megawatt outputs and curves 8-6 to 8-11 which show temperature rise and field currents under various operating conditions.

F. Three methods of generator loading are available:

- (1) Load sharing with other sources on system where generator loading increases and decreases proportionate to system load and governor speed droop characteristics.
- (2) Constant load utilizing a Basler kilowatt controller. Set point controls are available on main control panel.
- (3) Constant var output. Enabling control switch and var set point controls are on the main control panel.

5.10.4 To Shutdown

	<u>INITIAL</u>	<u>DATE</u>
A. Request permission of IID to drop load (if shutdown is required by plant internal problems)	_____	_____
B. Reduce load. See Section 5.2.4 V. for reduction rate	_____	_____
C. Trip generator circuit breaker	_____	_____
D. Reduce voltage to zero	_____	_____
E. Trip field circuit breaker	_____	_____
F. Make final running inspection. Check water and oil temperatures, and excess vibration	_____	_____
G. Test for rotor ground	_____	_____
H. Turn operation over to turbine operator for turbine shutdown	_____	_____
I. Stop generator makeup fan after turbine is tripped	_____	_____

- J. Make inspection after shutdown in accordance with manufacturer's check list. See instruction manual, page 4-15 onwards.
- _____

5.10.5 Emergency Conditions

- A. Generator shuts down and also trips turbine automatically on the following:

1. Low dc battery voltage
2. Reverse power
3. Field failure
4. Negative sequence current
5. Phase overcurrent
6. Neutral fault
7. Differential current
8. Ground fault
9. High air temperature causing CO₂ injection
10. Bearing overtemperature
11. Turbine problems - See Section 5.2.5

Except for bearing overtemperature and neutral ground the above sound a common alarm. Bearing over-temperature alarm is combined with the turbine.

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- 5.11.3 To Test 34.5-kV Line Grounding Switches
- 5.11.4 To Energize Main Transformer and 4-kV Bus
- 5.11.5 Normal Operation
- 5.11.6 Emergency Conditions

5.11 34.5 kV-System

The electrical system consists of the 34.5-kV switchyard, main transformer, auxiliary transformers, 4-kV switchgear and motor starters and 480-volt motor starters and feeders. The system provides auxiliary power to the plant, service to Union Oil Company's steam gathering system and the means of transferring power to the Imperial Irrigation District's transmission lines.

Main transformer must be energized prior to major testing of equipment and start-up of mechanical equipment. The main transformer does not have a 4-kV circuit breaker so that when the main transformer is energized, the 4-kV bus is energized.

Operation of 34.5-kV switchyard must be coordinated with the operation of the Imperial Irrigation District.

5.11.1 Prerequisite Conditions for Energizing 34.5-kV Switchyard, Main Transformer and 4-kV Switchgear

INITIAL DATE

A. Inspect switchyard and 4-kV switchgear. Verify that all 34.5-kV disconnect switches and power circuit breakers are open and tagged out.

B. Verify that all 4-kV circuit breakers and 4-kV motor starters are racked out into test position and all feeder switches open.

C. Verify that control and alarm circuits for 34-kV power circuit breaker BPS-0, BPN-0 (reclosers 152-1, -2), for the outgoing lines, and H1-0 (152-T) for the main transformer have been tested.

*Technically these are reclosers without internal automatic controls. In conformance with IID/SCE practice they will be referred to as power circuit breakers. IID switch numbers are used.

D. Verify that the oil levels in power circuit breaker BPS-0, BPN-0, and H1-0 (152-1, -2 and -T) and the transformer are acceptable.

E. Verify that protective relays for power circuit breaker BPS-0, BPN-0 and H1-0 (reclosers 152-1, -2 and -3) and for transformer are set and operational.

5.11.2 To Energize 34.5-kV Switchyard

A. Release clearances on all 34.5-kV switchyard equipment, except line disconnect and grounding switches

B. Line disconnects BPS-D2 and BPN-D2 as well as grounding switches BPS-GR and BPN-GR will be controlled by the IID and will always be locked with an IID padlock. Call IID dispatcher to close switches.

