CONTRACTOR REPORT

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UC-62c
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10 MWe Solar Thermal Central Receiver Pilot Plant Mode 5 Charging Only Acceptance Test Procedure 1150

McDonnell Douglas Astronautics Company
Huntington Beach, Ca

Prepared by Sandia National Laboratories, Albuquerque, New Mexico 87185 and Livermore, California 94550 for the United States Department of Energy under Contract DE-AC04-76DP00789.

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Huntington Beach, California

ABSTRACT

This document provides the detailed test procedure followed for Mode 5--Storage Charging Acceptance Testing. Results will be reported in a separate document to be published in 1985.

MODE 5 - CHARGING ONLY

ACCEPTANCE TEST

PROCEDURE 1150

REVISION: 0

OCTOBER 1982

PREPARED FOR SANDIA NATIONAL LABORATORIES
UNDER CONTRACT NO. 84-8173

10 MWe SOLAR PILOT PLANT

DAGGETT, CALIFORNIA

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
HUNTINGTON BEACH, CALIFORNIA

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APPROVED BY: R. L. Gervais

MODE 5 - CHARGING ONLY ACCEPTANCE TEST (1150)

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1.0 OBJECTIVES

During Mode 5 (Charging Only) operation, the plant is operated in a "sun following" control strategy under manual control. All of the receiver steam flows to the thermal storage charging heat exchangers to heat the Thermal Storage Unit oil. The total steam flow and resulting charge rate may fluctuate significantly depending on the amount of thermal (solar) power supplied to the plant. Operator control over input power is limited to commanding selected heliostats to "Track" or "Standby".

The overall objective of the 1150 test series is to demonstrate satisfactory Mode 5 operation in all possible control/operating configurations associated with this mode. The objective is also to verify published operating procedures or to modify the procedures as required to satisfy the operating intent of the plant. The actual procedures themselves (step-by-step activities) will be evaluated against currently published operating procedures. In the event selected steps of the procedure do not produce the desired condition or better ways of achieving the desired conditions are identified, the operating procedures will be revised to support subsequent testing.

It is also the intent of this procedure to gather limited quantities of plant performance data from which initial performance evaluations can be made. Subsequent operational tests can be geared to specific performance studies which may arise as a result of preliminary data analysis. The subsections and flow of the 1150 test procedure are shown in Figure 1-1, with the composite (charging and extraction) Thermal Storage Subsystem (TSS) Piping and Instrumentation Diagram (P&ID) in Figure 1-2.

1.1 Charging Heat Exchanger Startup

1.1.1 Verify the proper startup of a single charging heat exchanger train and transition from flow to the steam dump system to steady-state Mode 5 charging.

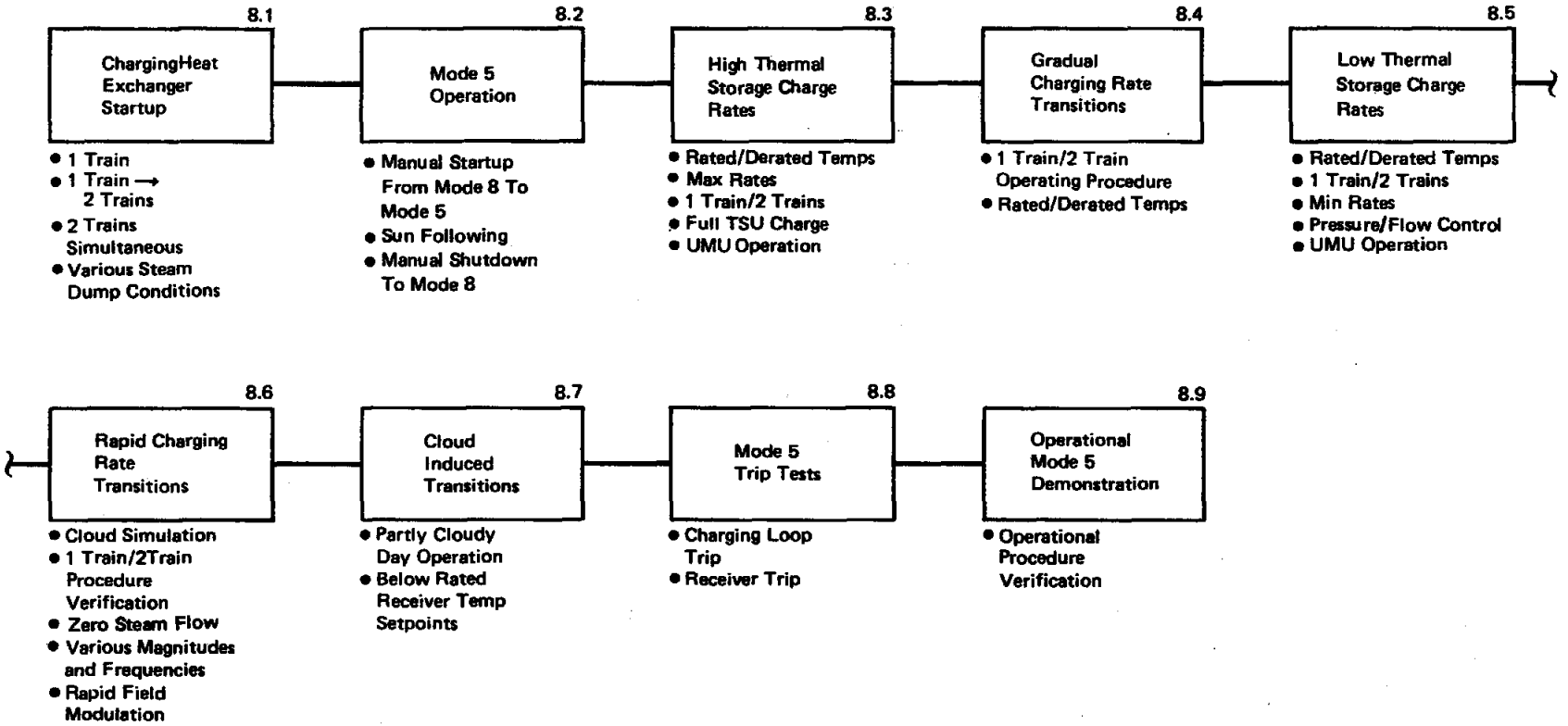

Figure 1-1. 1150 (Mode 5) Test Flow

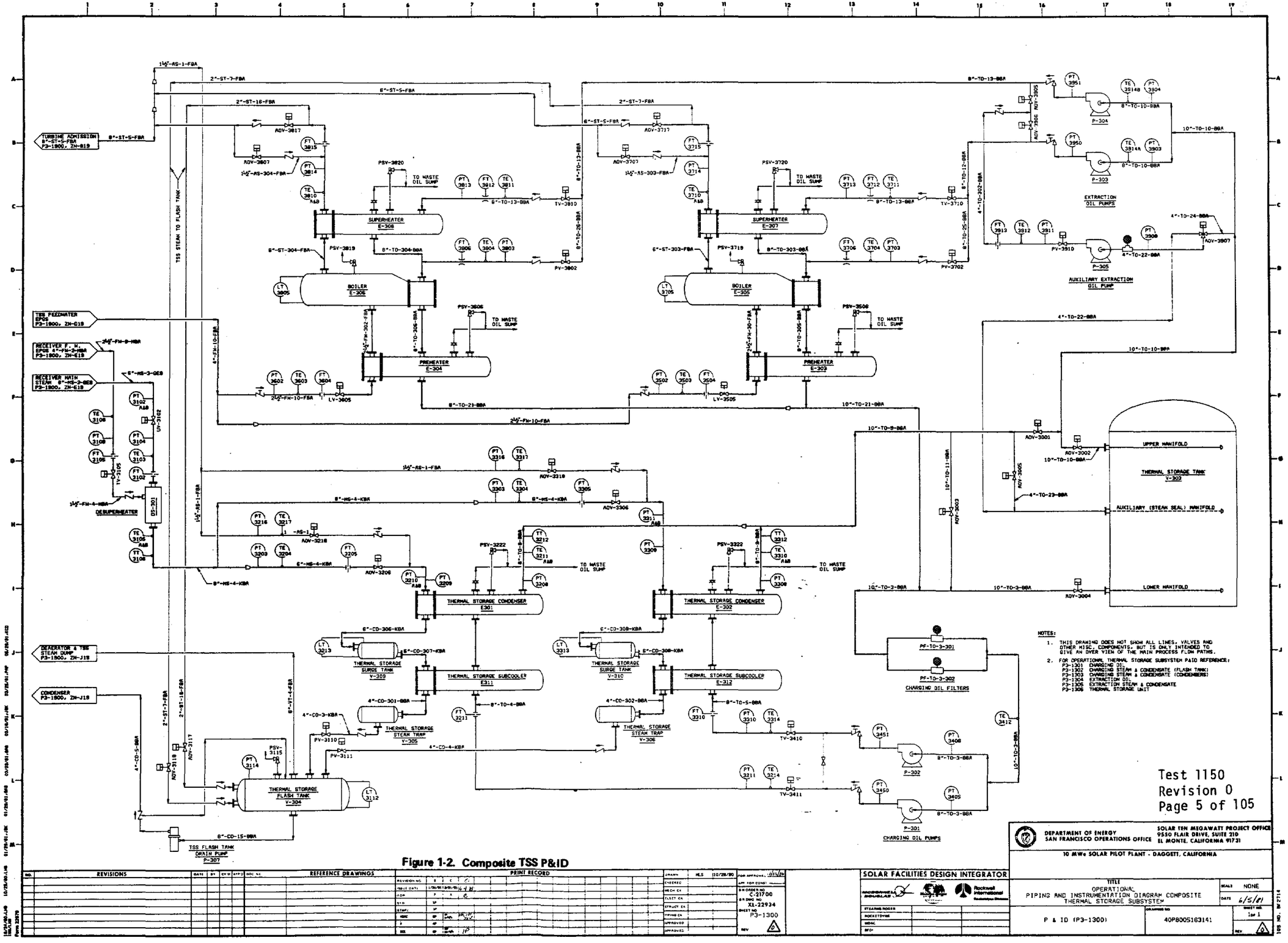

Figure 1-2. Composite TSS P&ID

DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

SOLAR TEN MEGAWATT PROJECT OFFICE
9550 FLAIR DRIVE, SUITE 210
EL MONTE, CALIFORNIA 91731

10 MWe SOLAR PILOT PLANT - DAGGETT, CALIFORNIA

SOLAR FACILITIES DESIGN INTEGRATOR

TITLE: OPERATIONAL PIPING AND INSTRUMENTATION DIAGRAM COMPOSITE THERMAL STORAGE SUBSYSTEM

P & ID (P3-1300)

40P8005163141

SCALE: NONE

DATE: 6/5/81

SHEET NO. 1 OF 1

REV. 0

P3-1300

REVISIONS | REFERENCE DRAWINGS | PRINT RECORD

1.1.2 Verify the proper startup of a single charging heat exchanger train followed (in series) by the startup of the second train and transition from steam dump flow to steady-state Mode 5 charging.

1.1.3 Verify the proper simultaneous startup of both charging heat exchanger trains and transition from steam dump flow to steady-state Mode 5 charging.

1.1.4 Demonstrate that the charging heat exchanger trains can be started satisfactorily from rated, derated and intermediate temperature steam dump flow conditions.

1.2 Mode 5 Operation

1.2.1 Demonstrate that the plant can be manually started from Mode 8 (Inactive) and transition into Mode 5 operation in a satisfactory manner.

1.2.2 Demonstrate stable, sun-following operation in Mode 5.

1.2.3 Demonstrate that the plant can be shut down manually from Mode 5 to Mode 8 in a satisfactory manner.

1.3 High Thermal Storage Charge Rates

1.3.1 Demonstrate Stable and Controlled Mode 5 operation at high steam flow rates and at both rated and derated receiver steam temperatures.

1.3.2 Determine the maximum thermal storage charge rates for operation of both one and two charging heat exchanger trains.

1.3.3 Demonstrate the capability to fully charge the Thermal Storage Unit (TSU).

1.3.4 Observe the behavior of the TSU thermocline as a function of time and initial conditions at maximum charge rates.

1.3.5 Observe the composition of the TSU ullage gas as determined by the Oxygen Analyzer.

1.3.6 Verify the proper operation of the Ullage Maintenance Unit (UMU) at maximum charge rates.

1.4 Gradual Charging Rate Transitions

1.4.1 Demonstrate stable and controlled Mode 5 operation during gradual transitions between high and low steam flow rates and between rated and derated receiver steam temperatures.

1.4.2 Develop the procedure for one and two charging heat exchanger train operation during transitions between high and low charging rates.

1.4.3 Establish flow conditions for the determination of the minimum stable Mode 5 operating points.

1.5 Low Thermal Storage Charge Rates

1.5.1 Demonstrate stable and controlled Mode 5 operation at low steam flow rates and at both rated and derated receiver steam temperatures.

