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Task Analysis of Nuclear Power Plant Control Room Crews

Data Results

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BioTechnology, Inc.

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ABSTRACT

A task analysis of nuclear power plant control room crews was performed by General Physics Corporation and BioTechnology, Inc., for the Office of Nuclear Regulatory Research. The task analysis methodology used in the project is discussed and compared to traditional task analysis and job analysis methods. The objective of the project was to conduct a crew task analysis that would provide data for evaluating six areas: (1) human engineering design of control rooms and retrofitting of current control rooms, (2) the numbers and types of control room operators needed with requisite skills and knowledge, (3) operator qualification and training requirements, (4) normal, off-normal, and emergency operating procedures, (5) job performance aids, and (6) communications. The data collection approach focused on a generic structural framework for assembling the multitude of task data that were observed. Control room crew task data were observed and recorded within the context of an "operating sequence." The data collection was conducted at eight power plant sites (in simulators and/or in control rooms) by teams comprising human factors and operations personnel. Plants were sampled according to NSSS vendor, vintage, simulator availability, architect-engineer, and control room configuration. The results of the data collection effort were compiled in a computerized task database. Six demonstrations for suitability analysis were subsequently conducted in each of the above areas and are described in this report. Volume 1 details the Project Approach and Methodology, and Volume 2 provides the Data Results including a description of the computerized task analysis data format.

CONTENTS

VOLUME 2. DATA RESULTS

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EXECUTIVE SUMMARY

Volume 2 of this report contains the data results of the crew task analysis project. Eight plants were selected for data collection using the methodology and procedures described in Sections 2 and 3 of Volume 1. Each plant was assigned a random two-digit identification number. The material in this volume is organized by plant according to the order in which the plants were visited by the data collection teams:

1. Plant 75
2. Plant 39
3. Plant 98
4. Plant 15
5. Plant 45
6. Plant 65
7. Plant 26
8. Plant 06

For each section, the plant data are presented in the following order:

- Brief plant description
- Panel layouts and designators
- System nomenclature and numbering
- Operating Sequence Overviews (OSOs)
- Task Sequence Charts (TSCs)

A master list of panel codes is presented in Section 9. This list was updated throughout the project and serves as a cross reference to compare systems/panel data across plants.

The purpose of Volume 2 is to serve as a primary source of supplementary data to the computerized task database. Potential database users should consult this volume to obtain an understanding of the plant type and characteristics, the details of the operating sequences (see OSO), and the overview of tasks contained in those sequences (see TSC). Finally, the panel layout diagrams and system nomenclature will provide the user with an understanding of the control room workspace as well as an understanding of control and display information within the workspace.

Section 10 describes the task data format on magnetic tape. The principal crew task data were contained on the Task Data Forms (TDFs) that were reviewed from a quality control and quality assurance standpoint. The data reside on the General Physics' SEEK database manager on a PRIME I-1000 computer. The data were delivered at the end of the project on magnetic tape to the NRC Office of Regulatory Research.

Summary statistics on the existing computerized task database are presented below:

PRIMARY PLANT	NUMBER OF SEQUENCES	NUMBER OF TASKS	NUMBER OF ELEMENTS
75	7	142	1879
39	9	199	3194
98	10	156	2849
15	7	223	3682
SECONDARY PLANT			
45	3	78	931
65	3	105	909
26	3	78	1316
06	3	81	618
TOTALS	45	1,062	15,378

The data above represent crew task behaviors from 24 unique operating sequences at eight nuclear plants. The use of the task data was illustrated by six demonstration examples in Section 5 of Volume 1.

TASK ANALYSIS OF
NUCLEAR POWER PLANT CONTROL ROOM CREWS
VOLUME 2: DATA RESULTS

1. PLANT 75

The data contained in this section are:

- Plant description (page 1-1)
- Panel layouts and designators (page 1-2)
- System nomenclature and numbering (page 1-5)
- Operating Sequence Overviews (page 1-10)
- Task Sequence Charts (page 1-17)

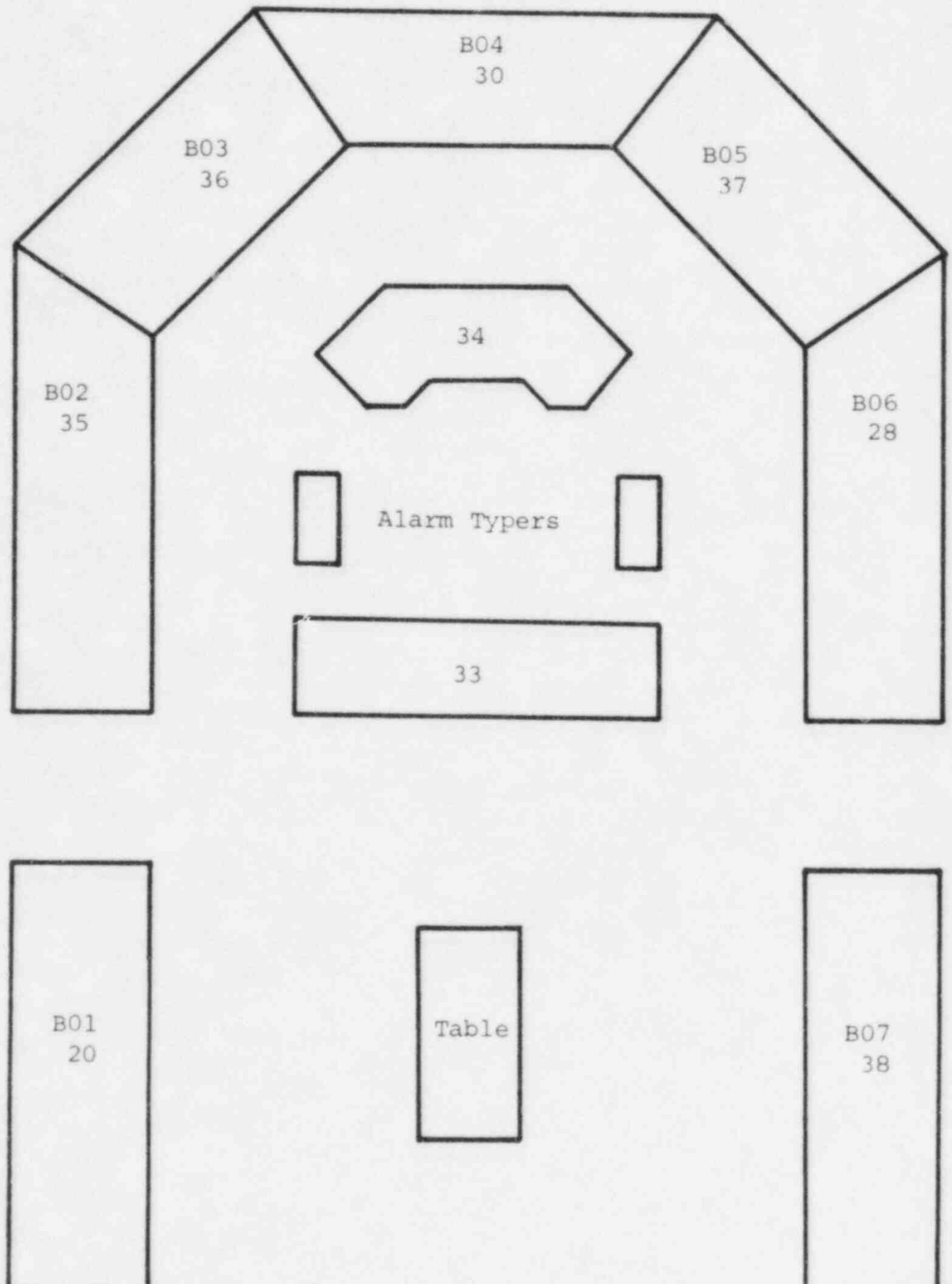
The following operating sequences were observed at Plant 75:

- 2 Change Boron Concentration
- 7 Loss of Condenser Vacuum
- 12 Chemical and Volume Control System Malfunction
- 15 Loss-of-Coolant Accident
- 19 Maintain Auxiliary Feedwater Pump
- 23 Bomb Threat
- 24 High Radiation Effluent

Plant 75, Unit 1 is a Combustion Engineering pressurized water reactor with a General Electric turbine-generator. The architect-engineer is Bechtel. The plant is under construction with licensing estimated for 1983. The control room is a single-unit control room. The data were collected at the Unit 1 simulator.

Plant 75 Panel/System	Number Assigned
B01 - Electrical Distribution Panel	20
• Switch Yard	
• Unit Distribution	
• Diesel Generators	
B02 - Engineered Safety Features	35
• Active Safety Injection Systems	
- High Pressure Safety Injection	
- Low Pressure Safety Injection	
- Containment Spray	
• Passive Safety Injection System	
- Safety Injection Tanks	
• Safety Systems Support Systems	
- Essential Spray Pond	
- Essential Cooling Water	
- Essential Chilled Water	
- Essential HVAC	
- Post Accident Monitoring System	
• Safety Equipment Status System	
B03 - Chemical and Volume Control Systems	36
• Reactor Coolant	
• Charging and Letdown	
• Boric Acid	
B04 - Reactor Systems	30
• Reactor Coolant	
• Reactor Control	
• Pressurizer Control	
B05 - Plant Protection and Condensate Systems	37
• Reactor Protection System	
• Core Protection Calculator	
• Engineered Safety Feature Actuation	
• Condensate	
B06 - Steam Generator/Turbine Generator Systems	28
• Main Steam	
• Feedwater	
• Auxiliary Feedwater	
• Condensate Transfer and Storage	
• Turbine Generator	
B07 - Miscellaneous and HVAC	38
• Auxiliary Steam	
• Containment Purge	
• Cooling Tower	
• Circulating Water	

Plant 75 Panel/System	Number Assigned
• Gas Radwaste	
• Plant Cooling Water	
• Instrument and Service Air	
• Nuclear Cooling Water	
Operators Console	
• Plant Monitoring Computer Interactive CRT	34
• Core Monitoring Computer (COLSS) Interactive CRT	
Communications Console	33
• Radiation Monitor CRT and Typewriter	
• Communications Equipment	
• Fire Protection Alarm CRT	



Plant 75 Control Room Layout

Plant 75 System Name	ABBR.	INPO System Number & Name
Auxiliary feedwater system	AFW	61. Auxiliary/emergency feedwater system
Auxiliary steam system	AS	42. Low pressure steam system
Cathode protection system	--	
Chemical and volume control system	CVCS	4. Chemical and volume control system
Chemical and volume control system	CVCS	7. Pressurizer relief/quench tank
Chemical and volume control system	CVCS	9. Primary chemical addition system
Chemical and volume control system	CVCS	19. Boronometer
Chemical and volume control system	CVCS	68. Liquid rad waste system
Chemical waste	--	
Chilled water	WC	88. Plant ventilation systems
HVAC - Ancillary buildings		
HVAC - Turbine building		
HVAC - Miscellaneous site structures	HVAC	Plant ventilation systems
HVAC - Fuel building		
HVAC - Radwaste Building		
Essential chilled water	EC	Plant ventilation systems
HVAC - Control building		
HVAC - Auxiliary building	HVAC	Plant ventilation systems
HVAC - Diesel generator building		
Chlorine injection system	--	80. Chlorination system
Circulating water system	CWS	75. Circulating water system
Condenser air removal system	CARS	55. Condenser air removal system
Condensate system	COND	56. Condensate system
Condenser transfer and storage	--	
Containment	CTMT	103. Containment system
Containment hydrogen control	--	28. Hydrogen recombiner and purge systems

Plant 75 System Name	ABBR.	INPO System Number & Name
Containment leak test system	--	
Containment purge system	CP	29. Containment purge system
Containment spray system	CS	26. Containment spray system
Containment spray system	CS	27. Containment iodine removal units
Control element drive mechanism control system	CEDMCS	1. Control rod drive system
Control element drive mechanism control system	CEDMCS	14. Rod position indication system
Cooling tower makeup and blowdown	--	
Core exit thermocouples	CET	17. In-core temperature monitor
Demineralized water	DW	
Diesel fuel oil and transfer system	FOT	
Diesel generator systems	DG	64. Emergency diesel generator system
Domestic water	--	
Engineered safety features actuation system	ESFAS	13. Engineered safety features actuation system
Engineered safety features actuation system	ESFAS	40. Main steam isolation valve activating system
Essential cooling water system	EW	76. Service water system
Essential spray ponds	--	76. Service water system
Excitation and voltage regulation	--	
Ex-core neutron monitoring	NIS	15. Nuclear instrumentation system
Feedwater extraction steam and drains system	FESDS	43. Extraction steam system
Feedwater control system (RRS)	FWC	59. Main Feedwater System
Feedwater heater extraction steam and drains	FHESD	60. Feedwater heater vent and drain system

Plant 75 System Name	ABBR.	INPO System Number & Name
Feedwater system	FW	59. Main feedwater system
Fuel pool cooling and cleanup system	--	33. Spent fuel pool cooling
Fire protection system	--	86. Fire protection system
Fire detection and alarm system	--	86. Fire protection system
Gaseous radwaste system	GRS	71. Waste gas disposal system
Generator hydrogen and CO_2 system	--	52. Main generator hydrogen and carbon dioxide gas system
Generator seal oil system	GSO	50. Seal oil system
Grounding system	--	
HVAC - Containment	--	22. Containment cooling system
In-core reactor instrumentation	--	17. In-core temperature monitor
Instrument air system	IA	78. Instrument air system
Loose parts and vibration monitoring system	LPVM	18. Loose parts monitoring system
Lube oil storage, transfer, and purification	LOT	
Lubrication oil system	LOS	47. Main turbine generator lube oil system
Meteorological instrumentation	--	
Main control board	MCB	
Main generation	MG	45. Main Turbine Generator
Main steam system	MS	39. Main and reheat steam system
Main turbine	MT	45. Main turbine generator
Main turbine control oil system	EHC	48. Main turbine electro-hydraulic control system
Nuclear cooling water	NC	8. Component cooling system
Oily waste and nonradioactive waste	--	

Plant 75 System Name	ABBR.	INPO System Number & Name
Plant annunciator	--	
Plant computer	PC	83. Plant computer
Plant cooling water system	PW	74. Secondary equipment closed cooling system
Turbine cooling water system	TC	74. Secondary equipment closed cooling system
Plant security	--	
125 VDC power	--	63. DC electrical distribution system
4.16 kV power	--	
Standby generation	--	
480-V power, switchgear	--	
480-V power, MCC	--	
Instrument AC power	--	
13.8-kV power	--	62. AC electrical distribution system
Uninterruptable AC power	--	
Normal lighting	--	
Essential lighting	--	
Yard, roadway, and fence lighting	--	
Emergency lighting	--	
Pressurizer and pressure relief system	PZR	2. Reactor coolant system
Pressurizer level control system	PZR-LCS	11. Pressurizer level control system
Pressurizer pressure control system	PZR-PCS	10. Pressurizer pressure control system
Primary sampling system	PSS	
Public offsite communications system	--	85. Communications system
In-plant communications system	--	85. Communications system
Private offsite communications system	--	85. Communications system
Radiation exposure and maintenance system	--	
Radiation monitoring system	RMS	20. Gross failed fuel detector
Radiation monitoring system	RMS	72. Area radiation monitoring system
Radiation monitoring system	RMS	73. Process radiation monitoring system

Plant 75 System Name

Radioactive laundry	LRW	69.	Liquid rad waste system
Radioactive waste drains	LRW	69.	Liquid rad waste system
Liquid radwaste system	LRW	69.	Liquid rad waste system
Reactor coolant system	RCS	2.	Reactor coolant system
Reactor coolant system	RCS	3.	Reactor coolant pump operation
Reactor power cutback system	RPCS		
Reactor regulating system	RRS	16.	Non-nuclear instrumentation system
Reactor protection system	RPS	12.	Reactor protection system
Safety equipment actuation system	SEAS		
Safety equipment status system	SESS		
Safety injection system	SI	6.	Safety injection system
Sanitary drainage and treatment	--		
Secondary chemical control system	--	36.	Turbine plant sampling system
Seismic instrumentation	--	84.	Seismic monitoring equipment
Service air system	SA	79.	Station air system
Serivce gases system	--	81.	Hydrogen gas storage system
Service gases system	--	82.	Nitrogen system
Shutdown cooling system	SC	5.	Residual heat removal system
Solid radwaste system	--		
Stator cooling system	--	53.	Stator water cooling system
Steam bypass control system	SBCS	41.	Steam dump/turbine bypass control system
Steam generator blowdown system	SGBD	38.	Steam generator blowdown system
Steam generator feedwater pump turbine	SGFPT	59.	Main feedwater system
Steam generator system	SG	35.	Steam generator system
Special process trace heating system	--	67.	Electrical heat tracing system
Freeze protection system	--	67.	Electrical heat tracing system

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: C-E/PWR

Operating Sequence ID: 02

CR Type: Single

Operating Sequence: Change Boron Concentration

Initial Conditions: The plant is in a normal full power lineup, in startup following a short maintenance outage. It is early in core life. All rods are fully withdrawn. Power is being raised by reactor coolant system dilution. Thermal power is at 80%.

