INTEGRATED TEST PROCEDURES
for the
RECEIVER TESTING

MOLTEN SALT ELECTRIC
EXPERIMENT, PHASE I

	APPROVAL	DATE
PREPARED BY (MMC)	John W. Hank	06/06/83
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CRTF/MMC SAFETY CHECKLIST

Test ID _____ Date _____

Test Title _____

1. Site Occupants O/S

   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
06/08/83	Procedure Release	

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1.0 INTRODUCTION

1.1 SCOPE

These Integrated Test Procedures cover the Receiver 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 Receiver and Thermal Storage Subsystems. The Receiver Subsystem consists of the receiver panel, cavity enclosure with one vertical aperture door, cold surge tank, booster pump, hot surge tank, overflow tank and control valves. The thermal storage tanks, a propane-fired salt heater, and cold salt pump are part of the Thermal Storage Subsystem which supplies molten salt to the Receiver Subsystem. The working fluid used by the Receiver and Thermal Storage Subsystems is a salt mixture of 60% $NaNO_3$ and 40% KNO_3. This fluid is heated using the reflected solar insolation that is concentrated on the receiver panel from the Collector Subsystem.

The Receiver Testing consists of two separate tests. The first, which is a program option, operates the new "salt loop" from the Thermal Storage Subsystem to the Receiver Subsystem under both steady state and transient conditions. This optional test will only be performed, if the steam generator is not available for test first. This first test can be accomplished without a heat rejection capability (i.e., without the steam generator). The second test, Receiver Integration (which is mandatory) checks out the entire Receiver Subsystem in a more thorough manner and is performed concurrently with the Steam Generation Acceptance Test. The first portion of the Receiver Integration Test is the accomplishment of the salt loop test (with extended operating times for 100% heliostat loading).

1.2 TEST OBJECTIVES

1.2.1 Primary Objective

The overall objective of the test is to demonstrate the performance of the Receiver Subsystem in conjunction with the Thermal Storage and Collector Subsystems. This will include the checkout of the salt loop from the storage area with the associated piping, boost pump, instrumentation, surge tanks and supporting controls. In addition, the integration of the MCS with the receiver must be evaluated.

1.2.2 Specific Objectives

The specific objectives of the Receiver Testing are:

a) Verify the thermal/hydraulic design of the new salt loop from the Thermal Storage to the Receiver Subsystem in both steady state and transient modes of operation.

b) Checkout instrumentation and control from the MCS.

c) Checkout the trace heating.

d) Checkout the receiver under all operating modes in combination with the new salt loop and MCS.

e) Verify operating procedures and train operating personnel.

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) The following subsystem interfaces will be checked out prior to the "Salt Loop" and Receiver Integration Tests (as a part of the stand alone checkouts):

1) RS with MCS
2) TSS with MCS
3) RS with TSS

f) 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) Heliostat field configurations (Appendix C) required,
4) Salt (both hot and cold) required for the test,
5) Data to be obtained and recorded during the test, and
6) 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.

2.0 SUPPORT REQUIREMENTS

2.1 EQUIPMENT

2.1.1 Zetex and/or Cal OSHA Protective Gloves

2.1.2 Fire Retardant Coveralls

2.1.3 Face Shields

2.1.4 Hard Hats

2.1.5 Collector Subsystem (222 Heliostats and Control System)

Power Level - see Appendix C for heliostat configurations

Warmup

12 1/2 % Load

25% Load

37 1/2% Load

50% Load

62 1/2 % Load

75% Load

87 1/2 % Load

100% Load

2.1.6 Thermal Storage Subsystem

2.1.7 TV Monitoring System

2.1.8 Radio Communication Systems

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

2.1.10 Commercial Power

2.1.11 Master Control Subsystem (EMCON)

2.1.12 HP Data System

2.1.13 Accurex Data Logger System

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
ST9BM501101	MSEE Flow Schematic CRTF

2.3 POWER (AC)

Item	Voltage (v)	Power (kW)
Receiver Subsystem		
Heat Trace Circuits	---	72.8
Booster Pump	480	29.8
Control	24 Vdc	0.2
Thermal Storage Subsystem		
Heat Trace Circuits	120/277	31.2
Cold Salt Pump	480	44.8
Control	24 Vdc	0.2

2.4 COMMODITIES

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

2.4.2 Demineralized Water

2.4.3 Instrument and Process Air

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

2.5 TEST PARTICIPANTS

The following personnel will be present for the Pretest Meeting, the Test Performance and Post Test Meeting:

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:

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 O/S Engineer 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.

3.1.1 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 (ST9BM501101) - When manual steps are called out for accomplishment, this schematic will provide the location of the specified item. Due to drawing 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 CTRF O/S Engineer shall take whatever immediate action is necessary to prevent injury to personnel and/or damage to equipment. CTRF 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
cfm	Cubic Feet per Minute
CRT	Cathode Ray Tube
CRTF	Central Receiver Test Facility
CS	Collector Subsystem
CSP	Cold Salt Pump
D/A	Data Acquisition
DEC	Decrease
EPGS	Electric Power Generation Subsystem
FC	Fail Closed
FCV	Flow Control Valve
FIT	Flow Indicating Transmitter
FM	Flow Meter
FMEA	Failure Modes and Effects Analysis
FO	Fail Open
FT	Flow Transmitter
gpm	Gallons per Minute
GROP	General Receiver Operations Procedure
GSGP	General Steam Generation Procedure
HPCV	Hand Pressure Control Valve
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 Sensor
MCS	Master Control Subsystem
MMC	Martin Marietta Corporation
MSEE	Molten Salt Electric Experiment
N/A	Not Applicable
$NaNO_3$	Sodium Nitrate
O/S	Operations and Safety Engineer

PCM	Process Control Module
PR	Pressure Regulator
PSIG	Pounds per square inch
PT	Pressure Transducer
RITP	Receiver Integrated Test Procedure
RS	Receiver Subsystem
SGS	Steam Generation Subsystem
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
UPS	Unit Protection System

3.4 DEFINITIONS

a) Empty Condition - The Receiver Subsystem is drained and the RS and TSS salt systems are trace heated to 500°F minimum.

b) Warm Standby Condition - In this manual condition, the RS salt system is at the cold salt temperature with salt flowing through the receiver and back to the Cold Storage Tank. Both the Cold Salt and Booster Pumps are operating.

c) On Line Condition - The RS and TSS salt systems are operating at normal temperatures with the Receiver and Collector Subsystems charging salt for the Hot Salt Tank.

d) Standby Mode - This is a mode set up by an automatic sequence in which the receiver is kept full of salt at a temperature of approximately 550°F. The bang-bang control (periodic cold salt cycling) of the flow control valves and cold salt pumps is activated.

e) Operational Mode - Term used by the MCS Specification which means the same as the On Line Condition.

f) Hot Startup - Is the automatic sequence that brings the RS from Standby back to the Operational Mode.

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

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

4.0 TEST OPERATIONS

4.1 GENERAL RECEIVER OPERATING PROCEDURES (GROP)

These procedures will detail the steps for bringing the Receiver and Thermal Storage Subsystems from ambient conditions to normal operations and then return them to ambient conditions. Also included is the emergency shutdown (due to various conditions).

- GROP#1 Receiver Pretest Checkout
- GROP#2 Receiver Startup (Manual)

  Cold Startup
  Warm Standby
  On Line

- GROP#3 Receiver Shutdown (Manual)

  On Line
  Warm Standby
  Shutdown and Drain

- GROP#4 Emergency Shutdown

  Commercial Power Loss
  PCM Failure

- GROP#5 Post Test Checklist

4.1.1 GROP#1 Receiver Pretest Checkout

This General Receiver Operation Procedure will be utilized as the daily/initial test Receiver Pretest Checklist for all Receiver Integrated Tests (RITPs) and test using the RS. The format for this procedure is the 1) RS Test Configuration Setup, 2) Tower Control Room Setup, and 3) Computer Room Setup. Other Subsystem Pretest Checklists are not part of this procedure but will be identified for accomplishment.

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

STEP	DESCRIPTION	VERIFICATION
1.	Accomplish the MCS Pretest Checklist.	_____

NOTE

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

RS Test Configuration Setup

NOTE

Step 13 calls for the accomplishment of the TSS Pretest Checklist (Test Configuration portion). It may be accomplished in conjunction with the Receiver Checkout to avoid duplication of effort.

1. Inspect salt system for evidence of leaks and insulation damage. Repair as required.

   - o All RS Piping
   - o Boost Pump and Sump
   - o Surge Tanks
   - o Vents
   - o Valves
   - o Receiver Assembly _____

CAUTION

A plugged vent can cause a severe pressure difference between the storage tanks and sumps.

2. Visually verify Boost Pump Sump and Hot Surge Tank vents are free of frozen salt. _____

STEP	DESCRIPTION	VERIFICATION
3.	Check for visual evidence of blown fuses, burned relays or burned electrical components throughout the Receiver subsystem.	_____
* 4.	Verify the amperage on the active heat trace circuits (following list). Current should be within 10% of listed value.	_____

STEP DESCRIPTION

LOCATION	HEATERS	ASSOC. T/Cs	CURRENT
Purge Valves	HTR-1/HTR-2/HTR-3	TEH-190, TEH-191, TEH-192,	4.8 A
	HTR-4/HTR-5/HTR-6	TEH-193, TEH-194, TEH-195,	4.8 A
	HTR-7/HTR-8/HTR-9	TEH-196, TEH-197, TEH-198	4.8 A
Drain Valves	HTR-10/HTR-11	TEH-180, TEH-181	3.4 A
	HTR-12/HTR-13	TEH-182, TEH-183	3.4 A
	HTR-14/HTR-15	TEH-184, TEH-185	3.4 A
	HTR-16/HTR-17	TEH-186, TEH-187	3.4 A
	HTR-18/HTR-19	TEH-188, TEH-189	3.4 A
Purge & Drain Manifolds	HTR-20	TEH-160, TEH-161	3.8 A
	HTR-21	TEH-176, TEH-177	6.2 A
Upper & Lower Headers	HTR-22	TEH-172, TEH-173,	6.1 A
	HTR-24	TEH-174,	6.1 A
	HTR-26	TEH-175	6.1 A
Secondary Header	HTR-23	TEH-172, TEH-173	6.1 A
	HTR-25	TEH-174	6.1 A
	HTR-27	TEH-175	6.1 A
Header East End	HTR-28	TEH-175	3.1 A
Receiver Outlet	R	TEH-157, TEH-158	12.8 A
	N	TEH-153, TEH-159	8.5 A
Receiver Inlet	O	TEH-152, TEH-156	9.6 A
	P/Q	TEH-150, TEH-151	7.6 A
		TEH-162, TEH-163	
Receiver Drain	T	TEH-154, TEH-155	6.2 A
Hot Surge Tank	U	TEH-166, TEH-167	8.5 A
Cold Surge Tank	V	TEH-164, TEH-165	12.6 A
Riser	H	TEH-131, TEH-211, TEH-241	18.5 A
	I	TEH-134, TEH-133	18.5 A
	J	TEH-136, TEH-135	9.5 A
Downcomer	K	TEH-130, TEH-212, TEH-240	17.0 A
	L	TEH-139, TEH-132	14.0 A
	M	TEH-137, TEH-138	4.9 A

5. Check Receiver Cavity Door, Cavity Wall, and its supports for evidence of scorching.

STEP	DESCRIPTION	VERIFICATION

6. Verify supply air is being supplied to the Cold Surge Tank as follows:

   a. Open valves on supply bottles.

   b. Verify supply bottles at 300 psig minimum.

   c. Adjust HPCV 171 to read 200 psig on PI 171.

7. Verify/adjust all pneumatic activated valve air sets to 30 psig outlet pressure on the valves listed.

   FCV 152 _____ FCV 190-198 _____

   FCV 180-189 _____ FCV 199 _____

   _____

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

   FCV 101 _____ FCV 161 _____

   FCV 102 _____ FCV 162 _____

   FCV 151 _____ _____

9. Check coolant pump and radiator for leak and proper operation. Verify coolant flow thru Boost Pump bearing. _____

10. Verify Boost Pump shaft is free to rotate. _____

11. Verify Boost Pump circuit breaker is on. _____

12. Verify pneumatics are supplied from the continuous duty compressor at 100 psig minimum as read on the local indicator. _____

13. Accomplish TSS Pretest Checklist (Test Configuration portion). _____

14. Accomplish CRTF Safety Checklist. _____

STEP DESCRIPTION VERIFICATION

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

16. Verify Accurex Scanners 1, 2, 3, 4 and 5 are ON and operating. _____

Computer Control Room Setup

NOTE

Steps 1 thru 4 will be accomplished when using the Collector Subsystem. Acceptable conditions will be established in the Pretest Meeting.

1. Verify winds are within acceptable limits. _____

2. Verify solar insolation is acceptable. _____

3. Verify cloud coverage is acceptable. _____

4. Verify TV cameras are ON and operational. _____

NOTE

Step 12 calls for the accomplishment of the TSS Pretest Checklist (Control Room Setup portion). It may be accomplished in conjunction with steps 5 thru 11 to avoid duplication of effort.

5. Verify RS trace heater circuits (Table 4.1-1, following page) and the listed SGS trace heater circuits are ON and operating. _____

T/C	Description	Accurex Scanner
TEH-305	Hot Salt Inlet Piping	3
TEH-306	Hot Salt Inlet Piping	3

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-150	Receiver Inlet - Heater P	1
TEH-151	Receiver Inlet - Heater P	1
TEH-152	Cold Surge Tank Inlet - Heater O	1
TEH-153	Hot Surge Tank Inlet - Heater N	1
TEH-154	Drain Line - Heater T	1
TEH-155	Drain Line - Heater T	1
TEH-156	Cold Surge Tank - Heater O	1
TEH-157	Receiver Outlet - Heater R	1
TEH-158	Receiver Outlet - Heater R	1
TEH-159	Hot Surge Tank Outlet - Heater N	1
TEH-160	Purge Line - Heater S	1
TEH-161	Purge Line - Heater S	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
TEH-166	Hot Surge - Heater U	1
TEH-167	Hot Surge - Heater U	1
TEH-172	Outlet of Pass #1 (Header)	1
TEH-173	Pass #10	1
TEH-174	Pass #11	1
TEH-175	Pass #18	1
TEH-177	Drain Line	1
TEH-176	Drain Line	1
TEH-180	Drain Valve #1	1
TEH-181	Drain Valve #2	1
TEH-182	Drain Valve #3	1
TEH-183	Drain Valve #4	1
TEH-184	Drain Valve #5	1
TEH-185	Drain Valve #6	1
TEH-186	Drain Valve #7	1
TEH-187	Drain Valve #8	1
TEH-188	Drain Valve #9	1
TEH-189	Drain Valve #10	1
TEH-190	Purge Valve #1	1
TEH-191	Purge Valve #2	1
TEH-192	Purge Valve #3	1
TEH-193	Purge Valve #4	1
TEH-194	Purge Valve #5	1
TEH-195	Purge Valve #6	1
TEH-196	Purge Valve #7	1
TEH-197	Purge Valve #8	1
TEH-198	Purge Valve #9	1

Table 4.1-1 RS Heat Trace Instrumentation

STEP DESCRIPTION VERIFICATION

6. Verify salt system temperatures, with the exception of the Receiver tubes, are greater than 500°F. (Check heat trace T/Cs on Accurex Data Scanner). _____

CAUTION

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

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

FCV 101	Open	FCV 162	Closed
FCV 102	Open	FCV 180 thru 189	Closed
FCV 151	Closed	FCV 190 thru 198	Closed
FCV 152	Closed	FCV 199	Open
FCV 161	Open		

_____

8. At the EMCON, cycle the valves listed in step 7 between full open and full closed (or vice versa). Observe operation of limit indicators. Return all valves to their fail position prior to continuing. _____

* 9. To verify proper operation of the Unit Protection System: Open FCV 151. _____

a) Input a 310 psig signal (PT-180 - Pump outlet pressure), then input a 1070°F signal (TE-102 - Receiver outlet temperature), and verify response of 1) command to defocus heliostats and 2) FCV 151 closure and FCV 152 opening.

b) Input a 16 psig signal (PT-181 - Receiver inlet pressure), then input a 1070°F signal (TE-102 - Receiver outlet temperature), and verify same response as a).

c) Input 1070°F signal (TE-102 - Receiver outlet temperature) and verify response of a command to defocus heliostats.