INITIAL DATE

- C. Under the jurisdiction of the IID dispatcher and in accordance with the dispatcher's switching instructions close isolating switches on both sides of power circuit breaker BPS-0 for Line 1. _____
- D. Close power circuit breaker BPS-0 and energize 34.5-kV bus. Verify operation of IDD metering circuits. _____
- E. Use phase rotation meter (or equivalent) at potential transformer fuse box and note direction. _____
- F. Inspect energized equipment for signs of distress. _____
- G. Trip power circuit breaker BPS-0 _____
- H. Close isolating switches for power circuit breaker BPN-0, Line 2 to Calpatría _____
- I. Close power circuit breaker BPN-0 _____

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INITIAL DATE

J. Inspect energized electrical equipment
 for signs of distress

K. Check if phase rotation has not changed.

L. Request clearance from IDD to complete
 loop Rio Vista-Brawley-Calipatria.

(Note: No synchronizing facilities have
been provided across 34.5 kV system).

If permission is granted, close BPS-0

5.11.3 To Test 34.5-kV Line Grounding Switches

34.5 kV isolating switches BPS-D2 and BPN-D2 on the incoming side of the 34.5-kV power circuit breakers are equipped with line grounding switches. To test, request that IID de-energize the Rio Vista-Brawley line and the Calpatria-Brawley line and operate switches.

5.11.4 To Energize Main Transformer and 4-kV Bus

A. Close isolating switches, H1-D1 and H1-D2
 transformer power circuit breaker H1-0

B. Close H1-0 energizing main transformer and
 4-kV bus.

INITIAL DATE

C. Inspect transformer and switchgear
for electrical stress.

D. Check bus voltage levels. If un-
acceptable, trip out H1-0 and adjust trans-
former taps.

5.11.5 Normal Operation

- A. All switches except ground switches and power circuit breakers
will remain closed.
- B. Monitor transformer and power circuit breaker oil levels.
- C. Monitor transformer temperatures.

5.11.6 Emergency Operation

5.11.6.1 34.5 kV Line 1 to Rio Vista

Line is tripped by:

- a) Pilot Wire Relay
- b) Directional Overcurrent Relays (back-up for pilot wire relay)
- c) Directional Ground Overcurrent Relay

All the above sounds a common alarm.

Plot wire system is provided with test switch and ammeter and a monitoring
relay which will alarm on pilot wire malfunction.

5.11.6.2 34.5-kV Line 2 to Calpatria

Line is tripped by:

- a) Distance Relays (3 zones)
- b) Directional Ground Overcurrent Relay

5.11.6.3 Main Transformer

Transformer is tripped by:

- a) Sudden Fault Pressure
- b) Differential Current
- c) High Winding Temperature
- d) Neutral Overcurrent
- e) Transformer Overcurrent
- f) Bus Ground Fault

All the above sound a common alarm.

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- 5.12.5 Cooling Water Makeup Pumps
- 5.12.6 Emergency Conditions

5.12 Auxiliary Power Systems

Auxiliary power systems consist of that part of the 4-kV bus supplying the 4-kV motors, the steam gathering system feeder, the auxiliary transformer feeder and the auxiliary transformer, the 480-volt motor control center, and the IID power service to the power plant and cooling water makeup pumps. The IID service to the power plant is connected to the "critical" bus in the 480 volt motor control center. Service to the cooling water makeup pumps is 240 volts and is independent of the plant. The 4-kV system is covered in Section 5.11.

5.12.1 Prerequisite Conditions to Energize Auxiliary Transformer and
480 Volt Bus

INITIAL DATE

A. Inspect auxiliary transformer and 480
volt motor control center. Verify that
all motor starters and feeder discon-
nect breakers are in the "test condi-
tion" and 4 kV transformer switch is
open.

B. Block 480 volt automatic transfer
switch to stop the switch from trans-
ferring the critical load bus to the
normal load bus. (It is assumed that
the critical load bus has been ener-
gized as part of the transition from
construction power to permanent power
service.)

C. Verify that protective relays have
been set and control circuits have been
tested.

INITIAL DATE

5.12.2 To Energize Auxiliary Transformer and 480-Volt Bus

A. Close 4-kV transformer feeder switch.
 Inspect transformer for distress.

B. Close 480-volt main circuit breaker.
 Inspect motor control center. Check
 ground detectors for operation.

C. Check phase rotation between a normal
 and critical load bus.

D. Unblock transfer switch and check that
 transfer switch operates automatically
 to switch load from the emergency power
 supply to normal bus.

E. Check whether voltages are acceptable.
 If not deenergize transformer and adjust
 taps.

5.12.3 Normal Operation

- A. All switches and circuit breakers are closed.
- B. Monitor auxiliary transformer temperature.
- C. Monitor ground detectors.