Sequence Initiator: Control room receives directive to continue to raise thermal power from 80% to 100%.

Progression of Action: The crew makes the necessary calculations and operates the chemical and volume control system to dilute the reactor coolant system boron concentration. Sampling is conducted to compare boron concentration in the reactor coolant system and pressurizer. An imbalance is found to exist and the crew initiates pressurizer spray to equalize the concentrations. When setpoints are reached, the crew verifies completion of dilution and restores systems to normal operating status.

Final Conditions: Plant is operating at full power with normal charging and letdown.

Major Systems: Chemical and Volume Control System (CVCS), Primary Sampling System (PSS), Pressurizer (PZR), Reactor Coolant System (RCS), Main Turbine (MT), Main Generator (MG), Main Turbine Control Oil System (EHC).

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition.

NSSS/Type: C-E/PWR

Operating Sequence ID: 07

CR Type: Single

Operating Sequence: Loss of Condenser Vacuum

Initial Conditions: The plant is operating at full power. Four circulating water pumps are running. Three of four air removal pumps are running. The plant is in a normal lineup with a reactor coolant system boron dilution in progress. The control element drive mechanism control system is operating in manual sequential.

Initiating Event: One circulating water pump trips, resulting in drop in condenser vacuum.

Progression of Action: Annunciator alerts the crew to malfunction. The crew verifies pump trip and initiates investigation of cause. Condenser vacuum starts to decrease; an additional air removal pump starts automatically to prevent further decrease in vacuum. The crew stops the dilution and reduces power manually to restore vacuum. The cause of the circulating water pump failure is diagnosed as a spuricus breaker relay trip. The relay is reset; the pump is restarted and runs normally. The crew restores the plant to full power and a normal lineup.

Final Conditions: The plant is operating at full power. Four circulating water pumps are running; three of four air removal pumps are running.

Major Systems: Circulating Water System (CWS), Condenser Air Removal System (CAR), Reactor Coolant System (RCS), Feedwater System (FWS), Control Element Drive Mechanism Control System (CEDMCS), Main Generator (MG), Chemical and Volume Control System (CVCS), In-Plant Communications System.

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident.

NSSS/Type: C-E/PWR

Operating Sequence ID: 12

CR Type: Single

Operating Sequence: Chemical and Volume Control System Malfunction

Initial Conditions: Plant is operating at full power. The control element drive mechanism control system is in manual sequential. The chemical and volume control system is lined up for automatic makeup to the volume control tank, and set to maintain 602 ppm. Shift turnover has just occurred. Previous shift experienced a high level and over-pressure in volume control tank, resulting in water relief valve lifting and consequential reduction in volume control tank level. The Relief valve was repaired by the Maintenance Section, and the volume control tank was refilled to the normal level, on the previous shift. An earlier failure of the boric acid flow transmitter has gone undetected.

Sequence Initiator: The failure of boric acid flow transmitter has resulted in a dilution of the volume control tank and, consequently, a slow reactor coolant system dilution. This causes a mismatch in turbine power and reactor power, causing a $T_{ave} - T_{ref}$ deviation and control element assembly insertion demand.

Progression of Action: The crew uses the control element assemblies to control the power excursion. When the power mismatch is corrected, the crew investigates and diagnoses the problem. The crew, using manual control of the malfunctioning controller, borates the reactor coolant system to allow withdrawal of the control element assemblies to their normal full power position. When the malfunction is repaired, the crew restores the chemical and volume control system to its normal full power configuration.

Final Conditions: The plant is operating at full power. The control element drive mechanism control system is operating in manual sequential with all control element assemblies fully withdrawn. The chemical and volume control system is operating normally in automatic makeup mode.

Major Systems: Control Element Drive Mechanism Control System (CEDMCS), Chemical and Volume Control System (CVCS), Reactor Coolant System (RCS), Pressurizer (PZR), Primary Sampling System (PSS), In-Plant Communications System.

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: C-E/PWR

Operating Sequence ID: 15

Operating Sequence: Loss of Coolant Accident

Initial Conditions: The plant is operating at full power with a normal lineup. The control element drive mechanism control system is in manual sequential.

Sequence Initiator: Unisolable small break loss of coolant accident (LOCA) inside the containment.

Progression of Action: A decrease in pressurizer (PZR) level and pressure results in a letdown system trouble alarm and a PZR trouble alarm. The crew starts a manual unit load reduction, then manually inserts a reactor power cutback, followed by a manual reactor trip. The Control Room Supervisor (CRS) declares a major event and the crew maintains critical safety functions. PZR pressure and level continue to decrease, resuting in a low pressure safety injection and containment isolation. The crew stops all reactor coolant pumps and establishes natural circulation. The CRS verifies that a small break LOCA has occurred and initiates the Station Emergency Plan. When the plant is stablilized, the crew starts a reactor coolant system cooldown and shutdown of auxiliary systems.

Final Conditions: The reactor is tripped with all control element assemblies fully inserted. Reactor coolant system is stablilized at 1750 psia. PZR level is 10% and recovering. Cooldown is in progress on natural circulation with the auxiliary feedwater system supplying both steam generators, and the steam bypass control system is being used to control steam generator pressure and cooldown rate. The safety injection system is supplying water through the cold legs of the reactor coolant system. A secondary plant shutdown is in progress.

Major Systems: AC Electrical Distribution (ACED), Auxiliary Feedwater System (AFW), Circulating Water System (CWS), Condensate System (COND), Containment (CTMT), Control Element Drive Mechanism Control System (CEDMCS), Core Exit Thermocouples (CET), Diesel Generator (DG), Main Feedwater System (FW), Main Generation (MG), Main Turbine (MT), Nuclear Instrumentation System (NIS), Plant Protection System (PPS), Pressurizer (PZR), PZR Pressure Control System (PZR-PC), PZR Level Control System (PZR-LC), Reactor Coolant System (RCS), Safety Injection System (SI), Steam Bypass Control System (SBCS), Steam Generating System (SG).

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

NSSS/Type: C-E/PWR

Operating Sequence ID: 19

CR Type: Single

Operating Sequence: Maintain Auxiliary Feedwater Pump

Initial Conditions: The plant is operating normally at full power. The auxiliary feedwater system is in a normal lineup.

Sequence Initiator: Work order for implementation of maintenance on the nonsafety auxiliary feedwater pump is received from the Maintenance Section.

Progression of Action: The Control Room Supervisor/Shift Supervisor approves the tagout. The crew then isolates and tags the nonsafety auxiliary feedwater pump. The Maintenance Section is informed that the pump is ready for maintenance. Upon completion of maintenance, the tags are removed and the pump is tested and restored to a normal lineup.

Final Conditions: The plant is operating normally at full power. The auxiliary feedwater system is in a normal lineup.

Major Systems: Auxiliary Feedwater System (AFW).

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Coordinate Plant Support Activities/Plant Security

NSSS/Type: C-E/PWR

Operating Sequence ID: 23

CR Type: Single

Operating Sequence: Bomb Threat

Initial Conditions: The plant is operating at full power with a normal lineup and crew complement during day shift.

Sequence Initiator: A bomb threat is received by telephone in the control room. The caller states that an explosive device has been hidden onsite.

Progression of Action: A member of the control room crew interrogates the caller. The caller states that the bomb is in the Turbine Building (not a Level 1 area). The Plant Security Supervisor is notified. The control room crew continues to monitor plant operations. The Control Room Supervisor informs the Station Manager and declares an Unusual Event. The Station Manager immediately assumes the role of Emergency Coordinator and initiates the Emergency Plan. Security Personnel implement their responsibilities in accordance with Emergency Plan and Security Procedures. The control room is notified that the device has been located and removed.

Final Conditions: The emergency condition is terminated. The plant continues normal full power operation.

Major Systems: In-plant Communications System, Private Off-Site Communications System.

Operating Sequence Overview

Plant: 75

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration--Radiological Emergency

NSSS/Type: C-E/PWR

Operating Sequence ID: 24

CR Type: Single

Operating Sequence: High Radiation Effluent

Initial Conditions: The plant is operating at full power with a normal lineup.

Sequence Initiator: Plant vent radiation detector fails high, causing a high radioactivity alarm.

Progression of Action: The crew verifies the alarm and initiates investigation of the cause by dispatching Health Physics Personnel to obtain radioactivity samples and investigate the radiation monitoring system. The crew makes preparations to initiate the Station Emergency Plan. The cause of the alarm is determined to be a failed detector. The crew notifies the Duty Manager (Station Manager). The crew initiates a work order for repair of the detector and directs Health Physics to continue periodic sampling until the detector is restored to service.

Final Conditions: Plant continues to operate at full power with a normal lineup.

Major Systems: Gaseous Radwaste System (GRS), Heating, Ventilation, and Air Conditioning System (HVAC), Radiation Monitoring System (RMS), Chemical and Volume Control System (CVCS), In-Plant Communications System.

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Change Boron Concentration

Operating Sequence ID: 02

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Determine change in boron concentration --- To establish volume of water needed for dilution	Procedure	Reactor Coolant Makeup System (CH) 41OP-1CH09	
2	Sample the reactor coolant system and pressurizer for boron --- To determine current boron concentrations	Operating practice		Primary Sampling System
3	Determine volume of make-up water required for dilution --- To establish volume and flow setpoints	Procedure	Reactor Coolant Makeup System (CH) 41OP-1CH09	
4	Calculate charging rate --- To assure power escalation limit is not exceeded	Operating practice		
5	Start dilution in reactor coolant system --- to reduce reactor coolant system boron concentration	Procedure	Reactor Coolant Makeup System (CH) 41OP-1CH09	Reactor Coolant System, Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Change Boron Concentration

Operating Sequence ID: 02

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Raise turbine power To balance turbine and reactor	Operating practice	Main Generation and Excitation (MB) 41OP-1MB01	Main Generation, Main Turbine, Main Turbine Control Oil System
7	Turn on pressurizer backup heaters and spray To equalize boron concentration in pressurizer and reactor coolant system	Chemistry sampling report; difference in PZR & RCS boron concentration 50 ppm	Reactor Coolant Makeup System (CH) 41OP-1CH09	Pressurizer Pressure Control System
8	Monitor plant parameters To assure parameters remain within operating limits	Operating practice		Main Generation Reactor Coolant System, Pressurizer
9	Monitor chemical & volume control system operation To assure performance as expected	Operating practice		Chemical & Volume Control System
10	Communicate with Chemistry Section To coordinate activities of Operations with other departments	Operating practice		In-plant Communications System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Functions/Generate Power

Operating Sequence: Change Boron Concentration

Operating Sequence ID: 02

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Communicate with Load Dispatcher --- To allow coordinator of power grid	Operating practice		Private, Off-Site Communications System
12	Set reactor makeup water and boric acid flow controllers --- To establish proper boron concentration in automatic operation	Dilution Completed	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
13	Monitor automatic makeup flow --- To assure makeup water is being supplied to the reactor coolant system at the new boron concentration	Procedure	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
14	Sample the reactor coolant system & pressurizer for boron --- To determine current boron concentrations	Operating practice		Primary Sampling System
15	Turn off pressurizer spray and backup heaters --- To restore equipment to normal operating status	Chemistry sample report: difference in PZR and RCS boron concentration in-band	Rx Coolant Makeup System (CH) 41OP-1CH09	Pressurizer Pressure Control

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Functions/Generate Power

Operating Sequence: Change Boron Concentration

Operating Sequence ID: 02

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Communicate with Station Manager --- To allow coordination of station functions	Dilution Completed		In-plant Communications System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Loss of Condenser Vacuum

Operating Sequence ID: 07

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Verify circulating water pump trip To determine alarm validity	Circulating water trouble alarm		Circulating Water System
2	Monitor plant parameters To maintain safe operation of plant	Operating Practice		Condenser Air Removal System, Reactor Coolant System
3	Verify automatic start of air removal pump To confirm automatic safety functions have activated	Procedure	Loss of Condenser Vacuum 41A0-1ZZ07	Condenser Air Removal System
4	Reduce turbine power To restore condenser vacuum	Low condenser vacuum	Main Generation and Excitation (MB) 41OP-1MB01	Main Generator
5	Reduce reactor power To balance turbine and reactor	Operating practice	Power Operations 41OP-1ZZ05	Control Element Drive Mechanism Control System
6	Stop reactor coolant system dilution To prepare to reduce power	Operating practice	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
7	Communicate with Load Dispatcher To allow coordination of power grid	Operating practice		Private Off-Site Communications System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Loss of Condenser Vacuum

Operating Sequence ID: 07

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
8	Dispatch plant equipment operators To determine cause of circulating water pump trip	Operating practice		In-plant Communications System
9	Fill out Log to comply with administrative procedures	Operating practice		
10	Direct plant equipment operator to reset 4.16 kV breaker relay To restore equipment operability	PEO report/No equipment damage		In-plant Communications System
11	Restart failed circulating water pump To restore plant to normal operating condition	PEO report/ relay reset and holding	Operating the Circulating Water System (CW) 41OP-1CW01	Circulating Water System
12	Reset the steam bypass control system condenser vacuum interlock To restore equipment to normal operating status	Annunciator	Power Operations 41OP-1ZZ05	Steam Bypass Control System
13	Raise turbine power To return to full power operation	Operating practice	Main Generation and Excitation (MB) 41OP-1MB01	Main Generator
14	Raise reactor power To balance turbine and reactor	Operating practice	Power Operations 41OP-1ZZ05	Control Element Drive Mechanism Control System, Reactor Coolant System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Loss of Condenser Vacuum

Operating Sequence ID: 07

Sequence Number	Task and Purpose	Cue	Procedure, Name & Number	Plant Specific System Name
15	Communicate with Station Manager To allow coordination of station functions	Operating practice		In-plant Communications System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and control plant operations/Mitigate Consequences of an Accident

Operating Sequence: Chemical & Volume Control System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Compare temperature indications To verify reactivity anomaly	High control rod insertion rate demand		Control Element Drive Mechanism Control System, Reactor Coolant System
2	Manually insert control rods To balance turbine and reactor	High Tave verified		Control Element Drive Mechanism Control System, Reactor Coolant System
3	Review information from previous shift To diagnose condition	Operating practice		Chemical & Volume Control System
4	Compare boron concentration in volume control tank and reactor coolant system To diagnose problem	Operating practice		Primary Sampling System
5	Evaluate chemical and volume control system status To diagnose condition	Operating practice		Chemical & Volume Control System
6	Communicate with Maintenance Section To restore equipment operability	Indications of no boric acid makeup flow in automatic		In-plant Communications System
7	Communicate with Station Manager To allow coordination of station functions	Operating practice		In-plant Communications System
8	Determine volume of boric acid required for boration To establish volume and flow setpoints	Operating practice	Reactor Coolant Makeup System (CH) 41OP-1CH09	