STEP	DESCRIPTION	VERIFICATION
	d) Input 400°F signal (TE-184 - HST Level) and verify response of 1) command to defocus heliostats, and, after a time delay, 2) FCV 101 and FCV 102 close.	
	e) Input 915°F signal (TE-140 - Receiver tube temperature) and verify response of a command to defocus heliostats.	_____
	f) Input a loss of receiver door-open signal (ZSH-DR) and verify a response of a command to defocus heliostats.	
10.	Verify Receiver uninterruptible power supply is ready and operational (battery gauge greater than 90v).	_____
* 11.	Cycle Receiver Cavity Door between full open and full closed and verify proper operation of limit indicators.	_____
12.	Accomplish TSS Pretest Checklist (Control Room portion).	_____
13.	Verify salt levels in the Storage Tanks, Sumps, and Surge Tanks are commensurate with test requirements and record heights.	
	Cold Storage Tank _____ in. (greater than 30 in.)	
	Cold Salt Sump _____ in. (less than 60 in.)	
	Hot Salt Sump _____ in. (less than 48 in.)	_____

4.1.2 GROP#2 Receiver Startup (Manual)

This General Receiver Operating Procedure will be utilized as the normal manual startup for all Receiver Integrated Tests (RITP's), when the RS is started prior to the Steam Generation Subsystem. The sequence will proceed through the Cold Startup and Warm Standby modes to the On Line condition. (The Warm Standby mode used in this manual sequence differs from the automatic sequence. Here the cold salt flow is maintained continuously through the Receiver).

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

STEP	DESCRIPTION	VERIFICATION
1.	Verify that the following Checklists have been completed:	
	MMC Receiver Pretest Checkout (GROP#1)	_____
	TSS Pretest Checklist (Appendix A)	_____
	Collector Pretest Checklist	_____
	MCS Pretest Checklist (Appendix B)	_____
	CRTF/MMC Pretest Checklist	_____
	CRTF Safety Checklist	_____
2.	Verify that all heat traced systems are operating and that all temperatures, with the exception of the following list, are greater than 500°F.	

Receiver Tubes	TEH 223
TE 180	TEH 224
TE 181	TEH 236
TE 184	TEH 238
TEH 217	TEH 239

_____

STEP DESCRIPTION VERIFICATION

3. Align/verify valves as follows:

Valve	Description	Position
Receiver		
FCV 101	Salt Flow Cont.	Open
FCV 102	Salt Flow Cont.	Open
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 171	CST Air Supply	Closed
HPCV 171	CST Air Supply	Set
FCV 180 thru 189	Drain/Purge Valves	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
Steam Generation Subsystem		
FCV 301	Evaporator Temp. Cont.	Closed
FCV 341	Cold Salt Inlet Cont.	Closed _____

4. 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.

5. Verify FCV 201 is closed. _____

6. Open FCV 211. _____

STEP	DESCRIPTION	VERIFICATION

CAUTION

If salt level in the Cold Sump is greater than 60 inches, visually check the Cold Sump Vent.

7. 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 10.

8. Set Cold Sump Level control set point to 50 inches. _____

9. Activate Cold Sump Level Control (FCV 201) and ensure Cold Sump Level increases to greater than 48 inches. _____

10. Set Cold Sump Level control set point to 15 inches. _____

11. Bring Heliostats up to Standby. (The specific Heliostats to be used will be determined in the Pretest Meeting. Use OP-78-03 for specific steps.) _____

12. Open Receiver Cavity Door. _____

13. Direct Warm Up Heliostats at Receiver. (Use CRTF's OP-78-03 for specific steps.) _____

14. Verify Receiver temperature (TE 131 thru TE 148) is greater than 430°F prior to continuing. _____

Note

If Receiver temperature remains below 430°F, increase the number of heliostats in use.

STEP	DESCRIPTION	VERIFICATION

15. Verify the following FCV's are open:

101_____	188_____
102_____	189_____
152_____	190_____
180_____	191_____
181_____	192_____
182_____	193_____
183_____	194_____
184_____	195_____
185_____	196_____
186_____	197_____
187_____	198_____
	199_____

_____

16. Start the Cold Salt Pump. _____

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

18. Start Cold Salt Boost Pump. _____

19. Verify outlet pressure (PT 180) is greater than 320 psi within 1 minute of Boost Pump activation. _____

20. Activate Hot Surge Tank Level Control (FCV 161/162) with a level set point of 60 inches. _____

21. Open FCV 151. _____

22. Close FCV 152. _____

23. Verify Hot Surge Tank level (LT 161) is greater than 10 inches prior to continuing. _____

24. Close FCV 199 and insure that Hot Surge Tank Level (LT 161) increases to greater than 55 inches prior to continuing. (Approximately 2 to 3 minutes) _____

25. Close the following FCV:

180_____	185_____
181_____	186_____
182_____	187_____
183_____	188_____
184_____	189_____

_____

Verify valve closure and wait 5 seconds prior to continuing. _____

STEP	DESCRIPTION	VERIFICATION

26. Sequentially close the following FCV's at 5 second intervals:

190_____	195_____
191_____	196_____
192_____	197_____
193_____	198_____
194_____	

_____

27. Reset Hot Surge Tank level control set point to 40 inches. _____

28. Confirm FCV 180 thru 199 are closed. _____

29. Open FCV 171. _____

30. Verify Cold Surge Tank level (LT 151) is less than 55 inches prior to continuing. _____

31. Close FCV 171. Record PT-182 pressure:_____psig _____

32. Activate Cold Surge Tank Level Control (FCV 151) with a set point of 55 inches. _____

33. Activate the Salt Flow Control (FCV 101 and FCV 102) with a flow set point of 90,000 lbs/hr. Wait 2 minutes prior to continuing. _____

34. Verify the following maximum variations in the control loops over a 10 minute period.

    - o Cold Surge Tank Level less than 5 inches.
    - o Hot Surge Tank Level less than 5 inches.
    - o Salt Flow Control less than 1,000 lbs/hr. _____

THE RS IS NOW IN THE WARM STANDBY MODE AWAITING DECISION TO START SOLAR CHARGING ACTIVITY.

Note

To maintain the Warm Standby condition (continuous salt flow) for an extended period of time accomplish the following:

a) Manually reset the Salt Flow Control valves (FCV 101 and FCV 102) to achieve a 20,000 lbs/hr flow rate (minimum flow).

b) Warm up Heliostats may be taken off receiver.

c) Close Receiver Cavity door.

STEP	DESCRIPTION	VERIFICATION
	d) If the previous steps in this note are accomplished, return to procedural step 2 and reconfirm correct test configuration prior to continuing.	_____
35.	Verify Receiver Cavity Door fully OPEN and Collector Subsystem ready.	_____
36.	Direct heliostats (number/pattern specified in Pretest Meeting per calling test) at the receiver.	_____
37.	Verify downcomer and headers trace heaters are off.	_____
38.	Set Operational Alarms.	_____

4.1.3 GROP#3 Receiver Shutdown (Manual)

This General Receiver Operating Procedure will be utilized as the normal manual shutdown for all Receiver Integrated Tests (RITP's), unless otherwise noted. The sequence will proceed from On Line operation, through the Warm Standby mode to Receiver Shutdown and Drain. (The Warm Standby mode used in this manual sequence differs from the automatic sequence. Here the cold salt flow is maintained continuously through the Receiver).

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

STEP	DESCRIPTION	VERIFICATION
1.	Deactivate Operational Alarms.	_____
2.	Command all heliostats to standby. Confirm heliostats at Standby prior to continuing.	_____

Note

To remain in the Warm Standby condition keep the warm up heliostats on.

3.	Close the Receiver Cavity Door once the warm up heliostats have moved to standby.	_____
4.	Reduce FCV 101 and FCV 102 to TBD %.	_____

RS NOW IN WARM STANDBY MODE. (Salt flow may be varied to provide desired temperature/flow thru the receiver.)

5.	Open FCV 152.	_____
6.	Close FCV 151.	_____
7.	Fully open FCV 101 and FCV 102.	_____
8.	Verify Downcomer and Headers trace heaters automatically turn on.	_____
9.	Stop the Cold Salt Boost Pump.	_____
10.	Stop the Cold Salt Pump.	_____
11.	Open FCV 162.	_____

STEP	DESCRIPTION	VERIFICATION

12. Open the following FCV's:

180_____	190_____
181_____	191_____
182_____	192_____
183_____	193_____
184_____	194_____
185_____	195_____
186_____	196_____
187_____	197_____
188_____	198_____
189_____	199_____

Verify correct valve positions and wait 2 minutes prior to continuing. _____

Note

If Hot Pump (SGS) is operating, wait 5 minutes then continue at step 16.

13. Close FCV 201, and open FCV 211 wait 2 minutes prior to continuing. _____

14. Close FCV 211. _____

15. If the SGS is not in operation, open FCV 301 and FCV 341 to drain salt. _____

16. Open FCV 151 and FCV 161. Wait 20 minutes (to allow RS salt drainage) prior to continuing. _____

17. Close the following FCV's:

151_____	186_____	195_____
161_____	187_____	196_____
162_____	188_____	197_____
180_____	189_____	198_____
181_____	190_____	301_____
182_____	191_____	341_____
183_____	192_____	
184_____	193_____	
185_____	194_____	

_____

THE RS IS NOW SHUTDOWN AND DRAINED.

4.1.4 GROP #4 Emergency Shutdown (Manual)

This General Receiver Operating Procedure will be utilized as the manual, Emergency Shutdown Procedure during Receiver Testing. It will cover two specific conditions: 1) Electrical or Power Loss, and 2) Process Control Module Failure (PCM 1 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

NOTE

In the event of a facility commercial power failure or fire alarm in 9980 or 9981, verify that the heliostats are moving off the target to the stowed position.

CAUTION

If not, push the SCRAM switch and verify that all heliostats are in the automatic SCRAM mode and moving to standby.

Part 1 - Commercial Power Loss

NOTE

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

a) The UPS will initiate heliostat defocus.

b) The following valves will fail OPEN: FCV-101, 102, 161, and 199.

c) The following valves will fail CLOSED: FCV 151, 152, 162, 180 thru 198, 201, 211, 221, 231, and 242.

d) The salt pump motors will stop.

e) Back up battery power will come up for the Receiver Assembly (only for manual control) and the Main Grid Circuit Breaker.

STEP DESCRIPTION VERIFICATION

NOTE

If power is off for a period of more than 1 minute, continue with this sequence. (If less than 1 minute, then Test Conductor can return to RS Startup).

1. Verify or manually open the following valves to 100% to allow salt drainage:

FCV 180-189	_____	FCV 161	_____
FCV 190-198	_____	FCV 162	_____
FCV 199	_____	FCV 211	_____
FCV 151	_____		
FCV 152	_____		

_____

2. Manually close FCV 211. Wait 20 minutes prior to continuing. _____

3. Close the receiver supply bottles hand valves (on the lifting module) and secure the pneumatic backup system. _____

4. Place the valve handwheels of all of the FCV's manually overridden in Step 1, in a neutral position. _____

5. When elecric power is restored, verify all trace heaters are ON and operating. _____

RS AND TSS ARE NOW IN SHUTDOWN CONFIGURATION AND DRAINED.

STEP	DESCRIPTION	VERIFICATION

Part 2 - Process Control Module Failure (PCM 1 and PCM 3)

I. PCM 1 Failure (Receiver Subsystem Control)

NOTE

Upon sensing a PCM 1 fault, the UPS will provide an alarm and:

a) Initiate heliostat defocus,

b) After a 20 second delay, turn off Boost Pump, and

c) Close FCV 151.

	1.	Verify heliostats are moving off target to the stand-by position.	_____
	2.	Silence (acknowledge) the Operational Alarms.	_____
	3.	Place TSS automatic controller (FCV 201) in the Manual mode.	_____

NOTE

The following steps will require coordination between the Tower Control and the Computer Control Rooms.

Tower	4.	Close the Receiver Cavity Door from the module control room.	_____
MCS	5.	If the SGS is not operating, stop the Cold Salt Pump.	_____
Tower	6.	At PCM 1, open the back door and place all Receiver control valves in the Manual mode.	_____
Tower	7.	At PCM 1, manually open FCV 101, FCV 102, and only when the SGS is not operating, FCV 151.	_____
Tower	8.	At the local control console, place all Receiver Shutoff valves in the Manual mode.	_____
MCS	9.	Close FCV 161.	_____
MCS	10.	Open FCV 152 and FCV 162.	_____

STEP	DESCRIPTION	VERIFICATION

Tower 11. At the local control console, open the following FCV's:

	186 _____	193 _____
180 _____	187 _____	194 _____
181 _____	188 _____	195 _____
182 _____	189 _____	196 _____
183 _____	190 _____	197 _____
184 _____	191 _____	198 _____
185 _____	192 _____	199 _____

_____

MCS 12. If the CSP is not operating, close FCV 201 and open FCV 211. Wait 2 minutes prior to continuing. _____

MCS 13. Open FCV 161. Wait 20 minutes prior to continuing. _____

MCS 14. Close FCV 152, FCV 161, FCV 211, and FCV 162. _____

Tower 15. At the local control console, close the valves listed in step 11. _____

Tower 16. At PCM 1, close FCV 151. _____

THE RS AND TSS ARE NOW SHUTDOWN AND DRAINED. EFFECT REPAIR OF PCM 1.

II. PCM 3 Failure (TSS AND SGS Control)

NOTE

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

a) Initiate heliostat defocus,

b) After a time delay, close FCV 211, and

c) Turn off Cold Salt and Boost Pumps.

1. Verify heliostats are moving off target to the standby position. _____

2. Silence (acknowledge) the Operational Alarms. _____

STEP	DESCRIPTION	VERIFICATION
	3. Place the following RS automatic controllers in the Manual mode. ° FCV 101 ° FCV 102	_____
	4. Close Receiver Cavity Door.	_____
	NOTE The following steps will require coordination between the Storage Area and the Computer Control Rooms.	
PCM 3	5. At PCM 3, open the back door and place all TSS control valves in the Manual mode.	_____
PCM 3	6. Close FCV 161 and open FCV 151 and FCV 162.	_____
MCS	7. Open the following FCV's: 180 _____ 187 _____ 194 _____ 181 _____ 188 _____ 195 _____ 182 _____ 189 _____ 196 _____ 183 _____ 190 _____ 197 _____ 184 _____ 191 _____ 198 _____ 185 _____ 192 _____ 199 _____ 186 _____ 193 _____	_____
MCS	8. Fully open FCV 101, FCV 102, and FCV 152.	_____
PCM 3	9. Close FCV 201 and open FCV 211. Wait 2 minutes prior to continuing.	_____
PCM 3	10. Open FCV 161.	_____
MCS	11. Wait 20 minutes then close FCV 151, and all FCVs listed in Step 7.	_____
PCM 3	12. Close FCV 152, FCV 161, and FCV 162.	_____
	THE RS AND TSS ARE NOW SHUTDOWN AND DRAINED. EFFECT REPAIR OF PCM 3.	

4.1.5 GROP #5 Receiver Post Test Checklist

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

STEP	DESCRIPTION	VERIFICATION

Control Room

NOTE

The TSS Post Test Checklist (Appendix A) may be accomplished in conjunction with this activity to avoid duplication of effort.