INITIAL DATE

5.12.4 To De-energize the Auxiliary System

- A. Trip auxiliary transformer feeder
- B. If 480 volt critical bus is to be de-energized open 480 volt feeder circuit breaker from the IID auxiliary supply

5.12.5 Cooling Water Makeup Pump Supply at Stanley Lateral and Spruce Lateral

- A. Disconnect cooling water pump motor leads from starters
- B. Inspect starters, grounds and controls for correct connections. Check operation of protective devices including phase rotation relay.

INITIAL DATE

C. Energize starters. Check operation
of control system

D. Check operation of remote control
system from Main Control Panel

E. Reconnect motors

F. Bump motors to verify correct rotation

5.12.6 Emergency Conditions

- A. Auxiliary transformer winding temperature alarm and trip on overtemperature. Transfer switch will operate and also initiate an alarm.
- B. Overcurrent and sudden fault pressure relay will trip the auxiliary transformer feeder and initiate an alarm. Transfer switch will operate and also initiate an alarm.
- C. 480 volt ground fault initiates alarm.
- D. Circuit trouble trips circuit breaker. Whether or not circuit trouble will initiate an alarm will depend on the load being served.
- E. Failure of cooling water makeup pumps initiates an alarm and also the loss of water flow.

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 - 5.13.5 Emergency Conditions

5.13 DC System

The DC system consists of batteries, charger and distribution panel and emergency oil pump.

5.13.1 Prerequisites for Energizing DC System

A. Circuit LB-9 supply to charger must be energized

INITIAL DATE

B. Batteries are filled with potassium hydroxide

5.13.2 To Energize DC System

5.13.2.1 Battery Charger

	<u>INITIAL</u>	<u>DATE</u>
A. Turn on charger. Adjust float and high rate switches per manufacturer's instructions	_____	_____
B. Verify operation ac failure, dc low voltage and ground fault relays	_____	_____

5.13.2.2 DC Distribution

A. Turn on, in sequence, dc circuit breakers in Panel D. Verify operation of dc under-voltage relays on turbine and generator control circuits and various indicating lights	_____	_____
B. Verify operation of circuit to annunciator thru annunciator test pushbutton	_____	_____
C. Verify operation of circuits to power circuit breakers thru indicating lights on main control panel.	_____	_____

5.13.3 Normal Operation

- A. Place battery on float charge. Nominal voltage is 134 volts.
- B. High rate charge is initiated manually and continues for a preset time. Nominal high rate voltage is 149 volts.
- C. Monitor to electrolyte level in batteries.
- D. Monitor charger output ammeter.

5.13.4 To Shutdown System

- A. Trip all circuit breakers
- B. Turn off rectifier
- C. For a long time shutdown see battery manufacturer's instructions for batteries.

5.13.5 Emergency Conditions

- A. Low ac voltage or loss of voltage will alarm.
- B. Low dc voltage at battery charger will alarm.
- C. Loss of control power voltage on turbine, generator or transformer circuits will alarm.
- D. Very low dc voltage will trip turbine and generator.

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5.14 AC Control Systems.

AC control systems fall into two groups:

Those that are part of motor control circuits and are supplied from individual control power transformers in the motor starters. These systems are energized as part of motor check out.

Those that supply instrumentation and water treatment, CO₂ systems and space heaters.

- 5.14.1 Prerequisite for Energizing Miscellaneous AC Control System

INITIAL DATE

A. Panel LB Energized

5.14.2 Instrumentation and Controllers

A. For control panel, verify that all
recorders and receivers are connected
and internal fuses in place

B. Energize circuit LB-14. Check opera-
tion of recorders. Set charts on cor-
rect time.

C. For field installed instruments including
water treatment system controller, verify
that all connections are complete, in-
ternal fuses are in place and individual
control power disconnect switches are
open

D. Energize Circuit LB-24

E. Close individual control power discon-
nect switches and verify operation

5.14.3 Normal Operation

A. Monitor Instruments

5.14.4 Shutdown Procedure

A. Open either individual control power disconnect switch or feeder circuit breaker at Panel LB.

5.14.5 Emergency Conditions

A. Circuit Failure

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SECTION 5.15

5.15 Lighting

5.15.1 480 Volt System

5.15.2 120 Volt System

5.15 Lighting

Two lighting systems are provided; a 480 volt system for area lighting in the switchyard and process area, the other a 120 volt system for building interior lighting.