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Chemical & Volume Control System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Start reactor coolant system boration To restore rod positions	Operating practice	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
10	Place the boric acid makeup flow controller in automatic mode To test equipment operability	Maintenance Section report flow transmitter repaired	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
11	Monitor reactor coolant system boration To assure performance as expected	Operating practice		Chemical & Volume Control System
12	Manually withdraw control rods To restore control rods to normal operating position	Control rod withdrawl demand signal		Control Element Drive Mechanism Control System, Reactor Coolant System
13	Fill out logs To document shift activities	Operating practice		
14	Review Technical Specifications To determine reporting requirements	Operating practice		
15	Place makeup mode controller in manual To terminate reactor coolant system boration	Boron concentration restored to desired value	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
16	Initiate automatic makeup of the reactor coolant system To restore chemical and volume control system to normal operating status	Rods restored to desired position	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine chemical and volume control system indications --- To identify cause of trouble alarm	Letdown trouble alarm		Chemical & Volume Control System
2	Examine containment parameters --- To identify cause of trouble alarm	Containment trouble alarm		Containment
3	Monitor pressurizer --- To track reactor coolant system inventory loss	Letdown trouble alarm		Pressurizer
4	Isolate Letdown --- To minimize reactor coolant inventory loss	Pressurizer level decreasing		Chemical & Volume Control System
5	Communicate plant status --- To coordinate administrative functions	Operating practice		
6	Operate the radiation monitoring system computer --- To monitor containment radiation levels	Operating practice		Radiation Monitoring System, Containment
7	Reduce turbine and reactor power --- To shut down in a safe and controlled manner	Operating practice		Control Element Drive Mechanism Control System, Electro-hydraulic Control System
8	Manually initiate reactor power cutback --- to shut down in a safe and controlled manner	Pressurizer pressure and level decreasing		Reactor Protection System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Manually trip the reactor To mitigate the consequences of the anticipated pressurizer level transient	Pressurizer level less than 25 percent		Reactor Protection System
10	Declare major event To cue crew to maintain safety functions	Reactor tripped	Emergency Operations 41EP-1ZZ01	
11	Examine turbine generator indications To verify turbine generator trip	Procedure	Emergency Operations 41EP-1ZZ01	Main Turbine, Main Generation
12	Reset steam bypass control system To restore system operability following reactor trip	Procedure	Reactor Trip 41RO-1ZZ01	Steam Bypass Control System
13	Monitor reactor coolant system parameters To verify subcooling margin	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System
14	Maintain steam generator level and pressure To assure reactor coolant system heat sink	Procedure	Emergency Operations 41EP-1ZZ01	Steam Generator System
15	Examine reactor coolant system indications To verify reactor trip	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Examine safety systems indications To confirm automatic safety functions have actuated	Procedure	Emergency Operations 41EP-1ZZ01	Engineered Safety Features Actuation System, Safety Injection System
17	Stop reactor coolant pumps To prevent equipment damage	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System, Chemical & Volume Control System
18	Monitor cold leg temperature To verify heat removal and heat source balance	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System
19	Compare plant parameters to engineered safety features setpoints To verify correct actuation of engineered safety features	Procedure	Emergency Operations 41EP-1ZZ01	Engineered Safety Features Actuation System
20	Examine engineered safety features actuation system indications To confirm automatic safety functions have actuated	PZR pressure below 1700 Psia	Emergency Operations 41EP-1ZZ01	Engineered Safety Features Actuation System
21	Compare safety injection and pressurizer parameters To verify adequate safety injection flow for pressurizer pressure	Procedure	Emergency Operations 41EP-1ZZ01	Safety Injection System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22	Monitor pressurizer pressure indications To verify pressurizer pressure control status	Procedure	Emergency Operations 41EP-1ZZ01	Pressurizer
23	Monitor reactor power To maintain critical safety functions	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System
24	Monitor core differential temperature To verify heat removal and heat source balance	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System
25	Examine steam plant indications To assure availability of heat sink	Procedure	Emergency Operations 41EP-1ZZ01	Steam Generator System, Steam Bypass Control System
26	Monitor pressurizer level To confirm addition of water to restore pressurizer level	Procedure	Emergency Operations 41EP-1ZZ01	Pressurizer
27	Examine chemical and volume control system indications To verify charging, letdown and bleed off flows	Procedure	Emergency Operations 41EP-1ZZ01	Chemical & Volume Control System
28	Monitor turbine generator To maintain critical safety functions	Procedure	Emergency Operations 41EP-1ZZ01	Main Turbine
29	Monitor safety equipment actuation system status To verify automatic safety functions have actuated	Procedure	Emergency Operations 41EP-1ZZ01	Safety Equipment Actuation System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
30	Observe containment radiation level To verify plant conditions	Procedure	Emergency Operations 41EP-1ZZ01	Containment
31	Determine reactor vessel water level To assure adequate core coverage	Procedure	Emergency Operations 41EP-1ZZ01	Reactor Coolant System
32	Observe electrical lineup indications To verify power to vital auxiliaries	Procedure	Emergency Operations 41EP-1ZZ01	Diesel Generator System, Main Generation
33	Check cooling water system lineups To verify balance of plant equipment cooling	Procedure	Emergency Operations 41EP-1ZZ01	Circulating Water System, Plant Cooling Water System, Nuclear Cooling Water System, Turbine Cooling System
34	Assess plant indications To complete diagnosis of the type of event	Procedure	Emergency Operations 41EP-1ZZ01	Containment, Steam Generator System
35	Trip main feedwater pump To remove unnecessary equipment from service	Operating practice	Main Feed Water Pump B Operation 41OP-1FP02	Feedwater System
36	Review key plant indications To verify loss of coolant accident	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Containment, Pressurizer, Safety Injection System, Steam Generator System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
37	Monitor containment parameters To maintain critical safety functions	Procedure	Emergency Operations 41EP-1ZZ01	Containment
38	Direct control room crew to maintain critical safety functions To coordinate crew's emergency actions	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	
39	Declare site emergency To initiate appropriate on- and off-site respon- ses	Procedure	Small Loss of Coolant 41RO-1ZZ08	In-plant Communications System
40	Monitor reactor coolant system temperature To verify plant cooldown	Operating practice		Reactor Coolant System
41	Start nonsafety auxiliary feedwater pump To provide water to the steam generators	Procedure	Small Loss of Coolant 41RO-1ZZ08	Auxiliary Feed- water System
42	Monitor reactor vessel water level To assure adequate core coverage	Procedure	Small Loss of Coolant 41RO-1ZZ08	Reactor Coolant System
43	Shutdown main feedwater pump To reduce steam demand	Procedure	Small Loss of Coolant 41RO-1ZZ08	Feedwater Sys- tem
44	Maintain steam generator level and pressure To cooldown reactor cool- ant system	Procedure	Small Loss of Coolant 41RO-1ZZ08	Steam Generator System, Feedwa- ter System, Steam Bypass Control System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
45	Reset low pressurizer pressure trip To reduce setpoint to allow plant cooldown	Low PZR pressure pre-tip alarm		Reactor Protection System
46	Monitor reactor coolant system temperatures To verify natural circulation flow	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Reactor Coolant System
47	Compare train A safety injection actuation signals to component status To assure system changes associated with safety injection	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Engineered Safety Features Actuation System
48	Lineup chemical and volume control system to borate the reactor coolant system To restore volume control tank level	VCT trouble alarm	Reactor Coolant Makeup System (CH) 41OP-1CH09	Chemical & Volume Control System
49	Compare train B safety injection actuation signals to component status To assure system changes associated with safety injection	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Engineered Safety Features Actuation System
50	Compare train B containment isolation actuation signals to component status To assure system changes associated with containment isolation	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Engineered Safety Features Actuation System

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
51	Compare t[illegible] B contain-ment isolati[illegible]ation signals to compo[illegible] status To assure system changes associated with contain-ment isolation	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Engineered Safety Features Actuation System
52	Observe reactor coolant system parameters To verify plant status	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Reactor Coolant System
53	Sample reactor coolant system for boron To verify shutdown margin	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Primary Sampling System
54	Observe containment para-meters To verify plant status	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Containment
55	Shutdown condensate pumps To remove unnecessary auxiliaries from service	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Condensate System
56	Check remotely operated reactor coolant system vent valves To identify location of leak	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Reactor Coolant System
57	Determine position of pressuurizer safety valves To identify location of leak	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Pressurizer

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
58	Evaluate plant parameters To verify conditions necessary to reset safety injection system	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Reactor Coolant System
59	Complete turbine trip checklist To assure equipment in proper shutdown configuration	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Main Turbine
60	Observe and record water inventory to assure sufficient water supply for cooldown	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Chemical & Volume Control System
61	Shut down cooling towers To remove unnecessary auxiliaries from service	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Circulating Water System
62	Observe containment radiation levels To maintain critical safety functions	Procedure	Small Loss of Coolant Accident 41RO-1ZZ08	Containment

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Auxiliary Feedwater Pump

Operating Sequence ID: 19

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Verify tagout To ensure proper isolation of equipment	Receipt of work order and clearance from Maintenance Section	Station Tagging and Clearance 40AC-0ZZ03	
2	Determine time required to complete maintenance To assure conformance to Technical Specifications	Operating practice		
3	Isolate nonsafety auxiliary feedwater pump To allow maintenance to be performed safely	Procedure	Station Tagging and Clearance 40AC-0ZZ03	Auxiliary Feedwater System, 4.16 kV Power
4	Remove maintenance clearance To prepare for surveillance test of pump	Completion of maintenance	Station Tagging and Clearance 40AC-0ZZ03	Auxiliary Feedwater System, 4.16 kV Power
5	Review surveillance test requirements To assure conformance to Technical Specifications	Operating practice		
6	Test nonsafety auxiliary feedwater pump To assure operability of equipment	Technical Specifications		Auxiliary Feedwater System
7	Restore nonsafety auxiliary feedwater pump lineup to normal To return equipment to service	Completion of Surveillance Test	Nonsafety Auxiliary Feedwater Pump Operation 41OP-1AF02	Auxiliary Feedwater System
8	Communicate with Station Manager To allow coordination of station functions	Operating practice		

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Coordinate Plant Support Activities/Plant Security

Operating Sequence: Bomb Threat

Operating Sequence ID: 23

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Interrogate caller To learn more about threat and permit trace	Telephone call Bomb Threat	Bomb Threat	Public Off-site Communications System
2	Notify Plant Security To obtain assistance	Procedure	Bomb Threat	In-plant Communications System
3	Communicate with Plant Equipment Operator To inform and direct actions of plant equipment operator during emergency	Operating practice		In-plant Communications System
4	Declare Unusual Event To initiate appropriate on-site response	Procedure	Emergency Classification EPIP-02	In-plant Communications System
5	Communicate with Load Dispatcher To allow coordination of power grid	Operating practice		Private off-site Communications System
6	Communicate with Station Manager To allow coordination of station functions	Operating practice		In-Plant Communications System
7	Conduct contingency planning To prepare for possible shutdown	Operating practice		

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration--Radiological Emergency

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Operate the radiation monitoring system computer To identify the alarming parameter	High radiation alarm		Radiation Monitoring System
2	Verify correct chemical and volume control system lineup To determine source of indicated release	Operating practice		Chemical & Volume Control System
3	Verify correct gaseous radwaste system lineup To determine source of indicated release	Operating practice		Gaseous Radwaste System
4	Monitor plant indications To identify trends associated with event	Operating practice		
5	Direct Health Physics Section to obtain environmental samples To verify and and determine extent of indicated release	Operating practice		In-Plant Communications System
6	Communication with Station Manager To allow coordination of station functions	Operating practice		In-Plant Communications System
7	Review Emergency Plan Implementing Procedure To classifiy potential event	Operating practice	Emergency Classification EPIP-02	
8	Review Technical Specifications To determine operational limitations associated with alarm	Operating practice		

TASK SEQUENCE CHART

Plant: 75

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration--Radiological Emergency

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Operate the radiation monitoring system computer --- To identify possible changes in alarm conditions	Operating practice		Radiation Monitoring System
10	Direct Maintenance Section to examine radiation monitor --- To investigate cause of alarm	HPS report: stack sample normal		In-Plant Communications System
11	Inform control room crew of status of event --- To coordinate actions of shift personnel	Operating practice		
12	Fill out log --- To comply with administrative procedures	Operating practice		
13	Coordinate corrective actions --- To assure Technical Specifications requirements are met	Technical Specifications		In-Plant Communications System

2. PLANT 39

The data contained in this section are:

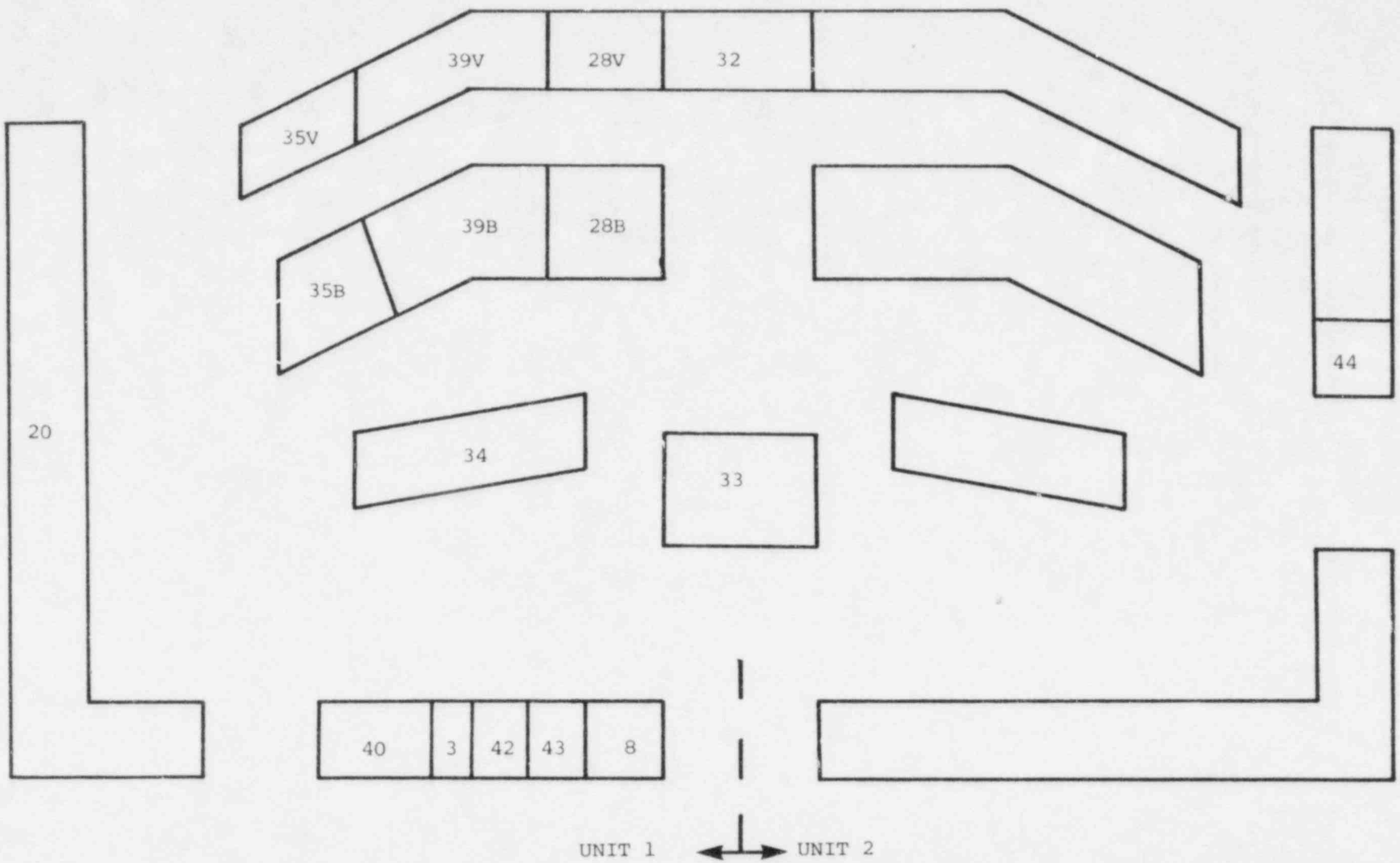
- Plant description (page 2-1)
- Panel layouts and designators (page 2-2)
- System nomenclature and numbering (page 2-4)
- Operating Sequence Overviews (page 2-7)
- Task Sequence Charts (page 2-16)

The following operating sequences were observed at Plant 39:

- 1 Increase Generator Output
- 5 Shutdown from Minimum Power
- 6 Nuclear Instrument Malfunction
- 13 Steam Generator Tube Rupture
- 15 Loss-of-Coolant Accident
- 16 Diesel Generator Start, Load, Run
- 19 Maintain Auxiliary Feedwater Pump
- 21 Change SRM Chart Recorder Paper
- 25 Radwaste Discharge

Plant 39, Unit 1 is a Westinghouse pressurized water reactor with a Westinghouse turbine-generator. The architect-engineer is Stone and Webster. The plant received its operating license in 1972. The control room is a multiple-unit control room. The data were collected at the Unit 1 simulator.