1. Verify RS trace heater circuits are operating (see Table 4.1-1) and that system temperatures, with the exception of the Receiver tubes, are 500° minimum. _____

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

FCV 101	Open	FCV 162	Closed
FCV 102	Open	FCV 171	Closed
FCV 151	Closed	FCV 180-189	Closed
FCV 152	Closed	FCV 190-198	Closed
FCV 161	Open	FCV 199	Open

_____

3. Verify Receiver Cavity Door is fully closed. _____

4. Accomplish the applicable portions of the MCS post test checklists (Appendix B). _____

STEP	DESCRIPTION	VERIFICATION
	Test Configuration	
1.	Inspect salt system for evidence of leaks and insulation damage. o All piping o Boost Pump, Sump, and Vent o Surge Tanks o Valves	_____
2.	Open the Receiver Cavity Door and inspect Receiver Assembly for evidence of leaks (white on black surface) and general condition. Close the door when the inspection is complete.	_____
3.	Check for visual evidence of blown fuses, burned relays, or burned electrical components throughout the Receiver Subsystem.	_____
4.	Close the receiver supply bottles hand valves and secure the pneumatic backup system.	_____
5.	Schedule/accomplish maintenance required on any RS components found faulty during test or post test activities.	_____
6.	Accomplish TSS Post Test Checklist (as required).	_____

4.2 RECEIVER INTEGRATED TEST PROCEDURES (RITP)

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

- RITP#1 Cold Salt Flow with Transients (Manual Startup)

  Initial Control Loop Checkouts

- RITP#2 Hot Salt Flow with Transients

  Control Loop Tuning

- RITP#3 Cold Salt Flow Margin Test

- RITP#4 Manual Sequence Demonstration

- RITP#5 Automatic Sequence Demonstration

- RITP#6 Cloud Simulation

4.2.1 RITP #1 Cold Salt Flow With Transients

PURPOSE: To bring the Receiver Subsystem manually up to the Warm Standby condition in conjunction with the initial control loop checkout of 3 controllers. Each control loop will be tested at low, medium, and high salt flow rates with a step response test at each level. Also, the paint on the receiver tubing will be cured during initial receiver warm up.

DESCRIPTION: Using parts of GROP#2 (Receiver Startup), the Receiver will be brought up to Warm Standby in two distinct stages. In the first stage (salt flow is shutoff from the receiver) the Cold Sump Level Control will be checked out. The second stage starts the salt flow through the receiver and returns it back to the Cold Storage Tank. Here, the Hot Surge Tank Level Control Loop followed by the Cold Surge Tank Level Control Loop are checked out. Once the performance of the three control loops are demonstrated, the Receiver Subsystem is operated at varying flow rates to verify system performance. The test will be completed by manually shutting down and draining the RS. Only the warmup heliostats will be used in this test.

OBJECTIVES:

a) Checkout of system and components

b) Control loop tuning of:

- o Cold Sump Level Control
- o Hot Surge Tank Level (Partial)
- o Cold Surge Tank Level Control

c) Instrumentation checkout

d) Demonstration of control stability

e) Test crew familiarization with system operation

f) Cure paint on the receiver tubing

g) Correct response to UPS trips

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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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 (i.e. all of the receiver temperatures should be checked for reasonableness with the cold salt flowing).

STEP	DESCRIPTION	VERIFICATION
1.	Perform the Receiver Pretest Checkout per GROP#1 (4.1.1) and the TSS Pretest Checklist (Appendix A).	_____

NOTE

The next activity will be to bring the system up to the Warm Standby mode in support of the initial control loop checkout for 3 of the TSS and RS control loops. They will include the:

- o Cold Sump Level Control (FCV 201)
- o Hot Surge Tank Level (FCV 161)
- o Cold Surge Tank Level Control (FCV 151)

2.	Accomplish steps 1 thru 7 of GROP#2 (4.1.2 Receiver Startup).	_____
3.	Verify the Cold Sump Level (LT 201) is greater than 40 inches prior to continuing. (Open FCV 201 to obtain required salt level.)	_____
4.	Close FCV 101 and FCV 102.	_____

NOTE

The next activity will be the control loop check-out of the Cold Sump Level Control. Should the control loop, during flow rate changes or step response tests, show incorrect response or in-adequate damping, accomplish the control loop tuning engineering activity. Following this, return to the low level salt flow condition and reaccomplish the control loop checkout.

° Cold Sump Level (LT 201) limits: 60 in. maximum

*If the Cold Sump Level Control has been checked out during SGS testing, continue at Step 16.

5.	Verify the salt level in the Cold Storage Tank is between 30 to 135 inches.	_____
6.	Start the Cold Salt Pump and verify outlet pressure (PT 180) is greater than 170 psi prior to continuing.	_____
7.	Open FCV 151 to 20% to provide a low level salt flow.	_____
8.	Close FCV 152.	_____

STEP	DESCRIPTION	VERIFICATION
9.	Activate the Cold Sump Level Control (FCV 201) with a set point of 15 inches.	_____
10.	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%	_____
11.	Over a 10 second time period, change the FCV 151 setting from 20% to 50% (medium flow).	_____
12.	Repeat step 9 for the 50% flow rate as follows:	
	a) Decrease to 40%	
	b) Increase to 50%	
	c) Increase to 60%	
	d) Decrease to 50%	_____
13.	Over a 10 second time period, change the FCV 151 setting from 50% to 90% (high flow).	_____
14.	Repeat step 9 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%	_____
15.	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.	
	a) Decrease to 80%	
	b) Decrease to 60%	
	c) Increase to 80%	

STEP	DESCRIPTION	VERIFICATION

d) Increase to 100%

e) Decrease to 70% _____

CAUTION

Since the Hot Salt Tank has no salt the introduction of a small amount of salt will freeze. Change the temperature set point on the Hot Surge Tank Level to 900°F. Close FCV 161 by the handwheel to prevent opening.

NOTE

When initially performing GROP#2 Step 13 (directing warmup heliostats at the receiver), it will require longer time delays for heliostat introduction to allow receiver paint curing. Using Figure 6 of Appendix C, the heliostats will be focused in pairs with a 10 minute delay prior to introducing the next pair (i.e. focus pair 1, wait 10 minutes, focus pair 2, wait 10 minutes, etc.).

16. Perform GROP #2 steps 11 thru 15. _____

17. Open FCV 101 and FCV 102 to achieve a 20% flow rate (low level flow). _____

18. Fully open FCV 151. _____

19. Close FCV 162. _____

20. Start the Cold Salt Boost Pump and verify outlet pressure (PT 180) is greater than 320 psi prior to continuing. _____

21. Close FCV 199 when the Hot Surge Tank Level (LT 161) increases to greater than 10 inches. _____

22. When the Hot Surge Tank Level is greater than 55 inches close FCV 180 thru FCV 189. Verify value closure and wait 5 seconds prior to continuing. _____

23. Open FCV 162 and manually maintain the Hot Surge Tank level between 40 and 60 inches. _____

STEP DESCRIPTION VERIFICATION

24. Sequentially close the following FCV's at 5 second intervals:

190	_____	195	_____
191	_____	196	_____
192	_____	197	_____
193	_____	198	_____
194	_____		

Confirm valves are closed. _____

25. Open FCV 171. _____

26. When the Cold Surge Tank Level is less than 55 inches, close FCV 171. _____

NOTE

The next activity will be the control loop checkout of the Hot Surge Tank 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 control loop checkout.

- Hot Surge Tank Level (LT 161) limits: 15 to 70 inches
- FCV 161 limits: 700 to 1100°F
- FCV 162 limits: 480 to 800°F

CAUTION

Carefully monitor the Cold Surge Tank pressure and level during this activity to prevent forcing salt from the relief valve.

STEP	DESCRIPTION	VERIFICATION
27.	Activate the Hot Surge Tank Level Control (FCV 161/162) with a set point of 40 inches.	_____
28.	Perform a step response test to introduce low amplitude flow transients into the 20% salt flow rate. Using 10% increments, change the FCV 101 and FCV 102 settings 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%	_____
29.	Over a 10 second time period, change the FCV 101 and FCV 102 settings from 20% to 50% (medium flow).	_____
30.	Repeat step 28 for the 50% flow rate as follows:	
	a) Decrease to 40%	
	b) Increase to 50%	
	c) Increase to 60%	
	d) Decrease to 50%	_____
31.	Over a 10 second time period, change the FCV 101 and FCV 102 settings from 50% to 80% (high flow).	_____
32.	Repeat step 28 for the 80% flow rate as follows:	
	a) Decrease to 70%	
	b) Increase to 80%	
	c) Increase to 90%	
	d) Decrease to 80%	_____
33.	Over a 10 second time period, decrease the FCV 101 and FCV 102 settings to 20% (low level flow).	_____

NOTE

At this low salt flow rate, it is the test team option to accomplish the UPS trips (see GROP#1, step 9 for specific inputs and response). Return the RS to the proper configuration prior to continuing.

STEP DESCRIPTION VERIFICATION

NOTE

The next activity will be the control loop checkout of the Cold Surge Tank 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.

° Cold Surge Tank Level (LT 151) limits: 10 to 80 inches

34. Activate the Cold Surge Tank Level Control (FCV 151) with a set point of 55 inches. _____

35. Perform a step response test to introduce low amplitude flow transients into the 20% salt flow rate. Using 10% increments, change the FCV 101 and FCV 102 settings 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% _____

36. Over a 10 second time period, change the FCV 101 and FCV 102 settings from 20% to a 50% (medium level). _____

37. Repeat step 35 for the 50% flow rate as follows:

    a) Decrease to 40%

    b) Increase to 50%

    c) Increase to 60%

    d) Decrease to 50% _____

38. Over a 10 second time period, change the FCV 101 and FCV 102 settings from 50% to 80% (high level). _____

39. Repeat step 35 for the 80% flow rate as follows:

    a) Decrease to 70%

    b) Increase to 80%

STEP	DESCRIPTION	VERIFICATION
	c) Increase to 90%	
	d) Decrease to 80%	
40.	Perform a step response test to introduce higher amplitude flow transients into the salt flow rate. Change the FCV 101 and FCV 102 settings as specified below, maintaining the setting until the level settles.	
	a) Decrease to 75%	
	b) Decrease to 50%	
	c) Decrease to 25%	
	d) Increase to 50%	
	e) Increase to 75%	

NOTE

At this high salt flow rate, it is the test team option to accomplish the UPS trips (see GROP#1, step 9 for specific inputs and response). Return the RS to the proper configuration prior to continuing.

NOTE

The following sequence will first establish a steady state cold salt flow and then vary the flow to ensure correct subsystem reaction.

The Test Team will monitor system temperatures, pressures, flow, controller performance, and subsystem interaction.

1.	Following the control loop tuning activity, the salt flow thru the Receiver (FT 101) should be at 75% flow rate. Maintain this condition for 2 minutes.	
2.	Over a 10 second time period increase the FCV 101 and FCV 102 settings to 100% design salt flow. Maintain this configuration for 2 minutes.	
3.	Over a 10 second time period decrease the FCV 101 and FCV 102 settings to 50%. Maintain this configuration for 2 minutes.	
4.	Increase the FCV 101 and FCV 102 settings to 80%. Maintain this condition for 2 minutes then return to 50%.	

STEP	DESCRIPTION	VERIFICATION
5.	Decrease the FCV 101 and FCV 102 settings to 20%. Maintain this condition for 2 minutes then return to 50%.	_____
6.	Repeat step 4 but change the time duration for stabilization to 30 seconds.	_____
7.	Repeat step 5 but change the time duration for stabilization to 30 seconds.	_____
8.	Perform GROP#3 Receiver Shutdown (Manual).	_____
9.	Perform GROP#5 Receiver Post Test Checklist.	_____
10.	Unlock FCV 161 and place the handwheel in the neutral position.	_____

4.2.2 RITP #2 Hot Salt Flow With Transients

PURPOSE: To bring the Receiver Subsystem up to the On Line condition in conjunction with the control loop tuning of the last 2 controllers. The Heliostat Field is brought up incrementally to 100% input power and maintained on line with the manual and automatic sequences. Low amplitude flux transients are introduced to verify system reaction and performance.

DESCRIPTION: The RS and TSS are manually brought up from the Shutdown condition to the Warm Standby mode. Heliostats are then added to increase receiver outlet temperature and allow the final RS control loop tuning. The RS/CS are then brought up, incrementally, to the 100% On Line Loading and maintained for a specified duration. Low amplitude flux stepping tests are made at low, medium, and high flux levels to verify the Salt Temperature Control. The RS is manually shutdown and then brought up to the On Line condition using the automatic sequence. Heliostats are again introduced incrementally up to 100% and sustained for a specified duration. The final testing is the inputting of higher amplitude heliostat transients on the receiver using 50% variations.

OBJECTIVES:

a) Checkout of system and components at operating temperatures

b) Control loop tuning of:

- o Hot Surge Tank Level/Hot Salt Flow Control
- o Salt Flow/Temperature Control

c) Demonstration of control stability

d) Demonstrate RS reaction to heliostat transients

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 response 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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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

RITP #2

Each of the instrumentation channels involved in this test shall be checked out by observing the displays on the EMCON console (i.e., all of the receiver temperatures should be checked for reasonableness with the cold and hot salt flowing.

Refer to Appendix C for the heliostat field configuration called for in this RITP.

STEP	DESCRIPTION	VERIFICATION

CAUTION

Prior to the start of this test, the hot tank must have been preheated with salt from the propane heater. At least 16 inches of hot salt should be in the hot tank. Also, monitor the cold tank salt level throughout this test.

1. Perform the Receiver Pretest Checkout per GROP#1 (4.1.1) and the TSS Pretest Checklist (Appendix A). _____

2. Perform the Receiver Startup (Manual) per GROP#2 (4.1.2) step 1 thru step 32. _____

NOTE

The RS is in the Warm Standby mode with the warmup heliostats on the panel.

3. Over a 15 second time period adjust FCV 101 and FCV 102 settings to 50%.

4. Perform a step response test by introducing transients into the salt flow rates. This is to verify the performance of the RS and TSS control loops checked out in RITP#1 following system shutdown and startup. Change the FCV 101 and FCV 102 settings as specified below, maintaining the new setting until the level settles.

   a) Decrease to 40%

   b) Decrease to 30%

   c) Increase to 50%

   d) Increase to 70%

   e) Increase to 80% _____

NOTE

In the following steps, that include the initial calling up of the Collector Subsystems, control of receiver temperatures will be accomplished be manually controlling FCV 101 and FCV 102 salt flow valves.

STEP	DESCRIPTION	VERIFICATION

CAUTION

It is critical that the operator monitor internal Receiver temperatures, as well as, outlet temperature in the test activity that precedes complete Salt Flow Control Loop checkout.

5. Direct 50% load of the Heliostat Field at the Receiver. _____

6. Adjust FCV 101 and FCV 102 to obtain a Receiver outlet temperature (TE 102) of 750°F. Note FCV 101 and FCV 102 settings: _____% and _____%. _____

NOTE

The next activity will be the final control loop checkout of the Hot Surge Tank 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 Hot Surge Tank Level (LT 161) limits: 15 to 70 inches
- o FCV 161 limits: 700 to 1100°F
- o FCV 162 limits: 480 to 800°F

7. Adjust the set point of FCV 161/162 to 850°F. _____

8. Perform a step response test to introduce transients into the salt flow rate established in step 6. Change the FCV 101 and FCV 102 settings as specified below, maintaining the new setting until the level settles.

   a) Decrease 5% from step 6 setting

   b) Decrease to 10% from step 6 setting

   c) Increase to step 6 setting

   d) Increase to 20% above step 6 setting

   e) Return to step 6 setting _____

9. Adjust the set point of FCV 161/162 to 700°F. _____

NOTE

The next activity will be the control loop checkout of the Salt Temperature Flow Control. Should the control loop, during flow changes or flux transients, show incorrect response, accomplish the control loop tuning activity. Following this, return to the initial portion of the checkout and

STEP	DESCRIPTION	VERIFICATION

reaccomplish the control loop checkout.

