MCR-83-548
CONTRACT SANDIA-81-7469

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INTEGRATED TEST PROCEDURES
for the
STEAM GENERATION ACCEPTANCE TESTING

MOLTEN SALT ELECTRIC
EXPERIMENT, PHASE I

	APPROVAL	DATE
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SAFETY ENGINEER (CRTF)		

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Denver Division
P.O. Box 179
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CRTF/MMC SAFETY CHECKLIST

Test ID _____ Date _____

Test Title _____

		O/S
1.	Site Occupants	
	Communications Established to all manned control points	_____
	Safety Equipment in Place	_____
	1. OSHA Protective Gloves	_____
	2. Fire Retardent Coveralls	_____
	3. Hard Hats/Face Shields	_____
	4. Approved Fire Extinguishers	_____
2.	Solar Only	
	"Test In Progress" Lights ON in the tower	_____
	Non-Test Personnel Informed and In Secure Location	_____
	Generator ON (Freq. OK)	_____
	Field Monitor on-call after solar startup	_____
	Communications Established	_____
	Tower Top Baracade up	_____
	Gates Closed and posted with red lights or signs	_____
	Field Clear, ready for startup	_____
3.	Control Room Locked	_____
4.	Beam UP Command Shall Be Given Only After Above Checklist Is Completed By O/S Engineer	_____

System Returned to A Safe Configuration _____

REVISION PAGE

REVISION NUMBER	DESCRIPTION	APPROVAL
06/10/83	Procedure Release	

TABLE OF CONTENTS

TABLE OF CONTENTS (con't)

TABLES

1.0 INTRODUCTION

1.1 SCOPE

These Integrated Test Procedures cover the Steam Generation Acceptance Testing of the Molten Salt Electric Experiment (MSEE) at the Central Receiver Test Facility (CRTF) in Albuquerque, New Mexico. The purpose of this test is to demonstrate the design and performance of the Steam Generation Subsystem. The Steam Generation Subsystem consists of an evaporator, steam drum, boiler recirculation pump, superheater and an attemperator.

The test program consists of three basic operating modes. Each test is designed to demonstrate the satisfactory performance of a particular operating mode of the Steam Generation Subsystem. The first test series (Test A) demonstrates startup from ambient conditions, operation at specified full load conditions, and overnight shutdown (without salt cycling). The second series (Test B) demonstrates startup from the standby condition, steady state operation at various loads, load changes within the normal operating range of 30 - 100% load and overnight shutdown (with salt cycling). The final test series (Test C) demonstrates safe shutdown of the Steam Generation Subsystem as the result of various specified upset conditions.

Overall control of this test shall be provided by the MCS through interfaces with the SGS Network 90 control system. Initial testing will be done controlling the SGS from the Network 90 console. Subsequent testing will be performed using the EMCON-D to send set point commands and on/off commands via the Network 90 to the SGS.

1.2 TEST OBJECTIVES

1.2.1 Primary Objective

The overall objective of the test is to demonstrate the performance of the Steam Generation Subsystem (SGS) in the Molten Salt Electric Experiment (MSEE). Satisfactory completion of this test will demonstrate that the SGS performs in accordance with the Steam Generation Subsystem Specification.

1.2.2 Specific Objectives

The specific objectives to be demonstrated by this activity are:

a) Subsystem startup from ambient conditions.

b) Normal operation up to 100% steady state load conditions.

c) Subsystem overnight shutdown and startup.

d) Steady state operation at varying loads and load changes within normal operating range of 30-100% load.

e) Safe shutdown of SGS as the result of specified upset conditions.

f) Subsystem performance and response using automatic sequencing.

1.3 TEST CONSTRAINTS

Before any tests are performed the following steps will be completed:

a) The Integrated Test Procedure (ITP) will be coordinated and approved with all responsible organizations.

b) After installation, all components/subsystems to be operated will have undergone successful stand-alone checkouts by the responsible test participants.

c) Potential hazards will be discussed and understood.

d) A Pretest Meeting will be held to review the specific test procedure and hazards. All test participants will be present. This meeting will be chaired by the Test Conductor.

e) During the Pretest Meeting, the Test Conductor will, as a minimum, review:
   1) Test description and objectives,
   2) Test personnel responsibilities and location during test,
   3) Salt (hot and cold) requirements for the test,
   4) Data to be obtained and recorded during the test, and
   5) Expected response to hazardous or emergency conditions that could be encountered during test. This will include the identification of the specific hazards associated with the planned test.

f) The following subsystem interfaces will be checked out prior to Steam Generation Acceptance testing (as a part of the stand alone checkouts):

   1) TSS with MCS
   2) SGS with MCS
   3) HRFS with MCS
   4) TSS with SGS
   5) SGS with HRFS

2.0 SUPPORT REQUIREMENTS

2.1 EQUIPMENT

2.1.1 Zetex and/or Cal OSHA Protective Gloves

2.1.2 Fire Retardent Coveralls

2.1.3 Face Shields

2.1.4 Hard Hats

2.1.5 Collector Subsystem (222 heliostats and control system)*

2.1.6 Receiver Subsystem*

2.1.7 Thermal Storage Subsystem

2.1.8 TV Monitoring System

2.1.9 Radio Communication System

2.1.10 Diesel Electric Generator (Primary Electrical Supply for the Collector Subsystem)

2.1.11 Commercial Power

2.1.12 Master Control Subsystem

2.1.13 Bailey Network 90

2.1.14 Acurex Data Logger System

2.1.15 Heat Rejection and Feedwater Subsystem

* If subsystem is to be used during SGS Testing

2.2 DOCUMENTS

Number	Title
MCR-83-514	MSEE Configuration Management Plan
MCR-83-515	MSEE Phase I Test Plan, 15 April 1983
MCR-83-531	MSEE Hazards Analysis
MCR-83-538	MSEE Master Control Subsystem Requirements Specification
MCR-83-541	MSEE System Specification

Number	Title
MCR-83-542	MSEE Receiver Subsystem Interface Control Document
MCR-83-543	MSEE Thermal Storage Subsystem Interface Control Document
MCR-83-544	MSEE Heat Rejection and Feedwater Subsystem Interface Control Document
MCR-83-545	MSEE Electric Power Generation Subsystem Interface Control Document
MCR-83-550	MSEE Special Procurement List
MCR-83-551	MSEE Failure Modes and Effects Analysis
OP-78-003	The Working Heliostat Field
OP-78-01	Steam/Water Heat Rejection System
SOP-02101-8102	SOLAR Operations, Addendum
SOP-02100-8102	Operating and Safety Procedure for CRTF SOLAR Operations
SOP-02000-8102	Operating and Safety Procedure for Non-Solar Activities at the CRTF
ST9BMS01101	MSEE Flow Schematic CRTF

2.3 POWER (ac)

Item	Voltage (v)	Power (kW)
Steam Generation Subsystem		
Recirculation Pump	480	8
Start-Up Heaters	480	70
Trace Heaters	110/277	17
Hot Salt Pump	480	5.6
Network 90	110	7
Thermal Storage Subsystem		
Cold Salt Pump	480	44.8
Trace Heaters	277	31.2
Control	24Vdc	0.2

Item	Voltage (V)	Power (kW)
Heat Rejection & Feedwater Subsystem		
Cooling Water Pump	480	32.3
Spray Water Pump	480	6.3
Feedwater Pump	480	121.7
Conden. Makeup Pump	480	2.8
Cycle Fill Pump	480	1.5
Dry Cooling Tower Fans	480	176.6
Heat Trace	480	1.6
Feedwater line	277	0.8
Deaerator Heater	480	270.
Control	24 Vdc	0.2

2.4 COMMODITIES

2.4.1 Quality Dry Compressed Air

2.4.2 Salt consisting of Sodium Nitrate ($NaNO_3$) 60%, Potassium Nitrate (KNO_3) 40%, by weight

2.4.3 Feedwater Quality Standards

Item	Limits	Test Method
Iron	10 ppb max.	Hach Colorimeter
pH	8.8 - 9.2	Leeds & Northrup
Dissolved Oxygen	7 ppb max.	Hach Chem Test Kit
Copper	5 ppb max.	Hach Colorimeter
Cation Conductivity	.5 mohms/cm max.	Leeds & Northrup
Hydrazine	20-100 ppm	Hach Colorimeter

2.4.4 Boiler Water Quality Standards

Item	Limits	Test Method
pH	9.5-10.5 at 77°F	Leeds & Northrup pH Mon
PO_4	10-40 ppm	Hach Colorimeter
Silica	6 ppm max.	Hach Colorimeter
Chloride	10 ppm mac.	Hach Chem Test Kit
Total Solids	100 pm max.	*

* Total solids is comprised of both disolved and suspended solids. The results of samples from two individual tests shall be added together for comparison to the 100 ppm. The dissolved solids will employ a modified conductivity meter while the suspended solids will be measured with a millipore filter.

2.4.5 Instrument and Process Air

2.4.6 Cooling Water (40% ethylene glycol, 60% water)

2.4.7 Hydrazine

2.4.8 Sodium Phosphate

2.5 TEST PARTICIPANTS

The following personnel will be present for the Pretest and Post Test Meetings:

a) MMC Test Conductor

b) Computer Operators

EMCON - Process Control Operator
HP and Modcomp - HST Console Operator

c) Test Engineers from the following responsible organizations if their subsystem is under test. Normally these personnel will only have to be on-site during actual testing (unless Pretest Meeting dictates otherwise).

CS - CRTF
RS - MMC
TSS - MMC
SGS - B&W
HRFS - CRTF
EPGS - CRTF
MCS - CRTF/MMC/B&W*
* If Network 90 is to be operated

d) CRTF Safety

3.0 SPECIAL CONSIDERATIONS

3.1 GENERAL

3.1.1 Test Sequence

The sequence of testing shown in this document is not mandatory unless specified. The rearrangement of the sequence and the conducting of additional tests will be at the discretion of the MMC Test Conductor with CRTF approval.

3.1.2 Nonconformance Reporting

Reporting of nonconformance (test unit failure, test specification deviation, etc.) shall be documented on a System/Software Anomaly Report, and recorded in the Test Conductors Log and Open Item Book. Resolution of a nonconformance shall be the responsibility of the MMC Test Conductor with CRTF approval.

a) System/Software Anomaly Report - will identify anomalies encountered during subsystem and system testing. It will provide 1) a description of the anomaly, 2) its impact to normal operation, 3) steps required for resolution, 4) action assignment for resolution, and 5) retest requirements.

b) Test Conductors Log - will provide a daily as run summary of testing activity to include anomalies and other pertinent information.

c) Open Item Book - will document anomalies and provide their current status (i.e. awaiting resolution, closed, etc.).

3.1.3 Documentation

All tests will be documented in a single copy of the test procedure designated as the OFFICIAL TEST COPY. Any anomalies or information pertinent to the test will be documented on a System/Software Anomaly Report, documented in the Test Conductors Log, and entered in the Open Item Book.

3.1.4 The Test Conductor will verify the accomplishment of each procedural step with his initials and date in the VERIFICATION column.

3.1.5 At the conclusion of testing, the disposition of the Official Test Copy and the Test Conductors Log will be the responsibility of the MMC Test Conductor. The disposition of the Open Items Book will be the responsibility of the test team. All three documents will be part of the turnover records. Data hardcopies will be maintained by Martin Marietta.

3.1.6 Major revision(s) to this procedure must be approved by the original approving authorities and must be documented on the revision page.

3.1.7 Minor revisions to this procedure will be made as real time redlines to the OFFICIAL TEST COPY. The procedure redlines must be approved by the Test Conductor and the O/S Engineer.

3.1.8 Annotate data records periodically with the date, time and recorder number. Recorders should be annotated at the start and conclusion of each major step during startup and shutdown.

3.1.9 There are two documents that will be required to be used in conjunction with this test procedure during testing. Ensure the Test Team has the most recent revisions of each.

a. MSEE Flow Schematic CRTF (ST9BMS01101) - When manual steps are called out for accomplishment, this schematic will provide the location of the specified item. Due to drowning updates, this schematic will provide the most accurate information.

b) MSEE Failure Modes and Effect Analysis (FMEA, MCR-83-551) - The emergency shutdown section of this procedure only addresses two critical situations. Should other critical situations (failures) arise, it is imperative that this document be available to provide information on the failure and direction as to how to alleviate the situation. Both the Test Conductor and all Operators should be familiar with the content of the FMEA.

3.2 GENERAL SAFETY REQUIREMENTS

The general safety requirements listed below will be enforced during this program.

3.2.1 If an unsafe condition develops, the MMC Test Conductor in conjunction with the CRTF O/S Engineer shall take whatever immediate action is necessary to prevent injury to personnel and/or damage to equipment. CRTF Safety will have the authority to halt testing when in their view conditions warrant.

3.2.2 The MMC Test Conductor and CRTF O/S Engineer are responsible for providing safe working conditions in and around the test configuration, and ensuring enforcement of all safety rules and regulations.

3.2.3 Where safety clothing or equipment is to be used, the test will not start until such items are in use.

3.2.4 Areas around the test configuration shall be kept clean and orderly, free of trash and combustibles.

3.2.5 This procedure contains procedural steps that control critical test parameters. The performance of these steps requires continuous monitoring of the primary indicator(s) involved during transient conditions. Prior to the start of test, the Operators and Test Conductor will read and understand the complete procedure, noting those actions required to terminate any critical condition. These actions will be reviewed at the Pretest Meeting.

3.2.6 The material written in a CAUTION or WARNING precedes the information it is intended to emphasize. A CAUTION is used to prevent personnel from damaging equipment. A WARNING is used to prevent personnel from endangering their safety and that of others.

3.2.7 Deviations from safety standards or regulations will be made only with the concurrence of CRTF Safety.

3.2.8 All test participants will be responsible for reviewing the procedure prior to each test for specific safety hazards that could be encountered during the test.

3.2.9 Molten salt will be greater than 430°F, consequently, special procedures will be used at all times if there is a chance of exposure to the molten salt. There is no danger from toxicity. Contact between water and molten salt should definitely be avoided, to eliminate splattering, which could cause severe burns. There is no chemical reaction between the water and molten salt.

3.2.10 Walkways, platforms and handrails will be provided for personnel working on the test configuration. Safety harnesses will be worn by any personnel working in a hazardous region such as high outside areas of the receiver or support equipment, when it is on top of the tower.

3.2.11 Hard hats will be worn by all personnel when in the CRTF tower area.

3.2.12 Pressurization, electrical, and general industrial safety requirements will be governed by Sandia SC-M-70-889 Manual for Industrial Safety. The CRTF O/S Engineer will ensure compliance with these safety requirements during test operations.

3.3 ABBREVIATIONS

A	Ampere
B&V	Black & Veatch
B&W	Babcock & Wilcox
BWCP	Boiler Water Circulation Pump
CRTF	Central Receiver Test Facility
CS	Collector Subsystem
CSP	Cold Salt Pump
DEC	Decrease
EPGS	Electric Power Generation Subsystem
EV	Evaporator
FC	Fail Closed
FCV	Flow Control Valve
FIT	Flow Indicating Transmitter
FM	Flow Meter
FO	Fail Open
FT	Flow Transmitter
FW	Feedwater
GROP	General Receiver Operating Procedure
GSGP	General Steam Generation Procedure
HP	Hewlett Packard
HRFS	Heat Rejection and Feedwater Subsystem
HSP	Hot Salt Pump
HTR	Heater
HV	Hand Valve
INC	Increase
KNO_3	Potassium Nitrate
lbs/hr	Pounds per Hour
LS	Level Switch
M	Manual
MCS	Master Control Subsystem
MMC	Martin Marietta Corporation
MSEE	Molten Salt Electrical Experiment
N/A	Not Applicable
$NaNO_3$	Sodium Nitrate
NWL	Normal Water Level
O/S	Operations and Safety Engineer
PR	Pressure Regulator
PSIG	Pounds per square inch
PT	Pressure Transducer

ABBREV. (Cont.)

RS	Receiver Subsystem
SGITP	Steam Generation Integrated Test Procedure
SGS	Steam Generation Subsystem
SH	Superheater
S.P.	Set Point
TBD	To Be Determined
T/C	Thermocouple
TE	Temperature Element
TEH	Temperature Element (Heat Trace)
TSS	Thermal Storage Subsystem
TT	Temperature Transducer

3.4 DEFINITIONS

The following terminology is used in referring to the various SGS conditions:

a) Empty Condition - Both the salt system and water/steam systems are empty and at ambient conditions.

b) Diurnal Shutdown Condition - The salt system is empty with temperature maintained by trace heating. The water/steam system pressure is maintained by the circulation heater.

c) Alternate Diurnal Shutdown Condition - The water/steam system pressure is maintained with energy input from the molten salt.

d) Warm Standby Condition - The salt system is approximately the cold salt temperature. The water/steam system is approximately 1100 psig.

e) Hot Standby Condition - The water/steam system is at approximately 1100 psig. The salt system is in the range of conditions between the On Line condition and the Warm Standby condition.

f) On Line Operation - The salt and water/steam systems are at normal operating conditions of at or greater than 30% load.

To prevent procedural misunderstanding during test, the following definitions are provided.

a) Activate - Will be used in this test procedure solely to direct the transfer of a control valve from manual to automatic control.

b) Deactivate - Will be used only to direct the transfer of a control valve from automatic to manual control.

c) Automatic - The specified valve or control loop is under computer control (EMCON or Network 90) and requires no manual action.

d) Manual - The specified valve or component is not under automatic computer control and requires manual positioning (from the console for a control valve or at the spacific valve for a hand valve or component).

4.0 TEST OPERATIONS

4.1 GENERAL STEAM GENERATION PROCEDURES (GSGP)

These procedures will detail the steps for bringing the SGS from ambient conditions to normal operation and then return it to ambient conditions. Also included are the Fossil Fired Heater Demonstration and Emergency Shutdown (various conditions).

- o GSGP #1 SGS Pretest Checklist
- o GSGP #2 SGS Startup (Manual)
  - Empty to Diurnal Shutdown
  - Diurnal Shutdown to Warm Standby
  - Warm Standby to On Line
  - Hot Standby to On Line
- o GSGP #3 SGS Shutdown (Manual)
  - Hot Standby
  - Warm Standby
  - Diurnal Shutdown and Drain
- o GSGP #4 Fossil Fired Heater Demonstration
- o GSGP #5 Emergency Shutdown
  - Commercial Power Loss
  - Process Control Module Failure
- o GSGP #6 Post Test Checklist
- o GSGP #7 MCS/Network 90 Integration of Control Checklist

4.1.1 GSGP #1 SGS Pretest Checklist

This General Steam Generation procedure will be utilized as the pretest checkout prior to each steam generation test or continuation of test following shutdown. The format for this procedure is the 1) SGS Test Configuration Setup, 2) Network 90 Control Room Setup, and 3) Computer Room Setup. Other Subsystem Pretest Checklists are not part of this procedure but will be identified for accomplishment. This sequence assumes the RS is not in operation.

Verify that all test personnel have been briefed on the scheduled test description, objectives, individual responsibilities, and expected response to emergency conditions.

NOTE

The steps indicated with an asterisk will be accomplished as a confidence check during the initial phases of test only. The steps with a # sign are applicable only from an Empty Startup.