Plant 39 Panel/System	Number Assigned
Radiation Monitoring	8
Liquid Waste	43
Boron Recovery & Waste Gas	42
Core Thermocouples	3
Nuclear Instrumentation System	40
Diesel Generators & ACED	20
Safeguards • RHR System • Containment Spray • Safety Injection • Containment Isolation • Reactor Coolant Pumps	35B/35V
Reactor & Primary Plant • Rod Control • Rod Position Indication • Reactor Temperature and Pressure Indications • Nuclear Instrumentation Indications • Pressurizer • Chemical & Volume Control System	39B/39V
Steam Plant • Main Turbine/EHC • ACED • Main Feedwater • Condensate • Auxiliary Feedwater • Steam Generators • Steam Dump Control • Component Cooling Water • Main Lube Oil • Reheat Steam	28B/28V
Supervisor's Desk • Off-site phones • Procedure storage	33
Operator's Desk/Computer Console	34
Meteorological Instruments	44



Plant 39 Control Room Layout

Plant 39 System Name	ABBR.	INPO System Number & Name
AC electrical distribution	ACED	62. AC electrical distribution system
Aerated drain	---	69. Liquid radwaste system
Air Ejector	AE	55. Condenser air removal system
Auxiliary feedwater system	AFW	61. Auxiliary feedwater system
Boron recovery	BR	68. Liquid rad waste (reactor coolant waste/recycle/boron recovery) system
Chemical and volume control system	CVCS	4. Chemical and volume control system
Component cooling	CC	8. Component cooling system
Condensate	CN	56. Condensate system
Containment	CTMT	103. Containment system
Containment for cooling and purging	---	29. Containment purge system
Containment spray	CS	26. Containment spray system
Containment vacuum	---	103. Containment system
Control rod drive system	CRDS	1. Control rod drive system
Electrohydraulic control system	EHC	48. Main turbine electrohydraulic control
Emergency diesel generator	DG	64. Emergency diesel generator system
Emergency power	---	62. AC electrical distribution system
Engineered safeguards	---	13. Engineered safety features actuation system
Gaseous waste disposal	---	71. Waste gas disposal system
Generator hydrogen	---	52. Main generator hydrogen and carbon dioxide gas system
Gland seal	GS	46. Main turbine and steam generator feed pump steam seal system
High pressure drain	HPD	60. Feedwater heater vent and drain system

Plant 39 System Name	ABBR.	INPO System Number & Name
Inside recirculation spray	CS	26. Containment spray system
Low pressure drain	LPD	60. Feedwater heater vent and drain system
Main feedwater	FW	59. Main feedwater system
Main lube oil	MLO	47. Main turbine generator lube oil system
Main reheat steam	MR	39. Main and reheat steam system
Main steam	MS	39. Main and reheat steam system 41. Steam dump/turbine bypass control system 40. Main steam isolation valve activating system
Main turbine	MT	45. Main turbine generator
Nuclear instrumentation system	NIS	15. Nuclear instrumentation system
Outside recirculation spray	CS	26. Containment spray system
Overhead gas	---	68. Liquid rad waste system
Pressurizer pressure control	PZRPC	10. Pressurizer pressure control system
Radiation monitoring system	RMS	73. Process radiation monitoring system 72. Area radiation monitoring system
Reactor coolant system	RCS	10. Pressurizer pressure control system 2. Reactor coolant system
Residual heat removal	RHR	5. Residual heat removal system
Rod control system	---	1. Control rod drive system
Rod position indication system	RPIS	14. Rod position indication system
Safety injection	SI	6. Safety injection system
Sampling	SS	--
Seal water	---	4. Chemical and volume control system

Plant 39 System Name	ABBR.	INPO System Number & Name
Steam generator	SG	35. Steam generator system
Switchyard distribution	---	62. AC electrical distribution system

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: W/PWR

Operating Sequence ID: 01

CR Type: Multiple

Operating Sequence: Increase Generator Output

Initial Conditions: The plant has been started up and has been operating at 80% power. The rod control system is in automatic, and the electro-hydraulic control system is in operator automatic.

Sequence Initiator: System Operator request for 90% power.

Progression of Action: The crew adjusts the electro-hydraulic control system settings to start the power increase. As power increases, pertinent plant parameters are monitored to ensure continuation of safe operation. The crew performs a boron dilution to maintain delta flux within limits.

Final Conditions: The plant is at 90% power and electro-hydraulic control system is still in operator automatic. The System Operator has been notified.

Major Systems: Electro-Hydraulic Control System (EHC), Main Turbine (MT), Steam Generators (SG), Reactor Coolant System (RCS), Rod Position Indication System (RPIS), Chemical and Volume System (CVCS), Nuclear Instrumentation System (NIS), Main Steam (MS), Feedwater (FW), Condensate (CN), High Pressure Drains (HPD), Low Pressure Drain (LPD).

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: W/PWR

Operating Sequence ID: 05

CR Type: Multiple

Operating Sequence: Shutdown from Minimum Power to Cold Shutdown.

Initial Conditions: The plant has been operating at full power for several months. Shutdown for refueling has begun. The previous shift has started the shutdown by reducing power to minimum load (20%) and satisfying the following conditions for shutdown to hot standby: High pressure and low pressure heater drain pumps locked out, steam dumps are in Tave mode; and automatic unblock of intermediate range and low power range trips has occured.

Sequence Initiator: Administrative order to continue shutdown.

Progression of Action: To achieve a hot standby condition, the crew shuts down the turbine, and shuts down the reactor. The crew transfers station service buses to the reserve station transformer. The crew begins degassification using the gas stripper to remove fission product gases and hydrogen from the reactor coolant system and borates the reactor coolant system to a shutdown concentration. The reactor is then cooled down to 350^{O}/450 psig using the steam dumps. The reactor is further cooled down using the residual heat removal system. The crew secures the main steam, main feed and condensate systems and places the steam generators in a wet layup condition. When reactor coolant system tempeature is below 160^{O}F, the crew charges the pressurizer solid, and maintains reactor coolant system pressure at 300-350 psig while continuing degassification.

Final Conditions: The reactor is subcritical, reactor coolant system temperature is 130^{O} and reactor coolant system pressure is 300-350 psig with the pressurizer filled. One reactor coolant pump is running, degassification is in progress, and the residual heat removal system is operating to maintain reactor coolant system temperature. The main steam, main feed and condensate systems are shutdown and a containment purge is in progress.

Major Systems: Electro-hydraulic Control System (EHC), Main Turbine (MT), Nuclear Instrumentation System (NIS), Reactor Coolant System (RCS), Rod Position Indication System (RPIS), Steam Generator (SG), Main Feedwater (FW), Switchyard Distribution, Containment (CTMT), Control Rod Drive (CRD), Main Reheat Steam, Chemcial & Volume Control System (CVCS), Main Lube Oil, Safety Injection (SI), Residual Heat Removal System (RHR), Sampling (SS), Main Steam System (MS), Generator Hydrogen, Radiation Monitoring System (RMS), Component Cooling Water (CC), Engineered Safeguards (ESF), Seal Water, Inside Recirculation Spray, Outside Recirculation Spray, Containment Spray (CS), Containment Air Cooling & Purging, Gland Seal (GS), Air Ejector (AE), Condensate (CN).

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore plant to safe condition

NSSS/Type: W/PWR

Operating Sequence: 06

CR Type: Multiple

Operating Sequence: Nuclear Instrument Malfunction

Initial Conditions: The plant is at 50% power with control rods in automatic.

Sequence Initiator: Power range channel N-44 fails upscale due to shorting of upper detector.

Progression of Action: Failure of instrument triggers several alarms and causes control rods to drive in. Crew reviews indications, diagnose problem and switches rod control to manual. The crew bypasses all functions for the failed channel, ensures rods are returned to the appropriate position, and informs supervisors and instrument technicians.

Final Conditions: The plant is at 50% power with control rods in manual. The power supply fuses for N-44 are removed and N-44 is bypassed on the:

1. Rod stop bypass switch
2. Dropped rod mode switch
3. Comparator channel defeat switch
4. Detector current comparator defeat switch

Major Systems: Nuclear Instrumentation System (NIS), Rod Control, Reactor Protection System (RPS), Reactor Coolant System (RCS), Rod Position Indication System (RPIS), Main Turbine (MT).

Operating Sequence Overview

Plant: 39

Operating Function/Subfunction: Supervise and Control Plant Operation/Mitigate Consequences of an Accident

NSSS/Type: W/PWR

Operating Sequence ID: 13

CR Type: Multiple

Operating Sequence: Tube Ruptures - Steam Generators

Initial Conditions: The plant is operating at 90% power; Unit 2 is operating and available to provide support systems, the Station Manager is on-site.

Progression of Action: The tube rupture causes a rapid decrease in pressurizer level and reactor coolant system pressure, and an increase in air ejector vent radiation levels. The crew observes these conditions, other relevant indications, and concludes that a steam generator tube rupture has occurred. The crew starts a second charging pump, secures letdown flow, trips the reactor, and initiates safety injection. After verifying proper operation of safety systems, the Shift Supervisor notifies the Station Manager to inform him of the problem and turn over the duties of station Emergency Manager. The Shift Technical Advisor independently confirms the diagnosis of the accident. After the condition is stabilized and level has been returned to the pressurizer, safety injection is reset and the emergency diesel generators are loaded. The faulted steam generator is identified and isolated from the secondary system. Cooldown and depressurization using the remaining steam generators and steam dumps is initiated. as the plant is cooled down, steam from the faulted steam generator is periodically bypassed to the main condensor to maintain pressure approximately equal to reactor cooldown system pressure.

Final Conditions: The faulted steam generator has been isolated. Primary pressure and steam generator pressure are equalized at a pressure below the steam generator relief valve setpoint and a cooldown is in progress.

Major Systems: Reactor Coolant System (RCS), Chemical and Volume Control System (CVCS), Aerated Drain, Radiation Monitoring System (RMS), Nuclear Instrumentation System (NIS), Rod Position Indication System (RPIS), Control Rod Drive (CRD), Safety Injection (SI), Engineered Safeguards (ESF), Main Turbine (MT), Main Lube Oil (MLO), Emergency Diesel Generator (DG), Containment (CTMT), Main Steam (MS), Emergency Power, Main Feedwater (FW), Auxiliary Feedwater System (AFW), Steam Generator (SG), Main Reheat Steam, Low Pressure Drain (LPD), High Pressure Drain (HPD), Condensate (CN), Sampling (SS).

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: W/PWR

Operating Sequence ID: 15

CR Type: Multiple

Operating Sequence: Loss of Coolant Accident

Initial Conditions: The plant is at 90% power with a normal lineup. The Station Manager is on site.

Sequence Initiator: A break in the reactor coolant system resulting in a leak rate of approximately 300,000 lbm/hour.

Progression of Action: The loss of coolant accident causes an increase in containment pressure and radiation levels and a rapid decrease in reactor coolant system (RCS) pressure and pressurizer level. The crew starts a second charging pump and isolates letdown to determine the leak rate. The reactor trips on high containment pressure and the crew initiates safety injection and verifies actuation of safety functions. The release of coolant in the containment causes a continued increase in containment pressure which initiates phase two containment isolation at 17.7 psia and phase three containment isolation and containment spray at 23 psia. The crew stops all reactor coolant pumps and operates the steam system power operated relief valves to cooldown the plant on natural circulation. The Shift Supervisor verifies that a small break loss of coolant accident inside the containment has occurred, declares a site emergency, and notifies the Station Manager to inform him of the situation and turn over the duties of station Emergency Manager. Upon receipt of a refueling water storage tank low level signal, the crew initiates safety injection swap-over to recirculation.

Final Conditions: The reactor is tripped with all control rods fully inserted. Reactor coolant system pressure is stabilized and reactor coolant system cooldown via the main steam power operated relief valves is in progress. The safety injection system is in the recirculation mode.

Major Systems: Reactor Coolant System (RCS), Main Turbine (MT), Chemical and Volume Control System (CVCS), Rod Control, Electro-Hydraulic Control (EHC), Safety Injection (SI), Switchyard Distribution, Containment (CTMT), Containment Spray, Engineered Safeguards, Steam Generator (SG), Main Steam (MS), Main Reheat Steam, Feedwater (FW), Auxiliary Feedwater (AFW), Radiation Monitoring (RMS), Condensate (CN), Low Pressure Drain (LPD), High Pressure Drain (HPD), Main Lube Oil (MLO), Pressurizer Pressure Control (PZRPC), Aerated Drain, Rod Position Indication System (RPIS).

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Test Equipment

NSSS/Type: W/PWR

Operating Sequence ID: 16

CR Type: Multiple

Operating Sequence: Diesel Generator Start, Load, Run

Initial Conditions: The plant is at power and the diesel generators are in a normal emergency standby condition.

Sequence Initiator: Periodic test and work schedule indicates number 1 diesel generator is to be tested during the shift.

Progression of Action: Prerequisite conditions for the test are verified. The crew starts the diesel generator and loads it for 2 hours. Then they unload, cooldown and shutdown the diesel engine. Test results are satisfactory. The crew fills out appropriate data sheets and logs.

Final Conditions: The plant is at power and diesel generators are in a normal emergency standby condition.

Major Systems: Emergency Diesel Generator (DG), AC Electrical Distribution (ACED).

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

NSSS/Type: W/PWR

Operating Sequence ID: 19

Operating Sequence: Maintain Auxiliary Feedwater Pump

Initial Conditions: The plant is operating normally at full power. The auxiliary feedwater system is in a normal lineup.

Sequence Initiator: A work order for implementation of maintenance on a motor driven feedwater pump is received.

Progression of Action: The Shift Supervisor authorizes the implementation of maintenance. The crew prepares a tag out, then isolates, drains, and defeats the automatic and manual start capabilities of the motor driven auxiliary feedwater pump by repositioning and tagging the appropriate devices. The maintenance section is informed that the pump is ready for maintenance. Upon completion of maintenance the tags are removed, pump operability is verified by performing the required periodic test, and the pump is restored to a normal lineup.

Final Conditions: The plant is operating normally at full power. The auxiliary feedwater system is in a normal lineup.

Major Systems: Auxiliary Feedwater System (AFW)

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Improve Equipment

NSSS/Type: W/PWR

Operating Sequence ID: 21

CR Type: Multiple

Operating Sequence: Change SRM Recorder Paper

Initial Conditions: The plant is at power, in a normal lineup

Sequence Initiator: End of paper indication observed on NR-45 flux recorder.

Progression of Action: As per administrative procedures, an operator changes chart paper when roll is used up. The operator removes the old paper from the recorder, records the date and time and forwards it to Station Records. He puts new paper in the recorder and records date and time.

Final Conditions: The plant is at power, in a normal lineup.

Operating Sequence Overview

Plant: 39

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration Radiological Emergency

NSSS/Type: W/PWR

Operating Sequence ID: 25

Operating Sequence: Radwaste Discharge

Initial Conditions: The plant is shutdown with degassification of the reactor coolant systm using the gas stripper in progress. A failure of a relief valve in the overhead gas system causes a release of radioactive gas through the process vent which exceeds Technical Specifications limits.

Sequence Initiator: Radiation Monitor Annunciator.