1.5.2 Determine the minimum stable thermal storage charge rates for operation of both one and two charging heat exchanger trains (both pressure and flow control operation).

1.5.3 Observe the behavior of the TSU thermocline as a function of time and initial conditions at minimum charge rates.

1.5.4 Observe the composition of the TSU ullage gas as determined by the Oxygen Analyzer.

1.5.5 Verify the proper operation of the Ullage Maintenance Unit at minimum charge rates.

1.6 Rapid Charging Rate Transitions

1.6.1 Demonstrate stable and controlled Mode 5 operation during rapid transitions (various magnitudes and frequencies) between high and low (and zero) steam flow rates and between rated and derated receiver steam temperatures (simulated cloud transients).

1.6.2 Verify the procedure for one and two charging heat exchanger train operation during rapid transitions between high and low charging rates.

1.7 Cloud Induced Transitions

1.7.1 Demonstrate stable and controlled Mode 5 operation during cloud induced transients with receiver steam temperature setpoints between rated and derated levels.

1.7.2 Gather manual control Mode 5 plant operating data during cloud passages.

1.8 Mode 5 Trip Tests

1.8.1 Demonstrate that controlled and stable receiver operations can be maintained through the steam dump system following a trip of the thermal storage charging loop which occurs during steady-state Mode 5 operation.

1.8.2 Demonstrate that the charging system can be successfully re-started following a charging loop trip.

1.8.3 Demonstrate satisfactory system response to a receiver trip which occurs during steady-state Mode 5 operation.

1.9 Operational Mode 5 Demonstration

1.9.1 Demonstrate satisfactory/operation of the plant utilizing the operational procedure developed during the 1040B/1150 test series.

	Verification Paragraph	Objective
2.0 ACCEPTANCE CRITERIA		
2.1 Charging Heat Exchanger Startup		
2.1.1 A single charging heat exchanger train can be properly started and transitioned from flow to the steam dump system to steady-state Mode 5 charging.	8.1.1	1.1.1
2.1.2 Both charging heat exchanger trains can be properly started in series and transitioned from steam dump flow to steady-state Mode 5 charging.	8.1.2	1.1.2
2.1.3 Both charging heat exchanger trains can be properly started simultaneously and transitioned from steam dump flow to steady-state Mode 5 charging.	8.1.3	1.1.3
2.1.4 The charging heat exchanger trains can be started satisfactorily from rated, derated and intermediate temperature steam dump flow conditions.	8.1.1 8.1.2 8.1.3	1.1.4
2.2 Mode 5 Operation		
2.2.1 The plant can be manually started from Mode 8 (Inactive) and transition into Mode 5 operation in a satisfactory manner.	8.2.1	1.2.1

		Verification Paragraph	Objective
2.2.2	The plant can be operated stably during sun-following Mode 5.	8.2.2	1.2.2
2.2.3	The plant can be shut down manually from Mode 5 to Mode 8 in a satisfactory manner.	8.2.3	1.2.3
2.3	High Thermal Storage Charge Rates		
2.3.1	Stable and controlled Mode 5 operation is maintained at high steam flow rates and at both rated and derated receiver steam temperatures.	8.3.1 8.3.2	1.3.1
2.3.2	The maximum thermal storage charge rates are determined for operation of both one and two charging heat exchanger trains.	8.3.1 8.3.2	1.3.2
2.3.3	The TSU can be fully charged.	8.3.3	1.3.3
2.3.4	Data are gathered and recorded concerning the behavior of the TSU thermocline as a function of time and initial conditions at maximum charge rates.	8.3.1 8.3.2	1.3.4
2.3.5	Data are gathered and recorded regarding the composition of the TSU ullage gas as determined by the Oxygen Analyzer.	8.3.4	1.3.5

		Verification Paragraph	Objective
2.3.6	The UMU operates properly at maximum charge rates.	8.3.1 8.3.2	1.3.6
2.4	Gradual Charging Rate Transitions		
2.4.1	Stable and controlled Mode 5 operation is maintained during gradual transitions between high and low steam flow rates and between rated and derated receiver steam temperatures.	8.4	1.4.1
2.4.2	The procedure is developed for one and two charging heat exchanger train operation during transitions between high and low charging rates.	8.4	1.4.2
2.4.3	Flow conditions are established for the determination of the minimum stable Mode 5 operating points.	8.4	1.4.3
2.5	Low Thermal Storage Charge Rates		
2.5.1	Stable and controlled Mode 5 operation is maintained at low steam flow rates and at both rated and derated receiver steam temperatures.	8.5.1 8.5.2	1.5.1

		Verification Paragraph	Objective
2.5.2	The minimum thermal storage charge rates are determined for operation of both one and two charging heat exchanger trains (both pressure and flow control operation).	8.5.1 8.5.2	1.5.2
2.5.3	Data are gathered and recorded concerning the behavior of the TSU thermocline as a function of time and initial conditions at minimum charge rates.	8.5.1 8.5.2	1.5.3
2.5.4	Data are gathered and recorded regarding the composition of the TSU ullage gas as determined by the Oxygen Analyzer.	8.5.3	1.5.4
2.5.5	The UMU operates properly at minimum charge rates.	8.5.1	1.5.5
2.6	Rapid Charging Rate Transitions		
2.6.1	Stable and Controlled Mode 5 operation is maintained during rapid transitions (various magnitudes and frequencies) between high and low (and zero) steam flow rates and between rated and derated receiver steam temperatures (simulated cloud transients).	8.6	1.6.1

		Verification Paragraph	Objective
2.6.2	The procedure is verified for one and two charging heat exchanger train operation during rapid transitions between high and low charging rates.	8.6	1.6.2
2.7	Cloud Induced Transitions		
2.7.1	Stable and controlled Mode 5 operation is maintained during cloud induced transients with receiver steam temperature set-points between rated and derated levels.	8.7	1.7.1
2.7.2	Manual control Mode 5 plant operating data are gathered and recorded during cloud passages.	8.7	1.7.2
2.8	Mode 5 Trip Tests		
2.8.1	Controlled and stable receiver operations are maintained through the steam dump system following a trip of the thermal storage charging loop which occurs during steady-state Mode 5 operation.	8.8.1	1.8.1
2.8.2	The charging system can be successfully re-started following a charging loop trip.	8.8.2	1.8.2

		Verification Paragraph	Objective
2.8.3	Satisfactory system response to a receiver trip which occurs during steady-state Mode 5 operation.	8.8.3	1.8.3
2.9	Operational Mode 5 Demonstration		
2.9.1	Satisfactory operation of the plant utilizing the operational procedure developed during the 1040B/1150 test series.	8.9	1.9.1

3.0 REFERENCES

3.1 Pilot Plant System Documentation

3.1.1 Pilot Plant System Description (RADL Item 2-1), Revised Sept. 1982.

3.1.2 Pilot Plant Startup and Acceptance Test Plan (RADL Item 2-46), Dec. 1980

3.1.3 Plant Operating/Training Manual (RADL Item 2-36), July 1982

3.1.4 Test Operations Plan (Draft), Sandia, May 1982

3.2 Logic Diagrams

3.2.1 MVCU Controller Functional Block Diagrams, Issued 7 May 1982

3.2.2 Overall Plant Trip Logic, Rev. 1, Oct. 24, 1981

3.3 Line Schedules

A. Auxiliary Steam (AS)
B. Bearing Cooling Water (BW)
C. Condensate (CO)
D. Circulating Water (CW)
E. Plant Drains (DR)
F. Demineralized Water (DW)
G. Equipment Cooling Water (EW)
H. Feedwater (FW)
I. Heptane (HP)
J. Main Steam (MS)
K. Nitrogen (N)
L. Instrument Air (NA)
M. Oily Water Drains (OW)
N. Raw Water (RW)

O. Service Air (SA)
P. Steam (Incl. Traps) (ST)
Q. Service Water (SW)
R. Thermal Oil (TO)
S. Ullage Gas (UG)
T. Vents (Incl. Relief Valves) (VT)

3.4 Single Line Diagrams

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E. 40E700 5133192, 480 V. MCC B
F. 40E700 5133193, 480 V. MCC C
G. 40E300 5132029, Load Center "A" and Receiver F.W. Pump
H. 40E700 5132120, Low Voltage AC and DC Distribution
I. 40E700 5133121, 480 V. MCC 1, 2, 3, 4
J. 40E700 5133262, Three Line Diagram 480 V. Load Center A
K. 40E900 5133352-3, 13.8 KV System
L. 40E900 5133355-1, 480 V. Switchgear B02 and
480 V. Motor Control Center B0L
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N. P3-1903, Feedwater and Condensate System
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P. P3-1905, Equipment Cooling Water System
Q. P3-1906, Circulating Water System
R. P3-1907, Sumps and Drains System
S. P3-1909, Sampling System
T. P3-1910, Condensate Polishing System
U. P3-1911, Service Water System
V. P3-1914, Instrument Air and Service Air Systems
W. P3-1915, Miscellaneous Systems

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GGGG. Control Loop Diagrams (RADL Item 2-37, Supplement - Part II - EPGS Control Loop Diagrams)

3.7 Instrument Index

3.7.1 Master Equipment List (MEL)

3.7.2 Measurements List

3.7.3 Master Information File (MIF)

3.8 Material Requisition and/or Specification

N/A

3.9 Vendor Data

N/A

3.10 Standards

N/A

3.11 Startup Schedule

3.11.1 10 MWe Pilot Plant Schedule, Start-Up and 2 Year Experimental Testing Phase

	Initial	Date
4.0 PREREQUISITES		
4.1 Turnover of the system to SCE is complete and in accordance with Section 5.4 of the SCE Startup Manual.		
4.2 Referenced material has been reviewed and later revision (if any) will not affect this test.		
4.3 The Master Tracking System has been reviewed and outstanding items (if any) will not affect this test. A summary list of outstanding items is attached on Appendix 10A.		
4.4 The Abnormal Equipment and Circuitry Log has been reviewed, is current, and is satisfactory for this test. A summary list is attached on Appendix 10B.		
4.5 The system has been walked through and verified complete to the extent required to conduct this test.		
4.6 Related prerequisite and preoperational tests (Test numbers 000-980) have been completed to the extent required to demonstrate the operability of the plant systems required for this test.		

	Initial	Date
4.7 Verify that all necessary control development tests (1010, 1030, and 1040) have been completed to the extent required to operate the TSS charging system over its entire operating range. Also, since it will be necessary to discharge the TSU periodically to permit the execution of 1150 tests, 1150 tests and 1160 (Storage Discharging) tests will be performed on an overlapping basis. Therefore, also verify that 1040 tests have been completed to the extent required to satisfactorily discharge the TSU to the levels required for 1150 tests.		
4.8 All test equipment as per Section 6.0 is available, calibrated, and in working order.		
4.9 The data base in the CCM and MVCU and control loop diagrams for the control loops under test have been validated and updated to proper test configuration.		
4.10 A pretest coordination meeting has been held to familiarize test and operations personnel with requirements of this test.		

5.0 LIMITS AND PRECAUTIONS

5.1 This test involves the use of redirected power on to the receiver. As a result, no personnel are permitted on or above the 15th tower level during these operating periods. Test personnel are permitted however in remote station #1 at the 13th and 14th level (see Section 5.10).

5.2 High temperature, high pressure steam and feedwater and high temperature oil will be flowing throughout the plant including the thermal storage equipment. Care should be exercised when working around any operating or flowing system. Avoid areas exposed to safety valve discharges.

5.3 Opening of the system for inspection, maintenance, or repair should be done only after internal temperatures and pressures have reached ambient conditions and proper clearances have been received.

5.4 The heliostat field should be kept clear of unattended vehicles. Personnel working in the collector field must be in communication with the control room and be working under the direction of the control room operator (see Section 5.10).

5.5 Visual inspections of hot areas should only be accomplished after cooldown and under extremely guarded conditions after proper clearances have been received.

5.6 Groups of 2 or more heliostats in one quadrant shall not perform simultaneous wire walks during operating hours without "alarming" personnel in the field and on the tower (see Section 5.10).

5.7 In case of a power failure or sustained dropout, tracking heliostats shall be directed to face up stow position.

5.8 Operating personnel should be familiar with emergency procedures involving defocus of the collector field during normal operation and following loss of primary field power.

5.9 During high power portions of this test procedure, the steam flow produced by the receiver can exceed the maximum TSS charging limitation. Therefore some reduction of collector field operation may be required.

5.10 SAFETY POLICIES

5.10.1 Introduction

The following outlines the Safety Policies that will be followed during the Thermal Storage Test (1150) period. In addition to these Safety Policies, all personnel involved in the program are encouraged to read and understand the SCE Accident Prevention Manual (APM). Questions regarding these rules should be directed to your immediate supervisor.

ONLY AUTHORIZED PERSONNEL will be allowed in the Collector Field, Receiver Tower, Core Area or Control Room during actual test periods. AUTHORIZED PERSONNEL are those individuals who have obtained approval from the Operating Foreman and/or who have previously demonstrated familiarity with the solar facilities design and the safety procedures.