STEP	DESCRIPTION	VERIFICATION
1.	Accomplish the MCS Pretest Checklist. (Appendicies E,F, & G)	_____

SGS Test Configuration Setup

NOTE

Steps 15 and 16 of Network 90 Control Room Setup call for the accomplishment of the TSS and HRFS Pretest Checklists. They may be accomplished in conjunction with the SGS Pretest Checklist to avoid duplication of effort.

1. Inspect the salt system for evidence of leaks and insulation damage. Repair as required.
   - o All SGS Piping
   - o Hot Salt Pump and Sump
   - o Vents
   - o Superheater and Evaporator _____

CAUTION

A plugged vent can cause a severe pressure difference between the storage tank and sump.

2. Visually verify Hot Sump Vent is free of frozen salt. _____

3. Inspect the water/steam system for evidence of leaks and insulation damage. Repair as required.
   - o All SGS piping
   - o Valves, Vents
   - o Drain Plugs
   - o Flange Connections
   - o Evaporator, Superheater
   - o Steam Drum, Attemperator
   - o BWCP
   - o Drain and Blowdown Tank _____

4. Check for visual evidence of blown fuses (at the SGS skid mounted control/power junction box), burned relays or burned electrical components through the SGS. _____

5. Verify electric power is available to the SGS skid mounted control/power junction box. _____

*6. Verify the amperage on the active heat trace circuits (following list). _____

Location	Heaters	Assoc.T/Cs	Current
Hot Salt Inlet Piping	HT-1	THE-05	7 A
Hot Salt Inlet Piping		THE-06	
Salt Piping between SH and EV	HT-2	THE-07	4 A
Salt Piping between SH and EV		THE-08	
Cold Salt Control Piping	HT-3	THE-09	6 A
Cold Salt Control Piping		THE-10	
Cold Salt Control Piping		THE-11	
EV Salt Outlet Piping	HT-4	THE-12	7 A
EV Salt Outlet Piping		THE-13	
EV Salt Outlet Piping		THE-14	
Salt Drain Piping	HT-5	THE-15	5 A
Salt Drain Piping		THE-16	
Salt Drain Piping		THE-17	
SH Outlet Overpress. Piping	HT-6	THE-18	3 A
EV Outlet Overpress. Piping		THE-19	
Evaporator	HT-7	THE-20	9 A
Evaporator		THE-21	
Superheater	HT-8	THE-22	22 A
Superheater		THE-23	
Feedwater Piping	HT-9	THE-24	2 A

7. Verify the amperage on the following Circulation Heaters by turning on the heater, taking the measurement, and turning off the heater. This must be done with water in the heater. Also HR-1 thru HR-4 will not operate unless the BWCP is running.

HR-1 42 A

HR-2 21 A

HR-3 12 A

HR-4 12 A

HR-5 12 A _____

STEP	DESCRIPTION	VERIFICATION

8. Start/Verify operating the air compressor and verify 80 psig tank pressure. _____

9. Verify/adjust all pneumatic activated valve air sets to the following pressures:

FCV 331 to 35 psi	FVC 382 to 20 psi
FCV 381 to 20 psi	FVC 384 to 20 psi

_____

* 10. Check the zero adjust on the following valve I/P transducers.

FCV 301 _____	FCV 341 _____
FCV 321 _____	FCV 351 _____
FCV 331 _____	

_____

11. Check the coolant pump and radiator for leak and proper operation. Verify coolant flow thru Hot Salt Pump bearing. _____

12. Verify Hot Salt Pump circuit breaker is ON. _____

13. Verify Hot Salt Pump shaft is free to rotate by manually reaching in and turning the shaft by hand. _____

14. Verify that the boiler water sampling station and the chemical feed station are ready for operation. _____

15. Fill the boiler water recirculation pump (BWCP) bearing cavity with demineralized water through the pump vent connection. (Because the water in the bearing cavity is in essentially a captive volume, prefilling with demineralized water reduces the potential for suspended solids entering the bearing cavity.) _____

16. Open the BWCP coolant supply isolation valve. Confirm coolant flow through the BWCP. _____

NOTE

The flow switch in the pump coolant supply line prevents starting of the BWCP with insufficient pump coolant flow (less than one GPM).

17. Verify that the Steam Drum gage glass water level indication is within 1/2 inch of LT-311 reading at the Network 90. _____

STEP	DESCRIPTION	VERIFICATION

18. If the SGS is in a wet layup condition with gas overpressure: (Refer to the SGS O&M Manual, Section 5, for further information)

a) Drain the system while maintaining gas overpressure.

b) Isolate the SGS from the gas overpressure system. _____

19. If the SGS is in a dry layup condition with gas overpressure, isolate the SGS from the gas overpressure system. _____

20. Verify water chemical analysis and feed systems are ready for operation. _____

Network 90 Control Room Setup (Coordinate with Computer Room)

NOTE

The following steps will initially be performed in the Network 90 Control Room. During the MCS integration tests (SGITP #9 & 10) they will be performed from the Computer Control Room.

1. Verify operational communications. _____

2. Verify electric power is available for Network 90 control system operation. _____

Network 90 Startup (Steps 3 and 4)

3. Verify/power up the following equipment:

a) Baily PCU
b) Operator Interface Driver Unit
c) Keyboard Console*
d) Printer* _____

* These components may be turned off when not in use.

4. Verify the following instruments are reading "active" on the EMCON:

TE-301	_____	PT-321	_____	Valve Position	
TE-331	_____	PT-382	_____	FCV 321	_____
TE-332	_____	PT-383	_____	FCV 331	_____
TE-382	_____	PT-384	_____	FCV 341	_____
TE-383	_____	PT-386	_____	FCV 351	_____
TE-384	_____			FCV 411	_____
TE-386	_____	LT-311	_____	FCV 501	_____
TE-388	_____				

_____

STEP	DESCRIPTION	VERIFICATION

5. Verify that the MCS is ready to accept/send signals for the Network 90/EMCON interface. _____

6. Verify PCM 1 (Tower Control Room), PCM 2, (Base of Tower), and PCM 3 (Storage Bldg) are ON and operating. _____

7. Verify Acurex Scanners 2, 3, and 5 are ON and operating. _____

8. Verify SGS trace heater circuits (Table 4.1-1, following page) are operating. _____

9. Verify salt system temperatures (on Acurex Scanner) are greater than 500°F. _____

CAUTION

Operating salt flow valves when they are colder than 480°F can result in bellows damage.

10. Verify the following valves are in their failed position.

FCV 301	Open	FCV 383	In position
FCV 321	Open	FCV 384	Open
FCV 331	Open	FCV 341	Closed
FCV 381	Closed	FCV 351	Open
FCV 382	Closed		

_____

NOTE

It may be more expeditious to perform steps 11 and 12 together.

11. Isolate the following transmitters by closing the isolation valve(s) closest to the transmitter.

FT 311	Main Steam Flow
FT 381	Attemperator Steam Flow
FT 411	Feedwater Flow
PT 321	Steam Delivery Pressure
PT 383	Steam Drum Pressure
PT 386	Feedwater Pressure
LT 311	Steam Drum Water Level

_____

T/C	Description	Acurex Scanner #
TEH-301	Feedwater - Heater FF	4
TEH-302	Feedwater - Heater FF	4
TEH-303	Feedwater - Heater EE	2
TEH-304	Feedwater - Heater EE	2
TEH-305	Hot Salt Inlet Piping	3
TEH-306	Hot Salt Inlet Piping	3
TEH-307	Salt Piping Between SH and EV	3
TEH-308	Salt Piping Between SH and EV	3
TEH-309	Cold Salt Control Piping	3
TEH-310	Cold Salt Control Piping	3
TEH-311	Cold Salt Control Piping	3
TEH-312	EV Salt Outlet Piping	3
TEH-313	EV Salt Outlet Piping	3
TEH-314	EV Salt Outlet Piping	3
TEH-315	Salt Drain Piping	3
TEH-316	Salt Drain Piping	3
TEH-317	Salt Drain Piping	3
TEH-318	SH Outlet Overpress. Piping	3
TEH-319	EV Outlet Overpress. Piping	3
TEH-320	Evaporator	3
TEH-321	Evaporator	3
TEH-322	Superheater	3
TEH-323	Superheater	3
TEH-324	Feedwater Piping	3

Table 4.1-1 SGS Heat Trace Instrumentation

STEP	DESCRIPTION	VERIFICATION

*12. Cycle the valves listed in step 9 between full open and full closed (or vice versa). Observe operation of limit (and position) indicators. Return all valves to their failed position prior to continuing. _____

*13. To verify proper operation of the Unit Protection System: open FCV 341 and close FCV 431. Response time for the following tests should be within 20 seconds.

a) Input a +7 inch signal (LT 311 - Steam Drum Level High) and verify a response of:

- Signal to turn off Hot Salt Pump
- FCV 431 opens
- FCV 301, FCV 341, and FCV 351 close.

b) Input TR-382 simulated signal (BWCP failure) and verify same response as a). _____

14. Verify the salt level in the Hot Salt Tank is commensurate with test requirements (based on Pretest determination). _____

15. Accomplish the TSS Pretest Checklist (Appendix A). _____

16. Accomplish the HRFS Pretest Checklist (Appendix C). _____

Computer Room Setup

NOTE

For SGITP #9 and #10 perform the Network 90 Control Room Setup from the MCS.

4.1.2 GSGP #2 SGS Startup (Manual)

This General Steam Generation Procedure will be utilized as the normal manual startup for all Steam Generation Integrated Tests (SGITP's), unless otherwise noted. This procedure is comprised of 4 specific sequences:

1. Empty Condition to Diurnal Shutdown
2. Diurnal Shutdown to Warm Standby
3. Warm Standby to On Line Condition
4. Hot Standby to On Line Condition.

The Test Conductor can use all or a portion of this procedure to bring the SGS to a required condition.

STEP DESCRIPTION VERIFICATION

Empty Condition to Diurnal Shutdown Mode

1. Verify that the following checklists have been completed:

   SGS Pretest Checklist (GSGP#1) _____

   HRFS Pretest Checklist (Appendix C) _____

   TSS Pretest Checkout (Appendix A) _____

   CRTF/MMC Pretest Checklist _____

   CRTF Safety Checklist _____

   MCS Pretest Checklist (Appendix E, F & G) _____

2. Align/verify valves as follows:

Valve	Description	Position
Water/Steam Side		
FCV 331	Attemperator Control	10% Open
HV 381	Drain	Closed
HV 382	Blowdown Control	Closed
HV 383	Blowdown Isolation	Closed
HV 384	Pump Isolation	Open
FCV 383	Evaporator Supply	Open
FCV 384	Circ. Htr. Supply	Open
HV 385	Steam Drum Vent	Open
HV 386	Sample Line Isolation	Closed

Valve	Description	Position
Water/Steam Side		
HV 388	Chemical Feed Isolation	Closed
HV 387	Chemical Feed Metering	Closed
HV 389	Chemical Feed Drain	Closed
FCV 411	Feedwater Flow Control	Closed
FCV 431	Deaerator Steam Flow	Closed
FCV 435	Deaerator Press. Relief	Closed
HV 481	Steam Block Shutoff	Open
FCV 491	Steam Block Shutoff	Closed
Salt Side		
FCV 201	Cold Sump Level	Closed
FCV 211	Cold Sump Isolation	Closed
FCV 221	Hot Sump Level	Closed
FCV 231	Hot Sump Isolation	Closed
FCV 301	Bypass Salt Flow Control	Closed
FCV 321	Main Salt Flow Control	Open
FCV 341	Cold Salt Isolation	Closed
FCV 351	Hot Salt Isolation	Closed
FCV 381	Evaporator Drain	Open
FCV 382	Superheater Drain	Open

3. Fill the BWCP bearing cavity with treated water through the pump vent connection. (Refer to the SGS O&M Manual for further information.)

NOTE

Prefilling the pump reduces the potential for suspended solids entering the cavity.

4. Power up the Master Control Subsystem for the HRFS and apply power to all control circuits except DTC-451 and FCV-421.

5. Fill the steam drum through the feedwater nozzle using FCV 411 and the Feedwater Pump with water to the minimum level visible in the gage glass (LT-311 at TBD inches). Use the steps outlined in the following note to accomplish this activity. Water temperature must be maintained between ambient and 150°F during filling. Close FCV 411 and turn off the FWP when complete.

STEP	DESCRIPTION	VERIFICATION

NOTE

Boiler water phosphates should be added to the boiler water during the fill of the SGS in the Startup from Empty. The phosphates are to be added by the chemical feed pump by the following procedure.

a. Prepare a 3% concentration phosphate solution using the appropriate ratio of trisodium phosphate and disodium phosphate as outlined in the SGS O&M Manual, Section 3.21.1. If the hydrated forms of the phosphate compounds are used, the water constituent of these compounds should be properly accounted for in calculating the weights of each compound required for the 3% solution.

b. Place the 3% phosphate solution in the chemical feed mix tank.

c. Fill the SGS using the feedwater pump and valve FCV-411. Fill at a 20% flow (2300 lb/hr at FT-411) which will result in a fill time of about 30 minutes.

d. During the entire period of SGS fill, operate the chemical feed pump to inject the phosphate solution into the feedwater line. The feed rate into the SGS at essentially atmospheric pressure will be about 0.20 gal/hr. This chemical feed rate for 30 minutes at 3% concentration will result in boiler water phosphate concentration of about 25 ppm, which is midrange of the required 10-40 ppm phosphate concentration in the boiler water.

STEP	DESCRIPTION	VERIFICATION

Deaerator Warmup

6. Set the controls for the DTC-451 for ramping the temperature of the deaerator from ambient to the set point of 390°F at a rate of 100°F/hr. _____

7. Turn on the deaerator immersion heater circuit at the MCS and start ramping the temperature control signal to DTC-451. _____

8. Verify deaerator heating by monitoring TT-451. _____

NOTE

During the time period required for deaerator warm up to 250°F, steps 24 thru 34 of this sequence may be performed to warm up the SGS.

9. When temperature of deaerator reaches 250°F:

   a) Turn on the control circuit to open vent valves FCV-483 and FCV-484.

   b) After 10 minutes close the FCV-484 vent valve.

   c) Manually open FCV-431 on the steam main to allow steam from the deaerator to warm the steam mains back to the isolation valves FCV-491 and FCV 501 for the steam generator and turbine, respectively.

   d) Turn on the Condensate Makeup Pump and control circuit for LT-471 to provide makeup as needed. _____

10. When deaerator temperature reaches 390°F, verify constant heating rate from the DTC-451 meters and constant pressure from PT-432 and PT-431. _____

11. Verify operation of steam main traps (visually observe condensate dripping out).

    a) T-481

    b) T-581 _____

12. Verify deaerator level is being maintained by Condensate Makeup Pump by monitoring LT-471. _____

NOTE

The HRFS can be maintained in this warm condition as long as required or can be started in the Warm Startup mode for on line testing of the SGS or EPGS.

STEP	DESCRIPTION	VERIFICATION

Spray Water and Feedwater Circuits

13. To minimize the thermal shock on the spray water and feedwater circuits, start circulating flow of 390°F water through these two circuits TBD hours (get from experience) before initiation of steam flow from the SGS to the HRFS. _____

14. Activate the FCV-401 Feedwater Pressure Control with a set point of 1200 psig. _____

15. Turn on the Spray Water Pump; verify flow by monitoring FT-482. _____

16. Turn on the Feedwater Pump; verify flow by monitoring PT-401, PT-481, and FT-481. Abort the test if pressure of PT-401 increases to 1400 psi; FCV-401 is not functioning. _____

17. Monitor TT-482; when 390°F is reached, continue into the Cooling Water Circuit portion (step 19). _____

18. Initiate hydrazine feed as follows:

    Dilute hydrazine to a one percent solution in the chemical feed tank (No. 2) and then initiate feed by energizing chemical feed pump No. 2. _____

Cooling Water Circuit (Refer to B&V HRFS Drawings for details)

19. Turn on cooling water pump but not the cooling tower fan motors; verify flow by monitoring TT-484 which should return to ambient air temperature. _____

20. Verify cooling water flow through sample precoolers by flow signal from (FS-481 local indicating light) in water sample table. _____

21. Manually control FCV-432 to allow 20 percent of the spray water to flow through the spray water heat exchanger. Monitor TT-482 to observe a drop in spray water temperature to verify operation of FCV-432, the heat exchanger and the cooling water pump. _____

22. Activate the FCV-432 Deaerator Pressure Control with a set point of 233 psig which causes all flow to bypass the heat exchanger; hence TT-482 will return to 390°F. Abort the test if TT-482 does not return to 390°F within 5 minutes. _____

STEP	DESCRIPTION	VERIFICATION

23. Turn off the cooling water pump (HRFS). _____

SGS Warmup

24. Verify steam drum water level is at the minimum level visible in the gage glass. _____

25. Verify FCV 411 is closed. _____

26. Start the Boiler Water Circulation Pump. (Ensure that the pump has been properly vented prior to start in accordance with SGS O&M Manual, Vol. 2, Appendix A.) _____

27. Close the FCV 383 Evaporator Supply Valve. _____

28. Start up all elements of the Electrical Circulation Heater in the following order:

    a) Start HR-5.

    b) Start HR-4.

    c) Start HR-3.

    d) Start HR-2.

    e) Start HR-1. _____

29. Activate the trace heater zones on the salt piping and shells of the evaporator and superheater. Throughout the startup, observe the heat trace zone temperatures to assure the various heat trace circuits are operating. Verify the SGS Temperatures (Acurex Scanner) increase to 500°F minimum. _____

30. Throughout the startup, maintain Steam Drum water level below gage glass centerline by blowing down as required through the Steam Drum blowdown line (valves HV-382 and HV-383). _____

31. Note when steam starts to issue vigorously from Steam Drum vent HV-385. Allow the venting for 10 minutes. _____

NOTE

Add water as required to keep the level visible in the gage glass by modulating FCV 411.

32. Close Steam Drum vent HV-385. _____

33. Place the transmitters listed below in service by accomplishing the following steps:

    a. Blow down the instrument piping through the instrument piping drain valves.

b. Allow water or condensate to fill the instrument lines.

c. Allow the water in the instrument lines to cool sufficiently before opening the isolation valve(s) to the transmitter such that the transmitter is not exposed to water in excess of the maximum temperature allowed.

ID.	Transmitter	Max Temp. (°F)
FT 311	Main Steam Flow	200
FT 381	Bypass Steam Flow	200
PT 321	Steam Delivery Pressure	200
PT 383	Steam Drum Pressure	200
PT 386	Feedwater Pressure	200
LT 311	Steam Drum Water Level	200

34. When Steam Drum pressure (PT 383) reaches 1100 (+50,-0) psig, de-energize circulation heaters HR-1, HR-2, HR-3, and HR-4.

NOTE

To maintain the SGS in the Diurnal Shutdown condition:

a) Keep circulation heater HR-5 on.

b) Stop the BWCP.

c) Bring Steam Drum water level to Normal Water Level (0 inches at LT-311).

d) Verify that the temperatures of the SGS salt trace heater circuits are 550°F minimum.

e) Turn off the Feedwater Pump and verify that FCV 401 closes.

f) Turn off the Spray Water Pump.

g) Shut off the chemical feed pump for hydrazine.

h) Verify the deaerator immersion heater turns on when TT-451 drops to 389°F.

SGS IS NOW IN DIURNAL SHUTDOWN MODE AND MAY BE LEFT IN THIS CONDITION PENDING DECISION TO CYCLE SALT.