Progression of Action: The crew verifies the alarm condition and automatic isolation of the containment vacuum system and gas tanks. The crew determines from the radiation monitoring system that the release exceeded Technical Specification limits. The Shift Supervisor initiates the applicable portions of the Emergency Plan and declares an unusual event. The crew notes that overhead gas system pressure is decreasing rapidly and identifies this system as the source of the leak. The release is terminated when a plant equipment operator reseats the relief valve. The Shift Supervisor dispatches the Health Physics Section to confirm emergency classification and determine site boundary dose rate. Within 10 minutes the readings on the radiation monitoring system return to normal. The Shift Supervisor terminates the unusual event and initiates the required reports.

Final Conditions: The plant is shutdown. The radioactive release has been terminated. Reactor coolant system degassification has been terminated and the waste gas system has been secured.

Major Systems: Boron Recovery (BR), Radiation Monitoring System (RMS), Overhead Gas, Gaseous Waste Displosal, Containment Vacuum.

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Increase Generator Output

Operating Sequence ID: 01

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Authorize power increase ------------------------ to comply with administrative procedures	Operating Practice		
2	Adjust turbine load setting ------------------------ to increase turbine generator output	Procedure	OP 2.2 Power Operation-Turbine	Main Turbine, Electro-Hydraulic Control System
3	Fill out logs ------------------------ to comply with administrative procedures	Procedure	AMD-29 Conduct of Operations	
4	Monitor turbine generator operation ------------------------ to assure performance as expected	Power increasing	OP 2.2 Power Operation Turbine	Main Turbine, Electro-hydraulic Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Increase Generator Output

Operating Sequence ID: 01

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Monitor plant parameters ------------------------ to assure performance as expected	Operating practice		High Pressure Drain, Low Pressure Drain, Chemical and Volume Control System, Rod Position Indication System, Nuclear Instrumentation System, Reactor Coolant System, Steam Generator, Main Steam, Feedwater Condensate
6	Operate the Chemical and Volume Control System ------------------------ to dilute boron concentration of the reactor coolant system	Delta flux approaching operating limit		Nuclear Instrumentation System, Rector Coolant System, Chemical and Volume Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Increase Generator Output

Operating Sequence ID: 01

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7	Dispatch Plant Equipment Operator to monitor condensate polishing system --- to assure performance as expected during power increase	Operating practice		
8	Communicate with Load Dispatcher --- to allow coordination of power grid	Power increased to 90%		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Reduce turbine generator load to minimum -------------------- to prepare for shutdown	Procedure	OP 2.2 Power Operation Turbine	Main Turbine, Electro-hydra-ulic Control System
2	Operate feed flow control system -------------------- to maintain steam generator level	Operating practice		Steam Generator, Main Feedwater
3	Transfer the station service buses to reserve station transfer buses -------------------- to provide power after turbine shutdown	Procedure	OP 2.1 Unit Power Operations	Switchyard Distribution
4	Monitor indications -------------------- to evaluate plant status	Operating practice		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Monitor nuclear instrumentation system --- to assure performance as expected	Procedure	OP 3.1 Unit Shutdown Operations	Nuclear Instrumentation System
6	Read procedures --- to assure compliance	Operating practice		
7	Determine volume of boric acid required for boration --- to establish integrator boration	Procedure	OP 3.2 Unit Shutdown Operation (RSD to 350/450)	
8	Insert control rods --- to reduce reactivity	Procedure	OP 3.1 Unit Shutdown Operation	Control Rod Drive, Rod Position Indication System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Open output circuit breakers ------------------------ to disconnect turbine generator from grid	Procedure	OP 2.1 Unit Power Operation	Main Turbine
10	Remove generator voltage regulator from service ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 2.2 Power Operation Turbine	Main Turbine
11	Trip the turbine generator ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 2.2 Power Operation Turbine	Main Turbine, Main Reheat Steam
12	Operate the chemical and volume control system in borate mode ------------------------ to increase reactor coolant system boron concentration	Procedure	OP 3.2 Unit Shutdown Operation (RSD to 350/450)	Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Start turbine oil pumps --- to ensure sufficient lube oil pressure during turbine coastdown	Operating practice		Main Lube Oil
14	Communicate with Load Dispatcher/System Operator --- to allow coordination of power grid	Operating procedure		
15	Dispatch Plant Equipment Operator to open generator breaker disconnects --- to obtain assistance	Procedure	OP 2.2 Power Operation Turbine	Switchyard Distribution
16	Inject borated water through the boron injection tank --- to increase Reactor Coolant System Boron Concentration	Operating practice		Safety Injection, Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
17	Initiate degassification of the Reactor Coolant System using the gas stripper ------------------------- to remove hydrogen and fission product gasses	Procedure	OP3.2 Unit Shutdown Operation HSD-350/450	Chemical & Volume Control System
18	operate the Chemical and Volume control system ------------------------- to maintain pressurizer level	Operating practice		Chemical & Volume Control System, Reactor Coolant, Residual Heat Removal System
19	Sample reactor coolant System ------------------------- to determine coolant activity, hydrogen and boron concentration	Procedure	OP 3.2 Unit Shutdown (HSD to 350/450)	Sampling

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
20	Operate steam dump controller ------------------------ to maintain a stable Reactor Coolant System Temperature	Procedure		Main Steam, Reactor Coolant
21	Fill out logs ------------------------ to comply with adminis-trative procedures	Procedure	ADM-29 Conduct of Operators	
22	Secure electro-hydraulic control system pump ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 2.2 Unit Power Operation Turbine	Electro-hydrau-lic Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23	Unblock high flux at shutdown alarm ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 3.1 Unit Shutdown Operation	Nuclear Instrumentation System
24	Line Chemical and Volume control system for automatic makeup flow ------------------------ to supply makeup water to the reactor coolant system at the cold shut down	Procedure	OP 8.3 Boron Concentration Control	Chemical & Volume Control System
25	Open reactor trip breakers ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 3.1 Unit Shutdown Operation	Control Rod Drive

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
26	Withdraw shutdown control rod banks --- to assure sufficient reactivity insertion rate	Procedure	OP 3.1 Unit Shutdown Operation	Control Rod Drive, Rod Position Indication System, Nuclear Instrumentation System
27	Position reactor coolant stop valves off backseat --- to prevent damage during cooldown	Procedure	OP 3.2 Unit Shut-down Operation (HSD 350/450)	Reactor Coolant System
28	Dispatch Plant Equipment operator into containment --- to inspect plant for leakage and prepare residual heat removal system for service	Operating practice		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown form Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
29	Dispatch Plant Equipment Operator to adjust support coolers ------------------------ to place system in shutdown line up	Procedure	OP 2.2 Unit Power Operation Turbine	Generator Hydrogen
30	Monitor the boron recovery and waste disposal system during degassification ------------------------ to assure performance as expected	Operating practice		Boron Recovery, Waste Disposal System, Radiation Monitoring System
31	Operate pressurizer pressure control system ------------------------ to attain depressurization rate consistent with cooldown rat.	Pressure approaching temperature limits for cooldown	OP 3.2 Unit Shutdown Operation (HSD 350/450)	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
32	Warm up residual heat removal system --- to prepare system for service	Procedure	OP 3.2 Unit Shutdown Operation (HSD-350/ 450)	Residual Heat Removal System, Component Cooling
33	Operate steam dump system --- to cooldown the plant	Procedure	OP 3.2 Unit Shutdown Operation (HSD 350/ 459)	Main Steam, Reactor Coolant System
34	Enable overpressure mitigating system --- to prevent overpressurization of the plant	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Reactor Coolant System
35	Secure two reactor coolant pumps --- to reduce heat addition	Operating practice		Reactor Coolant System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
36	Bypass steam dump interlock with low reactor coolant system temperature --- to allow continued steam dump operation	Procedure	OP 3.2 Unit Shutdown Operation (HSD 350/ 450)	Engineering Safeguards
37	Block "high steam and low tave or low press" signal to safety injection system --- to prevent inadvertent safety injection actuation	"Low Tave interlock alarm"	OP 3.2 Unit Shutdown Operation (HSD 350/ 450)	Engineered Safeguards
38	Block "low pressurizer pressure" signal to safety injection system --- to prevent inadvertent safety injection actuation	"PERM. to block SI PRZ Lo Press" status light	OP 3.2 Unit Shutdown Operation (HSD 350/ 450)	Engineered Safeguards

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operation/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
39	Open #1 seal water return bypass valve --- to remove heat from pump	Press. = 1500	OP.3.2 Unit Shutdown Operation (HSD 350/ 450)	Seal Water
40	Isolate the safety injection system accumulators --- to prevent inadvertent safety injection actuation	RCS pressure = 1000 psig	OP 3.2 Unit Shutdown Operation (HSD 350/ 450)	Safety Inject- ion
41	Place the residual heat removal system in oper- ation --- to enable cooldown below 350°	temperature = 350° pressure = 450 psi	OP 3.4 Unit Shutdown Operation (Solid Plant Oper- ation)	Residual Heat Removal System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minmum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
42	Deactivate low head safety injection --- to prevent inadvertent safety injection	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Safety Injection
43	Deactivate the inside recirculation spray system --- to place system in shutdown condition	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Inside Recirculation Spray
44	Deactivate the outside recirculation spray system --- to place system in shutdown condition	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Outside Recirculation Spray

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
45	Deactivate the containment spray system --- to place system in shutdown condition	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Containment spray
46	Lock out charging pump --- to prevent overpressurization of the plant while solid	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Chemical & Volume Control System
47	Operate the residual heat removal system --- to cooldown the reactor coolant system	Operating practice	OP 14 - Residual Heat Removal	Residual Heat Removal, Reactor Coolant System, Component Cooling

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
48	Insert shutdown banks --- to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Control Rod System
49	Secure steam dumps --- to assure equipment in proper shutdown configuration	Operating Practice	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Main Steam
50	Dispatch Plant Equipment Operator to cut in both trains of outside instrument air to containment --- to allow sustained operation of overpress mitigating system	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
51	Secure main feedwater pump --- to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Main Feedwater
52	Dispatch Plant Equipment Operator nitrogen blanket on steam generators --- to minimize corrosion of steam generators	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	
53	Initiate a purge of the containment --- to prepare for maintenance	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Containment Air Cooling & Purging, Containment

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
54	Secure gland seal steam system ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Gland Seal Steam
55	Break condensor vacuum ------------------------ to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Air Ejector
56	Raise level in the steam generators ------------------------ to prepare for wet layup	Operating practice		Main Feedwater, Condensate, Steam Generators

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
57	Secure condensate system --- to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Condensate
58	Operate the coolant charging system --- to fill the pressurizer	RCS temperature below 160°F	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Chemical and Volume Control System, Reactor Coolant System, Residual Heat Removal System
59	Dispatch Chemistry Section to place steam generator in wet lay-up condition --- to assure equipment in proper shutdown configuration	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Generate Power

Operating Sequence: Shutdown from Minimum Load to Cold Shutdown

Operating Sequence ID: 05

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
60	Secure pressurizer heaters --- to prevent inadvertent pressurization	Plant is solid	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Reactor Coolant System
61	Operate the chemical and volume control system --- to maintain reactor coolant system pressure	Operating practice		Chemical and Volume Control System, Reactor Coolant System, Residual Heat Removal System
62	Initiate auxiliary spray --- to cooldown the pressurizer	Procedure	OP 3.4 Unit Shutdown Operation (Solid Plant Operation)	Chemical & Volume Control System, Reactor Coolant System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore Plant to Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate a possible nuclear instrument malfunction ------------------------ to identify plant condition	Annunciators		Nuclear Instrumentation System
2	Verify power range detector failure ------------------------ to choose appropriate follow-up actions	Power range alarms	AP-4 Malfunction of Nuclear Instrument	Nuclear Instrumentation System
3	Shift control rods to manual mode ------------------------ to stop rod insertion	Procedure	AP-4 Malfunction of Nuclear Instrument	Rod Control System, Rod Position Indication System
4	Manually pull rods ------------------------ To increase reactor coolant temperature	Tave Tref	AP-4 Malfunction of Nuclear Instrument	Rod Position Indication System, Rod Control System, Reactor Coolant System, Nuclear Instrumentation System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore Plant to Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Monitor plant parameters ------------------------ to assure plant is in stable condition	Operating practice		Reactor Coolant System, Main Turbine, Steam Generator
6	Fill out logs ------------------------ to comply with administrative procedures	Procedure	ADM 29 Conduct of Operations	
7	Defeat protection functions for failed channel ------------------------ to restore plant to normal operating conditions	Procedure	AP-4 Malfunction of Nuclear Instrument	Nuclear Instrumentation System
8	Dispatch instrument technicians to repair nuclear instrument ------------------------ to restore system to normal operation	Procedure	AP-4 Malfunction of Nuclear Instrument	
9	Inform supervisory personnel ------------------------ to communicate plant status	Procedure	ADM 29 Conduct of Operations	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore Plant to Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
10	Review Technical Specifications ------------------------ to ensure compliance with safety limits	Operating practice	Technical Specifications	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Repture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate loss of coolant inventory -------------------------- to identify plant condition	Annunciators		Reactor Coolant System
2	Estimate rate of coolant loss -------------------------- to determine need for manual reactor trip and safety injection	Procedure	AP -16 Excessive Primary Plant Leakage	Reactor Coolant System, Chemical & Volume Control System
3	Turn off containment sump pumps -------------------------- to prevent inadvertent radioactivity release	Procedure	EP-4 Steam Generator Tube Rupture	Aerated Drain

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
4	Recognize that cues indicate a possible steam generator tube rupture ------------------------ to provisionally diagnose the accident	Annunciator		Radiation Monitoring System
5	Manually trip the reactor ------------------------ to reduce heat generation	Procedure	AP-16 Excessive Primary Plant Leakage	Nuclear Instrumentation System, Rod Position Indication System, Control Rod Drive System
6	Monitor pressurizer level ------------------------ to evaluate plant condition	Operating Practice		Reactor Coolant System
7	Monitor plant indications ------------------------ to evaluate compliance with procedural Documentation	Operating practice		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
8	Manually initiate safety injection ------------------------ to assure core coverage	Procedure	EP-4 Steam Generator Tube Rupture	Safety Injection, Engineered Safeguards
9	Line up the main turbine after unit trip ------------------------ to assure system is in proper shutdown configur-ation	Procedure	EP-1 Reactor Trip	Main Turbine, Main Lube Oil
10	Verify diesels running ------------------------ to assure performance as expected	Procedure	EP-4 Steam Generator Tube Rupture	Emergency Diesel Generator
11	Verify containment phase 1 isolation ------------------------ to assure performance as expected	Procedure	EP-4 Steam Generator Tube Rupture	Containment

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12	Verify the steam dump control system operation ------------------------ to assure stabilized reactor coolant system temperature	Procedure	EP-4 Steam Generator Tube Rupture	Main Steam, Reactor Coolant System
13	Verify emergency busses energized ------------------------ to assure performance as expected	Procedure	EP-4 Steam Generator Tube Rupture	Emergency Power
14	Verify main feedwater isolation ------------------------ to assure performance as expected	Procedure	EP-4 Steam Generator Tube Rupture	Main Feedwater
15	Analyze plant parameters ------------------------ to identify faulted steam generator	Procedure	EP-4 Steam Generator Tube Rupture	Steam Generator, Auxiliary Feedwater System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Confirm diagnosis --- to provide independent confirmation of plant condition	Procedure	EP-0 Immediate Actions & Diagnostic Procedure for STA	Reactor Coolant System, Steam Generator, Radiation Monitoring System
17	Monitor safety injection system --- to assure performance as expected	Operating practice		Safety Injection, Chemical & Volume Control System
18	Verify auxiliary feed-water operation --- to assure performance as expected	Procedure	EP-1 Reactor Trip	Auxiliary Feedwater System
19	Communicate with supervisory personnel --- to obtain assistance	Procedure	EPIP 1.01 Emergency Manager Controlling Procedure	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
20	Operate the steam dump system --- to decrease reactor Coolant system temperature	Procedure	EP-4 Steam Generator Tube Rupture	Main Steam, Reactor Coolant System
21	Isolate secondary side of steam generator --- to terminate radioactivity release to main steam system	Procedure	EP-4 Steam Generator Tube Rupture	Main Steam
22	Reset steam dump interlock --- to allow continued steam dump operation below 543 deg.	Annunciator		Main Steam
23	Operate auxiliary feedwater system --- to maintain steam generator water level	Procedure	EP-4 Steam Generator Tube Rupture	Auxiliary Feedwater System Steam Generator