5.10.2 General

A. SCE Accident Prevention Rules and Solar One Generating Station Operating Procedures shall be followed when working on all process and electrical distribution systems. Particular emphasis will be placed on SCE Clearance Procedures as defined in the APM.

B. In the event of an accident, SCE and DOE shall be notified and SCE will conduct an inquiry to identify the cause of the accident and take measures necessary to prevent its recurrence.

C. All personnel involved in testing and operations shall be cognizant and understand these Safety Policies. It will be the responsibility of ALL supervisors to insure these Safety Policies are followed.

D. SCE Control Operators shall have prior knowledge of ALL personnel working in a hazardous area, and will maintain communication with these personnel by use of radios or pagers.

E. ALL personnel shall obtain approval from the Operating Foreman BEFORE entering designated hazardous areas or working on any equipment. Personnel shall be notified by the Control Operator of any designated hazardous areas related to the requested approval.

F. ALL control systems related to Thermal Storage (1150) Testing shall be in good working condition.

G. A warning system shall be devised to indicate; test start, wire walk, stray heliostat, emergency stow, and test end. This warning system could be a sequence of whistle soundings, a public address message or flashing lights.

H. Identification badges will be issued to all personnel and shall be worn in a conspicuous location by everyone.

I. Hard hats shall be worn by all personnel within the plant area.

J. The Operating Foreman shall be notified immediately of any abnormal or hazardous situations observed.

5.10.3 Guests

A. Guests shall be accompanied by a qualified person when entering Collector Field, Receiver Tower, Core Area or Control Room during non operating periods. Guests will not normally be allowed in these areas during operating periods.

B. Guests on an exception basis may be allowed in the Collector Field, Receiver Tower, Core Area or Control Room during operating periods with the approval of the Operating Foreman and accompanied by AUTHORIZED PERSONNEL at all times.

C. Use of cameras shall be allowed only with the appropriate approvals. The Security Officer should be contacted regarding approval authority.

D. Temporary identification badges shall be issued by plant security and worn in a conspicuous location.

5.10.4 Collector Field

A. ONLY AUTHORIZED PERSONNEL shall be allowed in the Collector Field during its operation and only with the approval of the Operating Foreman. This limitation applies to the access roads leading to and from the Core Area.

B. AUTHORIZED PERSONNEL working in the Collector Field shall carry and wear, as required, safety approved dark glasses and maintain communication with the Control Operator by use of radios or pagers.

C. Personnel working in the Collector Field with motorized vehicles shall not leave vehicles unattended unless the Control Operator has cleared that area specifically for that purpose.

D. The Weather Station Towers are "OFF LIMITS" to all personnel during testing.

E. In the event of loss of electrical power, the Collector Field shall be cleared.

F. All heliostats involved in testing shall normally be placed in "standby" before sunrise. These heliostats shall normally not be moved to face down stow until after sunset, except in emergency conditions or in accordance with test requirements, and after an appropriate warning signal.

G. Wire walks involving the southeast quadrant should be initiated only from the ALT-1 stow position.

H. If more than two heliostats in one quadrant are required to wire walk, a wire walk notification shall be given.

I. Areas designated "Location of Bottom of Wire Walk" shall be marked in a conspicuous manner and will immediately be evacuated when the "wire walk" alarm is sounded.

J. Established "wire walks" will be used when moving heliostats between stow and "standby".

K. Sun images on heliostats should not be viewed intentionally with the naked eye or through any type of lensed mechanism.

5.10.5 Receiver Tower

A. ONLY AUTHORIZED PERSONNEL will be allowed on the Receiver Tower during testing.

B. Receiver Tower access shall normally be made by the elevator and limited to times when heliostats are in "standby" or "track" and only with the approval of the Operating Foreman. Movement up and down the Receiver Tower during wire walk periods shall be limited to emergency situations and requires the approval of the Operating Foreman.

C. Receiver panels should not be viewed directly by the naked eye or through any type of lensed mechanism.

D. Hazardous areas shall be posted and local danger spots safety striped. These areas are to be avoided during wire walks.

E. Personnel shall be restricted from the fifteenth level (directly above the BCS targets) during Receiver operation or with any portion of the Collector Field in track except for special situations left up to the discretion of the Operating Foreman. Dark glasses shall be used as protection from Receiver brightness.

6.0 TEST EQUIPMENT

NOTE: Depending on the results of specific plant stability tests, some or all of the following test equipment may be required. Test equipment equivalent to that specified may be used. Equipment serial number will be recorded prior to start of test and calibration shall be verified for expected test time period.

6.1 Indicating Instruments

None required

6.2 Sensors and Transducers

None required

6.3 Recording Equipment

6.3.1 Strip Chart Recorders

Make: Gould
Model: Brush 260
Number Required: 2

6.4 Others

6.4.1 Control Test Unit

Serial Number: MDAC Supplied
Number Required: 2

6.4.2 Transfer Function Analyzer

Make: EMR
Number Required: 1

6.4.3 Function (Wave) Generator

Make: Hewlett Packard
Model: 3310A
Number Required: 1

Initial	Date

7.0 INITIAL CONDITIONS

7.1 Environmental Conditions

7.1.1 Mode 5 testing should be carried out during clear or hazy weather periods when uniform and constant insolation levels are available to the collector field. The only exception occurs during tests specifically designed to investigate plant operation during partly cloudy periods (Section 8.7).

7.2 Temporary Installations

7.2.1 The Controls Test Units, Transfer Function Analyzer, Function Generator, and strip chart recorders are installed as required to support Section 8 testing.

7.3 Support Systems/Plant Operating Status

7.3.1 This test requires the operation of all plant systems excluding:

- Turbine generator system
- Beam characterization system
- Operational control system (OCS)
- Specifically instrumented heliostat and meterological measurement system (SHIMMS)

and all related power, instrumentation, and control equipment.

	Initial	Date
7.3.2 Auxiliary steam should be available from the auxiliary electric boiler or TSS extraction system to the deaerator and turbine seal steam regulator in sufficient quantities to properly deaerate the condensate and maintain a condenser vacuum.		
7.3.3 All aspects of the Data Acquisition System involving SDPC and DARMS information shall be operational including onsite recording, display, and playback capability. If the apparatus for transmission, recording, and processing of data at MDAC Huntington Beach is inoperable, the testing may proceed at discretion of the lead startup engineer.		
7.3.4 All "first out" trip parameters shall be properly loaded into the DARMS scan list and the high speed trip recording capability shall be operational.		
7.3.5 The TSU bed has been conditioned and the heat exchangers and TSS flash tank and all piping have been sufficiently cleaned on both oil and water/steam sides to support TSS charging loop operation. See TSU Bed Conditioning Procedure 1040A.		

	Initial	Date
7.3.6 All appropriate control valves, instruments and control loops have been loop checked and tuned and are operational to support the 1150 tests. See TSS Controls Test Procedure 1040B.		
7.3.7 The Ullage Maintenance Unit (UMU) has been checked out and is operational.		

7.4 Process Conditions

The following process and SDPC controller conditions should exist at the outset of testing as defined in Section 8 or at anytime when a restart of Mode 5 operation is required.

7.4.1 Feedwater shall be flowing through the condensate and feedwater system to the receiver. Feedwater chemistry shall be within the acceptable operating limits as defined by the sampling system alarm values (Ref: Sampling System Preoperational Test Procedure - No. 956).		
7.4.2 The receiver shall be producing steam and flowing through the downcomer to the steam dump system. The steam dump system shall be controlling system pressure to between 1450 and 1515 psig at PI 1001. Receiver steam temperature set point shall be >650°F to exceed the 50°F minimum		

		Initial	Date
	allowable superheat trip point. Redirected power to the receiver shall be that value provided by a predefined heliostat group. Receiver steam flow shall be that which naturally occurs in response to the heliostat group. Receiver feed pump shall be operating in an automatic (valve) control mode. Receiver flash tank shall be in its normal standby mode.		
7.4.3	A large fraction of the collector field heliostats shall be available to track the receiver. During portions of this test involving transitions to high charging rate operation, the required additonal heliostats should be tracking the "Standby" point.		
7.4.4	Controllers, valves and hand switches shall be in the status identified in Section 8.1.		

Initial	Date

8.0 PROCEDURE AND DATA COLLECTION

The basic procedure of the 1150 test series is to systematically operate the process equipment and its associated controllers over the normal and extreme operating ranges to verify functional operation and ability to meet plant performance and operating requirements. The control loops have been brought into service and verified one at a time using a closed loop control test in the 1040 B test series. If acceptable performance cannot be obtained, additional tuning or tests such as open loop tests on the processor or control components may be required to characterize the control loop so further control algorithm adjustments or modifications can be made. It is assumed that the test conductors, test engineers and control operators are closely familiar with the process and the control loops and therefore detailed step by step instructions are not required to conduct the tests.

8.1 CHARGING HEAT EXCHANGER STARTUP

8.1.1 Single Charging Train Startup

The following test sequence is written for the startup of charging heat exchanger train 1 (SKID SA-302). Similar instructions can be developed for train 2 (SKID SA-303) by substituting the appropriate tag numbers for hand switches, sensors, controllers and equipment.

		Initial	Date
8.1.1.1	Verify that the charging heat exchangers have cooled to a temperature substantially below their normal operating level.		
8.1.1.2	Verify that low temperature oil (425-450°F) is available in the thermal storage unit from the bottom manifold.		
8.1.1.3	Set up and verify the valve alignments as shown in Table 8-1.		
8.1.1.4	Set up and verify the controller/loop conditions as shown in Table 8-2.		
8.1.1.5	Verify that receiver steam is flowing through the main steam downcomer at a controlled temperature and pressure. (A pressure between 1450 and 1515 psig at PI 1001 and a temperature of 960°F at TI 2903 are required before actual charging operation can begin.) The total receiver flow should be approximately 50,000 lb/hr.		
8.1.1.6	Verify that the charging oil pump P-301 and flash tank drain pump P-307 are ready for operation. Verify that the steam line low point drains are operational.		
8.1.1.7	Toggle TD 3411 from "FLOW" to "TEMP" and back to "FLOW".		

Table 8-1

Initial Valve Alignment for Single Charging Train Startup

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
(Water/Steam)				
Main Steam Stop-MOV 1030	Closed	----	Closed	----
UV-3102	Closed	----	Closed	----
TV-3105	Closed	----	Closed	----
TDWIS	Open	----	Open	----
TDSBV	Closed	----	Closed	----
V-MS-3-301	Open	----	Open	----
V-MS-4-302	Open	----	Closed	----
AOV-3206	Closed	----	Closed	----
THSVV-1	Closed	----	(Closed)	----
V-CO-301-301	Open	----	(Open)	----
PV-3110	Closed	----	Closed	----
V-CO-303-305	Open	----	(Open)	----
V-MS-4-304	Closed	----	Open	----
AOV-3306	Closed	----	Closed	----
THSVV-2	(Closed)	----	Closed	----
V-CO-302-302	(Open)	----	Open	----
PV-3111	Closed	----	Closed	----
V-CO-304-306	(Open)	----	Open	----
AOV-3220	Closed	----	Closed	----
AOV-3320	Closed	----	Closed	----
TCVV-2, -3	Closed	----	Closed	----
V-VT-4-301	Open	----	Open	----

Table 8-1

Initial Valve Alignment for Single Charging Train Startup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
V-CO-15-307	Open	----	Open	----
V-CO-5-7	Open	----	Open	----
LV-74B Upstream and Downstream Block	Open	----	Open	----
LV-74D1 Upstream and Downstream Block	Open	----	Open	----
LV-74D2 Upstream and Downstream Block	Open	----	Open	----
PV 647C Upstream and Downstream Block	Open	----	Open	----
PV 640 Upstream and Downstream Block	Open	----	Open	----
AOV-3117	Closed	----	Closed	----
AOV-3118	Closed	----	Closed	----
THSBV-1 & -2 Vent Valves	Open	----	Open	----
THSBLV-1, 2, 3, 4 Vent Valves (Charging Oil)	Open	----	Open	----
AOV 3004	Open	----	Open	----
AOV 3003	Open	----	Open	----
AOV 3001	Closed	----	Closed	----
AOV 3002	Closed	----	Closed	----
AOV 3005	Open	----	Open	----

Table 8-1

Initial Valve Alignment for Single Charging Train Startup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
PV 3910	Closed	----	Closed	----
V-TO-3-301	Open	----	NA	----
V-TO-3-302	Open	----	NA	----
V-TO-3-303	NA	----	Open	----
V-TO-3-304	NA	----	Open	----
V-TO-3-305	Open	----	NA	----
V-TO-3-306	NA	----	Open	----
V-TO-4-307	Open	----	NA	----
V-TO-5-308	NA	----	Open	----
V-TO-4-310	Open	----	NA	----
V-TO-5-311	NA	----	Open	----
V-TO-9-312	Open	----	NA	----
V-TO-9-313	NA	----	Open	----
V-TO-301-309	Closed	----	Closed	----

Table 8-2

Controller/Loop Initial Conditions For Single Charging Train Startup

TEST 1150 PARAGRAPH 8.1.1

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	PC640/PC640	Auto/Console	115 PSIG		
	AM640	Auto/Console			
	PC647C/PC647C	Auto/Console	*		
	AM647C	Auto/Console			
	LC74D/LCM74D1	Auto/Console	95%		
	LCM74D2	Auto/Console	25 in		
	LC74B/LC74B	Auto/Console	20 in		
	AM74B	Auto/Console			
	PC3110/PCM3110	Auto/Cascade			Train 1 Startup
	PC3111/PCM3111	Auto/Cascade			Train 2 Startup
	UC3102/AM3102	Auto/Console			
	PC3102	Manual/Console		0%	
	FC3102	Manual/Console		0%	
	UD3102A	PT1001			

*Normal value as established in Test Series 1040B.