- o Receiver Temperature limits (TE 103-TE 120): 480 to 1100°F
- o Receiver Salt flow limits (to avoid laminar flow): 25,000 lbs/hr minimum
- o Receiver Outlet Temperature limits (TE 102): 500 to 1100°F

10. In 12 1/2% increments and allowing time for the RS to stabilize, direct 50% of the Heliostat Field at the Receiver. Manually adjust FCV 101 and FCV 102 to obtain a Receiver outlet temperature of 950°F. _____

11. Activate the Salt Temperature Control (FCV 101/102) with a set point of 950°F receiver outlet temperature (TE 102). _____

12. Set the Operational Alarms. _____

13. Maintain this steady state condition for 10 minutes. Monitor all temperature and check the temperature distribution on the receiver tubes. Verify the following maximum variations in the control loops during this period. _____

    - o Cold Sump Level: 5 inches
    - o Cold Surge Tank Level: 5 inches
    - o Hot Surge Tank Level: 5 inches
    - o Salt Flow Control: 1000 lbs/hr _____

14. Perform a step response test to introduce low amplitude flux on the receiver. Change the Heliostat Field power input as specified below. Maintain the new condition until the salt flow rate stabilizes.

    a) Decrease to 37 1/2%

    b) Decrease to 25%

    c) Increase to 37 1/2%

    d) Increase to 50% _____

15. Deactivate the Salt Temperature Control. Manually decrease the FCV 101 and FCV 102 settings to obtain a stable 1050°F receiver outlet temperature. _____

16. Activate the Salt Temperature Control with a set point of 1050°F. Verify the receiver outlet temperature remains at 1050°F over a 5 minute period. _____

STEP	DESCRIPTION	VERIFICATION
17.	Deactivate the Salt Temperature Control. Manually increase the FCV 101 and FCV 102 settings to obtain a stable 1040°F receiver outlet temperature.	_____
18.	Activate the Salt Temperature Control with a set point of 1050°F. Verify the automatic return of the receiver outlet temperature to a stable 1050°F.	_____
19.	Repeat steps 17 and 18 but change the manual step up for a 1020°F receiver outlet temperature.	_____
20.	Repeat steps 17 and 18 but change the manual set up for a 1000°F receiver outlet temperature.	_____
21.	In 12 1/2% increments, and allowing time for the RS to stabilize increase the Heliostat Field power into from 50% to 75%.	_____
22.	Perform a step response test to introduce low amplitude flux on the receiver. Change the Heliostat Field power input as specified below. Maintain the new condition until the salt flow rate stabilizes. a) Decrease to 62 1/2% b) Increase to 75% c) Increase to 87 1/2% d) Decrease to 75%	_____
23.	In 12 1/2% increments and allowing time for the RS to Stabilize increase the Heliostat Field power input from 75% to 100%.	_____
24.	Repeat step 22 for the Heliostat power inputs specified below. a) Decrease to 87 1/2% b) Decrease to 75% c) Increase to 87 1/2% d) Increase to 100%	_____
25.	Maintain this steady state 100% condition for 1 hour (30 minutes for "Salt Loop" Test). Monitor the RS and TSS temperatures, flows, levels, pressures, an control loop performance.	_____
26.	Accomplish the manual Receiver Shutdown (GROP#3).	_____

STEP	DESCRIPTION	VERIFICATION

NOTE

Verify salt levels in the Cold and Hot Storage Tanks will allow the continuation of the ITP. If there is not enough cold salt to support the test, either wait until SGS testing to dissipate salt temperature or decrease the times for steady state conditions during the automated test.

27. Accomplish the Automatic Receiver Cold Startup Sequence using a power input from the Heliostat Field for 50% Load. Maintain this steady state condition for 5 minutes while monitoring RS and TSS temperatures, flows, levels, pressures, and control loop performance. _____

28. Increase the power input of the Heliostat Field to 75%. Maintain this steady state condition for 5 minutes while monitoring RS and TSS temperatures, flows, levels, pressures, and control loop performance. _____

29. Reaccomplish step 28 increasing the power input to 100%. Maintain this steady state condition for 1 hour (30 minutes for "Salt Loop" testing). _____

NOTE

The last portion of this test will introduce higher amplitude heliostat transients to the operating Receiver Subsystem. Verify Cold/Hot Storage Tank Salt levels will support test requirements.

30. Decrease the power input of the Heliostat Field to 50%. Maintain this condition for 3 minutes. _____

NOTE

During the following heliostat field transients monitor RS and TSS temperatures, pressures, levels, flows and control loop performance.

31. Increase the power input of the Heliostat Field to 100%. Maintain this condition for 3 minutes to allow time to stabilize. _____

32. Turn off the Operational Alarms. _____

33. Deactivate the Salt Temperature Control and manually fully open FCV 101 and FCV 102. _____

34. Decrease the power input of the Heliostat Field to the warm up heliostats only. Maintain this condition until the operating control loops stabilize. _____

STEP	DESCRIPTION	VERIFICATION
35.	Increase the power input of the Heliostat Field to 100%.	_____
36.	Activate the Salt Temperature Control (FCV 101/102) with a set point of 1050°F receiver outlet temperature.	_____
37.	Allow the salt flow rate to stabilize, then reset operational Alarms.	_____

This completes the hot salt flow testing. It is now the Test Conductor's option to continue into RITP#3 (Margin Test) or shutdown the system with GROP#3 (Receiver Shutdown).

NOTE

To shutdown the system perform:

a) GROP #3 Receiver Shutdown, and

b) GROP#5 Receiver Post Test Checklist.

To continue on into RITP#3:

a) Verify salt levels in the Cold and Hot Storage Tanks will allow the Cold Salt Margin Testing.

b) Accomplish GROP#3 (Receiver Shutdown) from the On Line condition to the Warm Standby mode.

4.2.3 RITP#3 Cold Salt Margin Test

PURPOSE: To test the Receiver Subsystem at 110% of the designed cold salt flow through the receiver. This is to verify the structural integrity of the RS and control loop performance at a high salt flow rate.

DESCRIPTION: The RS and TSS are started from the Warm Standby condition (or manually brought up to Warm Standby). The salt flow rate is smoothly increased to 110% of the designed flow and maintained for 30 minutes. Following this test the RS is manually shutdown and drained. Only the warm up heliostats will be used for this activity.

OBJECTIVES:

a) Demonstration of RS structural integrity

b) Demonstration of control loop stability at high flow

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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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

RITP#3

STEP	DESCRIPTION	VERIFICATION

NOTE

This test can be started immediately after RITP#2 (or RITP#1)--with the RS in the Warm Standby mode, or from a shutdown condition. If starting from shutdown perform the following:

a) GROP#1 Receiver Pretest Checkout

b) GROP#2 Receiver Startup (Manual) thru step 32

NOTE

Due to the large volume of salt required for RITP#2, verify the salt level in the Cold Storage Tank will allow the accomplishment of this test. The salt level required is TBD inches. If there is not enough cold salt to support the test, wait until SGS testing dissipates the salt temperature of the Hot Storage Tank salt.

1. Set Operational Alarms. _____

2. With the RS in the Warm Standby mode, smoothly increase the FCV 101 and FCV 102 settings to TBD% to provide 110% of design salt flow thru the Receiver. _____

3. Maintain this steady state condition for 30 minutes. Monitor RS and TSS temperatures, flows, pressures, and control loop performance. _____

4. Perform GROP#3 Receiver Shutdown (Manual). _____

5. Perform GROP#5 Receiver Post Test Checklist. _____

4.2.4 RITP#4 Manual Sequence Demonstration

PURPOSE: To demonstrate the manual RS startup to the On Line condition, RS shutdown, and drain prior to checking out the automated RS sequences.

DESCRIPTION: The Receiver and Thermal Storage Subsystems are started up using GROP#2. The Collector Subsystem is brought up in 25% increments. Finally, the three subsystems are shut down and the RS and TSS drained to complete the test.

OBJECTIVES:

a) Demonstrate the manual startup, shutdown and drain sequences.

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

c) Test crew familiarization with system operations.

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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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

RITP#4

STEP	DESCRIPTION	VERIFICATION
1.	Preform GROP#1 Receiver Pretest Checkout (4.1.1).	_____
2.	Perform GEOP#2 Receiver Startup (Manual). The initial power input of the Heliostat Field will be 25%. Verify all control loops have stabilized prior to continuing.	_____
3.	Activate the Salt Temperature control with a set point of 1050°F for the receiver outlet temperature.	_____
4.	Increase the power input of the Heliostat Field to 50%. Verify all control loops have stabilized prior to continuing.	_____
5.	Increase the power input of the Heliostat 75%. Verify all control lops have stabilized and maintain this condition for 5 minutes.	_____
6.	Increase the power input of the Heliostat Field to 100%. Verify all control loops have stabilized and maintain this condition for 5 minutes.	_____
7.	Perform GROP#3 Receiver Shutdown (Manual). This will take the RS and TSS down through shutdown and drain.	_____
8.	If not continuing immediately into RITP#5, perform GROP#5 Receiver Post Test Checklist.	_____

4.2.5 RITP#5 Automatic Sequence Demonstration

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

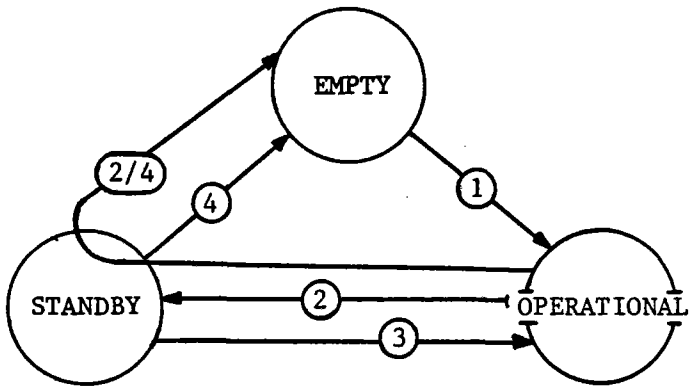
DESCRIPTION: The Receiver and Thermal Storage Subsystems are brought up to the operational mode using the Receiver Cold Startup Sequence. The Collector Subsystem is then brought up in 25% increments. Next, the Receiver Normal Shutdown and Hot Startup sequences are performed. At the Test Conductor's option the RS and TSS are brought to the standby mode and the Receiver Standby CST - Control sequence is performed during an overnight testing period (to checkout the bang-bang control). Following these checkouts the RS and TSS are drained by using the Receiver Drain Sequence.

OBJECTIVES: a) Checkout and demonstrate the Receiver Automatic Sequences.

b) Verify total system operation under automatic control.

c) Test crew familiarization with automatic system operation.

Automated Modes and Sequences



Receiver Operation Sequences

1. *Cold Startup*
2. *Normal Shutdown*
3. *Hot Startup*
4. *Drain*
5. *Standby CST - Control*

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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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

RITP#5

The Receiver automatic sequences are resident in PCM1.

To checkout the bang-bang control of the flow control valves and the Cold Salt Pumps with the Receiver Subsystem in the Standby mode will require a minimum of 1 overnight testing period (with the SGS not operating). If this is to be accomplished, schedule the test to make minimum impact on MSEE testing.

1. Perform GROP#1 Receiver Pretest Checkout (4.1.1).

2. Verify the following Checklists have been completed:

   TSS Pretest Checklist (Appendix A) _____

   Collector Pretest Checklist _____

   MCS Pretest Checklist _____

   Safety Checklist _____

   NOTE

   The 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.

   NOTE

   Test Conductor's Option: Disregard steps 4, 5, and 6, open FCV 101/102 to the 100% position, bring the power input of the Heliostat Field straight to the 100% Loading, and then activate the FCV 101/102 Salt Flow Control.

3. Perform the Receiver Cold Startup sequence. Use a 25% load for the initial power input from the Heliostat Field. _____

4. Increase the power input of the Heliostat Field to 50%. Verify all control loops have stabilized prior to continuing. _____

5. Increase the power input of the Heliostat Field to 75%. Verify all control loops have stabilized prior to continuing. _____

6. Increase the power input of the Heliostat Field to 100%. Verify all control loops have stabilized and maintain this condition for 5 minutes. _____

7. Perform the Receiver Normal Shutdown sequence. Wait TBD minutes prior to continuing. _____

STEP	DESCRIPTION	VERIFICATION
8.	Perform the Receiver Hot Startup Sequence. Use a 100 load for the power input from the Heliostat Field. Wait TBD minutes prior to continuing.	_____
9.	Perform the Receiver Normal Shutdown sequence.	_____

NOTE

The next activity is the checkout of the Receiver Standby, bang-bang control sequence. This will require an overnight testing period. If this is not to be accomplished at this time, continue at step 11.

10.	Checkout the operation of the control system in the Receiver Standby Operating Mode by performing the Receiver Standby CST-Control Sequence. Monitor system operation and temperatures throughout the duration of this test.	_____
11.	Perform the Receiver Drain Sequence.	_____
12.	Perform GROP#5 Receiver Post Test Checklist (4.1.5).	_____

4.1.6 RITP#6 Cloud Simulation

PURPOSE: Observe receiver efficiency and its ability to recover from simulated cloud passages.

DESCRIPTION: The Receiver and Collector Subsystems will be automatically brought up to 100% operational mode. For the simulation, clouds will be moving from west to east at approximately 5 miles/hour. The heliostat field will be decreased from 100% to 50% and to 25% and then returned in the reverse sequence to 100%. Following this testing, the RS and TSS will be automatically shutdown and drained.

OBJECTIVES:

a) Demonstrate RS recovery from simulated cloud passage

b) Demonstration of control stability

c) Obtain data on receiver efficiency for software modeling

d) Test crew familiarization with system transient 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)	_____	_____
RECEIVER/HRFS OPERATOR (CRTF)	_____	_____
SGS/TSS OPERATOR (CRTF)	_____	_____
FIELD MONITORS (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.

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

RITP#6

This procedure is written for a simulated cloud passage condition, but the operation will be similar to actual conditions except for heliostat removal. The test requires a clear day (maximum insolation) to provide data on receiver efficiency.

This test will use automatic sequences to bring the RS and TSS to the desired conditions. During the automatic sequence, should a control parameter or less than optimum controller performance dictate, the sequence can be aborted and the operator can manually take control of the system.

STEP	DESCRIPTION	VERIFICATION
1.	Perform GROP#1 Receiver Pretest Checkout (4.1.1).	_____
2.	Verify the following Checklists have been completed:	
	TSS Pretest Checklist (Appendix A)	_____
	Collector Pretest Checklist	_____
	MCS Pretest Checklist	_____
	Safety Checklist	_____
	NOTE	
	Test Conductor's Option: Disregard the incrementing of steps 3,4,5 and 6, open FCV 101/102 to the 100% position, bring the power input of the Heliostat Field straight to the 100% loading, and then activate the FCV 101/102 Salt Flow Control.	
3.	Perform the automatic Receiver Cold Startup Sequence. Use a 25% load for the initial power input from the Heliostat Field.	_____
4.	Increase the power input from the Heliostat Field to 50%. Verify all control loops have stabilized prior to continuing.	_____
5.	Increase the power input from the Heliostat Field to 75%. Verify all control loops have stabilized prior to continuing.	_____
6.	Increase the power input from the Heliostat Field to 100%. Verify all control loops stabilize and maintain this condition for 5 minutes.	_____

NOTE

The next activity is the cloud simulation testing. Ensure all test crews are familiar with their individual responsibilities due to the short time intervals required between steps.

CAUTION

Monitor receiver temperatures carefully during this testing for tube overheating can occur during this unbalanced flux heating.