STEP DESCRIPTION VERIFICATION

Diurnal Shutdown to Warm Standby Mode

1. Verify that all salt piping and valves heat tracing are operating and that temperatures are greater than 500°F (See Table 4.1-1). _____

2. Align/verify valves as follows:

Water/Steam Side

Valve	Description	Position
FCV-331	Attemperator Control	10% Open
HV 381	Drain	Closed
HV 382	Blowdown Control	Closed
HV 383	Blowdown Isolation	Closed
HV 384	Pump Isolation	Open
FCV 383	Evaporator Supply	Closed
FCV 384	Circ. Htr. Supply	Open
HV 385	Steam Drum Vent	Closed
HV 386	Sample Line Isolation	Closed
HV 388	Chemical Feed Isolation	Open
HV 387	Chemical Feed Metering	Open
HV 389	Chemical Feed Drain	Closed
HV 481	Steam Shutoff (Hand)	Open
HV 488	Feedwater Supply Isol.	Open
FCV 491	Steam Flow Control	Closed
Salt Side		
FCV 201	Cold Sump Level	Closed
FCV 211	Cold Sump Isolation	Closed
FCV 221	Hot Sump Level	Closed
FCV 231	Hot Sump Isolation	Closed
FCV 301	Bypass Salt Flow Control	Closed
FCV 321	Main Salt Flow Control	Open
FCV 341	Cold Salt Isolation	Closed
FCV 351	Hot Salt Isolation	Closed
FCV 381	Evaporator Drain	Closed
FCV 382	Superheater Drain	Closed

_____

STEP	DESCRIPTION	VERIFICATION
3.	Verify steps 4 thru 23 of the Empty condition to Diurnal Shutdown mode portion of this procedure (HRFS Startup) have been accomplished.	_____
4.	Bring the Steam Drum water level to Normal Water Level (0 inches) using FCV411 and the FWP.	_____
5.	Start the BWCP - if stopped during Diurnal Shutdown operation.	_____
6.	Note the Steam Drum pressure (PT-383). If pressure is a minimum of 1100 psig, turn off HR-5 Circulation Heater and continue at step 9.	_____
7.	Start up the elements of the Circulation Heater (turned off at Diurnal Shutdown) in the following sequence:	
	a) Start HR-4.	
	b) Start HR-3.	
	c) Start HR-2.	
	d) Start HR-1.	_____
8.	When SGS pressure (at PT-383) reaches 1100 psig, turn off all Circulation Heaters.	_____
9.	Open Evaporator Supply Valve FCV 383.	_____
10.	Close FCV 384.	_____

NOTE

If ambient conditions indicate freeze protection may be required for the circulation heater, valve FCV 384 may be left open.

NOTE

Throughout the period of salt loading and Warm Standby, monitor the Steam Drum water level. Maintain the level in the range between high water level alarm (+4 inches) and low water level alarm (-4 inches).

NOTE

If Cold Salt Pump is already on and operating, continue at step 21.

11.	Verify Cold Tank Level is greater than 30 inches.	_____

STEP	DESCRIPTION	VERIFICATION

NOTE

If the salt level is less than 30 inches ensure the Hot Salt Tank level is commensurate with test requirements specified in the Pretest Meeting.

12. Open the FCV 211 Cold Sump Isolation valve. _____

CAUTION

If Salt Level in the Cold Sump is greater than 60 inches, check the Cold Salt Vent.

13. Verify Cold Sump Level (LT 201) is less than 60 inches. _____

NOTE

If Salt Level in the Cold Sump is greater than 48 inches, continue at step 16.

14. Set Cold Sump Level to 50 inches. _____

15. Activate Cold Sump Level Control (FCV 201) and insure Cold Sump Level is greater than 48 inches within 2 minutes. _____

16. Set Cold Sump Level to 15 inches. _____

17. Open FCV 152. _____

18. Close/Verify FCV 151, FCV 241, and FCV 242. Verify correct valve positions prior to continuing. _____

19. Check PT-383 and verify it is at or above 1100 psig. _____

20. Start the Cold Salt Pump. _____

21. Verify Cold Salt Pump outlet pressure (PT 180) is greater than 170 psig within 1 minute of activation. _____

22. Fully open FCV 341 to fill the SGS with salt. _____

23. After 3 minutes open FCV 301 to 100% and position FCV 341 to obtain a 10% salt flow (7600 lbs/ hr) at FT-321. _____

24. Open Salt Drain Valves FCV 381 and FCV 382. Wait 2 minutes prior to continuing. _____

25. Close FCV 381 and FCV 382. _____

26. Close FCV 301. _____

STEP	DESCRIPTION	VERIFICATION
27.	Open FCV 491. Verify steam flow by monitoring TT-483 and PT-431.	_____
28.	Change control of FCV 435 to manual and open FCV 435 until TT-483 temperature reading reaches 450°F to vent nitrogen; then close FCV 435 and transfer control back to automatic.	_____
29.	Activate Feedwater Flow Control (FCV-411) with a set point of 0 inches (LT-311) in the steam drum water level. Verify flow by FT-411.	_____
30.	Activate Feedwater Temperature Controller (FCV 421) with a set point of 560 °F.	_____
31.	Verify that the feedwater is being heated in the FW heater (TT-421) and that the control signal from TT-421 is being transmitted to FCV-421 to allow steam into the FW heater.	_____
32.	Activate the Steam Pressure Control (FCV 431) with a set point of 1100 psig.	_____
33.	Turn on the cooling tower fan motors.	_____
34.	Verify operation of FCV-431 and controls for PT-431 by monitoring PT-432; PT-432 should rise to 250 psi and then be held at this pressure by operation of FCV-432 allowing excess heat to be dissipated through the spray water heat exchanger.	_____

NOTE

In the event the transient pressure change occurs more rapidly than can be compensated for by the heat removal through the spray water heat exchanger, pressure will build up to 265 psi at which pressure FCV-435 should be opened by its control to vent the steam until the pressure drops below 265 psi. Verify opening of FCV-435 if PT-432 reached 265 psi.

35.	With the steady flow of steam, TT-451 and TT-481 should reach new equilibrium temperature of 406°F, and DTC-451 controls will reduce power to the deaerator immersion heaters to zero. Verify.	_____

STEP	DESCRIPTION	VERIFICATION

36. Initiate dissolved oxygen sampling as follows:

    a) As soon as feedwater is initiated, start flow in No. 3, 4, and 5 sampling lines; activate dissolved oxygen analyzer DOT-480 and conducting analyzers CT-482 and CT-484. Monitor readings; if DOT-480 has a reading above TBD ppb or CT-482 and CT-484 below 8.5, sound an alarm and stop feedwater/steam flow until DOT-480 reading is TBD or below or conductivity readings of TBD or above.

    b) Record all other water analysis data as per Water Conditioning Data Sheet (Appendix B). _____

37. Verify that the feedwater flow being monitored by FT-411 is nearly identical to the steam flow monitored by FT-311 during steady state steam flow rates to the HRFS. _____

NOTE

If feedwater flow is not the same as the steam flow, the steam drum water level will either become too high or too low; hence, the operator should expect a low or high level alarm from LT-311.

NOTE

To maintain the Warm Standby condition, set valve FCV 341 to maintain a 10% salt flow (7600 lbs/hr) at FT-321.

NOTE

Test Conductor Option: Shutdown Cold Salt Pump and periodically restart CSP to maintain water/steam pressure (PT-321 at approximately 1100 psig).

THE SGS IS NOW IN WARM STANDBY MODE AND MAY BE LEFT IN THIS CONDITION PENDING DECISION TO USE HOT SALT.

Warm Standby to On Line Condition

1. Verify FCV 221 is closed. _____

2. Open FCV 231. _____

3. Verify Hot Salt Sump level is less than 48 inches. _____

NOTE

If Hot Sump level is greater than 40 inches activate the Hot Sump Level Control and continue at step 7.

STEP	DESCRIPTION	VERIFICATION
4.	Set Hot Sump level to 42 inches.	_____
5.	Activate Hot Sump Level Control FCV 221.	_____
6.	Verify Hot Sump level increases to greater than 40 inches within 2 minutes.	_____
7.	Set Hot Sump Level Control to 15 inches.	_____
8.	Activate Evaporator Salt Temperature Control FCV 301 with a set point of 850°F.	_____
9.	Activate Steam Delivery Temperature Control FCV 331 with a set point of 950°F.	_____
10.	Turn on the Hot Salt Pump.	_____
11.	During the following activity of increasing salt temperature, verify the operation of controls of PT-432 for controlling FCV 432 so that deaerator pressure is held constant at 233 psi and all energy is being rejected by the cooling water circuit and the dry cooling towers.	_____
	CAUTION Maintain PT-382 pressure less than 85 psig. Adjust FCV 341 as necessary to maintain it below 85 psig.	
12.	Gradually and simultaneously open FCV 351 while closing FCV 341 to achieve the temperature ramp rate specified below at the superheater salt inlet, TE 382. Maintain approximately a constant 10% salt flow (7600 lbs/hr) thru the SGS. - Temperature ramp rate: 100°F (TE 382) steps at 6 minute intervals (1000°F/hr)	_____
13.	Verify full closure of FCV 341.	_____
14.	When the salt inlet flow to the superheater consists of only hot salt (valve FCV-341 closed; valve FCV-351 positioned for 10% salt flow [7600 lbm/hr]), transfer control of steam delivery pressure to valve FCV-321 as follows:	
	a. Deactivate the FCV 431 Steam Flow Control.	
	b. Gradually open valve FCV 351 and adjust valve FCV 321 position to maintain SGS steam delivery pressure PT-321 at 1100 psig (+50 psi, -0). Manually set FCV 431 to allow specified steam flow.	_____

STEP	DESCRIPTION	VERIFICATION

NOTE

When valve FCV 351 is 100% open, steam delivery pressure is controlled by positioning valve FCV 321.

15. As load increases, control steam delivery pressure to 1100 psig by positioning FCV 321. _____

NOTE

The turbine/generator would be brought on line at this point in later testing. To simulate the turbine loading, FCV 431 will be varied to increase the steam being dumped to the deaerator (automatically by changing set points or manually by changing the valve position). The specific valve settings will be determined by experience in changing FCV 431 to obtain the required salt flow rate at FT-321.

16. When the steam load reaches 30% (approximately 3500 lbs/hr steam flow at FT-311), activate Steam Pressure Control FCV 321 with a set point of 1100 psig. _____

17. Set the operational alarms. _____

SGS IS NOW ON LINE IN AUTOMATIC BOILER FOLLOWING MODE

Hot Standby to On Line Operation

1. Determine steam temperature (at TE-331) and compare this to that required for hot restart temperature of the turbine. Steam Temperature required = TBD to 940°F. _____

2. Measure salt temperature at the inlet to the Superheater with TE-382.

   a) If TE-382 is less than the required steam temperature (step 1), proceed to step 3.

   b) If TE-382 is greater than the required steam temperature (step 1), proceed to step 11. _____

3. Deactivate the FCV 321 Steam Flow Control and fully open FCV 321. _____

NOTE

Until the Steam Drum Water Control is activated, monitor LT-311 and maintain it at 0 $\pm$4 inches by controlling the feedwater flow with FCV 411.

4. Activate the Evaporator Salt Inlet Control FCV 301 with a set point of 850°F. _____

5. Turn on/verify the Cold and Hot Salt Pumps are operating. _____

STEP	DESCRIPTION	VERIFICATION
6.	Position the FCV 341 and FCV 351 to match the superheater inlet temperature ±50°F (step 2) with approximately 10% (7600 lbs/hr) total salt flow at FT-321.	_____
7.	Gradually open FCV 351 while closing FCV 341 to achieve the temperature ramp rate specified below at the superheater salt inlet (TE-382). Maintain approximately a 10% salt flow (7600 lbs/hr) thru the SGS. - Temperature ramp rate; 100°F steps at 6 minute intervals (1000°F/hr)	_____
8.	When the salt inlet flow to the superheater consists of only hot salt (valve FCV 341 closed; valve FCV 351 positioned for 10% salt flow [7600 lbm/hr]), transfer control of steam delivery pressure to valve FCV 321 as follows: a. Deactivate the FCV 431 Steam Flow Control. Manually set FCV 431 to allow specified steam flow. b. Gradually open valve FCV 351 and adjust valve FCV 321 position to maintain SGS steam delivery pressure PT-321 at 1100 psig (+50 psi, -0).	
	NOTE When valve FCV 351 is 100% open, steam delivery pressure is controlled by positioning valve FCV 321.	
9.	As load increases, control steam delivery pressure to 1100 psig by positioning FCV 321.	
	NOTE The turbine/generator would be brought on line at this point in later testing. To simulate the turbine loading, FCV 431 will be varied to increase the steam being dumped to the deaerator (automatically by changing set points or manually by changing the valve position). These specific valve settings will be determined by experience in changing FCV 431 to obtain the required salt flow rate at FT-321.	
10.	When the load reaches 30% (approximately 3500 lbs/hr steam flow at FT-311) activate the Steam Pressure Control FCV 321 with a set point of 1100 psig.	_____
	NOTE The SGS is now On Line in the Boiler Following Mode. Set the operational alarms.	

STEP	DESCRIPTION	VERIFICATION
11.	Perform steps 3 thru 6 of this sequence (Hot Standby to On Line condition).	_____
12.	Monitor TE-332:	
	a) If TE-332 is 950 $\pm$ 40°F, go to step 14.	
	b) If TE-332 is outside of 950 $\pm$ 40°F, proceed to step 13.	
13.	Place FCV 331 in manual and gradually open FCV 331 until the steam delivery temperature (TE-332) matches the temperature required in step 1.	
	a) When the temperatures match, proceed to step 14.	
	b) If FCV 331 is fully opened and TE-332 has not been reduced to the value required in step 1, incrementally close FCV 351 and Open FCV 341 to decrease the superheater salt inlet temperature (TE-382). Maintain approximately 10% salt flow (7600 lbs/hr) through the SGS. Decrease the salt temperature at no greater than 100°F steps per 6 minutes until TE-331 is within allowable limits.	_____
14.	During step 13 b), monitor the TE-332 steam delivery temperature. Close FCV 331 as required to maintain TE-332 approximately equal to TE-382. When TE-332 reaches 950 $\pm$ 40°F, activate the FCV 331 Steam Delivery Temperature Control with a set point of 950°F.	_____
15.	Perform steps 7 thru 10 of this sequence (Hot Standby to On Line condition).	_____
16.	Set the operational alarms.	_____

SGS IS NOW ON LINE IN AUTOMATIC BOILER FOLLOWING MODE

4.1.3 GSGP #3 SGS Shutdown (Manual)

This General Steam Generation Procedure will be utilized as the normal manual shutdown for all Steam Generation Integrated Tests (SGITP's), unless otherwise noted. The sequence will proceed from On Line operation through Hot Standby, Warm Standby modes to Diurnal Shutdown and drain. This sequence assumes the RS is not in operation.

The Test Conductor can use all or a portion of this procedure to bring the SGS to a required condition.

STEP	DESCRIPTION	VERIFICATION

NOTE

Turbine loading has been simulated by varying the FCV 431 setting to dump steam in the deaerator. The specific value settings will be determined by experience to obtain the required salt flow rates at FT-321. At this point, FCV 431 settings are being controlled to simulate a decrease in turbine demand.

1. When steam demand has dropped to less than 3500 lbs/hr:

   a) Deactivate the FCV 321 Steam Pressure Control,

   b) Activate the FCV 431 Steam Pressure Control with a set point of 1100 psig. _____

2. Close FCV 321 to provide approximately 10% salt flow (7600 lbs/hr) at FT-321. _____

3. Deactivate the Steam Drum Level Control FCV 411. Manually maintain the steam drum water level at NWL (0 inches) using FCV 411 and the FWP _____

4. Simultaneously, gradually close FCV 351 while opening FCV 321 to maintain approximately 10% salt flow (7600 lbs/hr at FT 321). Continue until FCV 321 is fully open. _____

5. Incrementally close FCV 351 while opening FCV 341 to decrease the superheater salt inlet temperature (TE 382) while maintaining approximately 10% (7600 lbs/hr) total salt flow through the SGS. Decrease TE 382 by 100°F steps in 6 minute intervals (1000 F/hr). Continue this process until FCV 351 is closed and FCV 341 is positioned for approximately 10% salt flow. _____

6. Deactivate the FCV-301 Evaporator Salt Inlet Temperature Control. _____

SGS IS NOW IN HOT STANDBY.

STEP	DESCRIPTION	VERIFICATION

NOTE

While maintaining Hot Standby, use FCV 411 and the FWP to manually maintain the water level at NWL.

The SGS is in the Hot Standby condition as long as FCV 431 continues to maintain SGS pressure at a minimum of 1100 psig by passing steam to the deaerator. When the SGS has cooled sufficiently such that FCV 431 can no longer maintain 1100 psig (i.e., FCV 431 is closed), the SGS has reached the Warm Standby condition.

7. Turn off the Hot Salt Pump. _____

8. Turn off the Cold Salt Pump (Assuming the RS is not in operation). _____

SGS IS NOW IN WARM STANDBY. SEE FOLLOWING NOTE TO MAINTAIN THIS CONDITION.

NOTE

To maintain the Warm Standby condition accomplish the following:

a) Verify salt system temperatures (Tables 4.1-1, 4.2-1, and A) are 500°F minimum.

b) To maintain water/steam pressure at 1100 psig, reduce salt flow thru FCV 341 to lowest compatible with stable flow and/or minimum Cold Salt Pump flow.

c) Maintain the steam drum water level between $\pm$4 inches.

9. Close FCV 221. _____

10. Open FCV 231; wait 2 minutes and then close FCV 231. _____

11. Initiate the salt drain permit command (N90). _____

12. Open FCV 301, FCV 341, FCV 381, and FCV 382 to drain salt into the Cold Salt Sump. Wait 10 minutes prior to continuing. _____

13. Close FCV 201. _____

14. Open FCV 211; wait 2 minutes and then close FCV 211. _____

15. Open FCV 384. _____

16. Close FCV 383. Verify full closure. _____

STEP	DESCRIPTION	VERIFICATION
17.	Energize Electric Circulation Heater HR-5.	_____
18.	Stop the Boiler Water Circulation Pump.	_____
19.	Open FCV 351 to drain residual salt to the Hot Salt Sump.	_____
20.	Close Steam Shutoff Valve FCV 491. Verify PT-431 pressure drops.	_____

NOTE

Monitor the SGS water/steam system pressure (PT-383 and PT-321) to assure that pressure does not increase sufficiently, due to residual stored energy in the SGS, to lift relief valve PSV-381 (set pressure = 1310 psig). If SGS water/steam pressure rises above 1250 psig, shut off circulation heater HR-5 and open FCV-491 and maintain SGS pressure with HRFS valve FCV-431 until residual stored energy in the SGS is reduced. Operating experience will provide the best indication of when step 20 should be initiated without the need for re-establishing pressure control with FCV-431.