Table 8-2

Controller/Loop Initial Conditions For Single Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.1

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	UD3102B	Normal			
	UD3102C	Flow			
	TC3105/TC3105	Auto/Console	648°F		
	FCM3105	Auto/Cascade			
	TC3411/TC3411	Manual/Console	580°F		Oil Loop - Train 1
	FC3411	Auto/Cascade			
	FCY3411	Manual/Console		33.2%	
	FCM3411	Manual/Cascade		80%	
	TD3411	Flow			
	TC3413/PCM3413	Manual/Console		0%	Oil Pump - Train 1
	TC3410/TC3410	Manual/Console	580°F		Oil Loop - Train 2
	FC3410	Auto/Cascade			
	FCY3410	Manual/Console		33.2%	
	FCM3410	Manual/Cascade		80%	
	TD3410	Flow			

Table 8-2

Controller/Loop Initial Conditions For Single Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.1

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	TC3414/PCM3414	Manual/Console		0%	Oil Pump - Train 2
	Receiver Loops	Normal Operating Modes	*		

*Normal values as established in Test Series 1040B.

		Initial	Date
8.1.1.8	Command oil pump P-301 to start through either HS 3413A (console switch) HS 3413B (SDPC keyboard) And verify oil flow as indicated by FI 3211 on TSS CRT.		
8.1.1.9	Monitor pump discharge oil temperature (TI 3214) on the TSS CRT. Continue oil circulation until discharge oil temperature stabilizes and then switch PCM 3413 to Auto/Console and FCM 3411 to Auto/Cascade.		
8.1.1.10	Open AOV 3206 and then open bypass hand valves on charging steam line around valves MOV 1030 and UV 3102. NOTE: Warmup steam temperature cannot exceed 690°F as indicated by TI 3105A and TI 3105B. A temperature in excess of this value will activate a TSS charging loop trip. If a high temperature is experienced, the bypass isolation valve around UV 3102 should be partially closed.		
8.1.1.11	Open MOV 1030 and allow full steam pressure to the upstream side of UV 3102 (close MOV 1030 bypass valve). At this point, the steam pressure should be between 1450 and 1515 psig (as indicated by PI 1001 -- RS CRT) and the steam temperature should be 960°F (as indicated by TI 2903 -- RS-CRT).		

		Initial	Date
8.1.1.12	Open bootleg drain free blows at SA-301 outlet and SA-302 inlet.		
8.1.1.13	Gradually open UV-3102 by inputting a C.O. to FC 3102 and verify proper desuperheater (DS-301) operation. Close UV-3102 bypass hand valve.		
8.1.1.14	Continue to open UV-3102 until steam flow (FI 3102) is equal to approximately 10 KLBH.		
8.1.1.15	Close bootleg drain free blows.		
8.1.1.16	Adjust the setpoint of FC 3102 to a value equal to the P.V. and set FC 3102 to AUTO.		
8.1.1.17	Verify proper operation of desuperheater DS-301. Steam temperature shall be 650°F (nominal value) as measured by TI 3105A or 3105B.		
8.1.1.18	When condenser discharge oil temperature (TI 3211 A/B) increases to 550°F (on its way to a 580°F final control value), divert flow to the top TSU manifold. The required oil valve commands are: AOV 3001 (open) AOV 3002 (open) AOV 3003 (closed) AOV 3005 (closed) (AOV 3005 command executed last)		

		Initial	Date
8.1.1.19	Gradually increase the setpoint on FC 3102 until the P.V. equals approximately 40 KLBH. Verify proper operation of PC 3110.		
8.1.1.20	Verify that TC 3411 sequences to AUTO when the condenser discharge oil temperature (TI 3211 A/B) reaches 570°F.		
8.1.1.21	Adjust the PC 3102 controllset setpoint to a value equal to the current P.V. (PI 1001).		
8.1.1.22	Toggle UD 3102B to "PRESS."		
8.1.1.23	Adjust the setpoint on PC 3102 to a value equal to 1515 psig and toggle PD 1001A to "ENABLE." Verify that the steam dump valve goes fully closed (ZI 1001) and that PC 3102 is functioning properly.		
8.1.1.24	Adjust the setpoint on PC 3102 to a value equal to the current P.V. (PI 3102) and toggle UD 3102A to "PT 3102."		
8.1.1.25	Follow pressure stabilization, adjust the setpoint on PC 3102 to 1450 psig.		
8.1.1.26	Repeat steps 8.1.1.1 through 8.1.1.25 starting with a downcomer steam temperature of 775°F (TI 2903, steps 8.1.1.5 and 8.1.1.11).		
8.1.1.27	Repeat steps 8.1.1.1 through 8.1.1.25 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.1.5 and 8.1.1.11).		

		Initial	Date
8.1.2	Series Charging Train Startup The following test sequence is written for the startup of charging heat exchanger train 2 following the startup of charging heat exchanger train 1. Similar instructions can be developed for train 2 followed by train 1 by substituting the appropriate tag numbers for hand switches, sensors, controllers and equipment. When one loop is in operation, the inlet steam pressure regulators (PCV 3207, PCV 3307) are designed to maintain the inactive loop in a hot standby condition.		
8.1.2.1	Verify that the charging heat exchangers have cooled to a temperature substantially below their normal operating level.		
8.1.2.2	Verify that low temperature oil (425-450°F) is available in the thermal storage unit from the bottom manifold.		
8.1.2.3	Set up and verify the valve alignments as shown in Table 8-3.		
8.1.2.4	Set up and verify the controller/loop conditions as shown in Table 8-4.		
8.1.2.5	Verify that receiver steam is flowing through the main steam downcomer at a controlled temperature and pressure. (A pressure between 1450 and 1515 psig at PI 1001 and a temperature of 960°F at TI 2903 are required before actual charging operation can begin.) The total receiver flow should be approximately 50,000 lb/hr.		

Table 8-3

Initial Valve Alignment for Series Charging Train Startup

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
(Water/Steam)				
Main Steam Stop-MOV 1030	Closed	----	Closed	----
UV-3102	Closed	----	Closed	----
TV-3105	Closed	----	Closed	----
TDWIS	Open	----	Open	----
TDSBV	Closed	----	Closed	----
V-MS-3-301	Open	----	Open	----
V-MS-4-302	Open	----	Open	----
AOV-3206	Closed	----	Closed	----
THSVV-1	Closed	----	(Closed)	----
V-CO-301-301	Open	----	(Open)	----
PV-3110	Closed	----	Closed	----
V-CO-303-305	Open	----	(Open)	----
V-MS-4-304	Open	----	Open	----
AOV-3306	Closed	----	Closed	----
THSVV-2	(Closed)	----	Closed	----
V-CO-302-302	(Open)	----	Open	----
PV-3111	Closed	----	Closed	----
V-CO-304-306	(Open)	----	Open	----
AOV-3220	Closed	----	Closed	----
AOV-3320	Closed	----	Closed	----
TCVV-2, -3	Closed	----	Closed	----
V-VT-4-301	Open	----	Open	----

Table 8-3

Initial Valve Alignment for Series Charging Train Setup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
V-CO-15-307	Open	----	Open	----
V-CO-5-7	Open	----	Open	----
LV-74B Upstream and Downstream Block	Open	----	Open	----
LV-74D1 Upstream and Downstream Block	Open	----	Open	----
LV-74D2 Upstream and Downstream Block	Open	----	Open	----
PV 647C Upstream and Downstream Block	Open	----	Open	----
PV 640 Upstream and Downstream Block	Open	----	Open	----
AOV-3117	Closed	----	Closed	----
AOV-3118	Closed	----	Closed	----
THSBV-1 & -2 Vent Valves	Open	----	Open	----
THSBLV-1, 2, 3, 4 Vent Valves (Charging Oil)	Open	----	Open	----
AOV 3004	Open	----	Open	----
AOV 3003	Open	----	Open	----
AOV 3001	Closed	----	Closed	----
AOV 3002	Closed	----	Closed	----
AOV 3005	Open	----	Open	----

Table 8-3

Initial Valve Alignment for Series Charging Train Startup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
PV 3910	Closed	----	Closed	----
V-TO-3-301	Open	----	NA	----
V-TO-3-302	Open	----	NA	----
V-TO-3-303	NA	----	Open	----
V-TO-3-304	NA	----	Open	----
V-TO-3-305	Open	----	NA	----
V-TO-3-306	NA	----	Open	----
V-TO-4-307	Open	----	NA	----
V-TO-5-308	NA	----	Open	----
V-TO-4-310	Open	----	NA	----
V-TO-5-311	NA	----	Open	----
V-TO-9-312	Open	----	NA	----
V-TO-9-313	NA	----	Open	----
V-TO-301-309	Closed	----	Closed	----

Table 8-4

Controller/Loop Initial Conditions For Series Charging Train Startup

TEST 1150 PARAGRAPH 8.1.2

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	PC 640/PC640	Auto/Console	115 PSIG		
	AM640	Auto/Console			
	PC647C/PC647C	Auto/Console	*		
	AM647C	Auto/Console			
	LC74D/LCM74D1	Auto/Console	95%		
	LCM74D2	Auto/Console	25 in		
	LC74B/LC74B	Auto/Console	20 in		
	AM74B	Auto/Console			
	PC3110/PCM3110	Auto/Cascade			Train 1 Startup
	PC3111/PCM3111	Auto/Cascade			Train 2 Startup
	UC3102/AM3102	Auto/Console			
	PC3102	Manual/Console		0%	
	FC3102	Manual/Console		0%	
	UD3102A	PT1001			

*Normal value as established in Test Series 1040B.

Table 8-4

Controller/Loop Initial Conditions For Series Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.2

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	UD3102B	Normal			
	UD3102C	Flow			
	TC3105/TC3105	Auto/Console	648°F		
	FCM3105	Auto/Cascade			
	TC3411/TC3411	Manual/Console	580°F		Oil Loop - Train 1
	FC3411	Auto/Cascade			
	FCY3411	Manual/Console		33.2%	
	FCM3411	Manual/Cascade		80%	
	TD3411	Flow			
	TC3413/PCM3413	Manual/Console		0%	Oil Pump - Train 1
	TC3410/TC3410	Manual/Console	580°F		Oil Loop - Train 2
	FC3410	Auto/Cascade			
	FCY3410	Manual/Console		33.2%	
	FCM3410	Manual/Cascade		80%	
	TD3410	Flow			

Table 8-4

Controller/Loop Initial Conditions For Series Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.2

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	TC3414/PCM3414	Manual/Console		0%	Oil Pump - Train 2
	Receiver Loops	Normal Operating Modes	*		

*Normal values as established in Test Series 1040B.

		Initial	Date
8.1.2.6	Startup charging heat exchanger train 1 according to procedure steps 8.1.1.6 through 8.1.1.25.		
8.1.2.7	Verify that charging train 2 pressure (PI 3311) is approximately equal to 800 psig.		
8.1.2.8	Verify that charging oil pump P-302 is ready for operation. Verify that the steam line low point drains are operational.		
8.1.2.9	Toggle TD 3410 from "FLOW" to "TEMP" and back to "FLOW."		
8.1.2.10	Command oil pump P-302 to start through either HS 3414A (console switch) HS 3414B (SDPC keyboard) And verify oil flow as indicated by FI 3310 on TSS CRT.		
8.1.2.11	Monitor pump discharge oil temperature (TI 3314) on the TSS CRT. Continue oil circulation until discharge oil temperature stabilizes and then switch PCM 3414 to Auto/Console and FCM 3410 to Auto/Cascade.		