STEP	DESCRIPTION	VERIFICATION
7.	Decrease the power input of the heliostat field to 87 1/2%. Wait TBD prior to continuing.	
8.	Decrease the power input of the heliostat field to 75%. Wait TBD prior to continuing.	
9.	Decrease the power input of the heliostat field to 62 1/2%. Wait TBD prior to continuing.	
10.	Decrease the power input of the heliostat field to 50% Wait TBD prior to continuing.	
11.	Decrease the power input of the heliostat field to 37 1/2%. Wait TBD prior to continuing.	
12.	Decrease the power input of the heliostat field to 25%. Wait TBD minutes prior to continuing.	
13.	Increase the power input of the heliostat field to 37 1/2%. Wait TBD prior to continuing.	
14.	Increase the power input of the heliostat field to 50%. Wait TBD prior to continuing.	
15.	Increase the power input of the heliostat field to 62 1/2%. Wait TBD prior to continuing.	
16.	Increase the power input of the heliostat field to 75%. Wait TBD prior to continuing.	
17.	Increase the power input of the heliostat field to 87 1/2%. Wait TBD prior to continuing.	
18.	Increase the power input of the heliostat field to 100%. Wait TBD minutes prior to continuing.	
19.	Perform the automatic Receiver Normal Shutdown and Drain Sequences.	
20.	Perform GROP#5 Receiver 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	THE-218, THE-216	13.0 A
	L1-3		6.4 A
Hot Sump Outlet	L2-2	THE-219, THE-222	5.2 A
Sump Lines	BB/CC/DD	THE-225, THE-230	5.0 A
	C/D	THE-201, THE-202	4.0 A
	L1-1/L2-1, L4-1/L5-1	THE-226, THE-229	3.8 A
Cold Tank	CT-1	THE-233, THE-234,	15.2 A
	CT-2	THE-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	THE-231, THE-232	5.0 A
	L4-3		3.4 A
	W	THE-205, THE-206	5.0 A
	B/E	THE-203, THE-204	5.0 A

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

_____

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 (Hot Salt Sump Level - High) and verify response to be full closure of FCV 231.

   . Input TBD simulated signal (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. _____

Table A - TSS Heat Trace Instrumentation

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.

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. _____

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. _____

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. _____

STEP	DESCRIPTION	VERIFICATION

AUXILIARY DATA LOGGING/DISPLAY SYSTEM

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. _____

APPENDIX C: HELIOSTAT FIELD CONFIGURATIONS

A. Heliostat Field Configuration - Definition Groups

Warmup A	Figure C-1
25% Load	Figure C-2
50% Load	Figure C-3
75% Load	Figure C-4
100% Load	Figure C-5