21.	After all hot salt has been drained, (approximately 2 minutes) close FCV 301, FCV 341, FCV 351, FCV 381, and FCV 382.	_____
22.	Raise the Steam Drum water level to +6 inches.	_____
23.	Verify controls for PT-432 closes FCV 432 flow to the spray water heat exchanger. (TT-482 should be within 10°F of TT-451.)	_____
24.	Close FCV 411.	_____
25.	Verify feedwater flow is stopped to the SGS by monitoring FT-411.	_____
26.	Deactivate the FCV 331 Steam Delivery Temperature Control.	_____
27.	Turn off the cooling water pump.	_____
28.	Turn off the cooling tower fan motors.	_____
29.	Stop Feedwater Pump and verify that FCV 401 closes.	_____
30.	Stop Spray Water Pump.	_____
31.	Shutdown sampling and hydrazine feeding.	_____

STEP	DESCRIPTION	VERIFICATION

NOTE

To maintain the SGS in the Diurnal Shutdown condition:

[redacted]

b) Verify SGS heat trace circuits (Table 4.1-1) are 500°F minimum.

SGS IS NOW IN DIURNAL SHUTDOWN MODE.

NOTE

This procedure will not detail the steps to take the SGS from Diurnal Shutdown to the Empty Condition because it is not a planned part of the SGS testing. Refer to the SGS O&M Manual section 3.9 (Operating Procedures) for these detailed steps.

4.1.4 GSGP#4 FOSSIL FIRED HEATER DEMONSTRATION

The primary purpose of this General Steam Generation Procedure is to demonstrate the operation of the Propane Heater in charging hot salt for later usage by the SGS. This procedure will also be used for tests requiring hot salt when weather conditions do not allow adequate solar charging or when the Receiver of Collector Subsystems are not on line.

Turn on propane inlet and outlet lines trace heater circuits (THE 223, THE 224, and THE 239) a minimum of 10 hours prior to intended usage of the Propane Heater.

STEP DESCRIPTION VERIFICATION

1. Verify the Following Checklists have been completed:

   TSS Pretest Checklist _____

   MCS Pretest Checklist _____

   CRTF Safety Checklist _____

2. Check level of Propane Tank and verify sufficient propane for the present test - 900 gallons minimum (15%). _____

3. Check/ignite pilot lights of Propane Evaporators. _____

4. Verify system salt temperatures are 500°F minimum. _____

5. Align/verify valves as follows:

Valve	Description	Position
FCV 151	CST Level Control	Closed
FCV 152	CSBP Bypass	Open
FCV 161	Hot Salt Flow Control	Closed
FCV 301	Salt Temp Cont.	Closed*
FCV 341	Salt Flow Cont.	Closed*
FCV 351	Hot Salt Flow Cont.	Closed*
FCV 201	Cold Salt Flow Cont.	Closed
FCV 211	CST Isol. Valve	Closed
FCV 221	Hot Salt Flow Cont.	Closed
FCV 231	HST Isol. Valve	Closed
HV 281	Hot Sump Bypass	Closed
FCV 241	P.H. Isol. Valves	Closed
FCV 242	P.H. Isol. Valves	Closed

*Assuming SGS is not in operation. _____

STEP	DESCRIPTION	VERIFICATION

6. Verify all valves from Propane Tank to Heater are open, the Propane Evaporator pilot lights are on, and the pressure at the Heater inlet is 55 ± 5 psig. _____

7. Verify the following Heat Trace Circuits are greater than 500°F (all are on Acurex Scanner No. 2): _____

I.D.	Description	I.D.	Description
TEH-201	Boost Sump Drain, Heater D	TEH-226	Cold Sump Outlet
TEH-202	Cold Pump Outlet, Heater C	TEH-227	Cold Sump
TEH-203	Boost Pump Bypass, Heater E	TEH-228	Cold Sump
TEH-204	Boost Pump Outlet, Heater B	TEH-229	Cold Sump Inlet
TEH-205	Boost Sump, Heater W	TEH-230	Cold Tank Inlet
TEH-206	Boost Sump, Heater W	TEH-231	FCV-201
TEH-207	Boost Pump Outlet, Heater A	TEH-232	Cold Tank Outlet
TEH-208	Boost Pump Outlet, Heater A	TEH-233	Cold Tank #1,CT-1 thru 7
TEH-210	Cold Tank Bypass, Heater G	TEH-234	Cold Tank #2,CT-1 thru 7
TEH-211	Riser-Storage End-Heater H	TEH-235	Cold Tank #3,CT-1 thru 7
TEH-212	Downcomer-Storage-Heater K	TEH-238	FCV-242
TEH-213	Hot Tank #1	TEH-239	Propane Heater Outlet
TEH-214	Hot Tank #2	TEH-240	FCV 161, Heaters A-Y, K
TEH-215	Hot Tank #3	TEH-241	FCV-151, Heater H
TEH-215	Hot Tank #3		
TEH-223	Propane Heater Inlet		
TEH-224	Propane Heater Inlet		
TEH-225	Cold Sump Outlet		

8. Place Burner Switch (on Control Console) to PILOT. _____

9. Set Burner Temperature Controller to 700°F. _____

10. Start the Propane Heater. The ON light and TIMER light should be on. _____

NOTE

The fan motor will purge the system for 110 seconds prior to introduction of pilot flame gas. If IR Scanner does not detect a pilot flame within 6 seconds after pilot gas, the start sequence will be stopped. When the pilot flame is achieved, the PILOT LIGHT will come on.

11. After PILOT LIGHT comes on, switch to MAIN FUEL. Record the time. _____

STEP	DESCRIPTION	VERIFICATION
12.	Verify Cold Tank Level (LT-201) is greater than 30 inches. If the SGS is operating (On Line) continue at step 18.	_____
	CAUTION If salt level in the Cold Sump is greater than 60 inches, visually check Cold Salt Sump Vent.	
13.	Verify Cold Sump Level (LT 201) is less than 60 inches and temperature (TE 211) is greater than 500°F.	_____
	NOTE If salt level in the Cold Sump is greater than 48 inches, continue at Step 16.	
14.	Set Cold Salt Sump Level to 50 inches.	_____
15.	Activate Cold Sump Level Control (FCV 201) and insure Cold Sump level increases to greater than 48 inches within 2 minutes.	_____
16.	Set Cold Sump Level to 15 inches.	_____
17.	Open FCV 152.	_____
18.	Start Cold Salt Pump 14 minutes after MAIN FUEL was turned on (Step 11).	_____
19.	Verify Cold Salt Pump outlet pressure (PT 180) is greater than 170 psi within one minute of activation.	_____
20.	Open FCV 241 15 minutes after completing step 11.	_____
21.	Open FCV 242 to 100% open.	_____
	NOTE It will take approximately 4 minutes for the salt to flow through the Propane Heater.	
22.	Adjust the Propane Heater for a 1050°F outlet temperature (salt flow from heater). Set point is TBD.	_____
23.	Turn off the trace heater for salt line #12 (TEH-239).	_____
24.	Fill the Hot Salt Tank at a rate of 3 MW/hr by adjusting FCV 241 to TBD%.	_____
	NOTE This will be a salt level change of 47 inches/hour in the Cold Salt Tank. Record the valve setting of FCV 241 used to obtain the 1050°F salt: _____%.	

STEP	DESCRIPTION	VERIFICATION
25.	Monitor the salt level (LT 201) in the Cold Sump to insure it maintains 15 ± 3 inches.	_____
26.	Adjust Propane Heater to 600°F outlet temperature when the Hot Salt Tank level (LT 291) is within 10 inches of the desired level (6 inches of desired level in Cold Salt Tank). If salt flow is occurring through the Hot Salt Tank (SGS operating), set the Propane Heater to 600°F 4 minutes prior to Hot Pump shutoff.	_____
27.	After 3 minutes Deactivate Cold Sump Level Control (FCV 201)	_____
28.	Close FCV 201.	_____
29.	Stop the Cold Salt Pump when the pump outlet pressure (PT 180) drops below 150 psig.	_____
30.	Open FCV 241 to 100% open.	_____
31.	Open FCV 211.	_____
32.	Wait 2 minutes (to allow salt drainage) then close FCV 211.	_____
33.	Turn off Propane Heater 20 minutes after Cold Salt Pump shutdown.	_____
34.	Wait 10 minutes then close FCV 241 and FCV 242.	_____
35.	If the Propane Heater is to be used the following day, turn on the Propane Heater outlet line heat trace (TEH-239).	_____
36.	If the Propane Heater is not to be used the following day, turn off the Propane Heater inlet line heat trace (TEH-223, TEH-224).	_____

4.1.5 GSGP #5 Emergency Shutdown (Manual)

This General Steam Generation Procedure will be utilized as the manual, Emergency Shutdown Procedure during SGS Testing. It will cover two specific conditions: 1) Commercial Power Loss, and 2) Process Control Module Failure (PCM 2 and PCM 3). Realize these are only two of many possible emergency conditions therefore it is mandatory to have a current copy of MCR-83-551 MSEE Failure Modes and Effects Analysis (FMEA) readily available during test activities. The two failure modes identified above will, when encountered, require timely response and are incorporated into this procedure. Other failure modes, although quite possibly emergency in nature, will not be part of this procedure and, therefore, it is imperative the Test Conductor is intimately familiar with the FMEA.

STEP DESCRIPTION VERIFICATION

Part 1 - Commercial Power Loss

NOTE

In the event of a facility commercial power failure, the following events should automatically occur:

a) All pumps will stop.

b) All control signals from the EMCON and Network 90 will be lost.

c) Air compressors will stop.

d) The following valves will fail CLOSED: FCV 201, 211, 221, 231, 241, 242, 341, 381, 382, 384, 411, 431, 435, 471, 491, and 501.

e) The following valves will fail OPEN: FCV 301, 321, 331, 351, 384, and 421.

f) The trace heater circuits will de-energize.

1. Manually open the valve handwheels for FCV 341, FCV 381, and FCV 382. _____

2. Manually close the valve handwheel for FCV 351. _____

3. Manually open the valve handwheels for FCV 231 and FCV 211. _____

4. Wait 2 minutes then close FCV 231 and FCV 211. _____

5. Turn off pneumatic air supply switches. _____

6. Wait 20 minutes then manually close the following valves:

FCV 301	FCV 381
FCV 341	FCV 382

_____

STEP	DESCRIPTION	VERIFICATION

7. Manually open the valve handwheel for FCV 351. _____

8. When electric power is restored, verify all trace heater circuits (Tables 4.1-1 and A) are ON and operating. _____

NOTE

Once these valves are manually positioned, they must be manually placed in a neutral position prior to use under automatic control.

Part 2 - Process Control Module Failure (PCM 2 and PCM 3)

I. PCM 2 Failure (HRFS Control)

NOTE

Upon sensing a PCM 2 fault, the UPS will provide an alarm and:

a) Close FCV 301, FCV 341, and FCV 351,

b) Turn off the Hot Salt Pump,

c) When the steam pressure to the turbine drops below TBD, close FCV 491 and FCV 501, and

d) Turns off the feedwater, spray water, condensate, and condensate makeup pumps.

e) PSV-381 steam relief valve will probably blow.

1. Silence (acknowledge) the Operational Alarms. _____

2. Place the following TSS and SGS controllers in the Manual mode (from the EMCON/N90):

FCV 201	FCV 321
FCV 221	FCV 331
FCV 301	

_____

NOTE

If in the Diurnal Shutdown Mode, maintain the SGS in this condition.

3. Close FCV 201 and FCV 221. _____

STEP		DESCRIPTION	VERIFICATION
		NOTE The following steps will require coordination between the Computer Control Room, Network 90 room, and PCM 2 (base of tower).	
MCS/N90	4.	De-energize any operating Electric Circulation Heaters. (If in Diurnal Shutdown, leave HR-5 on.)	_____
MCS	5.	Turn off the Cold Salt Pump.	_____
MCS/N90	6.	Energize the Salt drain permit interlock and open FCV 301, and FCV 321.	_____
MCS/N90	7.	Stop the BWCP.	_____
MCS/N90	8.	Open FCV 384, FCV 381, and FCV 382.	_____
MCS	9.	Open FCV 211 and FCV 231. Wait 2 minutes prior to continuing.	_____
MCS/ N90	10.	Close the following valves: FCV 211 FCV 381 FCV 231 FCV 382	_____
Tower	11.	At PCM 2, open the back door and place all HRFS valve controls in the manual mode.	_____
PCM2	12.	Position FCV 432 to close flow to the spray water heat exchanger.	_____
PCM2	13.	Close FCV 401.	_____
PCM2	14.	Close FCV 411.	_____
PCM2	15.	Turn off the cooling water pump switch.	_____
PCM2	16.	Turn off the cooling tower fan motors switch.	_____
MCS	17.	Wait 30 minutes after PCM failure then open FCV 341 and FCV 351. Allow the salt to drain for 10 minutes then close FCV 301, FCV 341 and FCV 351.	_____

THE SGS, TSS, AND HRFS ARE SHUTDOWN. EFFECT REPAIR OF PCM 2.

STEP	DESCRIPTION	VERIFICATION

II. PCM 3 Failure (TSS and SGS Control)

NOTE

Upon sensing a PCM 3 fault, the UPS will provide an alarm and:

a) After a 20 second delay, close FCV 211 and FCV 231,

b) Turn off the Hot and Cold Pumps.

c) Close FCV 151 and FCV 501, and

d) Close FCV 301, FCV 341, and FCV 351.

1. Silence (acknowledge) the Operational Alarms. _____

NOTE

The following steps will require coordination between the Computer Control room, Network 90 room, and PCM 3 (storage area).

PCM3 2. At PCM 3, open the back door and place all TSS valve controls in the Manual mode. _____

PCM3 3. Manually close FCV 201 and FCV 221. _____

N90 4. Deactivate the FCV 301 and FCV 321 automatic control. _____

NOTE

If in Diurnal Shutdown mode, maintain the SGS in this condition.

N90 5. De-energize any operating Electric Circulation Heaters. (If in Diurnal Shutdown, leave HR-5 on.) _____

N90 6. Energize the Salt drain permit interlock and open FCV 301 and FCV 321. _____

N90 7. Stop the BWCP. _____

N90 8. Open FCV 381, FCV 382, and FCV 384. _____

MCS 9. Close FCV 491. _____

PCM3 10. Manually open FCV 211 and FCV 231. Wait 10 minutes prior to continuing. _____

STEP		DESCRIPTION	VERIFICATION
PCM3/ N90	11.	Close the following valves: FCV 211 FCV 381 FCV 231 FCV 382 FCV 301	_____
MCS	12.	Stop the Feedwater pump and close FCV 401.	_____
MCS	13.	Close FCV 411.	_____
MCS	14.	Turn off the cooling water pump switch.	_____
MCS	15.	Turn off the cooling tower fan motors switch.	_____
MCS	16.	Stop the Spray Water Pump.	_____
N90	17.	Initiate the salt drain permit and open FCV 341 and FCV 351. Wait 10 minutes to allow salt drainage then close FCV 341 and FCV 351.	

THE SGS, TSS, AND HRFS ARE SHUTDOWN. EFFECT REPAIR OF PCM 3.

NOTE

Two other emergency conditions (both UPS trips) are 1) BWCP failure and 2) Hot Sump Level high or low. These conditions are part of the integrated tests SGITP#6 and #7, and the shutdown portions of these procedures may be used to exit an emergency situation.

4.1.6 GSGP #6 SGS Post Test Checklist

This General Steam Generation Procedure will be utilized to verify SGS integrity following all tests that use the Steam Generation Subsystem. It may be used on a daily basis or following each SGS shutdown. The purpose of this procedure is to ensure the SGS is still operational (does not require maintenance, cleaning, etc) and to reduce the time required (and delays) for subsequent pretest activities. It is written assuming the SGS is in the Diurnal Shutdown mode.

STEP	DESCRIPTION	VERIFICATION

Control Room

NOTE

The TSS and HRFS Post Test Checklist (Appendix B & D) may be accomplished in conjunction with this activity to avoid duplication effort.

1. Verify SGS trace heater circuits are operating (see Table 4.1-1) and that salt system temperatures are 500°F minimum. _____

2. Verify the following valves are in their failed position:

FCV 301	Open	FCV 383	In position
FCV 321	Open	FCV 384	Open
FCV 331	Open	FCV 341	Closed
FCV 381	Closed	FCV 351	Open
FCV 382	Closed		

_____

3. Record salt level of the Hot Salt Pump Sump _____ in. _____

Test Configuration

CAUTION

Salt and water/steam temperatures will normally be maintained above 500°F. If repairs are required, the system will require shutting down to the Empty condition.

1. Inspect the salt system for evidence of leaks and insulation damage. Repair as required.
   - All SGS piping
   - Hot Salt Pump, Sump, and Vent
   - Valves
   - Superheater and Evaporator

_____

STEP	DESCRIPTION	VERIFICATION

2. Inspect the water/steam system for evidence of leaks and insulation damage. Repair as required.

. All SGS piping	. Superheater
. Valves, vents	. Evaporator
. BWCP	. Steam Drum
. Flange locations	. Attemperator
. Drain Plugs	. Drain and Blowdown Tank

3. Check coolant pump and radiator and verify operating. _____

4. Close/verify HV 386 (boiler water sample station). _____

5. Close/verify HV 387 (chemical feed station). _____

6. Schedule/accomplish maintenance required on any SGS components found faulty during test or post test activities. _____

7. Accomplish the TSS Post Test Checklist (Appendix B). _____

8. Accomplish the HRFS Post Test Checklist (Appendix D). _____

4.1.7 GSGP #7 MCS/Network 90 Integration of Control Checklist

This General Steam Generation Procedure provides the steps necessary to transition SGS control from the Network 90 console to the EMCON. The Network 90 will continue to automatically provide the following SGS functions: closed loop control, interlocking, and data acquisition.

STEP	DESCRIPTION	VERIFICATION
1.	Verify SGS is in Diurnal Shutdown and stable (Verify with B&W Engineer).	_____
2.	Coordinate between Network 90 and computer operators and verify that both systems are ready for the transfer process.	_____

NOTE

The next step is to actuate specific SGS controls and verify the correct ON/OFF indication at the EMCON.

3. From the EMCON console, input the signals specified in the following list and verify correct indications at the EMCON and Network 90 consoles:

ID	DESCRIPTION	SIGNAL 1	SIGNAL 2	
MAN-301	Manual Control	Off	On	
MAN-321	Manual Control	Off	On	
MAN-331	Manual Control	Off	On	
MAN-341	Manual Control	Off	On	
MAN-351	Manual Control	Off	On	
EDC	Evaporator Drain Command	On	Off	
SDC	Superheater Drain Command	On	Off	
BCP-ON	BWCP On	On	Off	
BCP-OFF	BWCP Off	On	Off	
ESH-1	Elect. Circulation Htr. 1	On	Off	
ESH-2	Elect. Circulation Htr. 2	On	Off	
ESH-3	Elect. Circulation Htr. 3	On	Off	
ESH-4	Elect. Circulation Htr. 4	On	Off	
ESH-5	Elect. Circulation Htr. 5	Off	On	
HPR-1	Hot Pump Not Running	Off	On	
CPR-1	Cold Pump Not Running	Off	On	
FCV-383	Elect. Htr. Bypass Valve	Open	Closed	
FCV-384	Elect. Htr. Startup Valve	Closed	Open	_____

NOTE

The next step is to activate the SGS control loops with the specified set points and verify the correct indication at the EMCON.

4. From the EMCON console, input the commands to activate the set points specified in the following list. Verify correct indications (scaling) at the EMCON console and that the indications are the same as that at the Network 90 console. Following the checkout, return the control loops to Manual control.