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
24	Monitor nuclear instruments --- to assure performance as expected	Procedure	EP-1 Reactor Trip	Nuclear Instrumentation System
25	Operate the pressurizer pressure control system in manual mode --- to reduce reactor coolant system pressure	Procedure	EP-4 Steam Generator Tube Rupture	Reactor Coolant System
26	Secure reheat steam system --- to place system in proper shutdown line up	Procedure	EP-1 Reactor Trip	Main Reheat Steam
27	Secure secondary drain system --- to prevent equipment damage	Operating practice		Low Pressure Drain, High Pressure Drain

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
28	Monitor subcooling --- to confirm adequate core cooling	Procedure	EP-4 Steam Generator Tube Rupture	Reactor Coolant System
29	Dispatch Plant Equipment Operator to fill emergency condensate tank --- to ensure sufficient cooling water supply	Operating practice		Condensate
30	Dispatch Plant Equipment Operator to load diesels --- to cool diesel turbocharger	Procedure	EP-4 Steam Generator Tube Rupture	Emergency Diesel Generator
31	Reset safety injection --- to allow operator control of equipment	Operating practice		Engineered Safeguards

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
32	Operate the main feed-water system --- to control steam generator level	Operating practice		Main Feedwater, Steam Generator
33	Sample the reactor coolant system --- to determine boron concentration	Procedure	EP-4 Steam Generator Tube Rupture	Sampling
34	Terminate safety injection --- to allow operator control of coolant inventory	Procedure	EP-4 Steam Generator Tube Rupture	Safety Injection
35	Operate the Chemical and Volume Control System --- to establish normal letdown	Procedure	EP-4 Steam Generator Tube Rupture	Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consquences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
36	Secure auxiliary feedwater --- to place in standby mode	Operating practice		Auxiliary Feedwater System
37	Compare chemistry sample results to specifications --- to determine if boron concentration is sufficient for cold shutdown	Procedure	EP-4 Steam Operator Tube Rupture	
38	Bypass main steam isolation valve --- to reduce pressure in the faulted steam generator	Procedure	EP-4 Steam Generator Tube Rupture	Main Steam

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate possible loss of coolant inventory ------------------------ to identify plant condition	Annunciators		Reactor Coolant System, Containment Radiation Monitoring System
2	Verify loss of coolant inventory ------------------------ to identify appropriate action/procedures	Decreasing pressurizer pressure & level		Reactor Coolant System Chemical and Volume Control System, Containment
3	Secure containment sump pumps ------------------------ to prevent inadvertent radioactivity release	Procedure	EP-2 Loss of Reactor Coolant	Aerated Drain
4	Adjust turbine load setting ------------------------ to reduce turbine power	Overpower ΔT annunciator		Main Turbine, Electro-hydraulic Contol

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operation/Mitigate Consequences of an Accident

Operating Sequence: Loss of Collant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Estimate rate of coolant loss ------------------------ to determine need for manual reactor trip and safety injection	Operating practice		Cemical and Volume, Reactor Coolant System
6	Verify reactor trip ------------------------ to assure performance as expected	Procedure	EP-1 Reactor Trip	Rod Control System Nuclear Instrumentation System Rod Position Indication System
7	Initiate safety injection ------------------------ to ensure core cooling	Procedure	EP-2 Loss of Reactor Coolant	Safety Injection
8	Verify containment isolation phase one ------------------------ to assure performance as expected	Procedure	EP-2 Loss of Reactor Coolant	Containment

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Line up the main turbine after unit trip ------------------------ to ensure system is in proper shutdown configuration	Procedure	EP-1 Reactor Trip	Main Turbine, Main Lube Oil
10	Verify the steam dump control system operation ------------------------ to assure stablilized reactor coolant system temperature	Procedure	EP-1 Reactor Trip	Main Steam
11	Verify main feedwater isolation ------------------------ to assure performance as expected	Procedure	EP-2 Loss of Reactor Coolant	Feedwater
12	Verify emergency busses energized ------------------------ to assure performance as expected	Procedure	EP-2 Loss of Reactor Coolant	Switchyard Distribution

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Verify containment isolation actuation high initiation --- to assure operation as expected	CLS high pressure alarm	EP-2 Loss of Reactor Coolant	Containment, Containment Vacuum
14	Isolate pressurizer spray and relief valves --- to isolate potential cause of depressurization	Procedure	EP-2 Loss of Reactor Coolant	Pressurizer Pressure Control
15	Monitor plant indications --- to evaluate compliance with procedural documentation	Operating practice	EP-0 Immediate Actions & Diagnostic Procedures for STA EP-1 Reactor Trip EP-2 Loss of Reactor Coolant	Safety Injection System, Reactor Coolant System, Rod Control System, Main Steam System, Main Reheat Steam System, Switchyard Distribution System, Main Turbine System, Feedwater System, Containment System, Auxiliary Feedwater System,

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
15	Cont.			Engineered Safeguards
16	Monitor containment pressure and temperature ------------------------ to assure containment integrity	operating practice	EP-2 Loss of Reactor Coolant	Containment
17	Verify high high containment isolation actuation imitation ------------------------ to assure performance as expected	CLS high-high annunciator	EP-2 Loss of Reactor Coolant	Engineered Safeguards Main Steam Containment Spray
18	Monitor auxiliary feed-water system operation ------------------------ to assure sufficient cooling capacity	Procedure	EP-2 Loss of Reactor Coolant	Auxiliary Feed-water System, Steam Generator

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
19	Stop reactor coolant pumps ------------------------ to prevent damage to pumps	Reactor coolant pressure approaches 1600 psig	EP-2 Loss of Reactor Coolant	Reactor Coolant System, Chemical and Volume Control System,
20	Communicate with supervisory personnel ------------------------ to obtain assistance	Procedure	EPIP 1.01 Emergency Manager Controlling Procedure	
21	Secure secondary drain pumps ------------------------ to prevent equipment damage	Operating Practice		Low Pressure Drain, High Pressure Drain
22	Monitor safety injection ------------------------ to assure performance as expected	Procedure	EP-2 Loss of Reactor Coolant	Safety Injection

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23	Operate steam generator power operated relief valves --- to cooldown plan	Procedure	EP-2 Loss of Reactor Coolant	Main Steam, Reactor Coolant System
24	Reset high high containment isolation actuation --- to allow operator control of equipment operation	Containment pressure = 14 psia		Containment, Engineered Safeguards
25	Confirm diagnosis --- to provide independent confirmation of plant condition	Procedure	EP-0 Immediate actions and Diagnostic Procedures for the Shift Technical Advisor	Pressurizer Pressure Control, Radiation Monitoring, Containment, Reactor Coolant System,
26	Determine subcooling --- to confirm adequate core cooling	Procedure	EP-2 Loss of Reactor Coolant	Reactor Coolant System,

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
2[illegible]	Secure containment spray pumps --- to remove non-essential equipment from service	Containment pressure = 9 psia		Containment, Containment Spray
29	Reset safety injection --- to allow operator control equipment operation	Operating Practice		Safety Injection, Engineered Safeguards
30	Dispatch Plant Equipment Operator diesel generators --- to cool the diesel turbo-charger	Procedure	EP- 2 Loss of Reactor Coolant	
31	Dispatch Plant Equipment Operator to fill emergency condensate tank --- to ensure sufficient cooling water supply	Operating practice		Condensate

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
32	Shift from auxiliary feed water system to main feed water ------------------------ to ensure adequate supply of cooling water	Emergency condensate tank low		Condensate, Freedwater, Auxiliary Feedwater
33	Operate feedwater bypass valves ------------------------ to maintain steam generator level	Operating practice		Feedwater, Steam Generator
34	Manually initiate swap over of safety injection to the recirculation mode ------------------------ to assure core coverage	RWST level = 19.5%	EP-2 Loss of Reactor Coolant	
27	Declare Site Emergency status ------------------------ to inform personnel of plant conditions	Procedure	EPIP 1.01 Emergency Manager Controlling Procedure	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Test Equipment

Operating Sequence: Diesel Generator Start, Load, Run

Operating Sequence ID: 16

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Verify pre-requisite conditions for test ------------------------ to permit test to the performed safely	Procedure	PT 22.3A Emergency Diesel Generator 1 Monthly Test	Emergency Diesel Generator
2	Dispatch Plant Equipment Operator to perform compressor test and pre-operational checks ------------------------ to prepare for diesel engine test	Procedure	PT 22.3A Emergency Diesel Generator Monthly Test	
3	Start a diesel generator ------------------------ to test equipment operability	Procedure	OP 6.1 1 Emergency Diesel Generator	Emergency Diesel Generator
4	Load the diesel generator ------------------------ to test equipment operability	Procedure	OP 6.1 1 Emergency Diesel Generator	Emergency Diesel Generator

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Test Equipment

Operating Sequence: Diesel Generator Start, Load, Run

Operating Sequence ID: 16

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Dispatch Plant Equipment Operator to monitor the diesel and record test data ------------------------ to obtain information on Diesel Performance	Procedure	OP 6.1 Emergency Diesel Generator	
6	Fill out logs ------------------------ to comply with administrative procedures	Procedure	PT 22.3A Emergency Diesel Generator 1 Monthly Test	
7	Unload the diesel generator ------------------------ to prepare for engine shutdown	Procedure	PT 22.3A 1 Emergency Diesel Generator Monthly Test	Emergency Diesel Generator
8	Shutdown the diesel generator ------------------------ to remove unnecessary equipment from service	Procedure	PT 22.3A Emergency Diesel Generator Monthly Test	Emergency Diesel Generator

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Test Equipment

Operating Sequence: Diesel Generator Start, Load, Run

Operating Sequence ID: 16

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Line up diesel generator for automatic start ------------------------ to place in standby condition	Procedure	PT 22.3A Emergency Diesel Generator 1 Monthly Test	Emergency Diesel Generator

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Implement

Operating Sequence: Maintain Auxiliary Feedwater Pump

Operating Sequence ID: 19

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Authorize maintenance of auxiliary feedwater pump ------------------------ to initiate maintenance	Receipt of work order for mainten-ance		
2	Prepare tag-out for motor drive auxiliary feedwater pump ------------------------ to prevent equipment damage during maintenance	Order from shift super-visor		
3	Isolate motor driven auxiliary feedwater pump ------------------------ to perform maintenance	Procedure	MOP 31.5 Removal of Safety Related Pump	Auxiliary Feedwater System
4	Dispatch maintenance section to perform main-tenance on auxiliary pump ------------------------ to repair pump	Operating practice		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Implement Maintenance

Operating Sequence: Maintain Auxiliary Feedwater Pump

Operating Sequence ID: 19

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Dispatch an operator to return pump to service and perform periodic test ------------------------ to return system to normal standby configuration	Procedure	MOP 31.4 Return to Service of Safety Related Pump	
6	Monitor progress of operator's actions ------------------------ to determine need for contingency plans	Operating practice		
7	Start the auxiliary feedwater pump ------------------------ to test pump operability	Procedure	MOP 31.4 Return to Service of Safety Related Pump	Auxiliary feedwater
8	Shutdown the auxiliary feedwater pump ------------------------ to test pump operability	Procedure	MOP 31.4 Return to Service of Safety-Related Pump	Auxiliary feedwater

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Implement Maintenance

Operating Sequence: Maintain Auxiliary Feedwater Pump

Operating Sequence ID: 19

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Inform supervisory personnel ------------------------ to comply with adminis-trative procedures	Procedure	ADM-29 Conduct of Operations	
10	Review test data ------------------------ to determine if test re-sults are satisfactory	Procedure	ADM-29 Conduct of Operations	
11	Fill out logs ------------------------ to comply with administra-tive procedures	Procedure	ADM-29 Conduct of Operations	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Maintain Plant Systems & Equipment/Improve Equipment

Operating Sequence: Charge SRM Recorder Paper

Operating Sequence ID: 21

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Remove paper roll from recorder ------------------------ to assure equipment operability	NR-45 Recorder paper is at end of roll		Nuclear Instrumentation System
2	Dispatch Recorder Operator to obtain new paper ------------------------ to assure equipment operability	Operating Practice		
3	Place paper roll in recorder ------------------------ to assure equipment operability	Operating Practice		Nuclear Instrumentation System
4	Record identifying information ------------------------ to provide identification of used paper roll	Procedure	ADM-29 Conduct of Operations	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: _ordinate Plant Support Activities/Administration-Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Inspect the radiation monitoring system ------------------------ to determine cause of alarm	Radiation monitoring annunciator	AP-5.1 Radiation Monitoring System Process Vent Particulate & Gaseous Monitor	Radiation Monitoring System
2	Verify automatic function ------------------------ to assure performance as expected	Procedure	AP-5.1 Radiation Monitoring System Process Vent Particulate & Gaseous Monitor	
3	Isolate vents from radio-active waste systems ------------------------ to identify sources of high radioactivity	Procedure	AP-5.1 Radiation Monitoring System Process Vent Particulate & Gaseous Monitor	Component Cool-ing Gaseous Waste
4	Secure containment va-cuum pumps ------------------------ to prevent equipment damage	Procedure	AP-5.1 Radiation Monitoring System Process Vent Particulate & Gaseous Monitor	

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Coordinate Plant Support Activities/Adminstration - Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Dispatch shift personnel to control room --- to obtain assistance	Operating practice		
6	Evaluate overhead gas system --- to determine cause of release	Procedure	AP-5.1 Radiation Monitoring System Process Vent Particulate & Gaseous Monitor	Overhead Gas
7	Dispatch Plant Equipment Operator to adjust relief valve --- to terminate release	Diagnosis indicates malfunction of relief valve		Overhead Gas
8	Review procedural documentation --- to assure required actions are completed	Operating practice		

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Coorinate Plant Support Activities/Administration - Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Secure degas operation --- to reduce radioactivity release	Operating practice		Chemical and Volume Control System
10	Delcare unusual event --- to initiate appropriate procedure	Procedure	EPIP-1.01 Emergency Manager Controlling Procedure	
11	Communicate with Health Physics team --- to provide information	Procedure	EPIP-1.01 Emergency Manager Controlling Procedure	
12	Monitor the radiation monitoring system --- to evaluate radioactivity release	Procedure	AP-5.1 Radiation Monitoring System Process Vent Part-iculate & Gaseous Monitor	Radiation Monitoring System

TASK SEQUENCE CHART

Plant: 39

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration - Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Communicate with supervisory personnel ------------------------ to provide information	Procedure	EPIP 1.01 Emergency Manager Controlling Procedure	
14	Notify off-site agencies ------------------------ to coordinate emergency operations	Procedure	EPIP 1.02	
15	Obtain meterological data ------------------------ to compute boundary dose	Procedure	EPIP 1.02	
16	Terminate unusual event status ------------------------ to return to normal administrative and communication status	Procedure	EPIP 1.02	

3. PLANT 98

The data contained in this section are:

- Plant description (page 3-1)
- Panel layouts and designators (page 3-2)
- System nomenclature and numbering (page 3-5)
- Operating Sequence Overviews (page 3-7)
- Task Sequence Charts (page 3-17)