		Initial	Date
8.1.2.12	Adjust the setpoint on PC 3102 to approximately 1000 psig.		
8.1.2.13	Following pressure stabilization, verify that the difference between PI 3303 and PI 3311 is less than 100 PSI and open AOV-3306. Verify steam flow to train 2 (FI 3305) and verify train 2 pressure control (PCM 3111 P.V.).		
8.1.2.14	Adjust the setpoint on PC 3102 to 1450 psig and verify proper charging oil/steam system operation.		
8.1.2.15	Verify that TC 3410 sequences to AUTO when the train 2 condenser discharge oil temperature (TI 3310 A/B) reaches 570°F.		
8.1.2.16	Repeat steps 8.1.2.1 through 8.1.2.15 starting with a downcomer steam temperature of 775°F (TI 2903, step 8.1.2.5).		
8.1.2.17	Repeat steps 8.1.2.1 through 8.1.2.15 starting with a downcomer steam temperature of 660°F (TI 2903, step 8.1.2.5).		
8.1.3	Parallel charging train startup. The following test sequence is written for the simultaneous (parallel) startup of both TSS charging heat exchanger trains.		

		Initial	Date
8.1.3.1	Verify that the charging heat exchangers have cooled to a temperature substantially below their normal operating level.		
8.1.3.2	Verify that low temperature oil (425-450°F) is available in the thermal storage unit from the bottom manifold.		
8.1.3.3	Set up and verify the valve alignments as shown in Table 8-5.		
8.1.3.4	Set up and verify the controller/loop conditions as shown in Table 8-6.		
8.1.3.5	Verify that the receiver steam is flowing through the main steam downcomer at a controlled temperature and pressure. (A pressure between 1450 and 1515 psig at PI 1001 and a temperature of 960°F at TI 2903 are required before actual charging operation can begin.) The total receiver flow should be approximately 50,000 lb/hr.		
8.1.3.6	Verify that the charging oil pumps (P-301, P-302) and flash tank drain pump (P-307) are ready for operation. Verify that the steam line low point drains are operational.		
8.1.3.7	Toggle TD 3411/TD 3410 from "FLOW" to "TEMP" and back to "FLOW."		

Table 8-5

Initial Valve Alignment for Parallel Charging Train Startup

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
(Water/Steam)				
Main Steam Stop-MOV 1030	Closed	----	Closed	----
UV-3102	Closed	----	Closed	----
TV-3105	Closed	----	Closed	----
TDWIS	Open	----	Open	----
TDSBV	Closed	----	Closed	----
V-MS-3-301	Open	----	Open	----
V-MS-4-302	Open	----	Open	----
AOV-3206	Closed	----	Closed	----
THSVV-1	Closed	----	(Closed)	----
V-CO-301-301	Open	----	(Open)	----
PV-3110	Closed	----	Closed	----
V-CO-303-305	Open	----	(Open)	----
V-MS-4-304	Open	----	Open	----
AOV-3306	Closed	----	Closed	----
THSVV-2	(Closed)	----	Closed	----
V-CO-302-302	(Open)	----	Open	----
PV-3111	Closed	----	Closed	----
V-CO-304-306	(Open)	----	Open	----
AOV-3220	Closed	----	Closed	----
AOV-3320	Closed	----	Closed	----
TCVV-2, -3	Closed	----	Closed	----
V-VT-4-301	Open	----	Open	----

Table 8-5

Initial Valve Alignment for Parallel Charging Train Startup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
V-CO-15-307	Open	----	Open	----
V-CO-5-7	Open	----	Open	----
LV-74B Upstream and Downstream Block	Open	----	Open	----
LV-74D1 Upstream and Downstream Block	Open	----	Open	----
LV-74D2 Upstream and Downstream Block	Open	----	Open	----
PV 647C Upstream and Downstream Block	Open	----	Open	----
PV 640 Upstream and Downstream Block	Open	----	Open	----
AOV-3117	Closed	----	Closed	----
AOV-3118	Closed	----	Closed	----
THSBV-1 & -2 Vent Valves	Open	----	Open	----
THSBLV-1, 2, 3, 4 Vent Valves (Charging Oil)	Open	----	Open	----
AOV 3004	Open	----	Open	----
AOV 3003	Open	----	Open	----
AOV 3001	Closed	----	Closed	----
AOV 3002	Closed	----	Closed	----
AOV 3005	Open	----	Open	----

Table 8-5

Initial Valve Alignment for Parallel Charging Train Startup (Continued)

Valve	Train 1		Train 2	
	Position	Verify	Position	Verify
PV 3910	Closed	----	Closed	----
V-TO-3-301	Open	----	NA	----
V-TO-3-302	Open	----	NA	----
V-TO-3-303	NA	----	Open	----
V-TO-3-304	NA	----	Open	----
V-TO-3-305	Open	----	NA	----
V-TO-3-306	NA	----	Open	----
V-TO-4-307	Open	----	NA	----
V-TO-5-308	NA	----	Open	----
V-TO-4-310	Open	----	NA	----
V-TO-5-311	NA	----	Open	----
V-TO-9-312	Open	----	NA	----
V-TO-9-313	NA	----	Open	----
V-TO-301-309	Closed	----	Closed	----

Table 8-6

Controller/Loop Initial Conditions For Parallel Charging Train Startup

TEST 1150 PARAGRAPH 8.1.3

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	PC640/PC640	Auto/Console	115 PSIG		
	AM640	Auto/Console			
	PC647C/PC647C	Auto/Console	*		
	AM647C	Auto/Console			
	LC74D/LCM74D1	Auto/Console	95%		
	LCM74D2	Auto/Console	25 in		
	LC74B/LC74B	Auto/Console	20 in		
	AM74B	Auto/Console			
	PC3110/PCM3110	Auto/Cascade			Train 1 Startup
	PC3111/PCM3111	Auto/Cascade			Train 2 Startup
	UC3102/AM3102	Auto/Console			
	PC3102	Manual/Console		0%	
	FC3102	Manual/Console		0%	
	UD3102A	PT1001			

*Normal values as established in Test Series 1040B.

Table 8-6

Controller/Loop Initial Conditions For Parallel Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.3

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	UD3102B	Normal			
	UD3102C	Flow			
	TC3105/TC3105	Auto/Console	648°F		
	FCM3105	Auto/Cascade			
	TC3411/TC3411	Manual/Console	580°F		Oil Loop - Train 1
	FC3411	Auto/Cascade			
	FCY3411	Manual/Console		33.2%	
	FCM3411	Manual/Cascade		80%	
	TD3411	Flow			
	TC3413/PCM3413	Manual/Console		0%	Oil Pump - Train 1
	TC3410/TC3410	Manual/Console	580°F		Oil Loop - Train 2
	FC3410	Auto/Cascade			
	FCY3410	Manual/Console		33.2%	
	FCM3410	Manual/Cascade		80%	
	TD3410	Flow			

Table 8-6

Controller/Loop Initial Conditions For Parallel Charging Train Startup (Continued)

TEST 1150 PARAGRAPH 8.1.3

Item Verified	Controller/Loop Tag	Control Mode	Setpoint	Commanded Output	Constraints or Special Conditions
	TC3414/PCM3414	Manual/Console		0%	Oil Pump - Train 2
	Receiver Loops	Normal Operating Modes		*	

*Normal values as established in Test Series 1040B.

	Initial	Date
8.1.3.8 Command oil pump P-301 to start through either HS 3413A (console switch) HS 3413B (SDPC keyboard) and verify oil flow as indicated by FI 3211 on TSS CRT.		
8.1.3.9 Command oil pump P-302 to start through either HS 3414A (console switch) HS 3414B (SDPC keyboard) and verify oil flow as indicated by FI 3310 on TSS CRT.		
8.1.3.10 Monitor pump discharge oil temperatures (TI 3214/3314) on the TSS CRT. Continue oil circulation until discharge oil temperatures stabilize and then switch PCM 3413/3414 to Auto/Console and FCM 3411/3410 to Auto/Cascade.		
8.1.3.11 Open AOV-3206 and AOV-3306 and then open bypass hand valves on charging steam line around valves MOV-1030 and UV-3102. NOTE: Warmup steam temperature cannot exceed 690°F as indicated by TI 3105A and TI 3105B. A temperature in excess of this value will activate a TSS charging loop trip. If a high		

		Initial	Date
	temperature is experienced, the bypass isolation valve around UV-3102 should be partially closed.		
8.1.3.12	Open MOV-1030 and allow full steam pressure to the upstream side of UV-3102 (close MOV-1030 bypass valve). At this point, the steam pressure should be between 1450 and 1515 psig (as indicated by PI 1001 -- RS CRT) and the steam temperature should be 960°F (as indicated by TI 2903 -- RS-CRT).		
8.1.3.13	Open bootleg drain free blows at SA-301 outlet and SA-302/303 inlets.		
8.1.3.14	Gradually open UV-3102 by inputting a C.O. to FC 3102 and verify proper desuperheater (DS-301) operation. Close UV-3102 bypass hand valve.		
8.1.3.15	Continue to open UV-3102 until steam flow (FI 3102) is equal to approximately 20 KLBH.		
8.1.3.16	Close bootleg drain free blows. Verify proper condenser pressure control (PCM 3110, PCM 3111).		
8.1.3.17	Adjust the setpoint of FC 3102 to a value equal to the P.V. and set FC 3102 to AUTO.		
8.1.3.18	Verify proper operation of desuperheater DS-301. Steam temperature shall be 650°F (nominal value) as measured by TI 3105A or 3105B.		

		Initial	Date
8.1.3.19	When condenser discharge oil temperatures TI 3211A/B or TI 3310A/B increase to 550°F (on the way to 580°F final control values), divert flow to the top TSU manifold. The required oil valve commands are: AOV 3001 (open) AOV 3002 (open) AOV 3003 (closed) AOV 3005 (closed) (AOV 3005 command executed last)		
8.1.3.20	Gradually increase the setpoint on FC 3102 until the P.V. equals approximately 40 KLBH. Verify proper operation of PC 3110/3111.		
8.1.3.21	Verify that TC 3411/3410 sequence to AUTO when the condenser discharge oil temperatures (TI 3211A/B, TI 3310A/B) reach 570°F.		
8.1.3.22	Adjust the PC 3102 controller setpoint to a value equal to the current P.V. (PI 1001).		
8.1.3.23	Toggle UD 3102B to "PRESS."		
8.1.3.24	Adjust the setpoint on PC 3102 to a value equal to 1515 psig and toggle PD 1001A to "ENABLE." Verify that the steam dump valve goes fully closed (ZI 1001) and that PC 3102 is functioning properly.		
8.1.3.25	Adjust the setpoint on PC 3102 to a value equal to the current P.V. (PI 3102) and toggle UD 3102A to PT 3102.		

		Initial	Date
8.1.3.26	Following pressure stabilization, adjust the setpoint on PC 3102 to 1450 psig.		
8.1.3.27	Repeat steps 8.1.3.1 through 8.1.3.26 starting with a downcomer steam temperature of 775°F (TI 2903, steps 8.1.3.5 and 8.1.3.12).		
8.1.3.28	Repeat steps 8.1.3.1 through 8.1.3.26 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.3.5 and 8.1.3.12).		

8.2 MODE 5 OPERATION

8.2.1 Plant Startup

Plant startup, startup of one or two TSS charging heat exchanger trains, and transition to steady-state Mode 5 operation is according to the sequence of steps in Section 8.1.

8.2.2 Sun Following

The initial conditions for the following Mode 5 operating points may be established as a result of the operations in Section 8.1. The total receiver steam flow rate following charging heat exchanger startup should be 50-60 KLBH. In the sun following operation, the heliostat field configuration (number and location of heliostats on track) should remain fixed. Steady-state Mode 5 operation should be achieved as early as possible in the morning and continued until at least midafternoon.

		Initial	Date
8.2.2.1	Verify stable sun following Mode 5 operation for a minimum of one hour with a single charging heat exchanger train in service and rated downcomer steam conditions of 960°F (TI 2903) and 1515 psig (PI 1001).		
8.2.2.2	Verify stable sun following Mode 5 operation for a minimum of one hour with a single charging heat exchanger train in service and de-rated downcomer steam conditions of 660°F (TI 2903) and 1515 psig (PI 1001).		
8.2.2.3	Verify stable sun following Mode 5 operation for a minimum of one hour with both charging heat exchanger trains in service and rated downcomer steam conditions of 960°F (TI 2903) and 1515 psig (PI 1001).		
8.2.2.4	Verify stable sun following Mode 5 operation for a minimum of one hour with both charging heat exchanger trains in service and de-rated downcomer steam conditions of 660°F (TI 2903) and 1515 psig (PI 1001).		
8.2.3	Manual Shutdown		
	Manual shutdown of the plant from steady-state Mode 5 operation to Mode 8 (Inactive) will be demonstrated. The initial conditions (prior to shutdown) should be:		
	(a) Downcomer steam conditions of 960°F (TI 2903), 1515 psig (PI 1001) and 50-60 KLBH.		