ID	DESCRIPTION	SIGNAL 1	SIGNAL 2
SP-EST	Evap. Salt Temp. S.P.	850°F	750°F
SP-DL	Steam Drum S.P.	0 in.	+2 in.
SP-SP	Steam pressure Set Point	1200 psig	1100 psig
SP-ST	Steam Temp. Set Point	567°F	520°F
SP-301	Set Point	Open	Closed
SP-321	Set Point	Open	Closed
SP-331	Set Point	Open	Closed
SP-341	Set Point	Open	Closed
SP-351	Set Point	Open	Closed _____

5. Verify the control loops, tested in the last step, are deactivated. _____

6. Continue with SGS testing from the EMCON console. Any activity (not including abnormal conditions) at the Network 90 should now be strictly passive - monitoring function only.

4.2 STEAM GENERATION INTEGRATED TEST PROCEDURES (SGITP)

These procedures will detail the steps to accomplish the Steam Generation Acceptance Testing defined in the MSEE Phase I Test Plan. The specific procedures included are as follows:

- o SGITP #1 Initial Control Loop Checkout (using hot salt less than 1050°F)
- o SGITP #2 Hot Salt Flows with Transients (includes final Control Loop Tuning)
- o SGITP #3 Diurnal Shutdown (No Salt Flow) - Hold Overnight
- o SGITP #4 Load Following - 10%/Minute
- o SGITP #5 Alternate Diurnal Shutdown (with Salt cycling) - Hold Overnight
- o SGITP #6 Feedwater Loss Safe Shutdown
- o SGITP #7 Salt Flow Loss Safe Shutdown
- o SGITP #8 Manual Sequence Demonstration
- o SGITP #9 Retest Under MCS Control (SGITP #2 thru #8)
- o SGITP #10 Automatic Sequence Demonstration

4.2.1 SGITP#1 Initial Control Loop Checkout

PURPOSE: The control loop checkout of 7 controllers. Each control loop will be tested at normal conditions and with step response tests to introduce transient flows, temperatures or pressures.

DESCRIPTION: Using parts of GSGP#2 (manual SGS Startup), the SGS, HRFS, and TSS will be brought up to On Line (30% loading) incrementally. Each of the 5 HRFS and 2 of the TSS control loops will be checked out during the startup, once the system conditions will allow their automatic control. The system condition at the end of the test is On Line at 30% loading.

OBJECTIVES:

a) Checkout of system and components

b) Control loop tuning of:

- o Feedwater Pump Pressure
- o Deaerator Pressure Control
- o Cold Sump Level Control
- o Hot Sump Level Control (partial)
- o Feedwater Flow/Steam Drum Level Control
- o Steam Pressure Control
- o Feedwater Temperature Control (partial)

c) Instrumentation checkout

d) Demonstration of control stability

e) Test crew familiarization with system operation

CONTROL LOOP TUNING SUCCESS CRITERIA: A proportional feedback control loop shall have a response time that is suitable for the function being performed, and the response shall be well-damped over the operating range. It shall be a design goal that closed-loop responses exhibit damping equivalent to 0.5 to 1.0 in a second-order system over the operating range, with no limit cycling under steady state conditions.

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

Each of the instrumentation channels involved in this test will be checked out by observing the displays on the EMCON console. The actual measurements will be checked for reasonableness with Network 90 readings and expected values.

When going through a complete SGS startup, the HRFS requires a TBD hours warmup period with 390°F water circulation prior to accepting SGS steam flow.

STEP	DESCRIPTION	VERIFICATION
1.	Using GSGP#2 (manual SGS Startup) Empty to Diurnal Shutdown sequence, perform steps 1 thru 13.	_____
	NOTE The next activity will be a partial control loop checkout of the FCV 401 Feedwater Pump Pressure Control. Should the control loop, during the pressure variation tests, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout. o FW Pump pressure range: 1230 to 1280 psig	
2.	Fully open FCV 401	_____
3.	Position FCV 432 to completely bypass all the spray water from the Spray Water Heat Exchanger.	_____
4.	Start the Spray Water Pump. Verify flow by monitoring FT-482.	_____
5.	Start the Feedwater Pump. Verify flow by monitoring PT-401, PT-481, and FT-481.	_____
6.	Activate the Feedwater Pump Pressure Control (FCV 401) with a set point of 1200 psig. Note the FCV 401 position setting: _____%.	_____
7.	Perform a step response test to introduce low amplitude pressure changes into the partial feedwater flow (FCV 411 is closed). Using 10% increments, change the FCV 401 settings as specified below. Maintain the specified condition until the pressure control settles.	

STEP	DESCRIPTION	VERIFICATION
	a) Increase 10% from the step 6 setting. Activate the FWP Pressure Control.	
	b) Increase 20% from the step 6 setting. Activate the FWP Pressure Control.	
	c) Decrease 10% from the step 6 setting. Activate the FWP Pressure Control.	
	d) Decrease 20% from the step 6 setting. Activate the FWP Pressure Control	_____
8.	Repeat step 7 except change to higher amplitude pressure changes.	
	a) Increase 20% from the step 6 setting. Activate the FWP Pressure Control.	
	b) Increase to 100%. Activate the FWP Pressure Control.	
	c) Decrease 20% from the step 6 setting. Activate the FWP Pressure Control.	
	d) Decrease to 10%. Activate the FWP Pressure Control.	_____

NOTE

Continue to monitor PT-401 pressure until the FWP Pressure control loop is fully checked out. If the control loop shows an indication of being unstable, accomplish the control loop tuning activity.

STEP	DESCRIPTION	VERIFICATION

9. Perform GSGP#2 (Empty to Diurnal Shutdown) steps 17 thru 21.

NOTE

The next activity will be a partial control loop checkout of the FCV 432 Deaerator Pressure Control. Should the control loop, during the pressure and flow variation tests, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout.

- o Deaerator pressure range: 0 to 270 psig
- o Deaerator operational temperature range: 390 to 406 °F

10. Perform a step response test to introduce low amplitude pressure changes in the Deaerator. Decrease the DTC-451 (or turn off) set points and use the CWP (and pressure relief valve) to decrease the deaerator pressure as specified below. Maintain the specified condition until the pressure control settles.

a) Activate the FCV 432 Deaerator Pressure Control with a set point of 233 psig.

b) Deactivate the Deaerator Pressure Control. Decrease the deaerator pressure to 200 psig.. Activate the Deaerator Pressure Control.

c) Deactivate the Deaerator Pressure Control. Decrease the deaerator pressure to 175 psig. Activate the Deaerator Pressure Control.

STEP	DESCRIPTION	VERIFICATION
11.	Note FCV 432 setting (during automatic control) at the end of step 10.e: _____% to the Deaerator.	_____

NOTE

Activating the Deaerator Pressure Control should cause all flow to bypass the heat exchanger (TT-482 will return to 390°F within 5 minutes.

12. Perform a step response test to introduce low amplitude valve setting changes on FCV 432 and verify correct recovery (DTC-451 at normal set point). Using 10% increments, change FCV 432 settings as specified below to divert spray water flow to the spray water heat exchanger and then activate automatic control. Allow the control to settle prior to changing condition.

a) Set FCV 432 to 10% flow to the Spray Water Heat Exchanger. Activate the Deaerator Pressure Control.

b) Set FCV 432 to 20% flow to the Spray Water Heat Exchanger. Activate the Deaerator Pressure Control.

c) Set FCV 432 to 30% flow to the Spray Water Heat Exchanger. Activate the Deaerator Pressure Control. _____

NOTE

Continue to monitor PT-432 pressure until the Deaerator Pressure control loop is fully checked out. If the control loop shows an indication of being unstable, accomplish the control loop tuning activity.

13. Perform GSGP#2 (Empty to Diurnal Shutdown) steps 23 thru 34. _____

NOTE

Manually position FCV 431 to control delivery steam pressure (PT-321) at 1100 psig and FCV 421 to control feedwater temperature at 545°F throughout the following steps until the control loops are actually checked out.

NOTE

If feedwater flow is not the same as the steam flow, the steam drum water level will either become too high or too low; hence, the operator should expect a low or high level alarm from LT-311.

STEP	DESCRIPTION	VERIFICATION

14. Verify that all TSS (Table A) heat traced systems and the RS heat trace systems (in Table 4.2-1) are operating and that all temperatures, with the exception of the following list, are greater than 500°F.

TEH 217	TEH 236
TEH 223	TEH 238
TEH 224	TEH 239

_____

15. Align/verify valves as follows:

Valve	Description	Position
Receiver		
FCV 101	Salt Flow Cont.	Closed
FCV 102	Salt Flow Cont.	Closed
FCV 151	CST Level Cont.	Closed
FCV 152	CSBP Bypass	Open
FCV 161	Hot Salt Flow Cont.	Closed
FCV 162	Cold Salt Flow Cont.	Open
FCV 199	Bypass Valve	Open
Thermal Storage		
FCV 201	Cold Salt Flow Cont.	Closed
FCV 211	CST Isolation	Closed
FCV 221	Hot Salt Flow Cont.	Closed
FCV 231	HST Isolation	Closed
FCV 241, FCV 242	Prop. Htr. Isolation	Closed
HV 281	Hot Sump Bypass	Closed
HV 282, HV 283	Olin Salt Loop	Open

_____

16. Perform GSGP#2, Diurnal Shutdown to Warm Standby sequence, steps 2 thru 10.

_____

T/C	DESCRIPTION	ACUREX SCANNER #
TEH-130	Downcomer - Heater K	4
TEH-131	Riser - Heater H	4
TEH-132	Downcomer - Heater L	4
TEH-133	Riser - Heater I	4
TEH-134	Riser - Heater I	4
TEH-135	Riser - Heater J	4
TEH-136	Riser - Heater J	4
TEH-137	Downcomer - Heater M	4
TEH-138	Downcomer - Heater M	4
TEH-139	Downcomer - Heater L	4
TEH-152	Cold Surge Tank Inlet - Heater O	1
TEH-156	Cold Surge Tank - Heater O	1
TEH-162	FCV 101 - Heater Q	1
TEH-163	FCV 102 - Heater Q	1
TEH-164	Cold Surge - Heater V	1
TEH-165	Cold Surge - Heater V	1

Table 4.2-1 RS Heat Trace Instrumentation (Partial)

STEP	DESCRIPTION	VERIFICATION
17.	Verify that Cold Salt Storage Tank Level is greater than 30 inches.	_____
	NOTE If the salt level is less than 30 inches ensure the Hot Salt Storage Tank level is commensurate with test requirements (as determined in the Pretest Meeting).	
18.	Verify FCV 201 is closed.	_____
19.	Open FCV 211.	_____
	CAUTION If salt level in the Cold Sump is greater than 60 inches, visually check the Cold Sump Vent.	
20.	Verify Cold Sump Level (LT 201) is less than 60 inches.	_____
21.	Verify the Cold Sump Level (LT 201) is greater than 40 inches prior to continuing (open FCV 201 to obtain salt level if required.)	_____
	NOTE The next activity will be the control loop checkout of the Cold Sump Level Control. Should the control loop, during flow rate changes or step response tests, show incorrect response or inadequate damping, accomplish the control loop tuning engineering activity. Following this, return to the low level salt flow condition and reaccomplish the control loop checkout. o Cold Sump Level (LT 201) limits: 60 inches maximum.	
22.	Verify the salt level in the Cold Storage Tank is between 30 to 135 inches.	_____
23.	Start the Cold Salt Pump and verify outlet pressure (PT 180) is greater than 170 psi prior to continuing.	_____
24.	Open FCV 151 to 20% to provide a low level salt flow.	_____
25.	Close FCV 152.	_____

STEP	DESCRIPTION	VERIFICATION
26.	Activate the Cold Sump Level Control (FCV 201) with a set point of 15 inches.	_____
27.	Perform a step response test to introduce low amplitude flow transients into the 20% salt flow rate. Using 10% increments, change the FCV 151 setting as specified below. Maintain the specified setting until the level settles.	
	a) Decrease to 10%	
	b) Increase to 20%	
	c) Increase to 30%	
	d) Decrease to 20%	_____
28.	Over a 10 second time period, change the FCV 151 setting from 20% to 50% (medium flow).	_____
29.	Repeat step 27 for the 50% flow rate as follows:	
	a) Decrease to 40%	
	b) Increase to 50%	
	c) Increase to 60%	
	d) Decrease to 50%	_____
30.	Over a 10 second time period, change the FCV 151 setting from 50% to 90% (high flow).	_____
31.	Repeat step 27 for the 90% flow rate as follows:	
	a) Decrease to 80%	
	b) Decrease to 70%	
	c) Increase to 80%	
	d) Increase to 90%	
	e) Increase to 100%	_____
32.	Perform a step response test to introduce higher amplitude flow transients into the salt flow rate. Change the FCV 151 setting as specified below, maintaining the setting until the level settles.	

STEP	DESCRIPTION	VERIFICATION
	a) Decrease to 80%	
	b) Decrease to 60%	
	c) Increase to 80%	
	d) Increase to 100%	
	e) Decrease to 70%	_____
33.	Perform GSGP#2 (Diurnal Shutdown to Warm Standby sequence) steps 17 thru 37. Disregard the control loops activation in steps 29, 30, and 32 - the flow, temperature, and pressure controls must be manually maintained until the control loops are checked out.	_____
	NOTE THE SGS IS NOW IN THE WARM STANDBY CONDITION.	
34.	Verify that all TSS (Table A) heat traced systems are operating and that all temperatures, with the exception of the following list, are greater than 500°F. TEH 217 TEH 236 TEH 223 TEH 238 TEH 224 TEH 239	_____
35.	Verify that the Hot Storage Tank Level is greater than TBD inches (determined in Pretest meeting).	_____
	NOTE The Hot Sump salt level will be manually controlled by FCV 221 until the control loop is checked out. Maintain the Hot Sump level at 15 $\pm$ 3 inches.	
36.	Open FCV 231.	_____
37.	Open FCV 221 to obtain a salt level of 15 inches and maintain it.	_____
38.	During the following activity of increasing salt temperature, verify the operation of controls of PT-432 for controlling FCV 432 so that deaerator pressure is held constant at 233 psi and all energy is being rejected by the cooling water circuit and the dry cooling towers.	_____

STEP	DESCRIPTION	VERIFICATION

39. Using a temperature ramp rate of 100°F per 6 minutes, gradually and simultaneously open FCV 351 while closing FCV 341 to achieve 850°F at TE-382 (superheater salt inlet Temperature). Maintain approximately a constant 10% salt flow (7600 lbs/hr) through the SGS.

NOTE

The salt temperature will be maintained at 850°F to provide a minimum steam flow to the HRFS and allow the following control loop checkouts.

NOTE

The next activity will be a partial control loop checkout of the Hot Sump Level Control. It will be tested now at 10% salt flow and later at salt flows that provide 30% and 60% steam loads. Should the control loop, during flow rate changes or step response tests, show incorrect response or inadequate damping, accomplish the control loop tuning engineering activity. Following this, return to the low level salt flow condition and reaccomplish the control loop checkout.

. Hot Sump level (LT-221) limits: 15 to 41 inches

40. Note the FCV 221 setting to manually maintain the 15 inch salt level: ____%. Activate the Hot Sump Level Control with a set point of 15 inches. _____

41. Perform a step response test to introduce low amplitude valve setting changes on FCV 221 (to change Hot Sump level) and verify correct recovery. Change the FCV 221 settings as specified below and then activate automatic control. Allow the control loop to settle prior to changing conditions.

a) Decrease 10% from the step 40 setting and allow the sump level to decrease. Activate the Hot Sump Level Control.

b) Increase 10% from the step 40 setting and allow the sump level to increase. Activate the Hot Sump Level Control.

c) Increase 20% from the step 40 setting and allow the sump level to increase. Activate the Hot Sump Level Control. _____

STEP	DESCRIPTION	VERIFICATION

NOTE

The next activity will be the control loop checkout of the FCV 411 Feedwater Flow/Steam Drum Level Control. Should the control loop, during flow rate changes or step response tests, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout.

- Steam Drum water level (LT-311) limits: 0 ± 4 inches
- Feedwater operational temperature (TE-386) limits: 500 to 575°F

STEP	DESCRIPTION	VERIFICATION
42.	Perform a step response test to introduce water level changes in the steam drum. Decrease the steam drum water level by blowing down, as required, using HV-382 and HV-383 to the levels specified below. Maintain each condition until the level control settles.	
	a) Decrease to -1 inch. Activate the Steam Drum Level Control.	
	b) Deactivate the control. Decrease to -2 inches. Activate the Steam Drum Level Control.	
	c) Deactivate the control. Decrease to -4 inches. Activate the Steam Drum Level Control.	_____
43.	Note the FCV 411 setting from 42.c) once the level control settles: _____%	_____
44.	Perform a step response test to introduce low to medium amplitude flow changes in the feedwater flow and verify correct recovery. Using 10% increments, change FCV 411 settings as specified below, maintaining each setting until the control settles.	
	a) Decrease 10% from the step 43 setting. Activate the Feedwater Flow Control.	
	b) Increase 10% from the step 43 setting. Activate the Feedwater Flow Control.	
	c) Decrease 20% from the step 43 setting. Activate the Feedwater Flow Control.	
	d) Increase 20% from the step 43 setting. Activate the Feedwater Flow Control.	
	e) Decrease 30% from the step 43 setting. Activate the Feedwater Flow Control.	_____
45.	During steady state steam flow rates to the HRFS, verify that the feedwater flow being monitored by FT-411 is nearly identical to the steam flow monitored by FT-311.	_____

STEP	DESCRIPTION	VERIFICATION

NOTE

If feedwater flow is not the same as the steam flow, the steam drum water level will either become too high or too low; hence, the operator should expect a low or high level alarm from LT-311.

NOTE

The next several steps are to verify the FCV 401 Feedwater Pump Pressure Control performance.

46. Note the feedwater flow rate at FT-411:_____gpm. _____

47. Perform a step response test to introduce low amplitude flow changes into the feedwater flow (FT-411). Change the FCV 411 valve settings to achieve the flow rates specified below. Maintain the specified condition until the pressure control settles.

a) Deactivate the Steam Drum Level Control (FCV 411).

b) Decrease the feedwater flow through FT-411 by 2 gpm from the step 46 flow rate.

c) Increase the feedwater flow through FT-411 by 2 gpm from the step 46 flow rate.

d) Decrease the feedwater flow through FT-411 by 5 gpm from the step 46 flow rate.

e) Increase the feedwater flow through FT-411 by 5 gpm from the step 46 flow rate. _____

48. Activate the FCV 411 Steam Drum Level Control with a set point of 0 inches; verify proper recovery. _____

49. Note the FCV 431 setting: _____% _____

NOTE

The next activity will be the control loop checkout of the FCV 431 Steam Pressure Control. Should the control loop, during the step response test, show incorrect response, accomplish the control loop tuning activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout. (Continue to manually control the feedwater temperature, FCV 421, at 545°F).