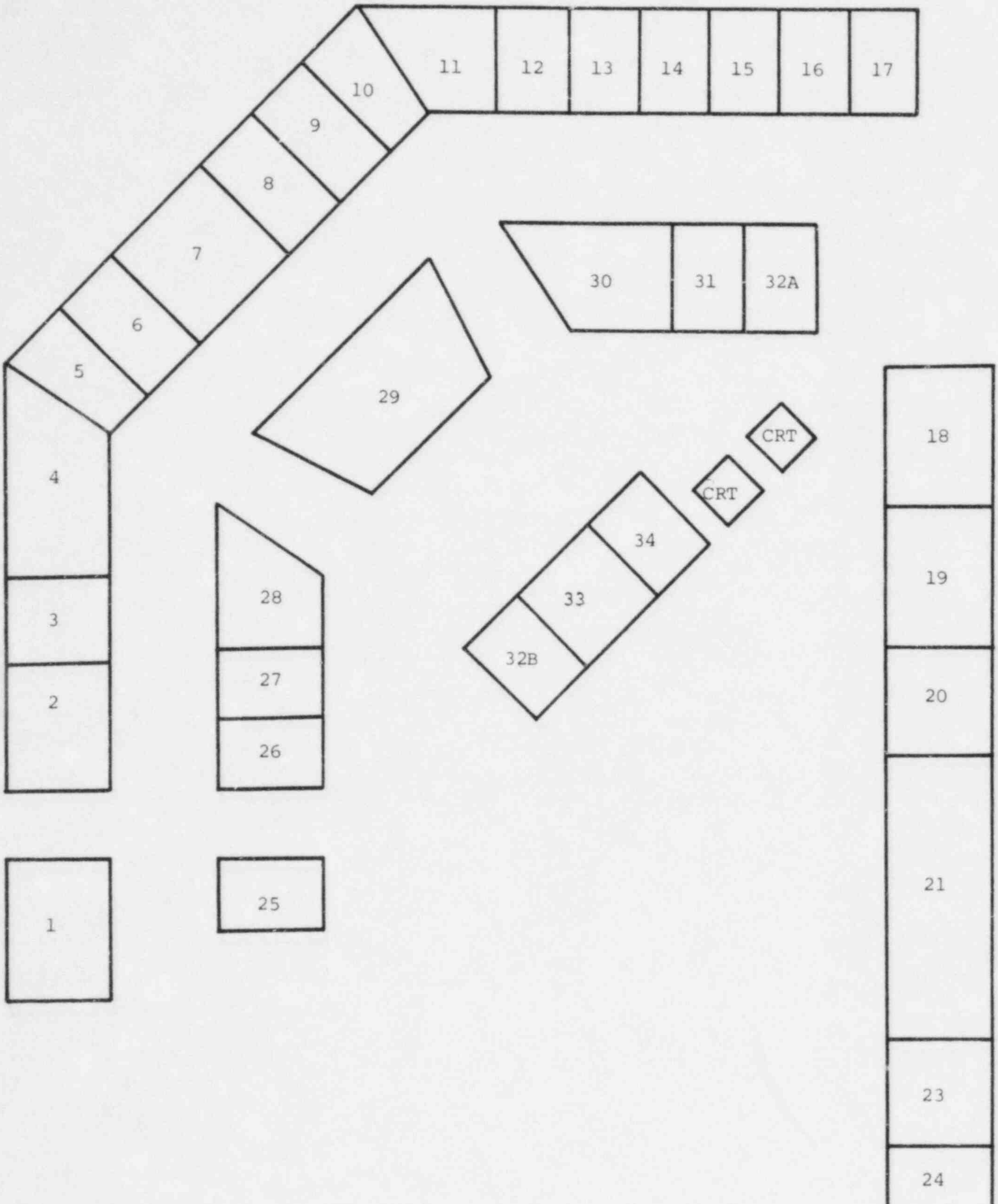
The following operating sequences were observed at Plant 98:

- 1 Increase Generator Output
- 3 Change Steam Supply (SJAE)
- 8 Reactor Vessel Level Control System Malfunction
- 20 Station Blackout
- 21 Change SRM Chart Recorder Paper
- 23 Bomb Threat
- 24 High Radiation Effluent

Plant 98, Unit 1 is a General Electric boiling water reactor with a General Electric turbine-generator. The architect-engineer is Bechtel. The plant is under construction with licensing estimated for 1985. The control room is a single-unit control room. The data were collected at the Unit 1 simulator.

Plant 98 Panel/System	Number Assigned
Process Radiation Monitoring	1
Feedwater Heat Cycle & Reactor Feedpump Turbine Test	2
Condensate System	3
Turbine-Generator Supervisory	4
Nuclear Steam System Temperature Recording & Leak Test	5
Traversing In-Core Probe	6
Control Rod Display	7
Area & Process Radiation Recorders	8
Main Steam Isolation Valve Leak Control	9
Automatic Depressurization & Relief Valves	10
2A Core Spray	11
2A Residual Heat Removal	12
Containment Control Panel	13
2B Core Spray	14
2B Residual Heat Removal	15
Reactor Core Isolation Cooling	16
High Pressure Core Injection	17
Diesel Generators Safeguards System	18
Plant Electrical Metering	19
Unit 1 Generator & Auxiliary Power	20
ESW Control & Electrical Power	21
Unit 1 Recombiner	23
Off Gas	24
HVAC	25
Feedwater System	26

Plant 98 Panel/System	Number Assigned
Condensate System	27
Main Turbine & Electro-Hydraulic Control	28
Reactor Control Console • Nuclear Instrumentation • Control Rod Drive System • Reactor Level Control • Reactor Water Makeup	29
Reactor Recirculation • Reactor Pressure Vessel • Reactor Water Clean-up • Sumps	30
Plant Service	31
Heating & Ventilation	32A
Operator Computer Peripheral	32B
Operator's Computer Console	33
Operator Computer Console & Desk	34



Plant 98 Simulator Layout

Plant 98 System Name	ABBR.	INPO System Number and Name
AC electrical distribution	ACED	62. AC electrical distribution system
Average power range monitoring	APRM	15. Nuclear instrumentation
Circulating water	---	75. Circulating water system
Condensate system	---	56. Condensate system
Condenser air removal	---	55. Condenser air removal system
Containment	---	103. Containment system
Control rod drive system	CRD	93. Control rod drive system
Emergency diesel generator	DG	64. Emergency diesel generator system
Emergency service water	---	113. Emergency service water system
Feedwater	FW	94. Reactor feedwater system
High pressure coolant injection	HPCI	97. High pressure coolant injection system
Intermediate range monitoring	IRM	15. Nuclear instrumentation
Main steam	MS	105. Main steam system
Off-gas	---	111. Off-gas system
Process radiation monitoring	---	73. Process radiation monitoring system
Reactor core isolation cooling	RCIC	97. High pressure (feedwater) coolant injection system
Reactor enclosure cooling water	---	76. Service water system (closed cycle cooling heat sink)
Reactor manual control system	RMCS	93. Control rod drive system
Reactor protection system	RPS	12. Reactor protection system
Reactor vessel	---	
Recirculation system	---	96. Recirculation system
Residual heat removal	RHR	5. Residual heat removal system

Plant 98 System Name	ABBR.	INPO System Number and Name
RHR service water	--	113. Emergency service water (high pressure service water) system
Rod position indication system	RPIS	14. Rod position indication system
Source range monitoring	SRM	15. Nuclear instrumentation
Standby liquid control	--	102. Standby liquid control system
Turbine auxiliaries	--	49. Reactor/turbine pressure regulating system 47. Main turbine generator lube oil system
Turbine-generator	--	45. Main turbine-generator

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: GE/BWR

Operating Sequence ID: 01

CR Type: Multiple

Operating Sequence: Increase Generator Output

Initial Conditions: The plant is at 75% power after completing main steam isolation valve closure test. Recirculation flow control is in manual.

Sequence Initiator: Main steam isolation valve closure test completed.

Progression of Action: Since power can be increased at a rate of 10 MWe/minute following this test, the crew raises reactor power by increasing recirculation flow. All associated plant functions are normal. The Reactor Operator uses the plant computer to monitor changes in core thermal performance.

Final Conditions: The plant is at 100% power. Recirculation flow is increased.

Major Systems: Recirculation, Plant Computer

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: GE/BWR

Operating Sequence ID: 03

CR Type: Single

Operating Sequence: Change Steam Supply (SJAE)

Initial Conditions: The plant is being heated up. Reactor pressure has reached 150 psig. The auxiliary steam system is supplying steam to the steam jet air ejectors.

Sequence Initiator: Steam pressure reaches 150 psig.

Progression of Action: When steam pressure reaches 150 psig, the crew opens the main steam supply to the steam jet air ejectors and directs a Plant Equipment Operator to close the auxiliary boiler supply. The main steam system line-up is verified and heat up continues.

Final Conditions: The plant is being heated up. The main steam system is supplying steam to the steam jet air ejectors.

Major Systems: Condenser, Main Steam (MS)

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to Safe Condition

NSSS/Type: GE/BWR

Operating Sequence ID: 08

CR Type: Single

Operating Sequence: Reactor Vessel Level Control System Malfunction

Initial Conditions: The plant has been operating at full power for two weeks with a normal full power line-up.

Sequence Initiator: Upscale failure of reactor vessel level channel A results in reduced feedwater flow accompanied by an incorrect reactor vessel high level alarm.

Progression of Action: The crew notes the discrepancy between the high level alarm and low reactor level and feedwater flow. To prevent a reactor scram, the crew attempts to manually restore feedwater flow. Although feedwater flow is quickly increased, level drops below 12.5 inches and a reactor scram occurs. The immediate actions required by a reactor scram are performed. The crew observes automatic transfer of station loads to off-site power. Level is restored before high pressure coolant injection and reactor core isolation cooling activate. The crew continues with a controlled shutdown of the plant.

Final Conditions: The plant is in a hot shutdown condition as per Technical Specifications. Reactor vessel level is being maintained at 32 inches.

Major Systems: Reactor Vessel, Feedwater (FW), Feedwater Control, AC Electrical Distribution (ACED), Reactor Protection System (RPS), Rod Position Indication System (RPIS), Turbine-Generator, Source Range Monitoring (SRM), Intermediate Range Monitoring (IRM), Turbine Bypass, Circulating Water, Condensate, Control Rod Drive (CRD), Average Power Range Monitoring (APRM).

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: GE/BWR

Operating Sequence ID: 10

CR Type: Multiple

Operating Sequence: Station Blackout

Initial Conditions: The plant is at full power with a normal plant line-up. Unit 2 is shut down for refueling.

Sequence Initiator: Total loss of off-site power.

Progression of Action: The operating crew verifies turbine trip and subsequent reactor scram. The crew verifies loss of off-site power by noting inoperative equipment and containment isolation. With a decrease in reactor level, an operator verifies automatic start of high pressure coolant injection and reactor core isolation cooling. Ten seconds into the sequence, the crew observes that the diesel generators have not started. Manually starting the diesels from the control room is unsuccessful.

The crew maintains stable plant conditions by throttling high pressure coolant injection and reactor core isolation cooling to maintain vessel level. During this time, the crew evaluates system status and plant conditions.

Seven minutes into the incident, all diesels are started locally and critical loads are restored. the crew verifies that all safety equipment has started and places RHR in the suppression pool cooling mode.

Final Conditions: The plant is in a stable condition; emergency equipment is available and the plant is ready to commence cooldown to cold shutdown. Off-site power has not been restored.

Major Systems: Diesel Generators (DG), High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Main Steam System (MS), Reactor Protection System (RPIS), and Residual Heat Removal System (RHR).

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: GE/BWR

Operating Sequence ID: 11

CR Type: Multiple

Operating Sequence: Anticipated Transient Without SCRAM

Initial Conditions: The plant is at 90% power with a normal system line-up

Sequence Initiator: Turbine trip

Progression of Action: The crew acknowledges annunciators and attempts to verify reactor scram. When the reactor does not scram, an operator generates additional scram signals. When the reactor still has not scrammed, an operator attempts to insert the control rods manually. This initiates a partial shutdown of the reactor. Reactor power is reduced to approximately 30%. The reactor is shut down by operation of the standby liquid control system.

When the attempts to generate additional scram signals are unsuccessful the shift supervisor declares a Site Emergency and plant personnel are notified.

Reactor pressure is controlled through manual operation of the relief valves. Reactor vessel level is maintained by high pressure coolant injection and reactor core isolation cooling. Suppression pool cooling is placed in service to maintain containment integrity and drywell cooling is re-established.

Final Conditions: Reactor power is decreasing through the intermediate range; high pressure coolant injection and reactor core isolation cooling are maintaining level; full control rod insertion is not yet completed.

Major Systems: Reactor Protection System (RPS), Reactor Manual Control System (RMCS), Rod Position Indication (RPIS), Diesel Generator (DG), Main Steam (MS), Reactor Vessel, High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Residual Heat Removal (RHR), Residual Heat Removal Service Water, Standby Liquid Control.

Operating Sequence Overview

Plant: 98

Operating Function/Subfunction: Maintain Plant Systems and Equipment/Test Equipment

NSSS/Type: GE/BWR

Operating Sequence ID: 17

CR Type: Multiple

Operating Sequence: MSIV Closure Exercise

Initial Conditions: The plant is operating at 75% power and all plant conditions have been satisfied in accordance with the surveillance test.

Sequence Initiator: Surveillance requirement

Progression of Action: In order to meet Technical Specificiation requirement 4.4.7, the crew verifies main steam isolation valve closure time by performing a full slow closure test. Test results are satisfactory.

Final Conditions: The plant is returned to its original operating condition.

Major Systems: Main Steam (MS).

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

NSSS/Type: GE/BWR

Operating Sequence ID: 20

CR Type: Multiple

Operating Sequence: Maintain Emergency Bus Tie-Breaker

Initial Conditions: The plant is at power with a normal line-up. An emergency bus breaker is out of service.

Sequence Initiator: Maintenance order for affected breaker.

Progression of Action: Upon receipt of the maintenance order, the Shift Supervisor directs the Senior Reactor Operator to prepare a tag out for the breaker and prepare for maintenance. In prepareation for maintenance, a surveillance test of the diesel generator is performed, to verify diesel generator operability. Test results are satisfactory and the Shift Supervisor authorizes maintenance on the breaker. Danger tags are hung on the breaker and maintenance is performed. Upon completion of maintenance, danger tags are removed. An operability test is performed on the affected breaker and test results are satisfactory.

Final Conditions: The plant is at power with a normal line-up.

Major Systems: AC Electrical Distribution (ACED), Diesel Generator (DG)

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Improve Equipment

NSSS/Type: GE/BWR

Operating Sequence ID: 21

CR Type: Multiple

Operating Sequence: Change SRM Recorder Paper

Initial Conditions: The plant is in a shutdown condition.

Sequence Initiator: Recorder has no blank paper.

Progression of Action: An operator changes recorder paper when blank paper is gone. He removes all paper from the recorder and replaces it with new paper. The old paper is forwarded to Station Records.

Final Conditions: The plant is in a shutdown condition.

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Plant Security

NSSS/Type: GE/BWR

Operating Sequence ID: 23

CR Type: Multiple

Operating Sequence: Bomb Threat

Initial Conditions: The plant is at full power with a normal line-up and crew complement.

Sequence Initiator: A bomb threat is received by telephone in the control room. The caller states that an explosive device has been hidden on-site.

Progression of Action: The Shift Supervisor interrogates the caller in an effort to learn more about the nature of the threat. Plant Security and the Station Manager are notified. The Shift Supervisor declares a Site Emergency and appropriate emergency response actions are initiated.

Final Conditions: Unnecessary site personnel are being evacuated; Plant Security is conducting a search for the explosive device.

Operating Sequence Overview

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

NSSS/Type: GE/BWR

Operating Sequence ID: 24

CR Type: Multiple

Operating Sequence: High Radiation Effluent

Initial Conditions: The plant is operating at 90% power during a power ascension following a refueling outage. A Reactor Operator and Senior Reactor Operator are on duty in the middle of the shift.

Sequence Initiator: Off-gas pre-treatment high radiation alarm.

Progression of Action: A problem is detected in the off-gas system; the Health Physics department is requested to perform an isotopic analysis. The Reactor Operator reduces power in an effort to bring activity below the alarm setpoint. The Load Dispatcher is informed of power decrease and the Shift Technical Advisor is requested to calculate the release. With activity continuing to rise, an accelerated shutdown is planned and the appropriate actions taken. When a main steam line high radiation alarm is received a manual scram is initiated. Following the scram, hydraulic control unit leakage leads to increasing reactor building airborne radiation alarms. The Senior Reactor Operator declares a site emergency and evacuates the reactor building.