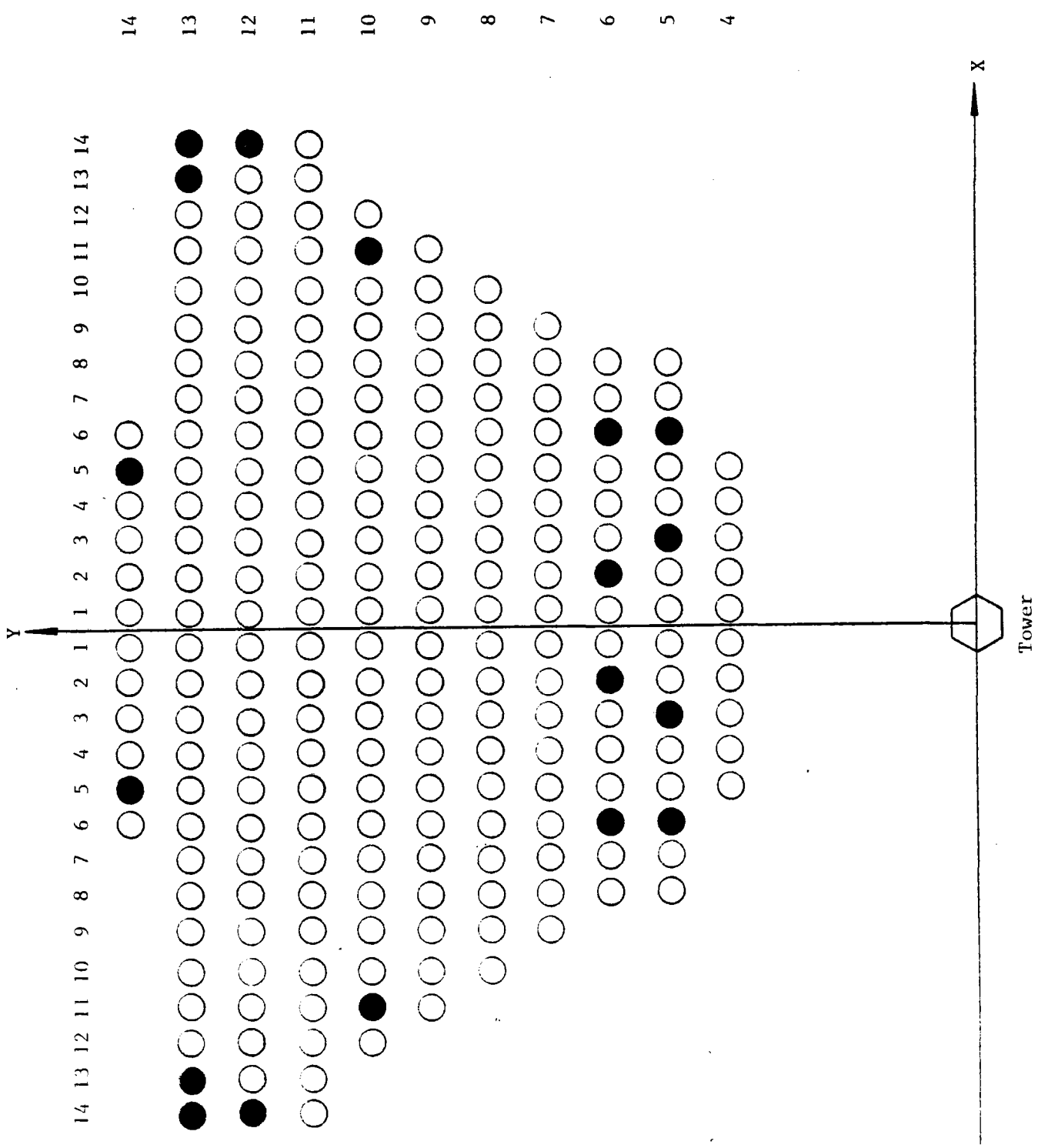


Figure C-1 Definition Group Warmup A

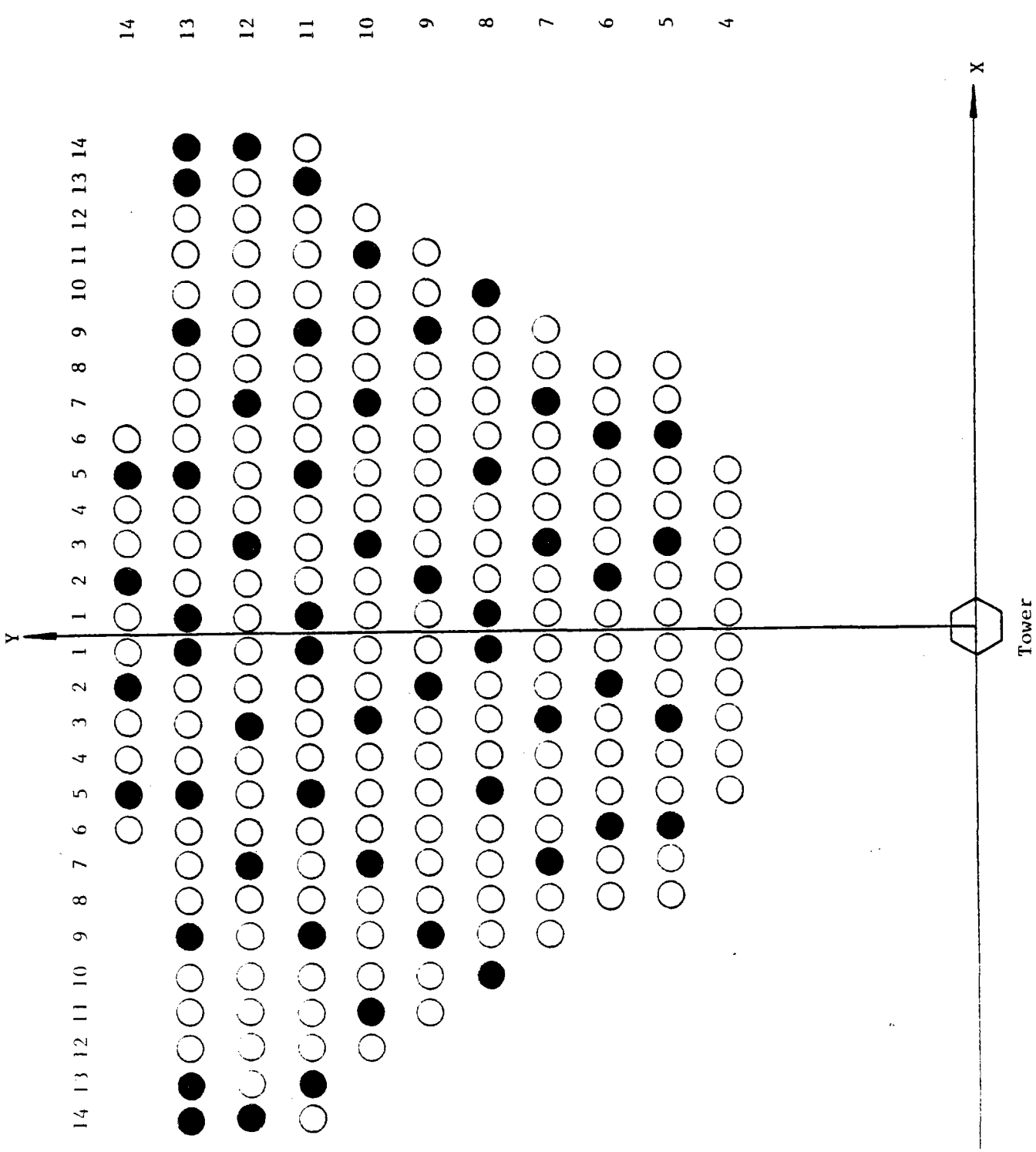


Figure C-2 Definition Group - 25% Load

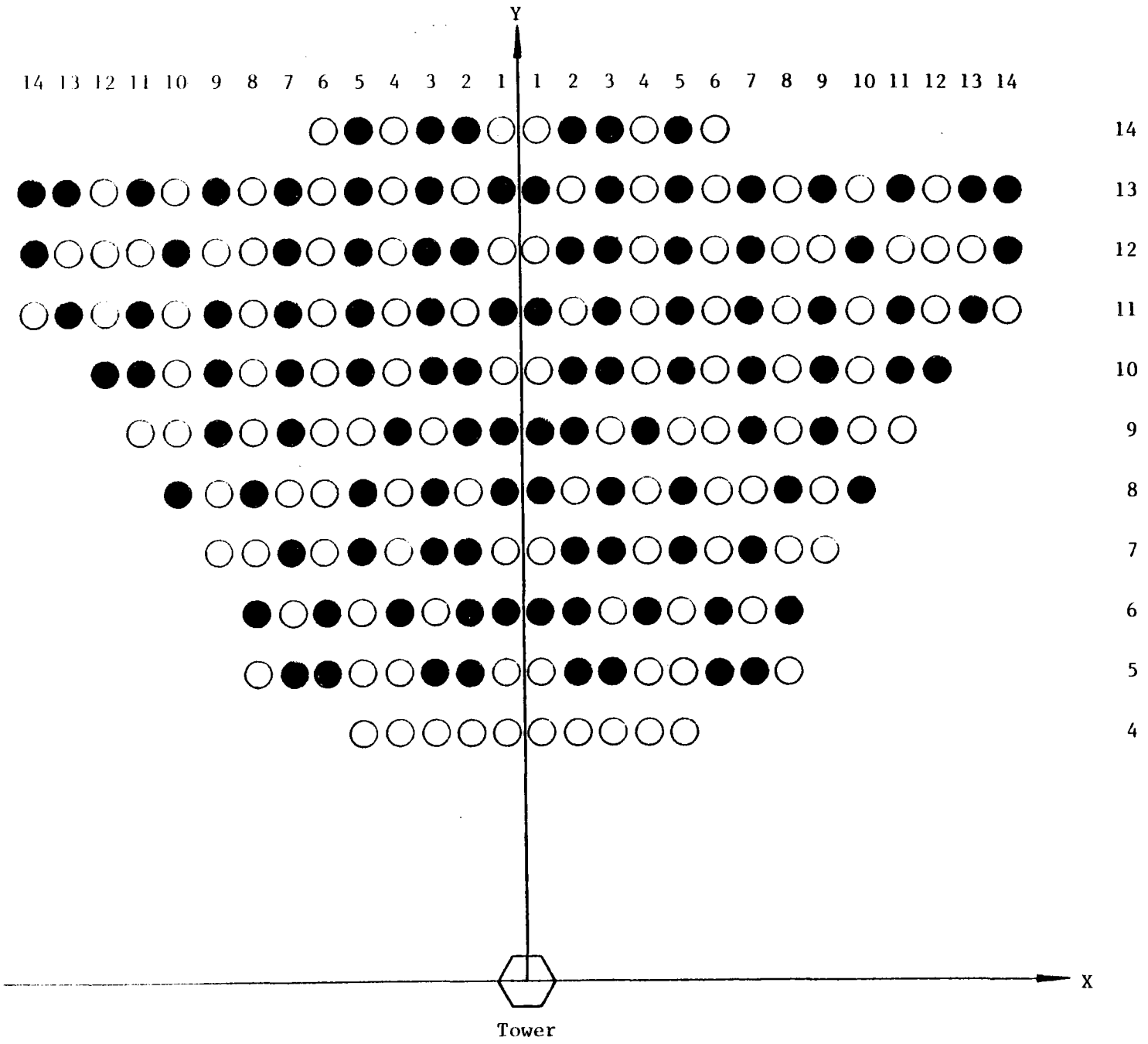


Figure C-3 Definition Group - 50% Load

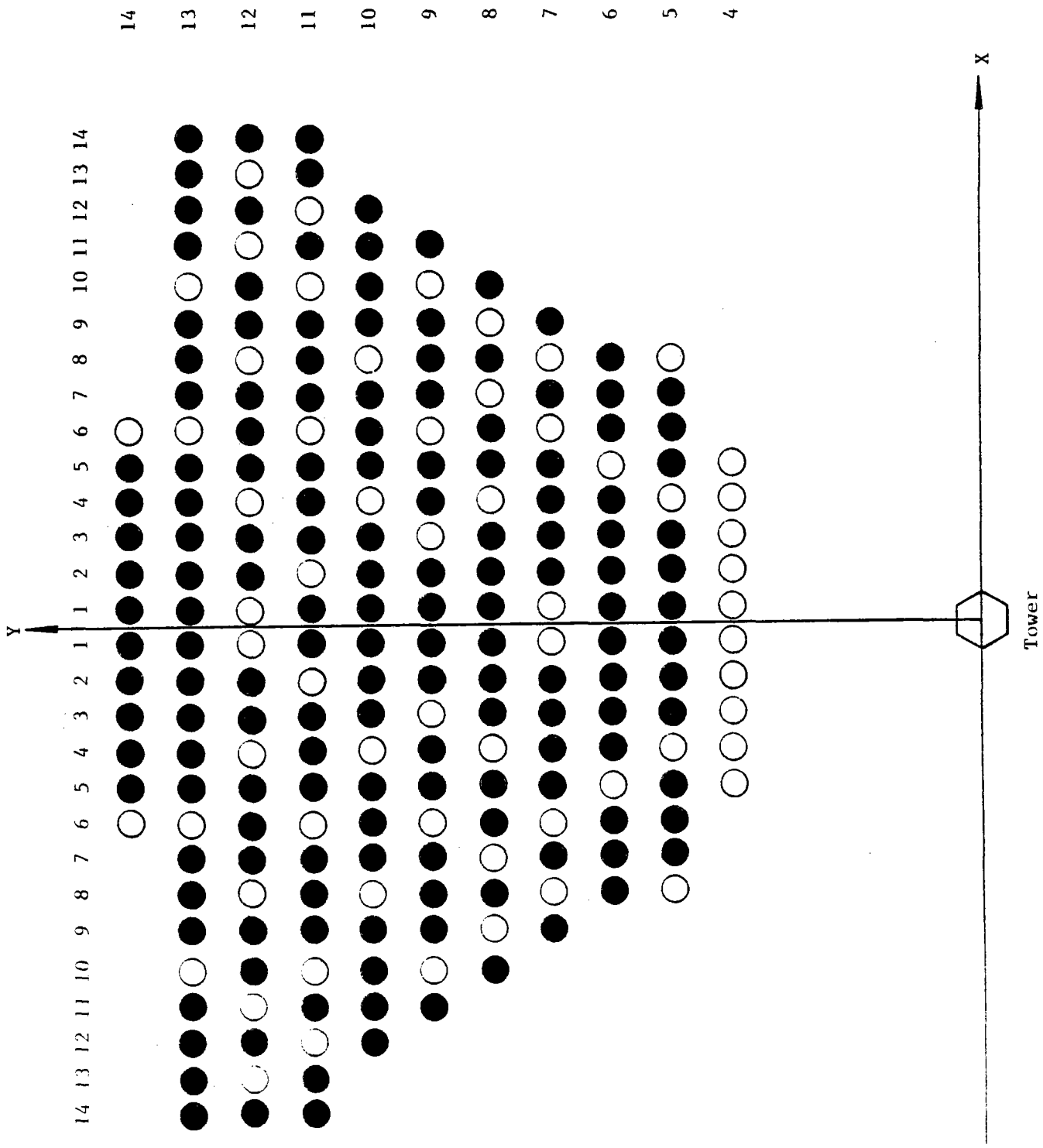


Figure C-4 Definition Group - 75% Load

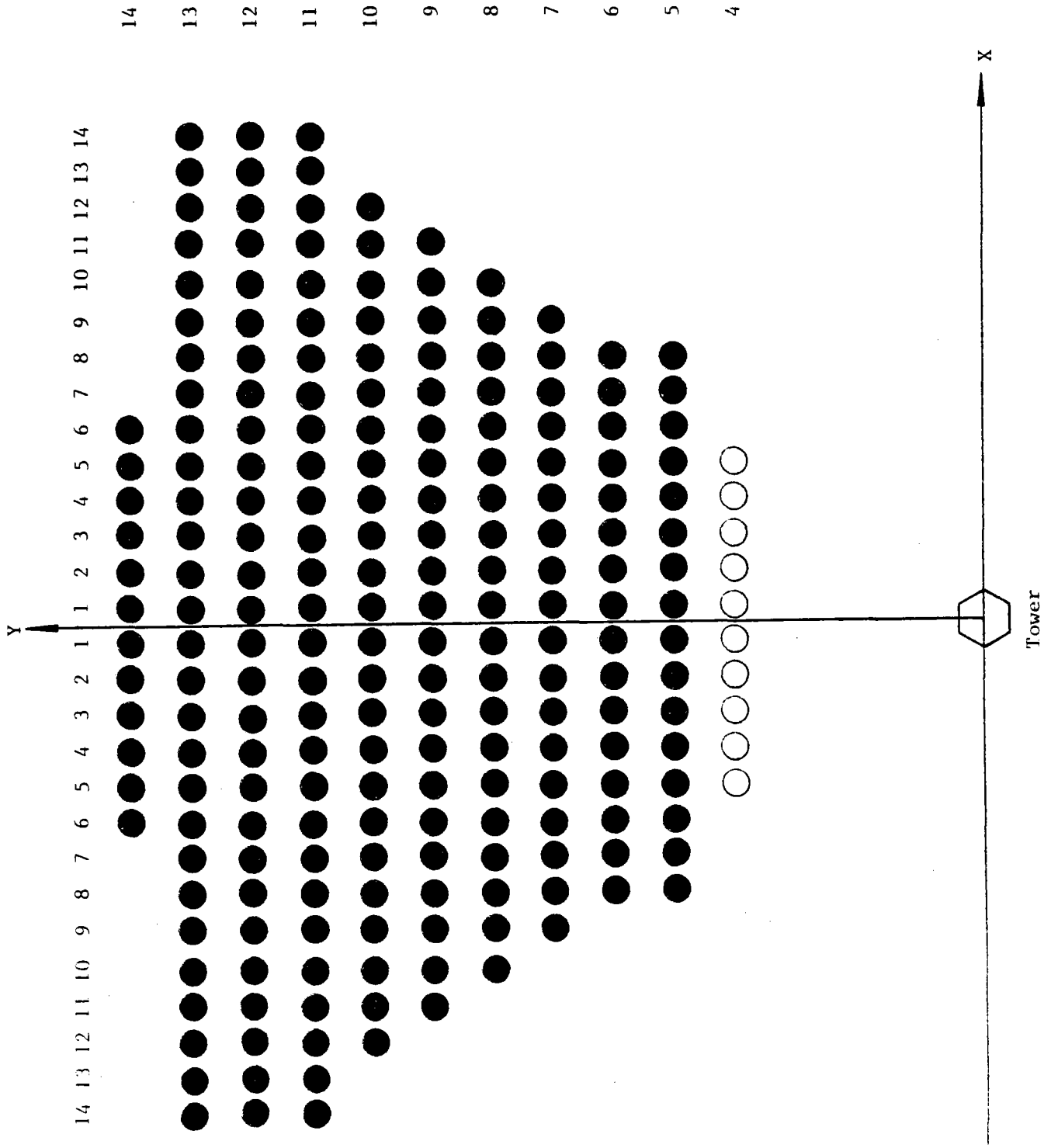


Figure C-5 Definition Group - 100% Load

B. Heliostat Field Configuration - Incremental Groups

Warmup Heliostat Pairs	Figure C-6
Warmup A to 25% Load	Figure C-7
25% Load to 50% Load	Figure C-8
25% Load to 37½% Load	Figure C-9
37½% Load to 50% Load	Figure C-10
50% Load to 75% Load	Figure C-11
50% Load to 62½% Load	Figure C-12
62½% Load to 75% Load	Figure C-13
75% Load to 100% Load	Figure C-14
75% Load to 87½% Load	Figure C-15
87½% Load to 100% Load	Figure C-16