STEP	DESCRIPTION	VERIFICATION
50.	Perform a step response test to introduce low to medium amplitude valve setting changes on FCV 431 and verify correct recovery. Using 5% increments, change FCV 431 settings as specified below. Allow the control to settle prior to changing condition.	
	a) Activate the Steam Pressure Control.	
	b) Increase 5% from the step 49 setting. Activate the Steam Pressure Control.	
	c) Increase 10% from the step 49 setting. Activate the Steam Pressure Control.	
	d) Decrease 5% from the step 49 setting. Activate the Steam Pressure Control.	
	e) Decrease 10% from the step 49 setting. Activate the Steam Pressure Control.	
	f) Increase 20% from the step 49 setting. Activate the Steam Pressure Control.	_____

STEP	DESCRIPTION	VERIFICATION
51.	Once the Steam Pressure Control settles, note the FCV 421 setting: _____%	_____

NOTE

The next activity will be a partial control loop checkout of the FCV 421 Feedwater Temperature Control. Should the control loop, during the step response tests, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout. (This control loop cannot be fully checkout out until the salt/steam temperatures are at rated values.)

- o Feedwater Heater operational temperature limits: 540 to 560 °F

52. Perform a step response test to introduce low to medium amplitude valve setting changes on FCV 421 and verify correct recovery. Using 10% increments, change FCV 421 settings as specified below. Allow the control to settle prior to changing condition.

a) Activate the Feedwater Temperature Control.

b) Increase 10% from the step 51 setting. Activate the Feedwater Temperature Control.

c) Decrease 10% from the step 51 setting. Activate the Feedwater Temperature Control.

d) Increase 20% from the step 51 setting. Activate the Feedwater Temperature Control.

e) Decrease 20% from the step 51 setting. Activate the Feedwater Temperature Control.

f) Increase 30% from the step 51 setting. Activate the Feedwater Temperature Control. _____

53. Repeat step 52 except this time FCV 331 will be varied at 20% increments to provide temperature changes. The FCV 421 control loop is still activated; verify correct response.

a) Decrease to 80%

STEP	DESCRIPTION	VERIFICATION
	b) Decrease to 60%	
	c) Decrease to 40%	
	d) Increase to 60%	
	e) Increase to 100%	_____

This completes the initial control loop checkout, SGITP#1. It is now the Test Conductor's option to continue into SGITP#2 (Hot Salt Flow with Transients) or shutdown the system to Diurnal Shutdown.

NOTE

a) To shutdown the system, perform GSGP#3 starting at step 3.

b) To continue into SGITP#2, maintain the present condition and verify salt levels in the Cold and Hot Storage Tanks are commensurate with test requirements (as determined in the Pretest Meeting).

4.2.2 SGITP #2 Hot Salt Flows with Transients

PURPOSE: This test will checkout the remaining SGS control loops during the initial, low level hot salt flows. The SGS will be brought up to the On Line, 100% load condition.

DESCRIPTION: Starting with the SGS in the on line 30% loading, 1 TSS and 2 SGS control loops are checked out. The SGS steam loading is then increased to 60%, and 100% with transient hot salt flows introduced at each level. The SGS is maintained in the On Line, 100% load condition for 1 hour. Following this test activity, the SGS operation transitions to the Diurnal Shutdown Mode.

OBJECTIVES:

a) Checkout of system and components.

b) Control loop tuning:

- Hot Sump Level Control (final portion)
- Evaporator Salt Inlet Temperature Control
- Steam Delivery Temperature Control
- Steam Pressure Control

c) Instrumentation Checkout

d) HRFS response to step input changes

e) Demonstration of control stability

f) Test crew familiarization with system operation

CONTROL LOOP TUNING SUCCESS CRITERIA: A proportional feedback control loop shall have a response time that is suitable for the function being performed, and the response shall be well-damped over the operating range. It shall be a design goal that closed-loop responses exhibit damping equivalent to 0.5 to 1.0 in a second-order system over the operating range, with no limit cycling under steady state conditions.

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

Each of the instrumentation channels involved in this test will be checked out by observing the displays on the EMCON console. The actual measurements will be checked for reasonableness with Network 90 readings and expected values.

STEP	DESCRIPTION	VERIFICATION

NOTE

If the system was shutdown to Diurnal Shutdown at the end of SGITP#1:

a) Perform GSGP#1 Pretest Checklist, and

b) Perform GSGP#2 (manual SGS Startup), Diurnal Shutdown to Warm Standby sequence and Warm Standby to On Line sequence thru step 7.

If going from SGITP#1 straight into SGITP#2, verify salt levels in the Hot and Cold Storage Tanks are commensurate with test requirements (as determined in the Pretest Meeting).

1. Verify that all TSS (Table A) heat traced systems are operating and that all temperatures, with the exception of the following list, are greater than 500°F.

TEH 217	TEH 236	
TEH 223	TEH 238	
TEH 224	TEH 239	_____

2. Verify that the Hot Storage Tank Level is greater than TBD inches. _____

NOTE

Manually control FCV 301 to achieve and maintain a salt temperature of 850°F at TE-301. Manually control FCV 331 to achieve and maintain a steam temperature of 950°F at TE-332.

STEP	DESCRIPTION	VERIFICATION
3.	Turn on the Hot Salt Pump if turned off following SG1TP#1, and verify outlet pressure (PT-382) is greater than TBD psi prior to continuing.	_____
4.	Gradually open FCV 351 while closing FCV 341 to achieve the temperature ramp rate specified below at the superheater salt inlet TE-382. Maintain approximately a constant 10% salt flow (7600 lbs/hr) thru the SGS.	
	• Temperature ramp rate: 100°F (TE-382) steps at 6 minute intervals (1000°F/hr)	_____
5.	Verify full closure of FCV 341.	_____
6.	When the salt inlet flow to the superheater consists of only hot salt (valve FCV 341 closed; valve FCV 351 positioned for 10% salt flow (7600 lbs/hr)), transfer control of the steam delivery pressure to FCV 321 as follows:	
	a) Deactivate the FCV 431 Steam Flow Control. Manually position FCV 431 to allow the specified steam flow.	
	b) Gradually open valve FCV 351 while adjusting valve FCV 321 position to maintain SGS steam delivery pressure (PT-321) at 1100 +50, -0 psig.	_____

NOTE

When FCV 351 is 100% open, steam delivery pressure is controlled by positioning FCV 321.

7. As load increases, control steam delivery pressure to 1100 psig by manually positioning FCV 321.

NOTE

To simulate the turbine loading, FCV 431 will be varied to increase the steam volume being dumped to the deaerator (automatically by changing set points or manually by changing the valve position). These specific valve settings will be determined by experience in changing FCV 431 to obtain the required salt flow rate at FT-311.

STEP	DESCRIPTION	VERIFICATION
8.	Gradually open FCV 321 and modulate FCV 431 to achieve a FT-311 steam flow rate of approximately 3,500 lbs/hr (30% load).	_____
9.	Note the FCV 221 setting (automatic control): _____%	_____
10.	Perform a step response test to introduce low amplitude valve setting changes on FCV 221 (to change Hot Sump level) and verify correct recovery. Change the FCV 221 settings as specified below and then activate automatic control. Allow the control loop to settle prior to changing conditions:	
	a) Decrease 10% from the step 9 setting and allow the sump level to decrease. Activate the Hot Sump Level Control.	
	b) Increase 10% from the step 9 setting and allow the sump level to increase. Activate the Hot Sump Level Control.	
	c) Increase 20% from the step 9 setting and allow the sump level to increase. Activate the Hot Sump Level Control.	_____
	NOTE The next activity will be the control loop checkout of the FCV 301 Evaporator Salt Inlet Temperature Control. Should the control loop, during flow rate or temperature variations, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the complete control loop checkout. • Evaporator salt inlet temperature (TE-301) limits: 500 to 880 °F	
11.	Activate the Evaporator Salt Inlet Temperature Control FCV 301 with a set point of 850°F.	_____

STEP	DESCRIPTION	VERIFICATION
12.	Perform a step response test to introduce temperature transients to the evaporator salt inlet temperature and verify correct control response. Change FCV 301 to obtain the temperatures specified below (TE-301) and then activate automatic control. Allow the control to settle prior to changing condition. a) Deactivate the FCV 301 control and increase its setting to decrease the temperature to 800°F. Activate the Evaporator Salt Inlet Temperature Control. b) Deactivate the FCV 301 control and increase its setting to decrease the temperature to 750°F. Activate the Evaporator Salt Inlet Temperature Control. c) Deactivate the FCV 301 control and decrease its setting to increase the temperature to 880°F. Activate the Evaporator Salt Inlet Temperature Control.	_____
13.	Gradually open FCV 341 while closing FCV 351 to reduce the TE-382 superheater salt inlet temperature to 800°F. Maintain the salt flow (FT-321) approximately constant throughout. Do not exceed the temperature ramp rate of 100°F/6 minutes. Verify correct Evaporator Salt Inlet Temperature Control response.	_____
	NOTE FCV 321 is controlling steam pressure under manual control. With a lower SH salt inlet temperature, steam pressure will want to drop, and must be compensated for by FCV 321. Steam flow is maintained by manually positioning FCV 431.	
14.	Reverse the step 13 activity to reclose FCV 341 and open FCV 351. Again maintain the salt flow rate constant and do not exceed 100°F/6 minutes.	_____
	NOTE The next activity will be the control loop checkout of the Steam Delivery Temperature Control FCV 331. Should the control loop, during flow rate or temperature variations, show incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the complete control loop checkout. · Steam Delivery temperature (TE-332) limits: 950 ± 40 °F.	

STEP	DESCRIPTION	VERIFICATION
15.	Activate the Steam Delivery Temperature Control FCV 331 with a set point of 950°F.	_____
16.	Perform a step response test to introduce temperature transients to the delivery steam temperature and verify correct control response. Change FCV 331 to obtain the temperatures specified below (TE-332) and then activate automatic control. Allow the control to settle prior to changing condition.	
	a) Deactivate the FCV 331 control and increase its setting to decrease the temperature to 900°F. Activate the Steam Delivery Temperature Control.	
	b) Deactivate the FCV 331 control and increase its setting to decrease the temperature to 850°F. Activate the Steam Delivery Temperature Control.	
	c) Deactivate the FCV 331 control and decrease its setting to increase the temperature to 990°F. Activate the Steam Delivery Temperature Control.	_____
17.	Repeat steps 13 and 14 to verify correct Steam Delivery Temperature Control response. This time use 950°F for the lower TE-382 temperature.	_____
18.	Gradually open FCV 321 and modulate FCV 431 to achieve a FT-311 steam flow rate of approximately 7,000 lbs/hr (60% load). Note the FCV 321 setting: _____%	_____
19.	Note the FCV 221 setting (automatic control): ___% Repeat step 10 using this new setting as the base from which to make the valve setting changes.	_____
20.	Vary the FCV 321 settings as specified below and verify correct operation of all activated control loops. Allow temperatures, pressures, and flow rates to stabilize prior to changing condition.	
	a) Decrease 10% from step 18 setting.	
	b) Decrease 20% from step 18 setting.	
	c) Return to step 18 setting.	
	d) Increase 10% from step 18 setting.	
	e) Return to step 18 setting.	

STEP	DESCRIPTION	VERIFICATION
21.	Gradually open FCV 321 and modulate FCV 431 to achieve a FT-311 steam flow rate of 11,580 lbs/hr (100% load).	_____

NOTE

The next activity will be the control loop checkout of the Steam Pressure Control FCV 321. Should the control loop, during steam flow rate variations, shown incorrect response, accomplish the control loop tuning engineering activity. Following this, return to the initial portion of the checkout and reaccomplish the control loop checkout.

- Steam Pressure (PT-321) operational limits: 1100 $\pm$ 50 psig.

22. Activate the FCV 321 Steam Pressure Control with a set point of 1100 psig. _____

23. Perform a step response test to introduce low to medium amplitude pressure transients to the main steam pressure and verify correct control response. Manually change FCV 431 to obtain the flow rates specified below at FT-311. Allow the control loop to settle prior to changing conditions.

a) Close FCV 431 to obtain an 11,000 lbs/hr flow rate.

b) Close FCV 431 to obtain a 10,500 lbs/hr flow rate.

c) Close FCV 431 to obtain a 10,000 lbs/hr flow rate.

d) Open FCV 431 to obtain an 11,000 lbs/hr flow rate.

e) Open FCV 431 to obtain a 12,000 lbs/hr flow rate.

f) Close FCV 431 to return to 11,580 lbs/hr flow rate. _____

24. Maintain this On Line, 100% load condition for 1 hour. Monitor control loop performance in this steady state operation. _____

25. Perform GSGP#3 (manual SGS shutdown) from the On Line condition to Diurnal Shutdown. _____

26. Perform GSGP#6, SGS Post Test Checklist (applicable sections only). _____

4.2.3 SGITP#3 Diurnal Shutdown (No Salt Flow) - Hold Overnight

PURPOSE: Maintain the SGS in the Diurnal Shutdown mode for a 12 hour, night time period to verify SGS integrity.

DESCRIPTION: The SGS will be brought to the Diurnal Shutdown mode following SGITP#2. In this operating state, the SGS will be maintained for a 12 hour period to verify subsystem performance. Note: This test does not have to be performed overnight. It can be performed during the day when test personnel are available.

OBJECTIVES:

a) Checkout of system and components

b) Verify system performance at minimum operating conditions

c) Test crew familiarization with maintaining SGS in the Diurnal Shutdown mode

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

SGITP#3

This test activity involves the maintaining of the steady state Diurnal Shutdown mode for a 12 hour period. Once the configuration is achieved, it will require a minimum test team involvement to monitor the three subsystems during the night time activity.

STEP	DESCRIPTION	VERIFICATION

NOTE

The SGITP#2 final configuration is to return the SGS, TSS, and HRFS to the Diurnal Shutdown mode. If entering this test from any other test configuration, perform the appropriate portions of SGSP#2 (manual SGS Startup) or GSGP#3 (manual SGS Shutdown).

1. Verify operation of the trace heater circuits on the SGS salt lines, shells of evaporator and superheater (see Table 4.1-1), and the TSS (see Table A) except for those listed below. Ensure that all temperatures are greater than 500°F (including drain lines and valves).

TEH 217	TEH 236
TEH 223	TEH 238
TEH 224	TEH 239

_____

2. Verify operation of HR-5 circulation heater circuit by checking for a contact closure on the OIU. _____

3. Bring the steam drum water level to +6 inches (The level should remain above -4 inches throughout the test period.) _____

4. Maintain this configuration for a 12 hour period.

   a) Monitor the SGS and TSS heat trace circuits (step 1) and ensure they remain greater than 500°F. _____

NOTE

The intent of Diurnal Shutdown is to be able to "walk away" from the system overnight. Therefore, during this test no water level or pressure adjustments should be required. The unit should be observed to assure the shutdown condition is maintained properly, or determinations made that adjustments to the operating procedure are required.

4.2.4 SGITP#4 Load Following Test - 10%/Minute

PURPOSE: This test will verify SGS performance during a 10% steam load per minute ramping. Starting at a 30% load, the SGS will be ramp loaded up to 100% and back down to 50%.

DESCRIPTION: The SGS will be started from the Diurnal Shutdown mode. Using the manual SGS Startup procedure (GSGP#2), the SGS is first brought up to the On Line, 10% load condition and then to a 30% load. It is then ramped up to 100% and back to 50%. The 30%, 100%, and 50% steady state load conditions will each be maintained for 30 minutes. The test will end with the SGS being returned to the Warm Standby mode.

OBJECTIVES:

a) Checkout of system and components

b) Verification of control loop performance during load ramping

c) Demonstration of control stability

d) Test crew familiarization with system performance

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#2 (manual SGS startup) Diurnal Shutdown to Warm standby sequence.	_____
2.	Perform GSGP#2 (manual SGS Startup) Warm Standby to On Line Sequence, (This will achieve the on line, 30% load condition.).	_____
3.	Maintain the 30% steady state load condition for 30 minutes. Monitor all control loop performance.	_____

NOTE

The next activity will be the load following test in which the SGS steam loading will be ramped up to 100% at a 10%/minute rate. Verify control loop performance during the ramping.

4. Using a ramp rate of 10% SGS steam loading per minute, modulate FCV 431 to achieve the steam flow rates specified below at FT-311. Note the FCV 431 settings to achieve the specified flows.

a) 4,630 lbs/hr (40% load). FCV 431 _____%

b) 5,790 lbs/hr (50% load). FCV 431 _____%

c) 6,950 lbs/hr (60% load). FCV 431 _____%

d) 8,100 lbs/hr (70% load). FCV 431 _____%

e) 9,270 lbs/hr (80% load). FCV 431 _____%

f) 10,420 lbs/hr (90% load). FCV 431 _____%

g) 11,580 lbs/hr (100% load). FCV 431 _____% _____

5. Maintain the 100% SGS steam loading for 30 minutes. _____

STEP	DESCRIPTION	VERIFICATION
6.	Using a ramp rate of 10% SGS steam loading per minute, modulate 431 to achieve the steam flow rates specified below at FT-311. The FCV 431 settings noted before may be used to obtain the required flow.	
	a) 10,420 lbs/hr (90% load)	
	b) 9,270 lbs/hr (80% load)	
	c) 8,100 lbs/hr (70% load)	
	d) 6,950 lbs/hr (60% load)	
	e) 5,790 lbs/hr (50% load)	_____
7.	Maintain the 50% SGS steam loading for 30 minutes.	_____
8.	Gradually close FCV 321 to achieve a 10% salt flow rate (7600 lbs/hr at FT-321).	_____
9.	Perform GSGP#3 (manual SGS Shutdown) steps 1 thru 8. This will bring the SGS to Warm Standby.	_____

This completes the Load Following Test, SGITP #4. It is assumed that the test activity will continue into SGITP#5 (Alternate Diurnal Shutdown - Hold Overnight) from the Warm Standby mode.

4.2.5 SGITP#5 Alternate Diurnal Shutdown (with Salt Cycling) - Hold Overnight

PURPOSE: Maintain the SGS in the Alternate Diurnal Shutdown mode for a 12 hour, night time period to verify SGS integrity.

DESCRIPTION: Starting with the SGS in the Warm Standby mode, it will be brought to the Alternate Diurnal Shutdown (with salt cycling) mode. In this operating condition, it will be maintained for a 12 hour period to verify subsystem performance. The SGS will be returned to the Warm Standby mode to complete the test activity.

OBJECTIVES

a) Checkout of system and components

b) Verify system performance at minimum operating conditions

c) Test crew familiarization with maintaining SGS in the Alternate Diurnal Shutdown mode.

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____ °F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

This procedure is written with the assumption that the SGS is started from the Warm Standby mode. If it is not, perform the applicable portions of GSGP#2 (manual SGS Startup) or GSGP#3 (manual SGS Shutdown) to achieve the Warm Standby mode.

This test activity involves the maintaining of the steady state Alternate Diurnal Shutdown mode for a 12 hour period. Once the configuration is achieved, it will require a minimum test team involvement to monitor the three subsystems during the night time activity.

STEP	DESCRIPTION	VERIFICATION
1.	Close the Steam Shutoff valve FCV-491. Verify PT-431 pressure drops.	_____
2.	Verify control for PT-432 closes FCV 432 flow to the spray water heat exchanger.	_____
3.	Bring the steam drum water level to +6 inches.	_____
4.	Stop the Feedwater Pump and verify that FCV 401 closes due to the feedwater pressure drop.	_____
5.	Close FCV 411.	_____
6.	Verify feedwater flow is stopped to the SGS by monitoring FT-411.	_____
7.	Shutdown the cooling water pump.	_____
8.	Shutdown the cooling tower fan motors.	_____
9.	Shutdown the sampling and hydrazine feeding.	_____
10.	Stop the Spray Water Pump.	_____
11.	Verify the deaerator immersion heaters become energized by DTC-451 when TT-451 drops to 390°F.	_____
12.	Verify operation of the trace heater circuits on the SGS salt lines, shells of evaporator and superheater (see Table 4.1-1), and the TSS (see Table A) except for those listed below. Ensure that all temperatures are greater than 500°F (including drain lines and valves).	