		Initial	Date
	(b) Steady-state Mode 5 operation with TSS steam inlet pressure controller UC-3102 in pressure control with one or two charging heat exchanger trains in operation. (c) Steam dump system is operational with the steam dump valve controller (PC 1001) in AUTO (pressure control).		
8.2.3.1	Verify initial conditions with both charging heat exchanger trains in operation.		
8.2.3.2	Adjust the setpoint on FC 3102 to 20 KLBH.		
8.2.3.3	Decrease the setpoint on the steam dump pressure controller (PSP 1001) to a value equal to approximately 10 psi below the P.V. on controller PC 1001.		
8.2.3.4	Toggle UD 3102B to "NORMAL" to switch UC-3102 from pressure to flow control and allow steam flow to TSS to stabilize.		
8.2.3.5	Verify proper operation of the steam dump system (PC 1001 and TC 1002).		
8.2.3.6	Place FC 3102 in MANUAL and close the TSS steam inlet valve (UV-3102).		
8.2.3.7	Turn off the charging oil pumps (P-301, P-302) using dedicated switches HS 3413A/ HS 3414A or keyboard functions HS 3413B/ HS 3414B immediately following 8.2.3.6.		

		Initial	Date
8.2.3.8	Close MOV-1030 and then close AOV-3206 and AOV-3306.		
8.2.3.9	Complete the transition from steam dump operation to Mode 8 (Inactive) using the standard procedures (Ref. 3.1.3).		
8.2.3.10	Repeat steps 8.2.3.1 through 8.2.3.9 with an initial steam temperature (TI 2903) of 660°F.		
8.2.3.11	Verify initial conditions with a single charging heat exchanger train in operation.		
8.2.3.12	Adjust the setpoint on FC 3102 to 10 KLBH.		
8.2.3.13	Decrease the setpoint on the steam dump pressure controller (PSP 1001) to a value equal to approximately 10 psi below the P.V. on controller PC 1001.		
8.2.3.14	Toggle UD 3102B to "NORMAL" to switch UC-3102 from pressure to flow control and allow steam flow to TSS to stabilize.		
8.2.3.15	Verify proper operation of the steam dump system (PC 1001 and TC 1002).		
8.2.3.16	Place FC 3102 in MANUAL and close the TSS steam inlet valve (UV-3102).		

		Initial	Date
8.2.3.17	Turn off the charging oil pump (P-301 or P-302) using dedicated switch HS 3413A or HS 3414A or keyboard function HS 3413B or HS 3414B immediately following 8.2.3.16.		
8.2.3.18	Close MOV-1030 and then close AOV-3206 or AOV-3306.		
8.2.3.19	Complete the transition from steam dump operation to Mode 8 (Inactive) using the standard procedures (Ref. 3.1.3).		
8.2.3.20	Repeat steps 8.2.3.11 through 8.2.3.19 with an initial steam temperature (TI 2903) of 660°F.		
8.3	HIGH THERMAL STORAGE CHARGE RATES		
8.3.1	Single Charging Heat Exchanger Train		
8.3.1.1	Start up a single charging heat exchanger train according to procedure steps 8.1.1.1 through 8.1.1.18 (inlet steam controller UC-3102 in flow control).		
8.3.1.2	Continue to add power to the receiver, with steam dump system pressure control, until all available heliostats are on TRACK.		
8.3.1.3	Gradually increase the setpoint (flow) on FC 3102 until the condenser drain valve (PV-3110) is approximately 80% open (ZI 3110). This operating point represents the maximum		

		Initial	Date
	single train charge rate condition. Verify stable and controlled operation at the maximum charging condition.		
8.3.1.4	Verify that the TSU UMU operates properly at the maximum charge rate and maintains the TSU ullage pressure within acceptable operating limits.		
8.3.1.5	Gather data to establish the behavior of the TSU thermocline as a function of time.		
8.3.1.6	Repeat steps 8.3.1.1 through 8.3.1.5 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.1.5 and 8.1.1.11).		
8.3.2	Both Charging Heat Exchanger Trains These tests should be run on high insolation days with the maximum charging rates determined near solar noon (all available heliostats on TRACK) to maximize receiver flow.		
8.3.2.1	Start up both charging heat exchanger trains according to procedure steps 8.1.3.1 through 8.1.3.19 (inlet steam controller UC-3102 in flow control).		
8.3.2.2	Continue to add power to the receiver, with steam dump system pressure control, until all available heliostats are on TRACK.		

	Initial	Date
8.3.2.3 Gradually increase the setpoint (flow) on FC 3102 until either condenser drain valve (PV-3110 or PV-3111) is approximately 80% open (ZI 3110 or ZI 3111). This operating point represents the maximum two train charge rate condition. Verify stable and controlled operation at the maximum charging condition.		
NOTE: If the steam dump valve (PV-1001) closes to a position less than 5% (ZI 1001) before the above condition is met, the TSS inlet steam controller UC 3102 will have to be switched to pressure control and the steam dump system taken out of service as follows:		
(a) Gradually decrease the setpoint on FC 3102 by an amount equal to the steam dump flow (the difference between total receiver flow, FI 2233, and total charging flow, FI 3102).		
(b) Reduce the total receiver flow by an amount equal to the reduction in step 8.3.2.3(a) (by removing heliostats from TRACK).		
(c) Place controller UC 3102 into pressure control according to procedure steps 8.1.1.21 through 8.1.1.25.		

		Initial	Date
	Then, gradually increase the number of heliostats on TRACK until the above condenser drain valve condition is met.		
8.3.2.4	Verify that the TSU UMU operates properly at the maximum charge rate and maintains the TSU ullage pressure within acceptable operating limits.		
8.3.2.5	Gather data to establish the behavior of the TSU thermocline as a function of time.		
8.3.2.6	Repeat steps 8.3.2.1 through 8.3.2.5 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.3.5 and 8.1.3.12).		
8.3.3	TSU Full Charge Continue the charging operation in either 8.3.1 or 8.3.2 until the TSU is fully charged. This condition is met when the TSU oil temperature is uniform (top to bottom) at 575°F and the charging pump inlet oil temperature (TI 3412) increases approximately 10°F (425°F to 435°F).		
8.3.4	TSU Ullage Gas Composition During the high charging rate tests, periodically monitor the composition of the TSU ullage gas as determined by the Oxygen Analyzer. Depending on previous results (test series 1040B), it may be necessary to		

		Initial	Date
	obtain TSU ullage gas samples, for analysis, at partial and full TSU charge conditions.		
8.4	GRADUAL CHARGING RATE TRANSITIONS The high charging rate transition tests should be run on high insolation days near solar noon. See Figures 8-1 and 8-2 for Section 8.4 test flow.		
8.4.1	Establish maximum two-train charging conditions according to procedure steps 8.3.2.1 through 8.3.2.3 with the steam dump system out of service and UC 3102 in pressure control.		
8.4.2	Input a value of 660°F to the receiver temperature setpoint TSP 2929.		
8.4.3	Verify stable and controlled TS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		
8.4.4	Following the verification in step 8.4.3, input a value of 960°F to the receiver temperature setpoint TSP 2929.		
8.4.5	Verify stable and controlled TSS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		
8.4.6	Adjust the setpoint on FC 3102 to a value approximately 25 KLBH below the current P.V.		

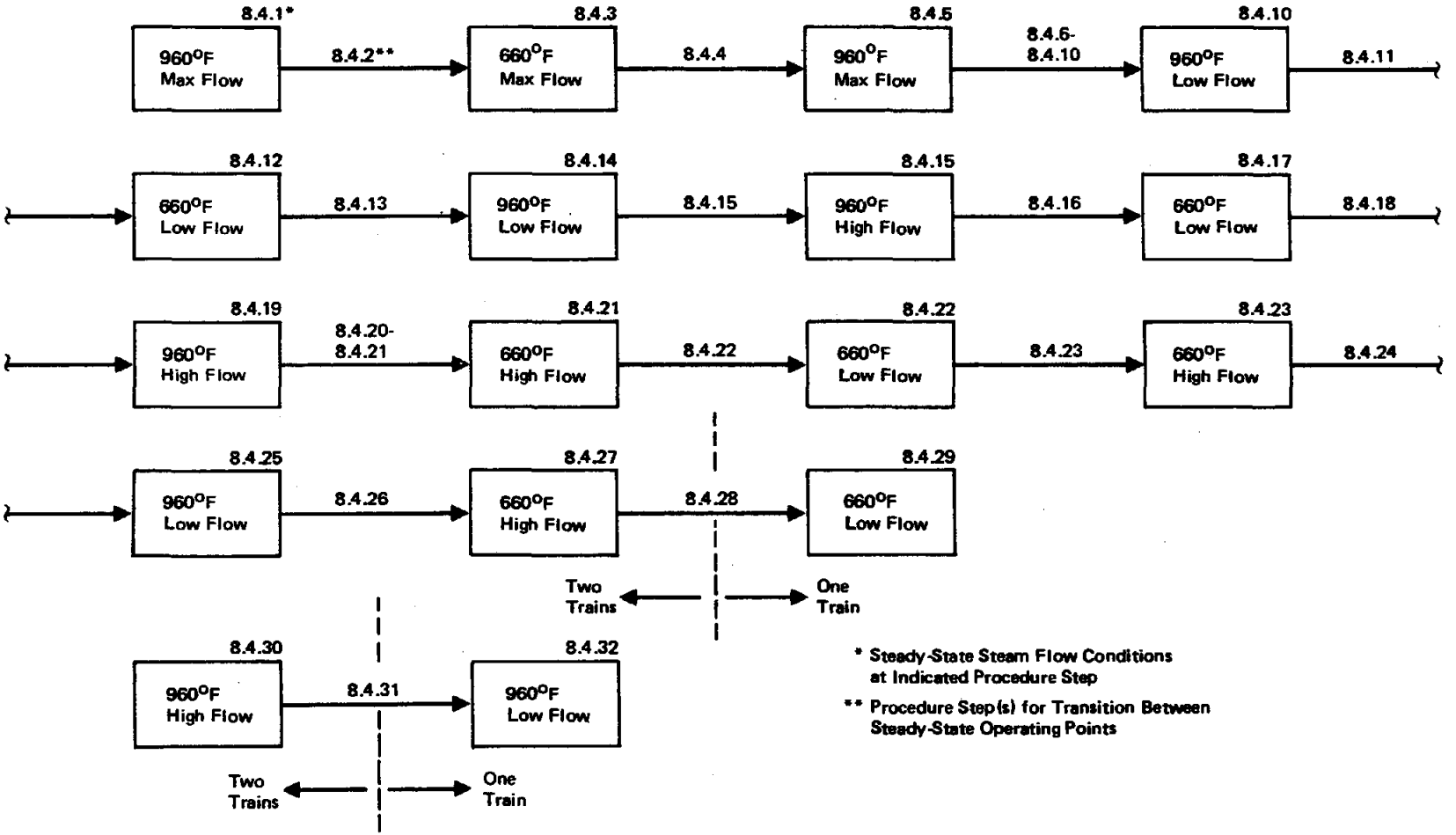

Figure 8-1. Charging Rate Transition Flow Chart

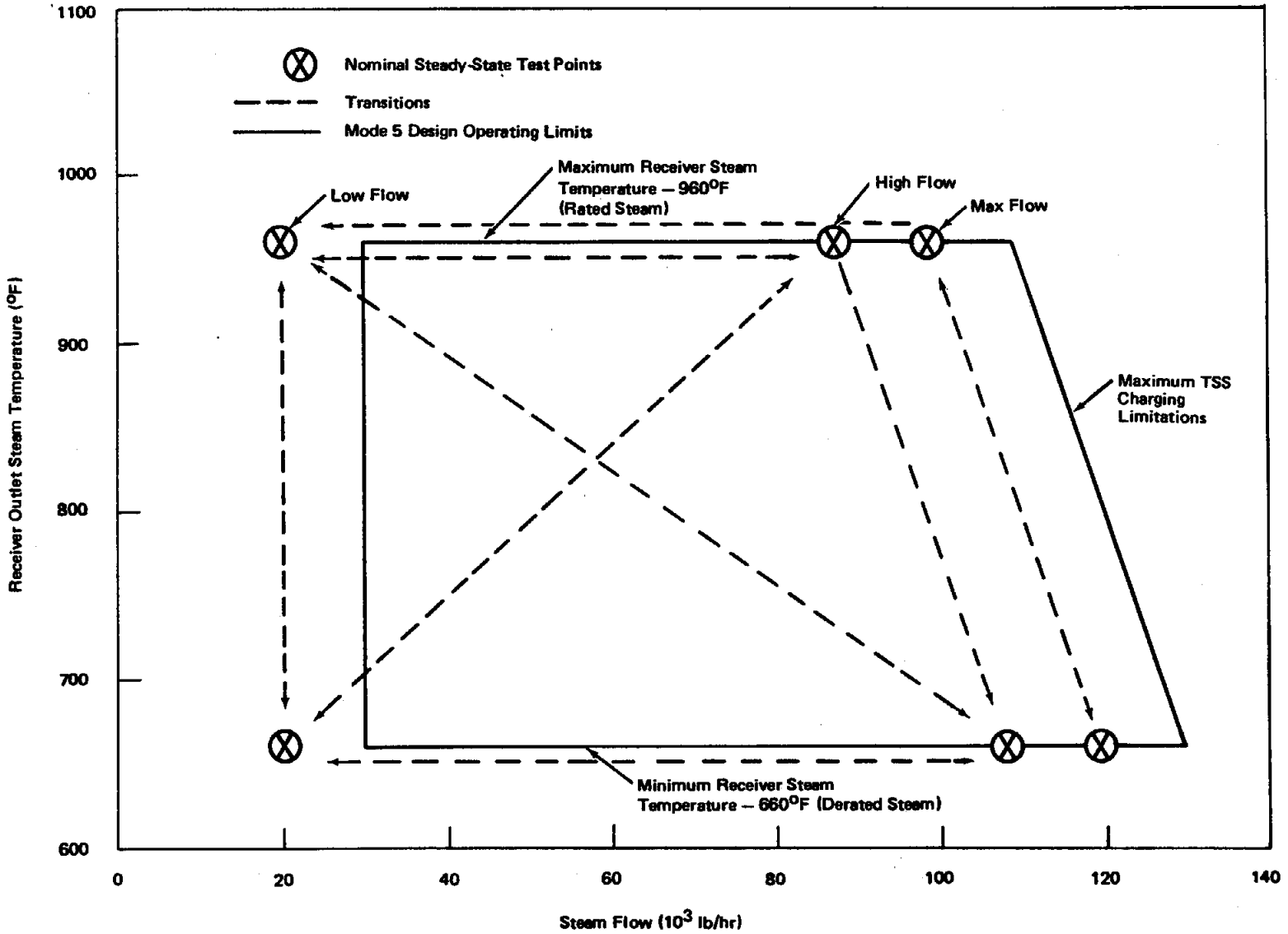

Figure 8-2. TSS Charging Rate Transitions (Section 8.4)