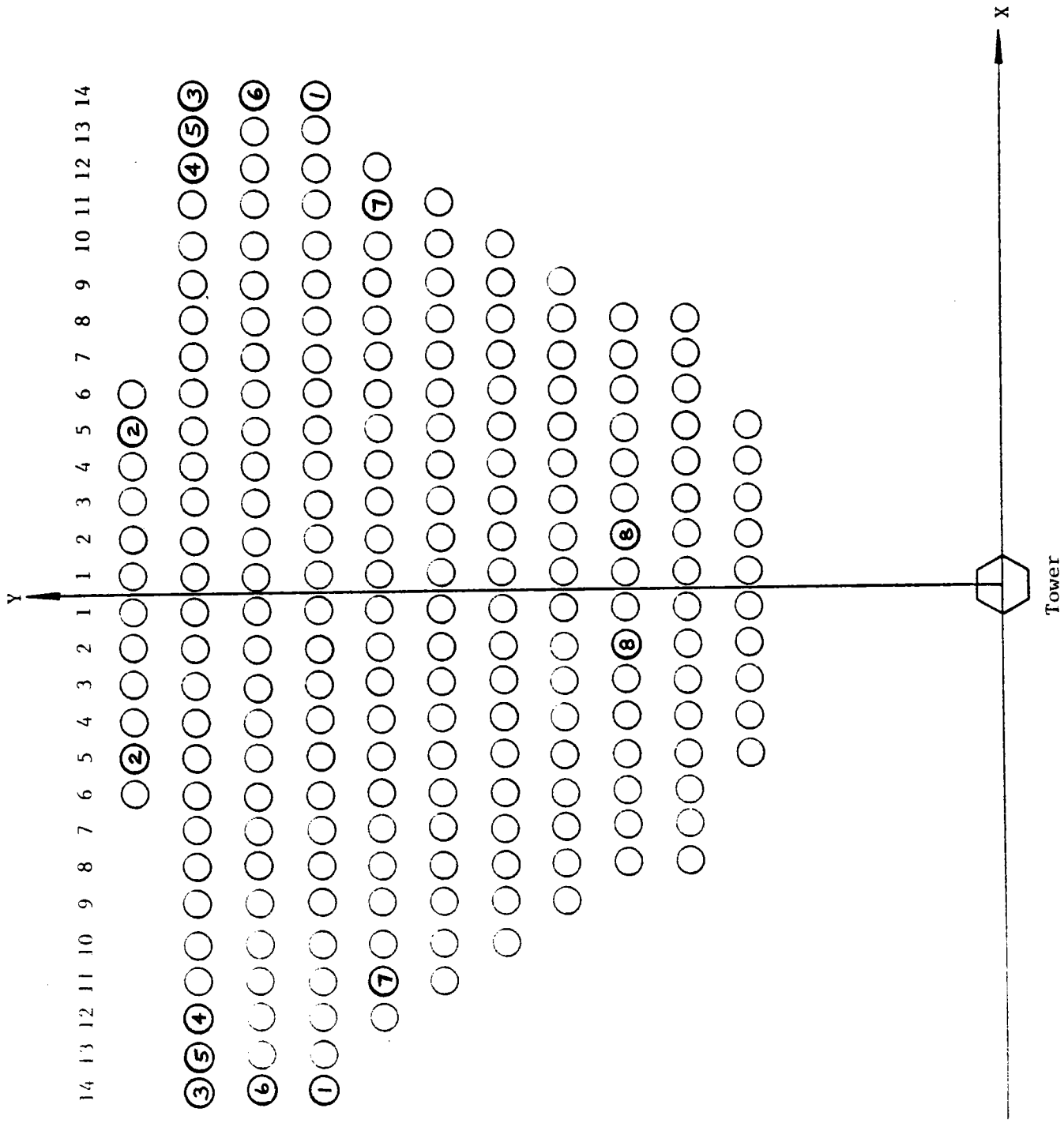


Figure C-6. Incremental Startup - Warmup Heliostat Pairs

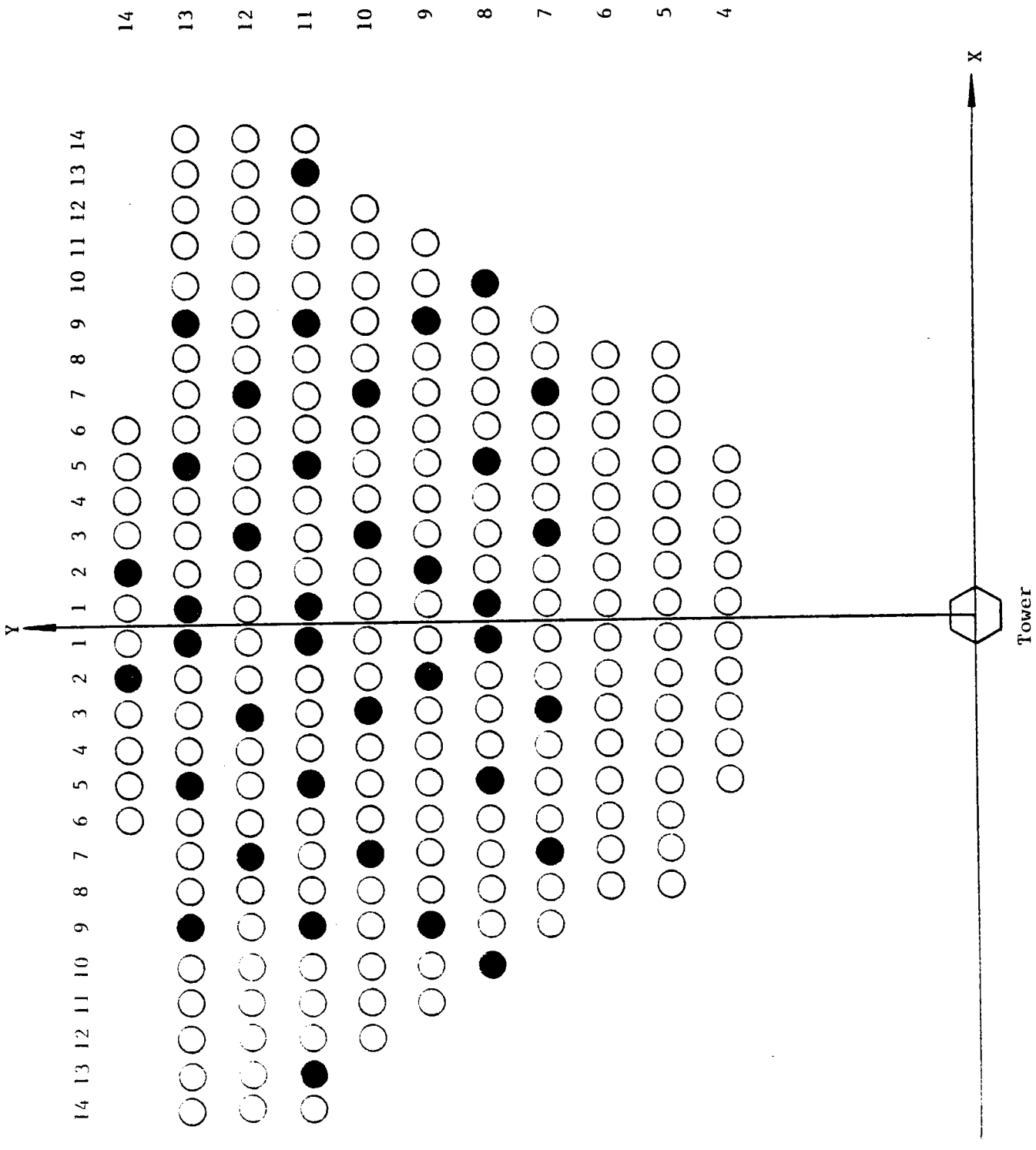


Figure C-7 Incremental Group - Warmup A to 25% Load

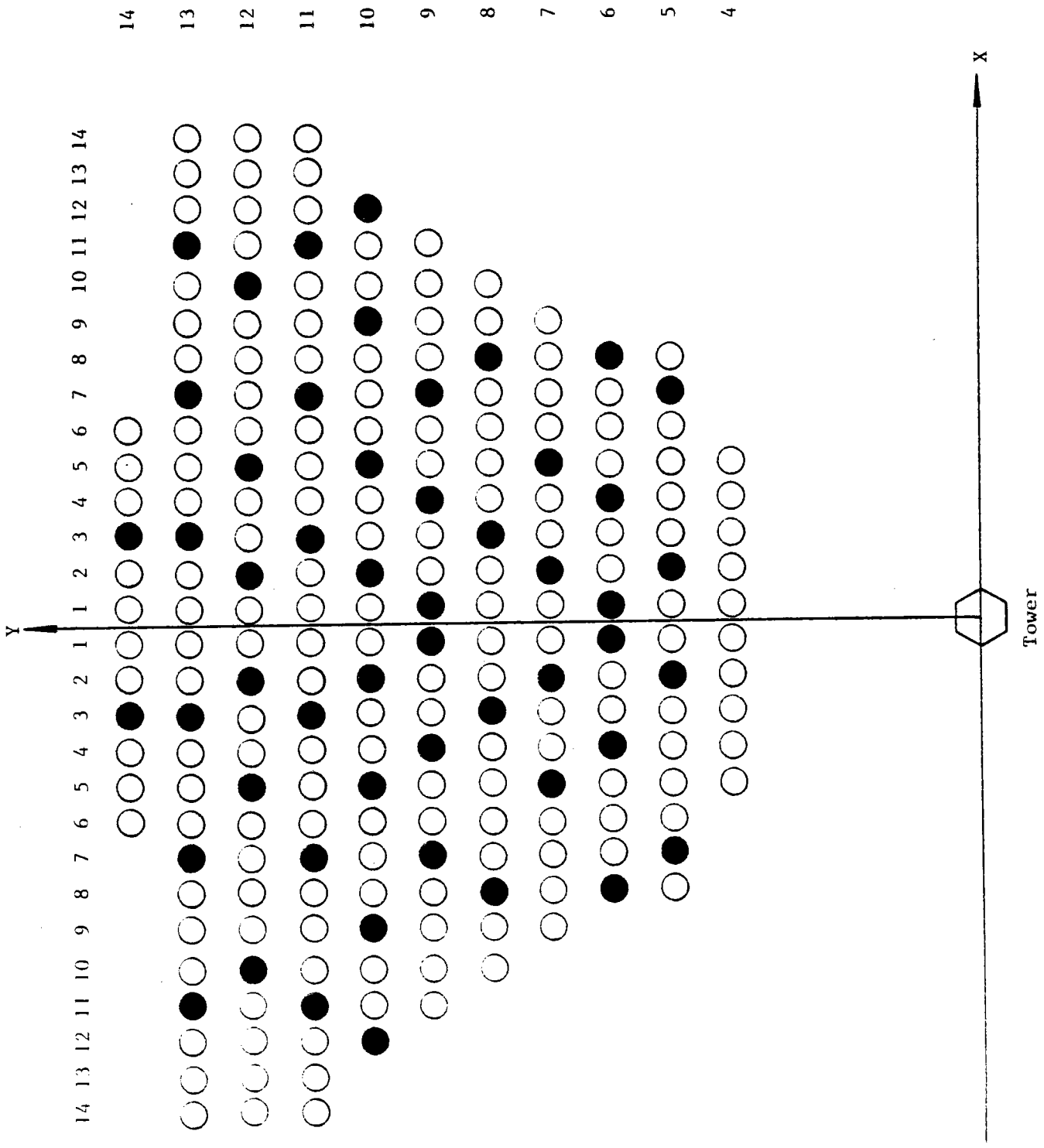


Figure C-8 Incremental Group - 25% Load to 50% Load

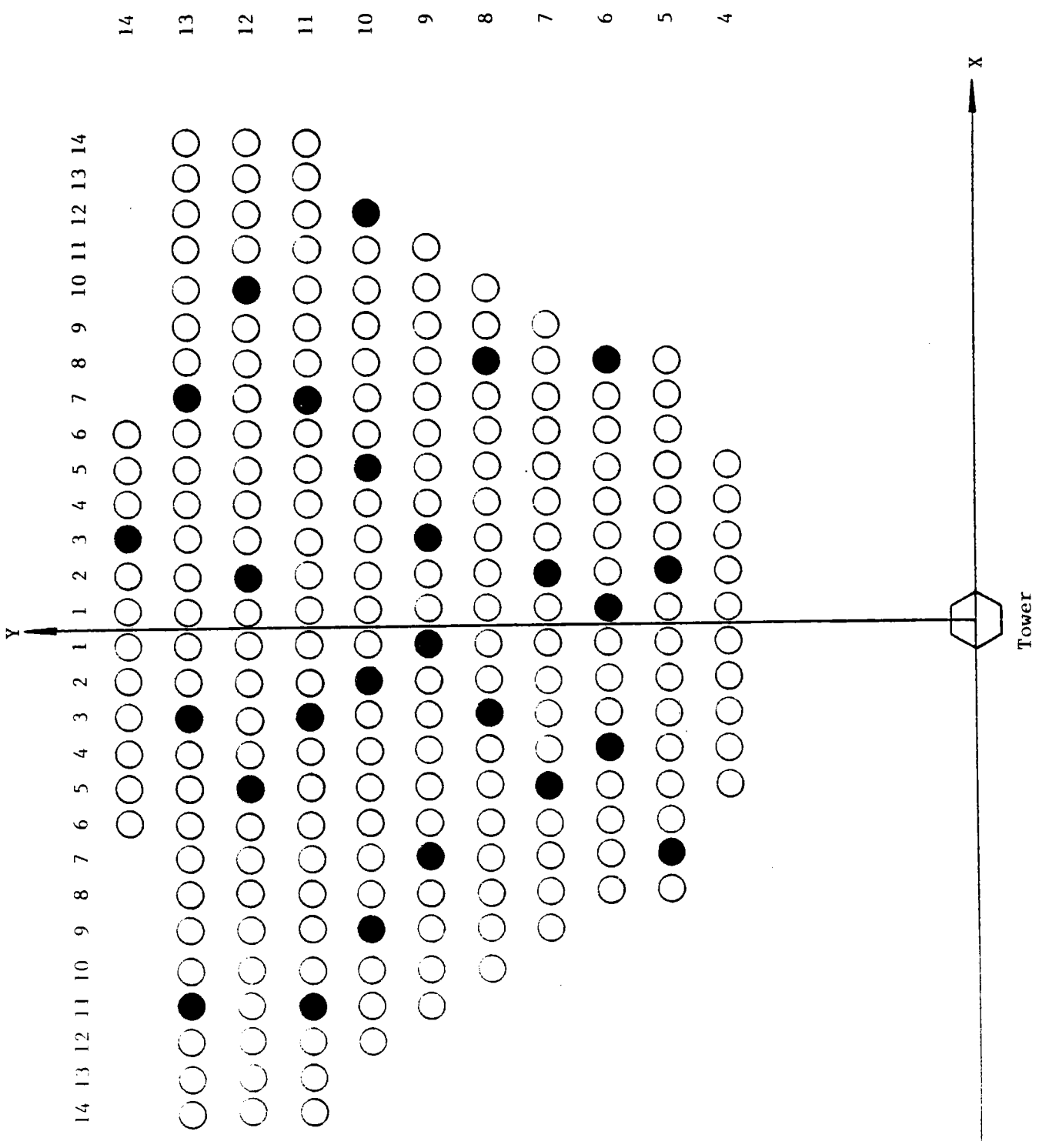


Figure C-9 Incremental Group - 25% Load to 37½% Load

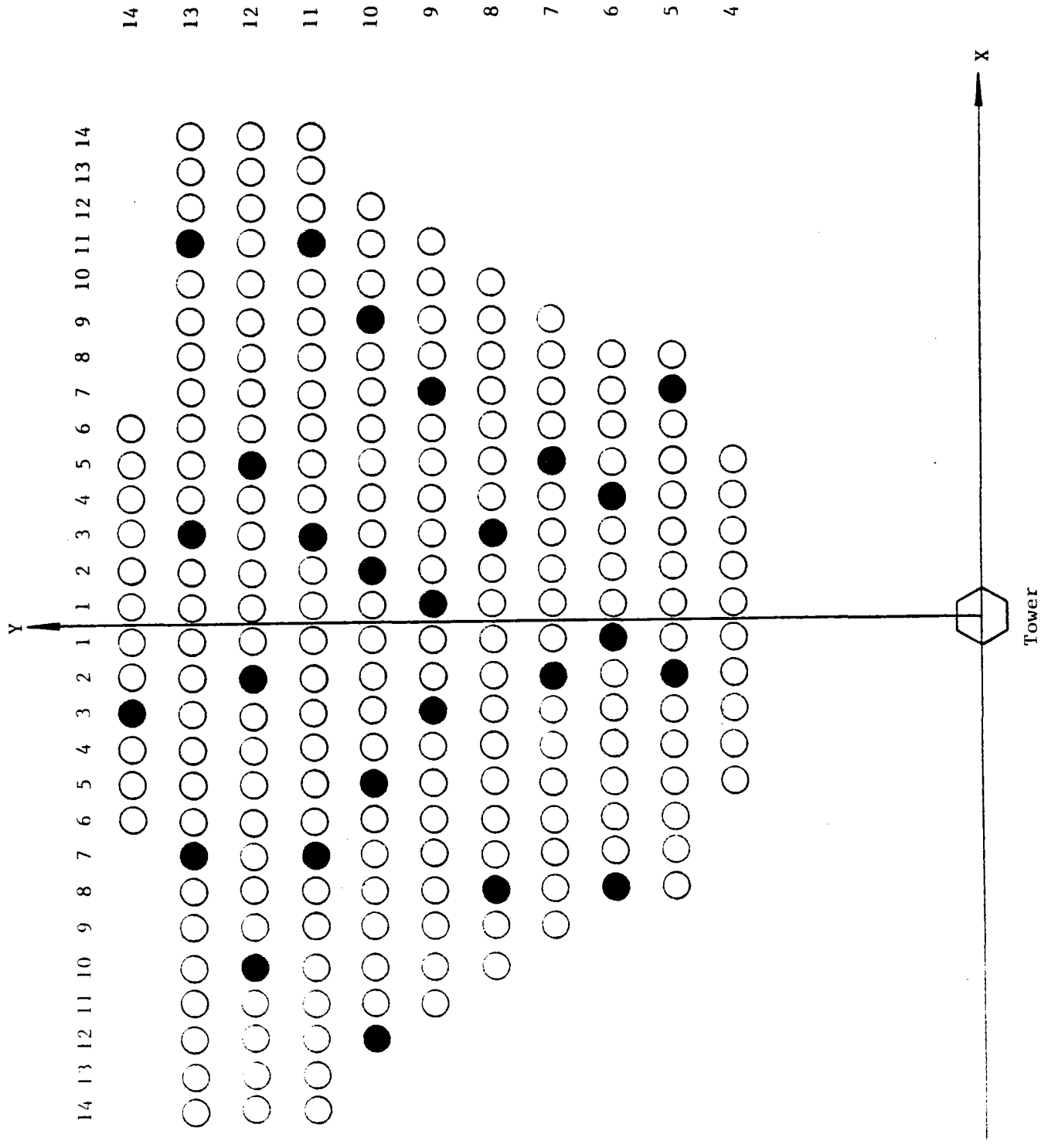


Figure C-10 Incremental Group - 37½% Load to 50% Load

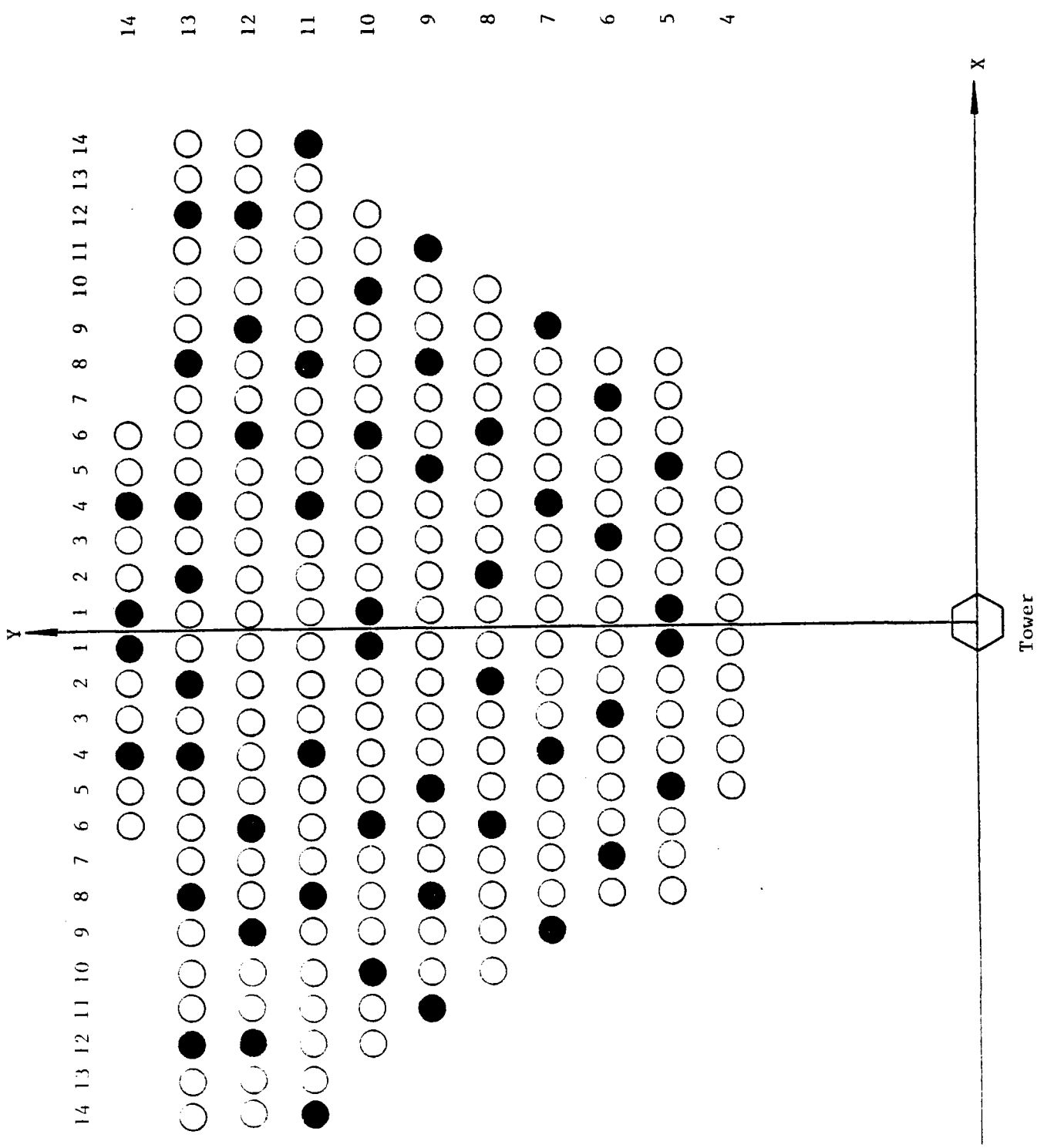