TEH 217	TEH 236
TEH 223	TEH 238
TEH 224	TEH 239

_____

THE SGS IS NOW IN THE ALTERNATE DIURNAL SHUTDOWN CONDITION.

STEP	DESCRIPTION	VERIFICATION
13.	Maintain this configuration for a 12 hour period.	
	a) Maintain SGS water/steam pressure by restarting the Cold Salt Pump, opening FCV 341, and replacing the SGS salt inventory as required. Steam drum pressure should remain at 1100 (+50,-0) psig.	
	b) Monitor steam drum water level; maintain the level in the range between high water level alarm and low level alarm (+6 to -4 inches).	
	c) Monitor the SGS and TSS heat trace circuits (step 12) and ensure they remain greater than 500°F.	_____
14.	Perform GSGP#2 (manual SGS Startup), the Diurnal Shutdown to Warm Standby sequence.	_____

NOTE

Due to the fact that the Diurnal Shutdown mode differs from this test's Alternate Diurnal Shutdown condition, some of the actions called out for performing may have already been achieved. Proceed thru the sequence to verify the SGS, TSS, and HRFS are in the proper Warm Standby mode.

4.2.6 SGITP#6 Feedwater Loss Safe Shutdown

PURPOSE: From 50% and full steam load conditions, upon reducing the feedwater flow to zero, the control system safely shuts down the SGS to the Diurnal Shutdown mode.

DESCRIPTION: Starting from the Warm Standby mode, the SGS is manually brought to the On Line, 50% load condition. A feedwater flow trip will be performed and, by automatic and operator actions, the SGS taken to the Diurnal Shutdown mode. The SGS is then brought to the On Line, 100% load condition and again tripped by a feedwater loss indication. Upon shutting down the SGS, the final configuration will be the Diurnal Shutdown mode.

OBJECTIVES:

a) Demonstrate control system performance in reacting to a feedwater trip
   - Unit Protection System
   - Master Control System
   - Network 90

b) Verify the structural integrity of the SGS

c) Demonstrate proper interaction between the SGS, TSS, and HRFS

d) Test crew familiarization with system reaction to trips

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

SG1TP#6

This integrated test can be accomplished at any point following completion of SG1TP#2.

When encountering a feedwater loss trip (steam drum level or BWCP failure), the control systems will accomplish the following actions:

a) Unit Protection System
   - Turn off the Hot Salt Pump
   - Shut off steam flow to turbine (FCV 501)
   - Reverse power direction relay opens generator circuit breaker

b) EMCON (automatic)
   - Dump steam to the Deaerator (FCV 431)
   - Maintain control of the HRFS

c) Network 90
   - Shut off salt flow by closing FCV 301, FCV 341, and FCV 351

d) Operator Action (at EMCON console)
   - Shutdown SGS, HRFS, and TSS to Diurnal Shutdown Mode

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#1 Pretest Checklist.	_____
2.	Perform GSGP#2 (Manual SGS Startup), Warm Standby to On Line sequence. (This will achieve the on line, 30% load condition.)	_____
3.	Gradually manually increase FCV 431 to achieve a FT-311 steam flow rate of approximately 5,790 lbs/hr (50% load). Maintain this condition for 5 minutes.	_____
4.	Input a -6 inch simulated signal at LT-311 (steam drum water level-low) to trip the system.	_____
	NOTE As an alternate method to trip the level, place the FCV 411 control in manual and reduce the feedwater flow until the trip level is reached.	
5.	Verify proper response of the following control systems: a) Unit Protection System b) Master Control System c) Network 90	_____

STEP	DESCRIPTION	VERIFICATION
6.	Verify all SGS (Table 4.1-1) and TSS (Table A) trace heater circuits are operating and that all temperatures, with the exception of the following list, are greater than 500°F. TEH 217 TEH 236 TEH 223 TEH 238 TEH 224 TEH 239	_____
7.	Perform GSGP#3 (manual SGS Shutdown) steps 8 thru the end of the sequence.	_____
	NOTE The SGS is now in the Diurnal Shutdown mode.	
8.	Perform GSGP#2 (manual SGS Startup), following sequences: a) Diurnal Shutdown to Warm Standby, and b) Warm Standby to On Line condition.	_____
9.	Gradually manually increase FCV 431 to achieve a FT-311 steam flow rate of approximately 11,580 lbs/hr (100% load). Maintain this condition for 5 minutes.	_____
10.	Input TBD signal (BWCP failure) to trip the system.	_____
	NOTE As an alternate method to trip the feedwater system, turn off the FWP and wait until the steam drum water level reaches its trip level.	
11.	Verify proper response of the following control system: a) UPS b) MCS c) Network 90	_____
12.	Perform GSGP#3 (manual SGS Shutdown) steps 8 thru the end of the sequence.	_____
13.	Perform GSGP#6 Post Test Checklist.	_____

4.2.7 SGITP#7 Salt Flow Loss Safe Shutdown

PURPOSE: From 50% and full steam load conditions, upon reducing the salt flow to zero, the control system safely shuts down the SGS to the Warm Standby mode.

DESCRIPTION: Starting from the Diurnal Shutdown mode, the SGS is manually brought to the On Line, 50% load condition. A salt flow trip will be performed and, by automatic and operator actions, the SGS taken to the Warm Standby mode. The SGS is then brought to the On Line, 100% load condition and again tripped by a salt flow loss indication. Upon shutting down the SGS, the final configuration will be the Warm Standby mode.

OBJECTIVES:

a) Demonstrate control system performance in reacting to a salt flow trip
   - Unit Protection System
   - Master Control System
   - Network 90

b) Verify structural integrity of the SGS

c) Demonstrate proper interaction between the SGS, TSS, and HRFS

d) Test crew familiarization with system reaction to trips.

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS SUPPORT OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

SGITP #7

This integrated test can be accomplished at any point following the completion of SG1TP#2.

When encountering a loss of salt flow trip (Hot, Cold or Booster Pump Sump Level-high), the control systems will accomplish the following actions. These are worst case actions and SGS test configuration specific.

a) Unit Protection System

- Turn off Cold Salt Pump
- Turn off Hot Salt Pump
- Close FCV 351
- Shut off steam flow to turbine (FCV 501)
- Reverse power direction relay opens generator circuit breaker

b) Master Control System

- Dump steam to Deaerator (FCV 431)
- Maintain control of HRFS

c) Operator Action (at EMCON console)

- Bring the SGS, TSS, and HRFS to the Warm Standby mode

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#1 Pretest Checklist.	_____
2.	Perform GSGP#2 (manual SGS Startup) for the following sequences:	
	a) Diurnal Shutdown to Warm Standby.	_____
	b) Warm Standby to On Line condition. (This will achieve the on line, 30% load condition.)	_____

STEP	DESCRIPTION	VERIFICATION
3.	Gradually manually increase FCV 431 to achieve a FT-311 steam flow rate of approximately 5,790 lbs/hr (50% load). Maintain this condition for five minutes.	_____
4.	Input TBD signal (loss of salt flow) to trip the system.	_____
5.	Verify proper response of the UPS and the MCS.	_____
6.	Verify all SGS (Table 4.1-1) and TSS (Table A) trace heater circuits are operating and that all temperatures, with the exception of the following list, are greater than 500°F. TEH 217 TEH 236 TEH 223 TEH 238 TEH 224 TEH 239	_____
	NOTE The SGS is now in the Warm Standby mode. If maintaining this condition, the CSP would be cycled to maintain water/steam pressure.	
7.	Perform GSGP#2 (manual SGS Startup), the Warm Standby to On Line condition sequence. This will bring the SGS to the On Line, 30% load condition.	_____
8.	Gradually manually increase FCV 431 to achieve a FT-311 steam flow rate of approximately 11,580 lbs/hr (100% load). Maintain this condition for 5 minutes.	_____
9.	Input TBD signal (loss of salt flow) to trip the system.	_____
10.	Verify proper response of the UPS and MCS.	_____
11.	Perform GSGP#3 (manual SGS Shutdown) steps 6 thru the end of the sequence.	_____
12.	Perform GSGP#6 Post Test Checklist.	_____

4.2.8 SGITP#8 Manual Sequence Demonstration

PURPOSE: To demonstrate the manual, uninterrupted SGS Startup to the On Line condition, SGS Shutdown to the Diurnal Shutdown mode, and Salt Drain prior to checking out the automatic SGS sequences.

DESCRIPTION: The Steam Generation, Thermal Storage, and Heat Rejection and Feedwater Subsystems are started up from the Diurnal Shutdown mode to the On Line condition. This will include the following separate sequences:

- Diurnal Shutdown to Warm Standby
- Warm Standby to On Line condition

Once the three subsystems are On Line, they will be shutdown using GSGP#3 and the salt lines drained to complete the test.

OBJECTIVES:

a) Demonstrate the manual startup and shutdown sequences

b) Verify all steps required for system operation are incorporated into the SGS automatic sequences

c) Test crew familiarization with system operation

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS SUPPORT OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____°F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

SGITP#8

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#1 SGS Pretest Checklist.	_____
2.	Perform GSGP#2 SGS Startup (manual):	
	a) Diurnal Shutdown to Warm Standby sequence	
	b) Warm Standby to On Line sequence	_____
3.	Maintain the On Line condition for 5 minutes.	_____
4.	Perform GSGP#3 SGS Shutdown (manual). This will take the SGS, TSS, and HRFS to Diurnal Shutdown and drain the salt system.	_____
5.	Perform GSGP#6 SGS Post Test Checklist.	_____

4.2.9 SGITP#9 MCS Control Demonstration (Retest)

PURPOSE: To retest SGITP#2 through #8 to demonstrate the Master Control System capability of controlling the TSS, HRFS, and SGS (by sending set point and on/off commands via the Network 90 to the SGS).

DESCRIPTION: The SGS, TSS, and HRFS are started up from the Diurnal Shutdown mode to the On Line, 30% load for the beginning of SGITP#2. Testing sequence is then to perform SGITP#2 through SGITP#8 under MCS control. There will be no "hands-on" activities from the Network 90 operator's console. Final test configuration will be returning the SGS to Diurnal Shutdown. All startup and shutdown sequences will be manual.

OBJECTIVES:

a) Checkout and demonstrate MCS control of the SGS

b) Demonstrate interaction of the TSS, SGS, and HRFS

c) Demonstration of control stability

d) Test crew familiarization with system operation using only the MCS

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS SUPPORT OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____ °F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

SGITP#9

This test procedure will set up the conditions for performing SGITP#2 and will then direct which SGITPs to perform and the order. When accomplishing the actual specified SGITP, obtain a new copy of that SGITP and insert it in the OFFICIAL TEST COPY BOOK immediately following SGITP#9.

During the performance of this test, there is to be no actions made from the Bailey Operator's Console. If there are any "MONITORS" at this console, ensure the Test Conductor has approved this function.

Verify sufficient hot salt to support test requirements. If more hot salt is required, use GSGP#4 (Propane Heater) or the RS/CS to charge and build up the hot salt supply.

The Pretest and Post Test Checklists called out for performance by the individual SGITPs may be disregarded (Test Team decision) if proceeding directly from one SGITP into another.

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#7 MCS/Network 90 Integration of Control Checklist.	_____
2.	Perform GSGP#1 SGS Pretest Checklist.	_____

NOTE

Because the initial portion of GSITP#2 (Hot Salt Flow with Transients) includes the control loop tuning of 4 controllers, the following steps will start up the SGS to the On Line, 30% load condition and then direct the accomplishment of portions of SGITP#2.

3.	Perform GSGP#2 (manual SGS Startup) for the following sequences:	
	a) Diurnal Shutdown to Warm Standby sequence,	_____
	b) Warm Standby to On Line sequence.	_____
4.	Note the FCV 431 valve setting to maintain the 30% load condition (3,500 lbs/hr): _____%	_____

STEP	DESCRIPTION	VERIFICATION
5.	Vary the FCV 431 settings (from the step 4 setting) as specified below and verify correct control loop operation. Allow temperatures, pressures, and flow rates to stabilize prior to changing condition. a) Decrease to 25% loading (2,900 lbs/hr) b) Decrease to 15% loading (1,800 lbs/hr) c) Increase to 20% loading (2,300 lbs/hr) d) Return to step 4 valve setting (30% loading)	_____
6.	Gradually manually increase FCV 431 to achieve a FT-311 steam flow rate of approximately 7,000 lbs/hr (60% load).	_____
7.	Note the FCV 431 valve setting to maintain the 60% load condition (7,000 lbs/hr): ____%	_____
8.	Vary the FCV 431 settings (from the step 7 setting) as specified below and verify correct control loop operation. Allow temperatures, pressures, and flow rates to stabilize prior to changing condition. a) Decrease to 50% loading (5,800 lbs/hr) b) Decrease to 40% loading (4,600 lbs/hr) c) Increase to 50% loading (5,800 lbs/hr) d) Return to step 7 valve setting (60% load)	_____
9.	Gradually manually increase FCV-431 to achieve a FT-311 steam flow rate of 11,580 lbs/hr (100% load).	_____
10.	Perform SGITP#2 (Hot Salt Flow with Transients) step 23 thru the end of the procedure.	_____
11.	Perform SGITP#3 Diurnal Shutdown (No Salt Flow) - Overnight Test.	_____
12.	Perform SGITP#4 Load Following Test.	_____
13.	Perform SGITP#5 Alternate Diurnal Shutdown (with salt cycling) - Overnight Test.	_____
14.	Perform SGITP#6 Feedwater Loss Safe Shutdown Test.	_____
15.	Perform SGITP#7 Salt Flow Loss Safe Shutdown Test.	_____
16.	Perform SGITP#8 Manual Sequence Demonstration.	_____

4.2.10 SGITP#10 Automatic Sequence Demonstration

PURPOSE: To demonstrate and checkout the 5 SGS Automatic Sequences.

DESCRIPTION: Starting from the Diurnal Shutdown mode, the Steam Generation, Thermal Storage, and Heat Rejection and Feedwater Subsystems are brought up to the Hot Standby mode using the SGS Fill-Startup sequence. They are then taken to the On Line, 100% load condition by the SGS On-Line sequence. After maintaining this mode for 30 minutes, the SGS, TSS, and HRFS are shutdown to the Diurnal Shutdown mode with the SGS Off-Line, SGS Warmdown, and SGS Drain sequences.

OBJECTIVES:

a) Checkout and demonstrate the SGS Automatic Sequences

b) Verify total system operation under automatic control.

c) Test crew familiarization with automatic system operation

CRTF/MMC PRETEST CHECKLIST

TEST PHASE: _____

TEST IDENTIFICATION: _____

DATE OF TEST: _____

PLANNED START TIME: _____

PLANNED COMPLETION TIME: _____

RESPONSIBLE OPERATING PERSONNEL:	PRIMARY	BACKUP
TEST CONDUCTOR (MMC)	_____	_____
CONTROLS ENGINEER (MMC)	_____	_____
CONSOLE OPERATOR (CRTF)	_____	_____
OPERATION/SAFETY ENGINEER (CRTF)	_____	_____
RS/HRFS SUPPORT OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____

TEST FILE: Test File Number _____ has been approved for this test.
Startup includes _____ heliostats.
The highest liquid outlet temperature expected for the test is _____°F salt, _____ °F water/steam.

TEST CONFIGURATION: _____

_____

_____

APPROVALS:

_____
MMC Test Conductor Date

_____
MMC Controls Engineer Date

_____
CRTF O/S Engineer Date

ITP PRETEST MEETING

TEST I/D: _____

TEST FILE #: _____

Using the MCS Specification's Instrumentation Listings, define the data to be recorded and the data rate required during the performance of the specific integrated test.

Identifier	Description	Data Rate

The SGS automatic sequences are resident in PCM 3.

The automatic sequence can be prematurely aborted, in which case the operator will have the capability to command the sequence to proceed or acknowledge the abort by stopping the sequence at that step and assuming control.

STEP	DESCRIPTION	VERIFICATION
1.	Perform GSGP#1 SGS Pretest Checklist.	_____
2.	Verify the following Checklists have been completed:	
	TSS Pretest Checklist (Appendix A)	_____
	HRFS Pretest Checklist (Appendix C)	_____
	MCS Pretest Checklist (Appendix E, F, and G)	_____
	CRTF Safety Checklist	_____
3.	Perform the SGS Fill-Startup Sequence.	_____
4.	Perform the SGS On-Line Sequence. Maintain this condition for 30 minutes.	_____
5.	Perform the SGS Off-Line Sequence.	_____
6.	Perform the SGS Warmdown Sequence.	_____
7.	Perform the SGS Drain Sequence.	_____
8.	Perform GSGP#6 SGS Post Test Checklist.	_____

APPENDIX A: THERMAL STORAGE SUBSYSTEM PRETEST CHECKLIST

This Pretest Checklist will be used in conjunction with an Integrated Test Procedure.

STEP DESCRIPTION VERIFICATION

NOTE

The steps indicated with an asterisk will be accomplished as a confidence check during the initial phases of test only.

Test Configuration

1. Verify salt levels in the Cold Salt Tank, Hot Salt Tank, Cold Salt Sump and Hot Salt Sump are sufficient for Test requirements. _____

2. Inspect salt system (all piping, pumps, sumps, and valves) for evidence of leaks and insulation damage. Repair as required. _____

3. Check for visual evidence of blown fuses or burned relays in power control J-Box. _____

* 4. Verify the amperage on the active heat trace circuits. _____

LOCATION	HEATERS	ASSOC. T/Cs	CURRENT
Hot Tank Outlet	L1-2,L1-4	TEH-218, TEH-216	13.0 A
	L1-3		6.4 A
Hot Sump Outlet	L2-2	TEH-219, TEH-222	5.2 A
Sump Lines	BB/CC/DD	TEH-225, TEH-230	5.0 A
	C/D	TEH-201, TEH-202	4.0 A
	L1-1/L2-1, L4-1/L5-1	TEH-226, TEH-229	3.8 A
Cold Tank	CT-1	TEH-233, TEH-234,	15.2 A
	CT-2	TEH-235	16.5 A
	CT-3		16.6 A
	CT-4		3.7 A
	CT-5,CT-6		17.5 A
	CT-7		9.2 A
Boost Pump Lines	L4-2	TEH-231, TEH-232	5.0 A
	L4-3		3.4 A
	W	TEH-205, TEH-206	5.0 A
	B/E	TEH-203, TEH-204	5.0 A

STEP	DESCRIPTION			VERIFICATION
	Cold Tank Inlet	F/G/X	TEH-209, TEH-210, TEH-207, TEH-208 TEH-237	9.0 A
	Cold Sump	CS-1	TEH-227, TEH-228	10.0 A
		CS-2		10.3 A
		CS-3		15.2 A
		CS-4		4.9 A
	Hot Sump	HS-1	TEH-220, TEH-221	10.2 A
		HS-2		4.8 A

5. Start air compressor and verify 80 psig tank pressure. _____

6. Verify air flow through the Cold Salt Pump bearing. _____

* 7. Check zero adjust on the following valve I/P transducers:

FCV-201	Cold Sump Level Control Valve
LT 201	Cold Sump Level Transmitter
FCV-221	Hot Sump Level Control Valve
LT 221	Hot Sump Level Transmitter
FCV-241	Propane Heater Salt Flow Control Valve _____

8. Verify HV 281 Closed. _____

CAUTION

A plugged vent can cause a severe pressure difference between the tanks and sumps. The tanks are critical because of their size. Adding salt with no venting can cause an overpressure condition. Removal of salt with no vent will cause a reduced pressure. The negative allowable pressure of the hot tank is 5 psi. A greater pressure difference will pull the liner away from the insulation.