5.15.1 480 Volt System

A. Inspect system. Verify that fixtures
are lamped, and interiors cleaned,
covers properly fastened and connections
complete

INITIAL DATE

B. Test lighting contactor by hand and
through photocell

C. At Panel LH, energize each circuit
in turn. Verify operation of circuit

INITIAL DATE

- D. At night, energize lighting system,
 (if not already energized by photocell)
 inspect areas that are being illumi-
 nated. Adjust directional lights if
 necessary for optimum performance

5.15.2 120 Volt System

- A. Inspect system in office building,
 instrument air shed, fire pump
 controller building, and chemical
 storage shed. Verify that fixtures
 are properly lamped and clean
- B. At Panel 1A, energize each circuit in
 turn and verify operation
- C. At night, energize lighting system
 and adjust where possible for
 optimum system performance

5.16 Main Control Panel

5.16.1 Prerequisite Conditions

- A. Before the control panel can be operated it is necessary for the following electric circuits to be energized:
- a. Turbine dc control power
 - b. Generator dc control power
 - c. BPS-0 Line 1 dc control
 - d. BPN-0 Line 2 dc control
 - e. H1-0 transformer dc control power
 - f. Annunciator dc power (close local switch in panel)
 - g. Instrument chart drive ac power supply
- B. Instrument air must be supplied to panel and air pressure regulators set to pressures required by plant design.

5.16.2 Start-up Conditions

The following items should be checked during start-up of panel:

	<u>INITIAL</u>	<u>DATE</u>
a. Set electric clock to correct time.	_____	_____
b. Install charts in recorders and turn to correct time.	_____	_____
c. Test annunciator as follows:	_____	_____

- (1) Push Test Button - First out drops should go to intermittent fast flash; standard drops should go to steady flash; alarm horn should sound.
- (2) Push Silence Button - Alarm horn should stop and all drops should continue as above.
- (3) Push Acknowledge Button - First out drops should remain at fast flash; standard drops to OFF.
- (4) Push Reset Button - First out drops should go to OFF.

All other functions in the control panel will be started with the system being controlled.

5.16.3 Normal Operation

The normal operating condition of the control panel will be determined by the normal operation requirements of the systems controlled.

5.16.4 Shutdown

If the power plant is to be shutdown for a long period, turn off all electric power and air supplies to panel. Air conditioning must be maintained in the control room to protect components of control panel.

5.16.5 Emergency Conditions

Emergency conditions that affect the control panel are those described for the various systems controlled.

6.0 Equipment Acceptance Tests

6.1 The several contracts with the equipment suppliers specify equipment acceptance tests either at the factory and/or at the Brawley site.

6.2 The acceptance tests at the Brawley site will be conducted after the plant equipment and the interconnected systems have been operated as detailed in the previous sections of this volume.

The acceptance tests will be conducted at a time mutually agreed between the Chief Operator and the Supplier of the equipment.

6.3 Details of the equipment acceptance tests may be found in the contract procurement documents, or are required to be provided by the equipment suppliers prior to acceptance testing.

6.4 The following summary covers the site acceptance tests specified in the major equipment contracts.

6.4.1 Turbine Generator Acceptance Test

The assembled turbine shall be tested at Brawley site in conformance with the ANSI Standards and ASME Power Test Code. Supplier shall provide test personnel at the job site. Supplier shall provide necessary instrumentation.

Tests shall include, but not be limited to the following:

Operation of steam valves and associated governor controls.

Vibration - Maximum shaft vibration

Speed governor and system

Overspeed trip

Trip valves

Rotor overspeed run

Steam rate at guaranteed conditions

OSHA sound level

6.4.2 Condensers Acceptance Test

Each condenser shall be tested to verify the guaranteed performance as specified on the data sheets. The tests shall be in accordance with the applicable ASME Code. The supplier shall include a complete test procedure.

If the flow conditions for which the condenser is guaranteed cannot be provided at the time of the acceptance tests, the purchaser reserves the right to negotiate modified acceptance tests.

6.4.3 Cooling Tower Acceptance Test

Subject to testing in accordance with the Cooling Tower Institute Standard ATP-105 to determine that it meets guaranteed performance.

The wet bulb temperature shall be measured in accord with the ASME Power Test Code (100 ft. upstream of the cooling tower).

6.4.4 Bridge Crane Acceptance Test

The crane shall be tested at the site to demonstrate its compliance with the specification. The supplier shall supply the test instrumentation and personnel.

The purchaser will supply the test weights. Tests up to 125% of maximum rating shall be required separately on both main and auxiliary hooks.