		Initial	Date
8.4.7	Decrease the setpoint on the steam dump pressure controller (PSP 1001) to a value equal to approximately 10 psi below the P.V. on controller PC 1001.		
8.4.8	Toggle UD 3102B to "NORMAL" to switch UC-3102 from pressure to flow control and allow steam flow to TSS to stabilize.		
8.4.9	Verify proper operation of the steam dump system (PC 1001 and TC 1002) and adjust PSP 1001 to 1515 psig.		
8.4.10	Gradually decrease the setpoint on FC 3102 to a final value of 20 KLBH and verify stable and controlled TSS charging system operation during the flow transition and at the final operating conditions.		
8.4.11	Following the verification in step 8.4.10, input a value of 660°F to the receiver temperature setpoint TSP 2929.		
8.4.12	Verify stable and controlled TSS charging system operation during the receiver steam temperature transition and at the final operating conditions.		
8.4.13	Following the verification in step 8.4.12, input a value of 960°F to the receiver temperature setpoint TSP 2929.		

		Initial	Date
8.4.14	Verify stable and controlled TSS charging system operation during the receiver steam temperature transition and at the final operating conditions.		
8.4.15	Following verification in step 8.4.14, gradually increase the setpoint on FC 3102 to the value established in step 8.4.6 and allow charging system temperatures to stabilize.		
8.4.16	Input a value of 660°F to the receiver temperature setpoint TSP 2929 and immediately start decreasing the setpoint on FC 3102 (slowly) to a final value of 20 KLBH.		
8.4.17	Verify stable and controlled TSS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		
8.4.18	Following the verification in step 8.4.17, input a value of 960°F to the receiver temperature setpoint TSP 2929 and immediately start increasing the setpoint on FC 3102 (slowly) to a final value equal to that in step 8.4.15.		
8.4.19	Verify stable and controlled TSS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		

		Initial	Date
8.4.20	Input a value of 660°F to TSP 2929 and allow the TSS charging system temperatures to stabilize.		
8.4.21	Gradually increase the setpoint on FC 3102 until either condenser drain valve (PV-3110 or PV-3111) is approximately 80% open (ZI 3110 or ZI 3111) or the steam dump valve (PV-1001) closes to 5% open position (ZI 1001).		
8.4.22	Gradually decrease the setpoint on FC 3102 to a final value of 20 KLBH and verify stable and controlled TSS charging system operation during the flow transition and at the final operating conditions.		
8.4.23	Following verification in step 8.4.22, gradually increase the setpoint on FC 3102 to the value established in step 8.4.21 and verify stable and controlled system operation during the flow transition and at the final operating conditions.		
8.4.24	Input a value of 960°F to the receiver temperature setpoint TSP 2929 and immediately start decreasing the setpoint on FC 3102 (slowly) to a final value of 20 KLBH.		
8.4.25	Verify stable and controlled TSS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		

		Initial	Date
8.4.26	Following the verification in step 8.4.25, input a value of 660°F to the receiver temperature setpoint TSP 2929 and immediately start increasing the setpoint on FC 3102 (slowly) to a final value equal to that in step 8.4.21.		
8.4.27	Verify stable and controlled TSS charging system operation during the receiver steam temperature/flow transition and at the final operating conditions.		
8.4.28	Following the verification in step 8.4.27, gradually decrease the setpoint on FC 3102 to a value equal to the maximum single train charging rate flow established in step 8.3.1.6. At this point, shut down charging train 2 by closing AOV-3306 and then turning off P-302. Continue to decrease the setpoint on FC-3102 to a final value of 20 KLBH.		
8.4.29	Verify stable and controlled charging system operation during the charging system/flow transition.		
8.4.30	Establish/re-establish two-train charging system operation with UC-3102 in flow control, receiver temperature setpoint TSP 2929 equal to 960°F and steam flow equal to the value established in 8.4.6. Verify stable charging system operation.		

		Initial	Date
8.4.31	Following the verification in step 8.4.30, gradually decrease the setpoint on FC 3102 to a value equal to the maximum single train charging rate flow established in step 8.3.1.3. At this point, shut down charging train 2 by closing AOV-3306 and then turning off P-302. Continue to decrease the setpoint on FC 3102 to a final value of 20 KLBH.		
8.4.32	Verify stable and controlled charging system operation during the charging system/flow transition.		
8.5	LOW THERMAL STORAGE CHARGE RATES		
8.5.1	Single Charging Heat Exchanger Train		
8.5.1.1	Start up a single charging heat exchanger train according to procedure steps 8.1.1.1 through 8.1.1.19 (inlet steam controller UC-3102 in flow control).		
8.5.1.2	Gradually decrease the setpoint on FC 3102 until the charging oil pump trips due to low flow or stable operating conditions cannot be maintained (thus determining the minimum single train charging rate).		
8.5.1.3	Re-establish conditions as specified in step 8.5.1.1 and gradually decrease the setpoint on FC 3102 until the minimum stable operating conditions are achieved (as determined in step 8.5.1.2). Verify stable and controlled charging system operation at these conditions.		

		Initial	Date
8.5.1.4	Verify that the TSU UMU operates properly at the minimum charge rates and maintains the TSU ullage pressure within acceptable operating limits.		
8.5.1.5	Gather data to establish the behavior of the TSU thermocline as a function of time.		
8.5.1.6	Repeat steps 8.5.1.1 through 8.5.1.5 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.1.5 and 8.1.1.11).		
8.5.2	Both Charging Heat Exchanger Trains		
8.5.2.1	Start up both charging heat exchanger trains according to procedure steps 8.1.3.1 through 8.1.3.21 (inlet steam controller UC-3102 in flow control).		
8.5.2.2	Gradually decrease the setpoint on FC 3102 until either charging oil pump trips due to low flow or stable operating conditions cannot be maintained (thus determining the minimum two train charging rate).		
8.5.2.3	Re-establish conditions as specified in step 8.5.2.1 and gradually decrease the setpoint on FC 3102 until the minimum stable operating conditions are achieved (as determined in step 8.5.2.2). Verify stable and controlled charging system operation at these conditions.		

		Initial	Date
8.5.2.4	Repeat steps 8.5.2.1 through 8.5.2.3 starting with a downcomer steam temperature of 660°F (TI 2903, steps 8.1.3.5 and 8.1.3.12).		
8.5.2.5	Increase the receiver temperature setpoint (TSP 2929) to 960°F and increase receiver power to establish a total flow of approximately 70 KLBH.		
8.5.2.6	Gradually increase the setpoint on FC 3102 until the P.V. equals approximately 40 KLBH.		
8.5.2.7	Adjust the PC 3102 controller setpoint to a value equal to the current P.V. (PI 1001).		
8.5.2.8	Toggle UD 3102B to PRESS.		
8.5.2.9	Adjust the setpoint on PC 3102 to a value equal to 1515 psig and toggle PD 1001A to "ENABLE." Verify that the steam dump valve goes fully closed (ZI 1001) and that PC 3102 is functioning properly.		
8.5.2.10	Adjust the setpoint on PC 3102 to a value equal to the current P.V. (PI 3102) and toggle UD 3102A to "PT 3102."		
8.5.2.11	Follow pressure stabilization, adjust the setpoint on PC 3102 to 1450 psig.		

		Initial	Date
8.5.2.12	Gradually decrease the receiver power by placing heliostats from TRACK to STANDBY until either charging oil pump trips due to low flow or stable receiver/charging system operating conditions cannot be maintained (thus determining the minimum Mode 5 charging rate).		
8.5.2.13	Re-establish conditions as specified prior to step 8.5.2.12 and gradually decrease the receiver power until the minimum stable operating conditions are achieved (as determined in step 8.5.2.12). Verify stable and controlled charging system operation at these conditions.		
8.5.2.14	Increase the receiver power until the receiver/charging system flow is approximately 40 KLBH and then decrease TSP 2929 to 660°F.		
8.5.2.15	Following flow/temperature stabilization, repeat step 8.5.2.12.		
8.5.2.16	Re-establish stable conditions as specified in 8.5.2.15 and gradually decrease the receiver power until the minimum stable operating conditions are achieved (as determined in step 8.5.2.15). Verify stable and controlled charging system operation at these conditions.		

		Initial	Date
8.5.3	TSU Ullage Gas Composition During the low charging rate tests, periodically monitor the composition of the TSU ullage gas as determined by the Oxygen Analyzer. Depending on previous results (test series 1040B), it may be necessary to obtain TSU ullage gas samples, for analysis, at partial and full TSU charge conditions.		
8.6	RAPID CHARGING RATE TRANSITIONS This portion of the procedure is designed to assess the ability of the plant to maintain Mode 5 operation during a series of transients introduced by the collector field simulating operation during cloud passages. The tests are carried out for a series of transients at various frequencies and magnitudes.		
8.6.1	Establish Mode 5 operation with both charging heat exchanger trains in service, controller UC-3102 in pressure control, (1450 psig) using PT 3102, and a receiver temperature setpoint of 960°F.		
8.6.2	Gradually increase the number of heliostats tracking the receiver until all available heliostats are in TRACK or the maximum charging conditions are established. Steps 8.6.3 - 8.6.10 are designed to evaluate plant operation during symmetric disturbances.		

		Initial	Date
8.6.3	Command ring one to standby and then return to track mode. Monitor process parameters and verify that the plant can operate stably during this power transition. Monitor individual receiver panel and charging train conditions for proper operation.		
8.6.4	Repeat step 8.6.3 for ring 2 of the collector field.		
8.6.5	Repeat step 8.6.3 for ring 3 of the collector field.		
8.6.6	Repeat step 8.6.3 for ring 4 of the collector field.		
8.6.7	Repeat step 8.6.3 for ring 5 of the collector field.		
	Proceed through the subsequent steps of Section 8.6 until the controllability limit is reached from the standpoint of combined receiver, feed pump, and charging system operation. From the receiver steam standpoint, the limit is reached when receiver (mix) steam temperature oscillates by more than ±75°F. The steam temperature setpoint (TSP 2929) may be adjusted to a value between rated (960°F) and derated (660°F) depending on the results of the above steps. During each transient, primary water/steam process parameters should be closely monitored for impending alarm and/or trip conditions. Receiver panel metal temperatures and related strain gauge data should be monitored for excessive local temperatures or temperature gradients and related panel expansions. Preheat panel		

		Initial	Date
	flows and discharge temperatures should be monitored for the approach of boiling in individual panels. Boiling in a preheat panel may result in a stagnation of flow in the affected panel. Charging trains should be closely monitored for charging pump low flow trips.		
8.6.8	Repeat step 8.6.3 for rings 2 and 3 of the collector field simultaneously and monitor process conditions.		
8.6.9	Repeat steps 8.6.3 for rings 2, 3, and 4 of the collector field simultaneously and monitor process conditions.		
8.6.10	Repeat step 8.6.3 for rings 2 - 5 of the collector field simultaneously and monitor process conditions.		
8.6.11	Depending on results obtained in the previous steps of this section, carryout additional (simulated cloud) transients by using combinations of segments that provide zero receiver power and approach the nonsymmetric aspects of cloud passage over the collector field. The required commands to the collector field can be carried out through a simple commands file. Record all such commands issued as well as appropriate process conditions that occur from the transients.		
8.7	CLOUD INDUCED TRANSITIONS		
	Note: This portion of the test should be carried out only if the charging system operated in a stable and controlled manner		

	Initial	Date

during the controlled transients created during Section 8.6 of this procedure. In addition, these steps should be carried out only if the test engineer has a reasonable confidence that the system can maintain stable operation based on past operating experience. It is required that the charging system and plant trip functions, including those contained in Section 8.8 of this procedure, be operating properly as a prerequisite to this portion of the test.