9. Verify both tanks and both sump vents are free of frozen salt. _____

STEP	DESCRIPTION	VERIFICATION

NOTE

Accomplish steps 10 and 11 only if using the Propane Heater.

10. Check level of propane tank and verify sufficient propane for the present test - 900 gallons minimum. _____

11. Check/ignited pilot lights for propane evaporators. _____

12. Inspect fan and louvers in pump house for proper operation. Set fan thermostat to 70°F. _____

* 13. Check coolant pump and radiator for leak and proper operation. _____

14. Verify coolant flow through the Hot Salt pump bearing. _____

15. Turn/verify the Hot and Cold Pump circuit breakers ON. _____

16. Verify the pump shafts are free to rotate. _____

Control Room - TSS Specific

1. Verify TSS trace heater circuits (Table A, following page) are on. _____

2. Verify TSS salt temperatures are 480°F minimum. _____

CAUTION

Operating valves when they are colder than 480°F .can result in bellow damage.

3. Verify the following valves are in their failed position.

FCV 201	Closed	FCV 231	Closed
FCV 211	Closed	FCV 241	Closed
FCV 221	Closed	FCV 242	Closed

_____

T/C	DESCRIPTION	ACUREX SCANNER #
TEH-201	Boost Sump Drain - Heater D	2
TEH-202	Cold Pump Outlet - Heater C	2
TEH-203	Boost Pump Bypass - Heater E	2
TEH-204	Boost Pump Outlet - Heater B	2
TEH-205	Boost Sump - Heater W	2
TEH-206	Boost Sump - Heater W	2
TEH-207	Boost Pump Outlet - Heater A	2
TEH-208	Boost Pump Outlet - Heater A	2
TEH-209	Cold Tank Inlet - Heater F	2
TEH-210	Cold Tank Bypass - Heater G	2
TEH-211	Riser - Storage End - Heater H	2
TEH-212	Downcomer - Storage - Heater K	2
TEH-213	Hot Tank #1	2
TEH-214	Hot Tank #2	2
TEH-215	Hot Tank #3	2
TEH-216	FCV-211, Line X	2
* TEH-217	Cold/Hot Tank Bypass - Heater AA	2
TEH-218	Hot Tank Outlet	2
TEH-219	Hot Sump Outlet	2
TEH-220	Hot Sump	2
TEH-221	Hot Sump	2
TEH-222	Hot Sump	2
* TEH-223	Propane Heater	2
* TEH-224	Propane Heater	2
TEH-225	Cold Sump Outlet	2
TEH-226	Cold Sump Outlet	2
TEH-227	Cold Sump	2
TEH-228	Cold Sump	2
TEH-229	Cold Sump Inlet	2
TEH-230	Cold Tank Inlet	2
TEH-231	FCV-201,	2
TEH-232	Cold Tank Outlet	2
TEH-233	Cold Tank #1, CT-1 thru 7	2
TEH-234	Cold Tank #2, CT-1 thru 7	2
TEH-235	Cold Tank #3, CT-1 thru 7	2
* TEH-236	Cold/Hot Tank Bypass, Heater AA	2
TEH-237	FCV-162, Heater F	2
TEH-238	FCV-242	2
* TEH-239	Propane Heater Outlet	2
TEH-240	FCV-161, Heaters A-Y, K	2
* TEH-241	FCV-151, Heater H	2

* Normally not operating during system operation.

Table A - TSS Heat Trace Instrumentation

STEP	DESCRIPTION	VERIFICATION
4.	Cycle valves FCV 211 and FCV 231, between full open and full closed. Observe operation of limit indicators.	_____
	CAUTION Opening valves FCV 201 and FCV 221 without subsystem in operation will cause overfilling the sumps.	
5.	To verify proper operation of the Unit Protection System: open valves FCV 211 and FCV 231.	_____
	. Input TBD simulated signal at LT-221 (Hot Salt Sump Level - High) and verify response to be full closure of FCV 231.	
	. Input TBD simulated signal at LT-201 (Cold Salt Sump Level - High) and verify response to be full closure of FCV 211.	_____
6.	Record tank levels (for system operating analysis).	
	Hot Storage Tank _____ in.	
	Cold Storage Tank _____ in.	_____

APPENDIX B: Thermal Storage Subsystem Post Test Checklist

This Post Test Checklist should be performed following test shutdown to verify TSS integrity. The purpose is to ensure the TSS is operational (does not require maintenance, cleaning, etc) and to reduce the time required for subsequent pretest activities.

STEP	DESCRIPTION	VERIFICATION

Control Room

1. Verify TSS trace heater circuits are ON and operating (see Table A). _____

2. Verify system temperatures are 500°F minimum. _____

3. Verify the following valves are in their failed position.

FCV 201	Closed	FCV 231	Closed
FCV 211	Closed	FCV 241	Closed
FCV 221	Closed	FCV 242	Closed

_____

4. Verify electric heaters in the Cold Salt Tank, Hot Salt Sump, and Cold Salt Sump are ON and operating. _____

5. Record salt levels in the following:

Hot Storage Tank	_____	in.
Cold Storage Tank	_____	in.
Hot Salt Sump	_____	in.
Cold Salt Sump	_____	in.

Test Configuration

1. Inspect salt system (all piping, pumps, sumps, vents, tanks, and valves) for evidence of leaks and insulation damage. Repair as required. _____

2. Check for visual evidence of blown fuses, burned relays, or burned electrical components throughout the TSS. _____

3. Check coolant pump and radiator and verify operating. _____

4. Schedule/accomplish maintenance required on any TSS component found faulty during test or post test activities. _____

APPENDIX C: HEAT REJECTION AND FEEDWATER SUBSYSTEM PRETEST CHECKLIST

This Pretest Checklist will be used in conjunction with an Integrated Test Procedure.

STEP DESCRIPTION VERIFICATION

Water Quality Circuit

1. Verify that the demineralizer water storage tank is 80% filled with acceptable quality water. Record level.
   LI-481 _____. _____

2. Make an analysis of the treated water at HV-466, and record on the Water Conditioning Data Sheet (Table B). _____

3. Align/verify valves as follows:

HV-445	Closed	HV-461	Open
HV-446	Closed	HV-463	Open
HV-447	Open	HV-464	Closed
HV-448	Open	HV-470	Open
HV-449	Open	HV-477	Open
HV-453	Open	HV-478	Closed
HV-454	Open	HV-479	Open

_____

4. Turn/verify power on to the following:

CS-485	LS-484
CS-487	LS-485
FS-480	LS-486
FS-481	Water Sample Table

_____

5. Verify water flow through dimineralizer cartridges and FCV 485, FI-481 _____. _____

6. Turn on Cycle Fill Pump. Verify flow through sample coolers:
   FS-480 _____
   PI-492 _____ _____

7. Record conductivity of:
   CS-485 _____
   CS-487 _____ _____

8. Verify that LS-485 closes FCV 485 when tank level reaches 9'-6" and FCV 485 cycles open and close as the level in demineralized water tank varies. _____

STEP	DESCRIPTION	VERIFICATION

Cooling Water Circuit

1. Align/verify valves as follows:

HV-400	Open	HV-427	Open
HV-401	Closed	HV-428	Closed
HV-411	Open	HV-429	Open
HV-412	Closed	HV-430	Open
HV-413	Open	HV-431	Open
HV-414	Open	HV-432	Open
HV-415	Open	HV-433	Closed
HV-416	Closed	HV-434	Open
HV-417	Closed	HV-435	Open
HV-418	Open	HV-436	Open
HV-419	Open	HV-437	Open
HV-421	Closed	HV-438	Closed
HV-422	Closed	HV-439	Open
HV-423	Closed	HV-440	Open
HV-424	Open	HV-441	Open
HV-425	Open	HV-442	Closed
HV-426	Open		

_____

2. Fill the circuit by operating glycol booster pump and cooling water pump with 40% ethylene glycol and 60% water, using demineralized water and inorganic salt inhibitor, DOWTHERM SR-1 or similar, and venting all high point valves, as well as, HV-412, HV-428, HV-433, HV-438, and condenser vents HV-593 and HV-598. Verify flow through precoolers in water sample table by FS-481. _____

3. Drain coolant from expansion tank to lower level of 1 inch above bottom of LI-483. _____

4. Close HV-418 on discharge of glycol pump and vent expansion tank to 3 psig. _____

STEP	DESCRIPTION	VERIFICATION

Spray Water, Feedwater, and High Pressure Steam Circuits

1. Align/verify valves as follows:

HV-403	Closed	HV-481	Open
HV-404	Closed	HV-482	Closed
HV-405	Open	HV-483	Closed
HV-450	Open	HV-484	Closed
HV-451	Open	HV-485	Closed
HV-452	Open	HV-486	Closed
HV-455	Closed	HV-487	Open
HV-456	Open	HV-488	Open
HV-457	Open	HV-489	Closed
HV-460	Open	HV-490	Closed
HV-462	Open	HV-491	Open
HV-465	Open	HV-492	Open
HV-466	Closed	HV-493	Closed
HV-467	Open	HV-494	Open
HV-471	Open	HV-495	Closed
HV-472	Closed	HV-496	Open
HV-473	Open	HV-497	Open
HV-474	Open	HV-498	Closed
HV-475	Closed	HV-499	Open
HV-476	Closed		

2. Adjust the layup water in the deaerator to centerline of deaerator level (106'-0-5/8") by draining through strainer valves HV-455 or HV-465 or by adding through HV-402 on the CMU line from the cycle fill pump.

3. Verify the high pressure steam piping is drained from layup water and is blanketed with nitrogen.

Instruments and Controls

1. Check for visual evidence of blown fuses or burned relays in power control J-Box.

2. Start air compressor and verify 80 psig tank pressure.

STEP	DESCRIPTION	VERIFICATION

3. Set the adjust points of the following control devices to the listed set points. Confirm settings.

FCV 401	PT-401	1200 Psi
FCV 411	FT-411	SGS input
FCV 421	TT-421	550°F
FCV 431	PT-432	233 psi
FCV 432	PT-432	250 psi
(Alternate Turbine Operating Mode)		
FCV 435	PT-432	265 psi
(Transient Steam Flows)		
DTC-451	TT-451	390°F
FCV 471	LT-471	12 inches
CMU Pump	LT-471	8 inches

4. Cycle the following valves between full open and full closed. Observe operation of limit indicators.

FCV 401	Feedwater Recirculation
FCV 411	Feedwater Flow Control
FCV 421	Steam Flow Control
FCV 431	Flow Control/Steam Pressure
FCV 432	Spray Water Diverter
FCV 435	Steam Vent
FCV 471	Condensate Flow Control
FCV 483, FCV 484	Deaerator Vents
FCV 491	Steam Flow Control

5. Verify correct switch settings:

a) Conductivity

1)	CS-485	5 microohms
2)	CS-487	5 microohms

b) Flows

1)	FS-480	10 gpm
2)	FS-481	15 gpm

STEP	DESCRIPTION	VERIFICATION

c) Level

1)	LS-451	Level 104'-10-5/8"
2)	LS-452	Level 107'-2-5/8"
3)	LS-484	6'-4"
4)	LS-485	9'-6"
5)	LS-486	5'-0"

d) Temperature

1)	TS-481	TBD	_____

6. Verify the following valves in their failed position:

FCV 401	Open	FCV 435	Closed	
FCV 411	Closed	FCV 471	Closed	
FCV 421	Open	FCV 483	Closed	
FCV 431	Open	FCV 484	Closed	
FCV 432	Bypass Spray Water Heater	FCV 491	Closed	_____

Table B-1 WATER CONDITIONING DATA SHEET 1

Quality Control Limits

SAMPLE	IN-LINE MONITORS	CHEMICAL ANANYSIS							
		O_2(ug/1)	N_2H_4(ug/1)	NH_3(ug/1)	Alk(mg/1)	SiO_2(ug/1)	PO_4(mg/1)	Fe(ug/1)	Cl^-(mg/1)
1) D.D. Effluent	Temp.	Max 5 (D)		0.0 (W)	0-4 (D)	Max 20 (W)			
2) D.D. Spray Water	Temp. Cation Cond Spec. Cond				0-4 (W)			Max 5 (W)	0.0 (W)
3) Condensate Pump Discharge	Temp. Cation Cond Spec. Cond O_2	Max 5 (D)	20-100 (D)	0.0 (W)		Max 20 (W)	0.0 (W)	Max 5 (W)	
4) Steam to D.D.(Steam after RRV)	Temp. Spec. Cond						0.0 (W)		0.0 (W)
5) Condensate after Chemical Feed	Temp. Spec. Cond pH	Max 5 (D)	20-100 (D)		0-4 (D)			Max 5 (W)	0 (W)
6) SGS Sample Station (Steam Drum)	Temp. Spec.Cond Cation Cond pH	Max 5 (W)	20-100 (D)	0.0 (W)	0-4 (W)	Max 20 (W)	3-5 (D)		0.0 (W)
Cycle Fill Pump (Local Sample)					Hardness 0.0 (D)				0.0 (W)
D.I. Effluent (Local Sample)	Spec. Cond				Hardness 0.0 (D)				0.0 (W)

D - Daily
W - Weekly

Continuous monitors displayed on EMCON: line 5-CC-486; DOT 480
line 3-CC-482

Table B-2 WATER CONDITIONING DATA SHEET 2

SAMPLE	IN-LINE MONITORS	pH	SPEC. COND. $\left(\frac{\text{umho}}{\text{cm}}\right)$	TDS (mg/1)
1) D.D. Effluent	Temp.	8.8-9.2 (D)	5-10 (W)	
2 D.D. Spray Water	Temp. Cation Cond. Spec. Cond.	8,8-9.2 (W)	5-10 (D)	
3) Condensate Pump Discharge	Temp. Cation Cond. Spec. Cond. O_2	8.8-9.2 (D)	5-10 (W)	Max 10
4) Steam to D.D. (Steam after PRV)	Temp. Spec. Cond.	8.8-9.2 (D)	5-10 (W)	
5) Condensate after Chemical Feed	Temp. Spec. Cond. pH	8,8-9.2 (D)	5-10 (D)	Max 10
6) SGS Sample Station (Steam Drum)	Temp. Spec. Cond. Cation Cond. pH	9.5-10.5 (D)	20-40 (D)	Max 10
Cycle Fill Pump (Local sample)		6.7-8.3 (D)	Max 1.0 (D)	
D.I. Effluent (Local sample)	Spec. Cond.	6.7-8.3 (D)	Max 1.0 (D)	

* Grab samples for conductivity will be measured by a Markson conductivity meter and solids will be measured by a chemetrics TDS meter.

APPENDIX D: HEAT REJECTION AND FEEDWATER SUBSYSTEM POST TEST CHECKLIST

This Post Test Checklist will be used in conjunction with an Integrated Test Procedure. The purpose is to ensure the HRFS is operational (does not require maintenance, cleaning, etc.) and to reduce the time required for subsequent pretest activities.

STEP DESCRIPTION — VERIFICATION

Control Room

1. Verify the following valves in their failed position:

FCV 401	Open	FCV 435	Closed
FCV 411	Closed	FCV 483	Closed
FCV 421	Open	FCV 484	Closed
FCV 431	Open	FCV 491	Closed
FCV 432	Bypass Spray Water Heater		

Test Configuration

1. Inspect the water/steam system for evidence of leaks and insulation damage. Repair as required. _____

2. Check for visual evidence of blown fuses or burned relays in the power control J-Box.

3. Check the cooling tower fans for any obstructions to operation. _____

4. Adjust the layup water in the deaerator to centerline of deaerator level (106') by draining through strainer valves HV-455 or HV-465 or by adding through HV-402 on the CMU line from the cycle fill pump. _____

5. Schedule/accomplish maintenance required on any HRFS component found faulty during test or post test activities. _____

STEP	DESCRIPTION	VERIFICATION

EMCON D/2 HOST START-UP CHECKLIST

1. Equipment powered up:

   a. Host cabinet
   b. Operator Console 1
   c. Operator Console 2
   d. (2) LA-120 Terminals
   e. VT-100 Terminal
   f. Tri-log printer _____

2. Disk Packs (2) installed in drives, disk drives running with "READY" lamp lit. _____

3. EMCON system booted and "START-UP" command file executed:

   a. Correct date and time
   b. Disk unit DL1 mounted
   c. CCM, PCM's loaded (optional)
   d. EMCON host programs running

1.	SPNCOL	5.	CONSL2
2.	POWER	6.	CONSL1
3.	ALRMMX	7.	SYSMON
4.	ALARMS	8.	TRACKR

_____

4. MSSND program executing when data logging/display is required on the Auxiliary Data Logging/Display System. _____

EMCON SHUTDOWN

1. Terminate MSSND execution. _____

2. Execute "SHUT UP" command file

   a. No devise modifications _____

3. Spin down disk drives. _____

4. Turn off power to equipment. _____

APPENDIX F: ACUREX STARTUP/SHUTDOWN CHECKLISTS

STEP	DESCRIPTION	VERIFICATION

ACUREX START-UP CHECKLIST

1. Equipment powered up:

    a. Host chassis - Autodate Ten/50
    b. Electrohome monitor
    c. GT-100 Terminal
    d. Texas Instruments 820 RO Terminal _____

2. Tape Cassette loaded in host drive. _____

3. Recent (within TBD minutes) log-out of temperatures available on Tl printer. _____

ACUREX SHUTDOWN

1. Terminate host operation via key switch control. _____

2. Turn off power to equipment. _____

APPENDIX G: AUXILIARY DATA LOGGING/DISPLAY CHECKLISTS

STEP	DESCRIPTION	VERIFICATION

AUXILIARY DATA LOGGING/DISPLAY SYSTEM STARTUP

1. Equipment powered up:

    a. H-P 1000 Cabinet
    b. H-P 2645 Terminal
    c. H-P 2621 Terminal
    d. Tektronix 4014 Terminal
    e. Tektronix 463 hard-copy unit
    f. (6) Display CRT's
    g. Versatec Video Copier
    h. Versatec Printer
    i. H-P 7925 Disc Drive _____

2. Disk pack installed in drive, disc drive running with "READY" lamp lit. _____

3. System booted:

    a. Correct date and time
    b. Transfer file IMSRP executed

4. MSPAS program executing when data logging/display is required and MSSND has been started on the EMCON host. _____

5. Following support programs available for execution:

    a. MSRTP
    b. MSPSU
    c. MSDSD
    d. MSSL1 thru MSSL6
    e. MSCDT _____

SHUTDOWN

1. Terminate programs. _____

2. Spin down disc drive. _____

3. Turn off power to equipment. _____