Figure C-11 Incremental Group - 50% Load to 75% Load

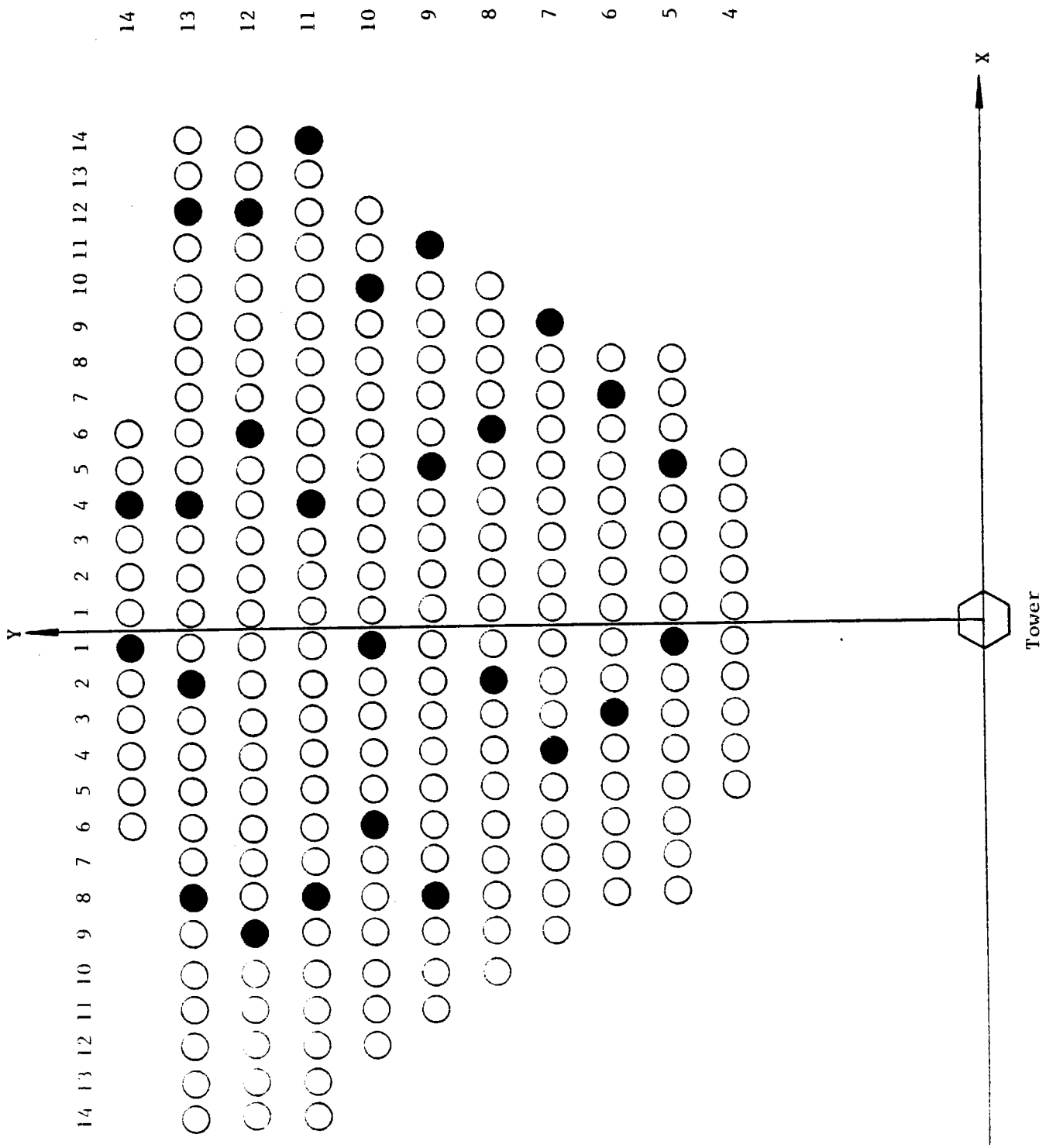


Figure C-12 Incremental Group - 50% Load to 62½% Load

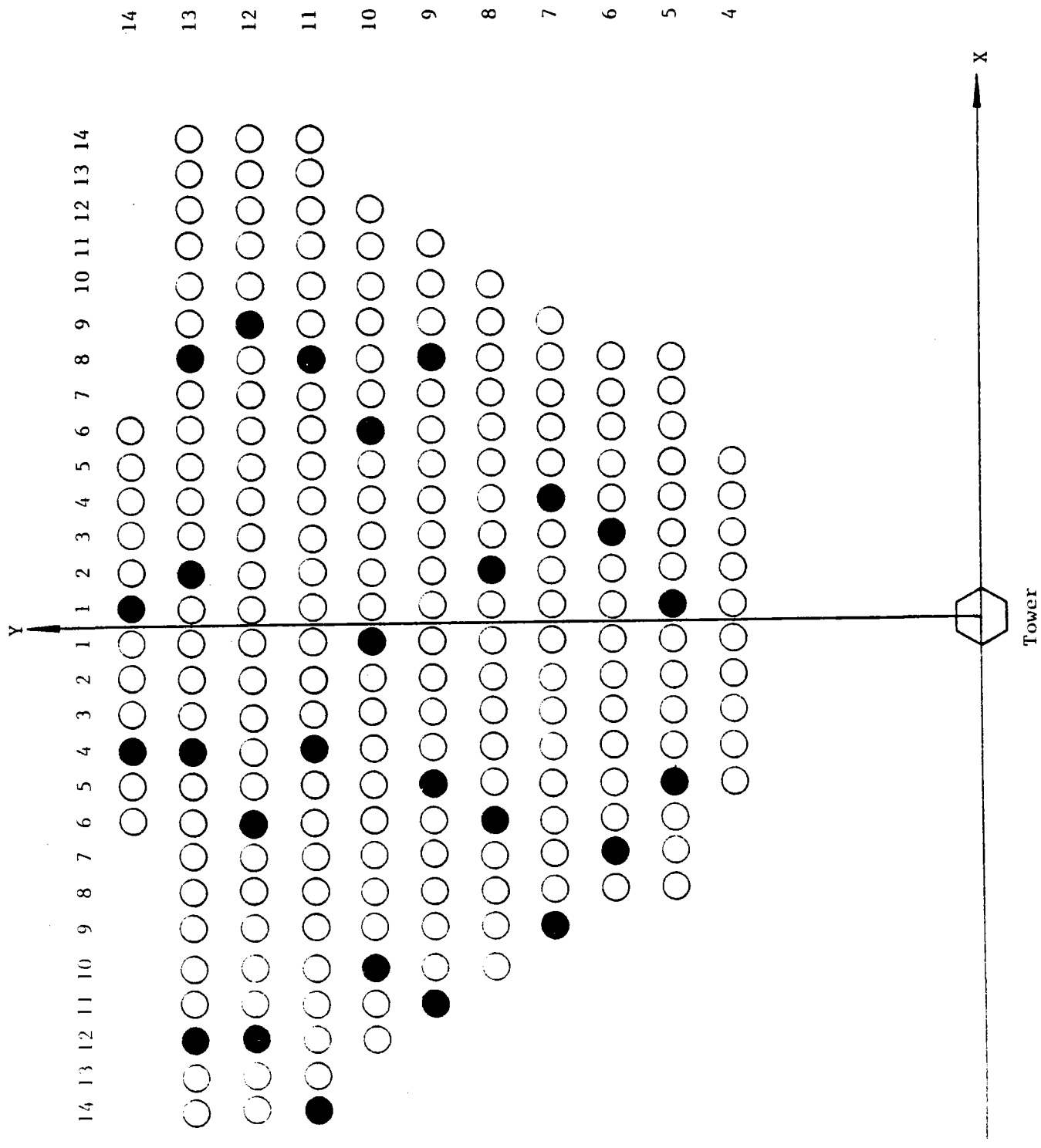


Figure C-13 Incremental Group - 62½% Load to 75% Load

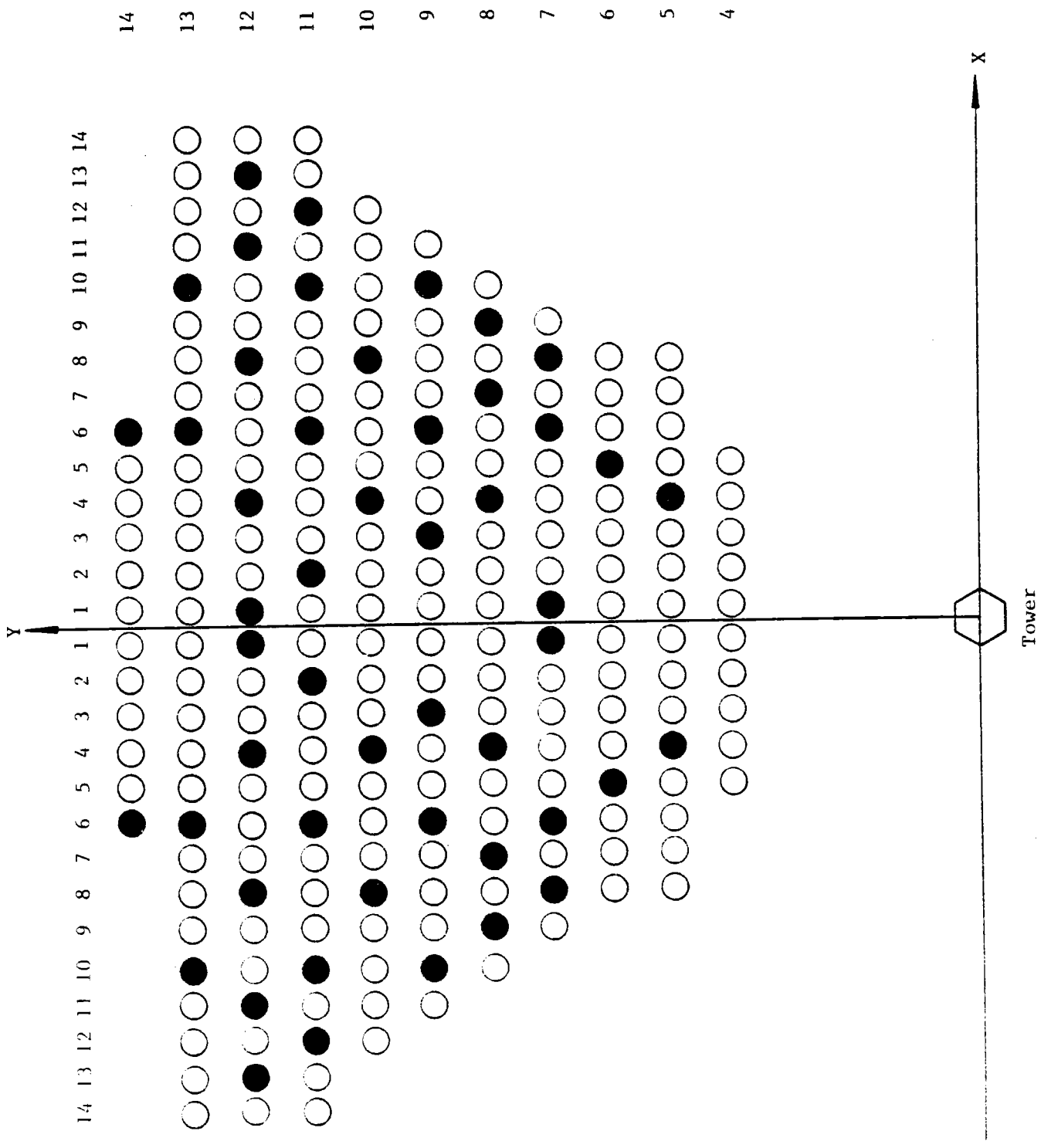


Figure C-14 Incremental Group - 75% Load to 100% Load

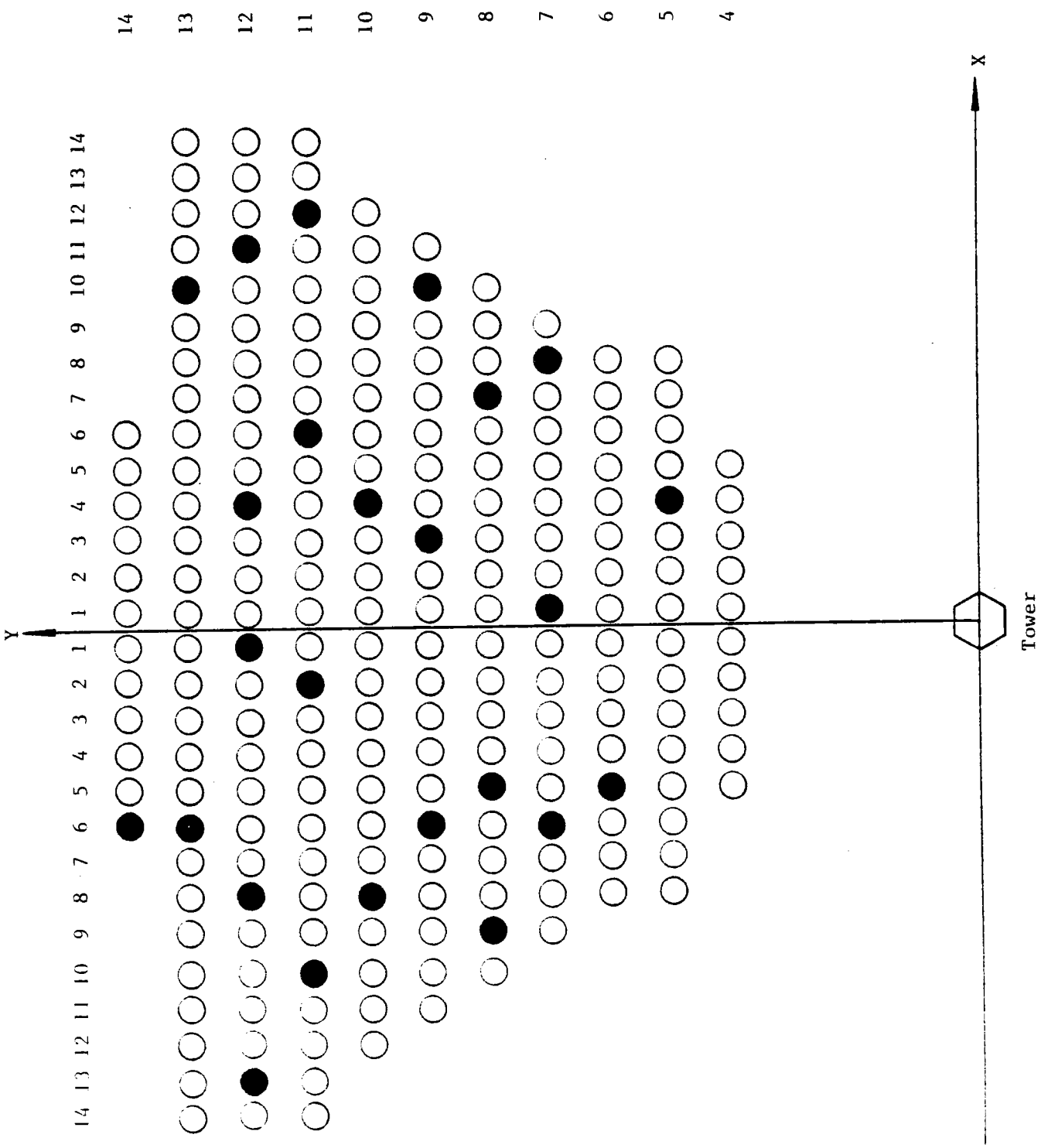


Figure C-15 Incremental Group - 75% Load to 87½% Load

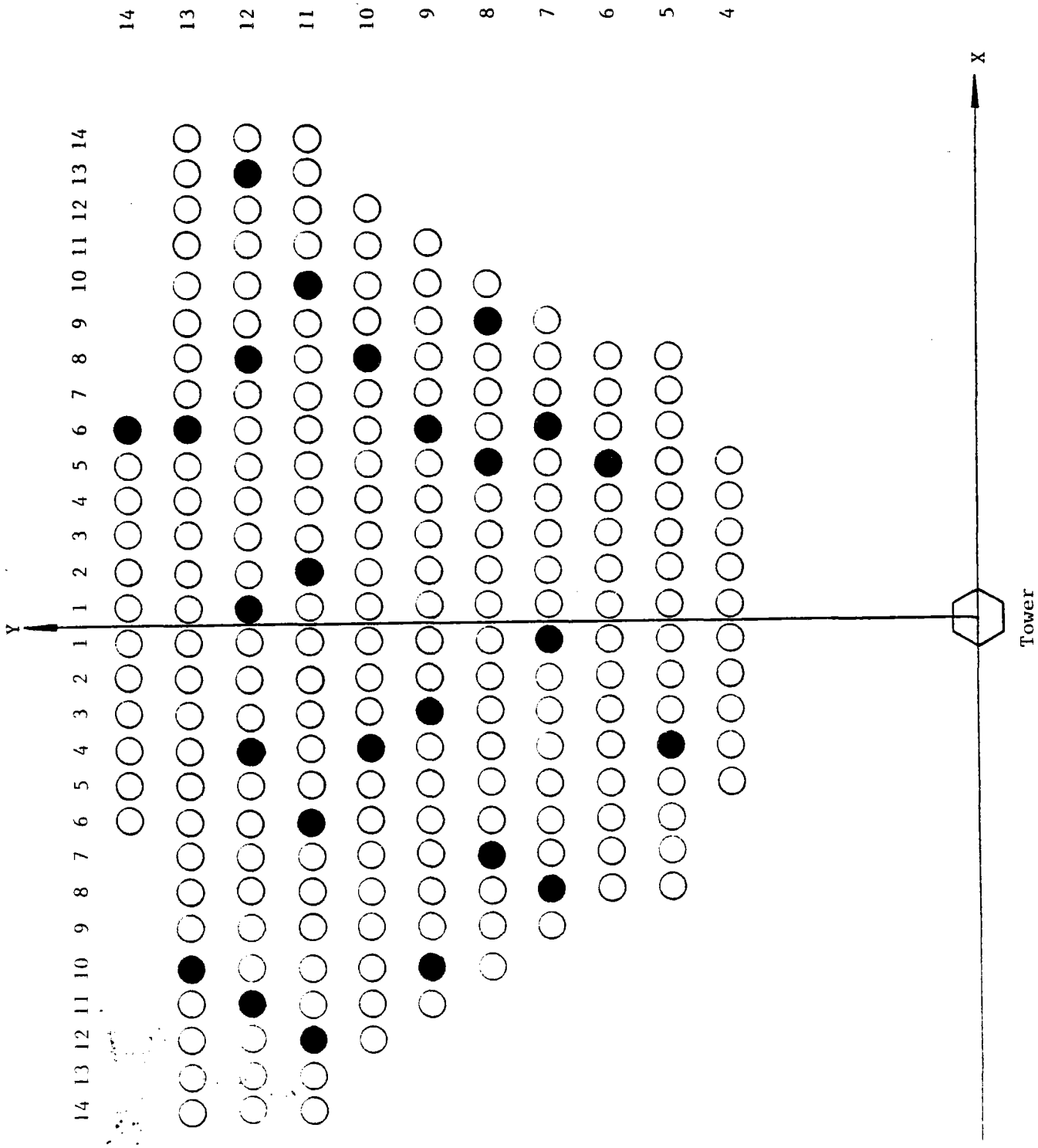


Figure C-16 Incremental Group - 87½% Load to 100% Load