8.7.1 Verify that the plant (receiver and charging system) is operating in a moderate to high charging rate condition with the charging system controlling steam pressure to 1450 psig, both charging trains in operation, receiver controlling steam temperature to 960°F and the receiver feed pump in valve control.

8.7.2 Continue operation during the passage of partial cloud cover and monitor system response. Verify that the receiver feed pump, receiver controllers, and charging system operate in a stable manner, maintaining system steam temperature and pressure while exposed to the changing power (and steam flow) environment. Note this test should not be carried out if the partly cloudy condition will completely block the insolation from the entire collector field. During any cloud passage tests, particular

	Initial	Date

attention should be paid to possible upset conditions in the receiver and possible charging pump low flow trips.

8.7.3 Repeat step 8.7.2 for a variety of partly cloudy events. These events should be carried out at various times during the day and at differing redirected power levels. Record sufficient data to characterize cloud type, insolation fall off, and pertinent process/control stability data.

8.8 MODE 5 TRIP TESTS

The purpose of this section of the procedure is to:

(a) Demonstrate the ability of the steam dump system to accept steam flow, in the event of a TSS charging system trip, and to permit continued operation of the receiver.

(b) Demonstrate the ability to restart the charging system following a charging system trip.

(c) Demonstrate proper response of the receiver/charging system to a receiver trip.

	Initial	Date
The tests in this section should be executed at a convenient point in the test program, possibly during the high charging rate tests.		
8.8.1 TSS Charging System Trip		
8.8.1.1 Establish Mode 5 operation with both charging heat exchanger trains in service, total steam flow approximately 70 klbh, controller UC-3102 in pressure control (1450 psig) using PT 3102, and a receiver temperature setpoint of 960°F.		
8.8.1.2 Verify that the steam dump controller PC 1001 is in the automatic control mode with a pressure override set point (PSP 1001) 75 psig above the current downcomer pressure (PI 1001).		
8.8.1.3 Verify that the condenser is operating at an absolute pressure $\leq$2.5 in Hg and that the circulating water pumps and cooling towers are operating properly.		
8.8.1.4 Press the CHARGING TRIP pushbutton on the TSS console. Monitor plant parameters for acceptable operation:		
(a) Verify that the charging system steam inlet valve (UV-3102) closes, the charging oil pumps (P-301, -302) shut off, the charging heat exchanger inlet steam valves (AOV-3206, -3306)		

	Initial	Date
close (due to low oil flow), the condenser drain valves (PV-3110, -3111) close, and the oil temperature control valves (TV-3410, -3411) open.		
(b) Monitor steam system pressure rise and verify that the steam dump valve opens and, following an acceptable overshoot, controls system pressure at its set point value (~75 psi above the initial downcomer pressure value).		
(c) Verify that the steam dump desuperheater responds properly by controlling steam temperature entering the condenser to ~20°F superheat (on a steady state basis) and the initial transient does not lead to a high steam temperature trip.		
(d) Verify that a condenser overpressure and trip condition does not occur as a result of the rapid initiation of steam dump system operation.		
(e) Verify that no significant receiver upset occurs during the transient and that stable controlled operation is maintained during the period immediately following the charging system trip and initiation of flow to the steam dump system.		

		Initial	Date
8.8.1.5	Repeat steps 8.8.1.1 through 8.8.1.4 at the maximum two-train charging rate condition for 960°F receiver steam.		
8.8.1.6	Repeat steps 8.8.1.1 through 8.8.1.4 at the maximum two-train charging rate condition for 660°F receiver steam.		
8.8.2	Charging System Re-Start The following test sequence applies to a charging system re-start immediately following a charging system trip.		
8.8.2.1	Verify that conditions are acceptable for a re-start and reset the TSS RLU.		
8.8.2.2	Verify that low temperature oil (425°F) is available in the thermal storage unit from the bottom manifold.		
8.8.2.3	Set up and verify the valve alignments as shown in Table 8-5.		
8.8.2.4	Set up and verify the controller/loop conditions as shown in Table 8-6.		
8.8.2.5	Verify that receiver steam is flowing through the main steam downcomer at a controlled temperature and pressure. (A pressure between 1450 and 1515 psig at PI 1001 and a temperature of 960°F at TI 2903 are required before actual charging operation		

		Initial	Date
	can begin.) The total receiver flow should be approximately 50,000 lb/hr.		
8.8.2.6	Verify that the charging oil pumps (P-301, P-302) and flash tank drain pump (P-307) are ready for operation. Verify that the steam line low point drains are operational.		
8.8.2.7	Toggle TD 3411/TD 3410 from "FLOW" to "TEMP" and back to "FLOW."		
8.8.2.8	Command oil pump P-301 to start through either HS 3413A (console switch) HS 3413B(SDPC keyboard) and verify oil flow as indicated by FI 3211 on TSS CRT.		
8.8.2.9	Command oil pump P-302 to start through either HS 3414A (console switch) HS 3414B (SPDC keyboard) and verify oil flow as indicated by FI 3310 on TSS CRT.		
8.8.2.10	Monitor pump discharge oil temperatures (TI 3214/3314) on the TSS CRT. Continue oil circulation until discharge oil temperatures stabilize and then switch PCM 3413/3414 to Auto/Console and FCM 3411/3410 to Auto/Cascade.		

		Initial	Date
8.8.2.11	Open AOV-3206 and AOV-3306 and then gradually open UV-3102 by inputting a C.O. to FC 3102 and verify proper desuperheater (DS-301) operation.		
8.8.2.12	Slowly open UV-3102 to a position corresponding to approximately 20 klbh (determined from previous two-train startups).		
8.8.2.13	Verify proper condenser pressure control (PCM 3110, PCM 3111).		
8.8.2.14	Adjust the setpoint of FC 3102 to a value equal to the P.V. and set FC 3102 to AUTO.		
8.8.2.15	Verify proper operation of desuperheater DS-301. Steam temperature shall be 650°F (nominal value) as measured by TI 3105A or 3105B.		
8.8.2.16	When condenser discharge oil temperatures TI 3211A/B or TI 3310A/B increase to 550°F (on the way to 580°F final control values), divert flow to the top TSU manifold. The required oil valve commands are: AOV 3001 (open) AOV 3002 (open) AOV 3003 (closed) AOV 3005 (closed) (AOV 3005 command executed last)		
8.8.2.17	Gradually increase the setpoint of FC 3102 until the P.V. equals approximately 40 KLBH. Verify proper operation of PC 3110/3111.		

		Initial	Date
8.8.2.18	Verify that TC 3411/3410 sequence to AUTO when the condenser discharge oil temperatures (TI 3211A/B, TI 3310A,B) reach 570°F.		
8.8.2.19	Adjust the PC 3102 controller setpoint to a value equal to the current P.V. (PI 1001).		
8.8.2.20	Toggle UD 3102B to "PRESS."		
8.8.2.21	Adjust the setpoint on PC 3102 to a value equal to 1515 psig and toggle PD 1001A to "ENABLE." Verify that the steam dump valve goes fully closed (ZI 1001) and that PC 3102 is functioning properly.		
8.8.2.22	Adjust the setpoint on PC 3102 to a value equal to the current P.V. (PI 3102) and toggle UD 3102A to "PT 3102."		
8.8.2.23	Following pressure stabilization, adjust the setpoint on PC 3102 to 1450 psig.		
8.8.2.24	Repeat steps 8.8.2.1 through 8.8.2.23 starting with a downcomer steam temperature of 660°F (TI 2903, step 8.8.2.5).		
8.8.3	Receiver System Trip		
8.8.3.1	Establish Mode 5 operation with both charging heat exchanger trains in service, charging rate at or near the two-train maximum, controller UC-3102 in pressure control (1450 psig) using PT 3102, and a receiver temperature setpoint of 960°F.		

		Initial	Date
8.8.3.2	Press the RS TRIP pushbutton on the RS console. Monitor plant parameters for acceptable response:		
	(a) Verify a TSS charging system trip (initiated by the RS TRIP) and system response according to 8.8.1.4(a).		
	(b) Verify proper receiver system response to trip.		
8.8.3.3	Repeat steps 8.8.3.1 and 8.8.3.2 at a receiver temperature setpoint of 660°F.		
8.9	OPERATIONAL MODE 5 DEMONSTRATION During test series 1040B and the previous sections of this test series, procedures were verified and/or developed for the operation of the TSS charging system. The final procedures, which will become part of the "Plant Operating/Training Manual," are to be demonstrated in the section.		
8.9.1	Verify single charging train startup operational procedure.		
8.9.2	Verify series charging train startup operational procedure.		
8.9.3	Verify parallel charging train startup operational procedure.		

		Initial	Date
8.9.4	Verify high to low charging rate transition operational procedure.		
8.9.5	Verify cloudy-day Mode 5 operational procedure.		
8.9.6	Verify trip restart operational procedure.		
8.9.7	Verify manual shutdown operational procedure.		

	Initial	Date
9.0 SYSTEM RESTORATION		
9.1 Shutdown the system and prepare for operation in other plant operating modes.		
9.2 Initiate trace heating if a subfreezing condition is anticipated.		
9.3 Remove supporting electronic checkout equipment e.g., strip chart recorders, control test unit, or transfer function analyzer from the individual MVCU's (unless required for subsequent testing) and restore control wiring.		
9.4 Inform SCE station shift operating foreman that the test is completed and the plant may be prepared for the next test.		

10.0 ATTACHMENTS

Appendix 10A Master Tracking System

Appendix 10B Abnormal Equipment and Circuits

Appendix 10C SDPC and DARMS Data Scan Lists

Appendix 10D Control Loop Tuning Forms

Appendix 10E Completion Record

Appendix 10A

MASTER TRACKING SYSTEM

Item No.	Description	Section Affected	Initial/Date

Appendix 10B

ABNORMAL EQUIPMENT AND CIRCUITS

Item No.	Description	Section Affected	Initial/Date

Appendix C
SDPC AND DARMS DATA SCAN LISTS

(To be supplied)

Control Loop Tuning

Controller Tag _____

MVCU No. _____

Function Type _____

Test No. 1150

Paragraph _____

Line _____ Control Engr. _____

Date _____

		Initial Setting	Trial 1	Trial 2	Trial 3	Trial 4	Final Values
Gains	K1						
	K2						
	K3						
	K4						
	K5						
Alarms (Values)							
	Setpoint Low						
	Setpoint High						
	PV Low						
	PV High						
	Output Low						
	Output High						
Ramp Rates (Values)							
	Output						
	Setpoint						
Limiting (Select)							
	Setpoint						
	Output						
	High Dynamic						
	Low Dynamic						
Mode (Select)							
	Cascade						
	Normal						
Setpoint							

Appendix 10E

COMPLETION RECORD

TEST OPERATIONS PLAN TEST SPECIFICATION NO.	1150 PROCEDURE SECTION NO.(S)	COMPLETION INITIAL/DATE
1150-1	8.1.1	
	8.1.2	
	8.1.3	
	8.2.1	
	8.2.2	
	8.2.3	
1150-4	8.8.1.6	
1150-5	8.8.1.5	
1150-8	8.8.3.3	
1150-9	8.8.3.2	
1150-10	8.5.2.16	
1150-11	8.5.2.13	
1150-12	8.3.2.6	
1150-13	8.3.2.3	
1150-14	8.4.13	
	8.4.14	
1150-15	8.4.23	
1150-16	8.4.18	
	8.4.19	
1150-17	8.4.11	
	8.4.12	
1150-18	8.4.26	
	8.4.27	
1150-19	8.4.15	
1150-20	8.4.22	
	8.4.28	
	8.4.29	
1150-21	8.4.24	
	8.4.25	

Appendix 10E

COMPLETION RECORD

TEST OPERATIONS PLAN TEST SPECIFICATION NO.	1150 PROCEDURE SECTION NO.(S)	COMPLETION INITIAL/DATE
1150-22	8.4.4	
	8.4.5	
1150-23	8.4.16	
	8.4.17	
1150-24	8.4.6	
	8.4.7	
	8.4.8	
	8.4.9	
	8.4.10	
	8.4.31	
	8.4.32	
1150-25	8.4.2	
	8.4.3	
	8.4.20	
	8.4.21	
1150-26	8.7.1	
	8.7.2	
	8.7.3	

December 19, 1984

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