Final Conditions: A rapid shutdown is in progress, alert activities (Emergency Plan) are in progress.

Major Systems: Off-gas system, Process and Area Radiation Monitoring systems, Control Rod Drive Hydraulics.

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Increase Generator Output

Operating Sequence ID: 01

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Monitor generator output To verify that power change does not exceed administrative limits	Planned power increase		Generator
2	Communicate with Load Dispatcher To allow coordination of power grid	Operating practice		
3	Operate the plant computer To monitor core thermal performance	Planned power increase		Plant Computer
4	Operate the recirculation system To increase reactor power	Procedure		Recirculation
5	Monitor rod blocks To ensure that rod block setpoints are not exceeded	Power increase		Rod Block
6	Fill out logs To document plant condition	Operating practice		

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Increase Generator Output

Operating Sequence ID: 01

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7	Monitor reactor power To verify anticipated reactor response	Operating practice		Average Power Range Monitoring
8	Return generator voltage regulator to balanced condition To return equipment to normal operating condition	Annunciator		Generator
9	Monitor plant parameters To ensure performance as expected	Operating practice		Main Stream, Feedwater
10	Monitor turbine-generator indications To verify anticipated turbine response	Operating practice		Turbine-Generator
11	Set up rod blocks To allow rod motion	Power increase		Rod Block Monitoring
12	Inform supervisory personnel To report plant condition	Operating practice		

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Change Steam Supply (SJAE)

Operating Sequence ID: 03

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Open main steam valves to air ejectors To place system in normal line-up	Steam pressure = 150 psig.	GP-2 Plant start-up	Main Steam, Condenser Air Removal
2	Dispatch Plant Equipment Operator to close auxiliary steam supply valves to air ejectors To reduce load in auxiliary steam system	Main steam valves open	GP-2 Plant start-up	
3	Monitor turbine bypass valve position To verify automatic actions	Procedure	GP-2 Plant start-up	Reactor/Turbine Pressure Regulating
4	Monitor steam jet air ejector steam pressure To assure performance as expected	Main steam being supplied to SJAE	GP-2 Plant start-up	Main Steam
5	Verify condenser air removal system line-up To ensure proper line-up	Operating practice	GP-2 Plant start-up	Main Steam, Condenser Air Removal

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate a level control malfunction To identify plant condition	Annunciator		
2	Operate feedwater system To restore vessel level	Inadequate feed flow indications	OT-5 Reactor Low Water Level	Feedwater, Feedwater Control
3	Monitor reactor level and pressure To assure adequate core coverage	Procedure	OT-1 Scram with-out Group 1 Isolation	Reactor Vessel
4	Verify reactor scram To assure automatic reactivity insertion	Procedure	OT-1 Scram with-out Group 1 Isolation	Reactor Protection
5	Verify turbine-generator trip To assure performance as expected	Procedure	OT-1 Scram with-out Group 1 Isolation	Turbine-Generator
6	Monitor reactor plant parameters To assure performance as expected	Operating practice		

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7	Insert source range and intermediate range monitors --- To monitor reactor power	Procedure	OT-1 Scram without Group 1 Isolation	Source Range Monitoring, Intermediate Range Monitoring
8	Operate nuclear instrumentation system --- To maintain monitoring ability	Procedure	OT-1 Scram without Group 1 Isolation	Nuclear Instrumentation
9	Monitor reactor power and period --- To ensure 80 second period and subsequent leveling of power in source range	Procedure	OT-1 Scram without Group 1 Isolation	Source Range Monitoring, Intermediate Range Monitoring
10	Review pertinent procedures --- To identify appropriate follow-up actions	Operating practice	OT-1 Scram without Group 1 Isolation OT-5 Reactor Low Water Level	
11	Verify transfer to off-site power --- To ensure automatic actions occur as expected	Annunciator	OT-1 Scram without Group 1 Isolation	

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12	Shut down feed and condensate pumps --- To reduce capacity of condensate feed system	Procedure	OT-1 Scram without Group 1 Isolation	Condensate, Feedwater
13	Examine high pressure coolant injection/reactor core isolation cooling indications --- To verify that high pressure coolant injection/reactor core isolation cooling have not initiated	Procedure	OT-1 Scram without Group 1 Isolation	High Pressure Coolant Injection, Reactor Core Injection Cooling
14	Shutdown two circulating water pumps --- To remove non-essential equipment from service	Procedure	OT-1 Scram without Group 1 Isolation	Circulating Water
15	Reset Scram --- To reduce uncontrolled cooldown	Annunciator	OT-1 Scram without Group 1 Isolation	Reactor Protection System

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that the cues indicate a loss of off-site power ------------------------- to identify plant condition	Darkness		
2	Verify reactor scram ------------------------- to assure performance as expected	Procedure	OT-2 Reactor Scram with Group 1 isolation	Reactor Protection
3	Verify turbine-generator trip ------------------------- to assure performance as expected	Procedure	OT-2 Reactor Scram with Group 1 isolation	Turbine-generator
4	Monitor vessel pressure and level ------------------------- to assure that pressure and level stay within normal operating limits	Procedure	OT-2 Reactor Scram with Group 1 isolation	Reactor Vessel
5	Manually start diesel generators ------------------------- to restore vital loads	Failure of diesel to activate	E-2 Station Blackout, Loss of all AC Power	Diesel Generator
6	Verify automatic start of high pressure coolant injection ------------------------- to assure performance as expected	Decreasing level	OT-2 Scram with Group 1 Isolation	High Pressure Coolant Injection

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7	Review pertinent procedures --- to verify immediate actions and identify follow-up actions	Completion of immediate actions	E-1 E-2 Station Blackout	
8	Verify automatic start of reactor core isolation cooling --- to assure performance as expected	Decreasing level	OT-2 Scram with Group 1 Isolation	Reactor Core Isolation Cooling
9	Verify main steam isolation valve closure --- to verify main steam isolation	Procedure	OT-2 Scram with Group 1 Isolation	Main Steam
10	Communicate with load dispatcher --- to restore off-site power	Procedure	E-2 Station Blackout	
11	Manually control high pressure coolant injection and reactor core isolation cooling --- to maintain level	Increasing level	OT-2 Scram with Group 1 Isolation	High Pressure Coolant Injection Reactor Core Isolation Cooling

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12	Align control board control devices ------------------------- to return control to position consistent with operating state	Operating practice		
13	Examine DC lube oil pump indications ------------------------- to verify equipment availability	Procedure	E-2 Station Blackout	Feedwater, Turbine Generator, Recirculation, Seal Oil
14	Examine instrumentation ------------------------- to verify instrumentation operability	Operating practice		
15	Dispatch Plant Equipment Operator to start diesel generators locally ------------------------- to restore vital loads	Inability to start diesels from control room	E-2 Station Blackout	
16	Monitor drywell pressure ------------------------- To verify loss of coolant accident conditions do not exist	Operating practice		Containment

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
17	Secure high pressure coolant injection ------------------------- to bring level within procedural guidelines	Level > 10 in. and rising	OT-2 Scram with Group 1 Isolation	High Pressure Coolant Injection
18	Secure reactor core isolation coolin" ------------------------- to bring level within procedural guidelines	Increasing level	OT-2 Scram with Group 1 Isolation	Reactor Core Insulation Cooling
19	Reset diesel generator circuit breakers ------------------------- to respond to diesel generator activation	Procedure	E-2 Station Blackout	
20	Examine system indications ------------------------- to verify restoration of vital loads	Procedure	E-2 Station Blackout	
21	Examine electrical distribution board indications ------------------------- to verify restoration of emergency power	Diesel generator "on" alarm		AC Electrical Distribution Diesel Generator

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22	Reset the scram ------------------------ to reduce uncontrolled cooldown	Procedure	OT-2 Scram with Group 1 Isolation	Reactor Protection System
23	Restart reactor core isolation cooling ------------------------ to permit level control	Changing level	OT-2 Scram with Group 1 Isolation	Reactor Core Isolation Cooling
24	Place suppression pool cooling in service ------------------------ to maintain containment integrity	Procedure	E-2 Station Blackout	Residual Heat Removal, RHR Service Water
25	Insert source range and intermediate range monitors ------------------------ to monitor reactor power	Procedure	OT-2 Scram with Group 1 Isolation	Source Range Monitoring, Intermediate Range Monitoring
26	Start turbine bearing oil lift pumps ------------------------ to prevent damage to turbine during coastdown	Procedure	E-2 Station Blackout	Main Turbine Lube Oil System

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
27	Re-establish drywell cooling ------------------------ to limit drywell pressure increase	Drywell pressure & temperature increasing		Containment
28	Monitor containment radiation levels ------------------------ to ensure radiation levels do not exceed operating limits	Operating practice		Process Radiation Monitoring

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate turbine trip ------------------------ to identify plant condition	Annunciators		
2	Recognize that cues indicate that reactor did not scram ------------------------ to identify plant condition	Scram signal		Rod Control
3	Verify that reactor did not scram ------------------------ to identify appropriate follow-up actions	CRT indication		Rod Control
4	Manually scram reactor ------------------------ to generate reactor scram signal	Procedure	OT-2 Scram with Group 1 Insertion	Reactor Protection System
5	Align control board control devices ------------------------ to return control to position consistent with operating state	Operating practice		Instrumentation

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Communicate with Load Dispatcher ------------------------- to allow coordination of power grid	Operating practice		
7	Dispatch Plant Equipment Operator to bypass the rod sequence control system ------------------------- to permit manual insertion of rods	Procedure	OT-2 Scram with Group 1 Insertion	Rod Sequence Control System
8	Dispatch Plant Equipment Operator to trip the reactor locally ------------------------- to cause rod insertion	Procedure	OT-2 Scram with Group 1 Insertion	Reactor Protection System
9	Place mode switch in shutdown ------------------------- to generate reactor scram signal	Procedure	OT-2 Scram with Group 1 Insertion	Reactor Protection System
10	Verify automatic start of high pressure coolant injection ------------------------- to assure performance as expected	Operating practice		High Pressure Coolant Injection

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Verify automatic start of reactor core isolation cooling ------------------------- to assure performance as expected	Operating practice		High Pressure Coolant Injection
12	Manually insert control rods ------------------------- to shut down the reactor	Failure of reactor to scram	OT-2 Scram with Group 1 Insertion	Rod Control
13	Manually operate relief valves ------------------------- to limit reactor pressure	Power oscillation	OT-2 Scram with Group 1 Insertion	Main Steam
14	Place suppression pool cooling in service ------------------------- to maintain containment integrity	Procedure	OT-2 Scram with Group 1 Insertion	Residual Heat Removal
15	Monitor vessel pressure and level ------------------------- to ensure that pressure and level limits are not exceeded	Operating practice		Reactor Vessel

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Operate standby liquid control system ------------------------- to reduce reactor power	Failure of complete scram	OT-2 Scram with Group 1 Insertion	Standby Liquid Control System
I7	Declare Site Emergency status ------------------------- to initiate notification procedures	Operating practice		
18	Monitor high pressure coolant injection and reactor core isolation cooling ------------------------- to assure parameters remain within operations limits	Operating practice		High Pressure Coolant Injection, Reactor Core Isolation Cooling
19	Re-establish drywell cooling ------------------------- to limit drywell pressure increase	Procedure	OT-2 Scram with Group 1 Insertion	Reactor Equipment Cooling Water
20	Insert source range and intermediate range monitors ------------------------- to monitor reactor power	Decreasing reactor power	OT-2 Scram with Group 1 Insertion	Source Range Monitoring, Intermediate Range Monitoring

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
21	Trip the feed pump turbines --- to remove non-essential equipment from service	Procedure	OT-2 Scram with Group 1 Insertion	Feedwater System
22	Verify diesel generator start --- to ensure power supply to vital loads	LOCA alarm	OT-2 Scram with Group 1 Insertion	Diesel Generator
23	Re-set control rod drive pump --- to permit continued rod insertion	Inability to insert rods		Control Rod Drive System
24	Operate nuclear instrumentation --- to maintain monitoring ability	Procedure	OT-2 Scram with Group 1 Insertion	Intermediate Range Monitoring
25	Dispatch Plant Equipment Operator to bypass the 2 psig isolation setpoint for drywell --- to restore equipment availability	Procedure	OT-2 Scram with Group 1 Insertion	

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient without a Scram

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
26	Manually operate high pressure coolant injection --- to maintain level	Procedure		High Pressure Coolant Injection

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: MSIV Closure Exercise

Operating Sequence ID: 17

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Authorize test performance ------------------------ to initiate surveillance test	Procedure	(Procedure unavailable)	
2	Determine rod block margins ------------------------ to ensure reactor does not scram during surveillance test	Operating practice		Rod Block Monitoring
3	Communicate with Load Dispatcher ------------------------ to allow coordination of power grid	Operating practice		
4	Initiate main steam isolation valve closure test ------------------------ to allow test to be performed	Procedure	(Procedure unavailable)	
5	Monitor reactor power ------------------------ to ensure that pressure spikes do not cause reactor to scram	Operating practice		Average Power Range Monitoring

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: MSIV Closure Exercise

Operating Sequence ID: 17

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Measure valve closure time -------------------------- to ensure that closure time is within technical specifications	Procedure	(Procedure unavailable)	Main Steam
7	Setup rod blocks -------------------------- to allow rod motion	Annunciator		Rod Block Monitoring
8	Reset generator voltage regulator in balance alarm -------------------------- to allow subsequent alarms to be received	Annunciator		Generator
9	Review test data -------------------------- to comply with procedure	Procedure	(Procedure unavailable)	

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Emergency Bus Tie-Breaker

Operating Sequence ID: 20

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Authorize maintenance on emergency bus tie-breaker ------------------------- to allow maintenance to be performed	Maintenance order	(Procedure unavailable)	
2	Prepare tagout for emergency bus tie-breaker ------------------------- to prevent equipment damage during maintenance	Order from SS	(Procedure unavailable)	
3	Start and synchronize an emergency diesel generator ------------------------- to perform surveillance test prior to maintenance	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution
4	Adjust emergency diesel generator speed and voltage ------------------------- to perform surveillance test prior to maintenance	Procedure	(Procedure unavailable)	Diesel Generator

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Emergency Bus Tie-Breaker

Operating Sequence ID: 20

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Unload and shutdown an emergency diesel generator -------------------------- to return diesel generator to normal operating status following surveillance test	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution
6	Place (permit) tags -------------------------- to ensure personnel safety	Procedure	(Procedure unavailable)	
7	Dispatch maintenance department -------------------------- to perform maintenance on breaker	Breaker racked out		
8	Remove permit tags -------------------------- to return equipment to service	Maintenance complete	(Procedure unavailable)	
9	Start and load diesel generator -------------------------- to perform breaker operability test following maintenance	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Emergency Bus Tie-Breaker

Operating Sequence ID: 20

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
10	Synchronize and close in alternate bus supply ------------------------ to perform breaker operability test following maintenance	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution
11	Shift load from diesel generator to alternate bus supply ------------------------ to perform breaker operability test following maintenance	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution
12	Synchronize and load diesel generator ------------------------ to return equipment to normal configuration following operational test	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution
13	Synchronize and close in normal bus supply ------------------------ to return equipment to normal configuration following operational test	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Emergency Bus Tie-Breaker

Operating Sequence ID: 20

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
14	Unload and shutdown diesel generator --------------------------- to return equipment to normal configuration following operation test	Procedure	(Procedure unavailable)	Diesel Generator, AC Electrical Distribution

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Improve Equipment

Operating Sequence: Change Chart Recorder Paper

Operating Sequence ID: 21

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Remove paper from recorder ------------------------- to ensure equipment operability	Chart recorder paper at end of roll		
2.	Dispatch an operator to obtain new paper ------------------------- to ensure equipment operability	Operating practice		
3.	Place paper in recorder ------------------------- to ensure equipment operability	Operating practice		

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Plant Security

Operating Sequence: Bomb Threat

Operating Sequence ID: 23

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Interrogate caller ------------------------ to learn more about threat	Phone call	Bomb threat	
2.	Inform control room personnel ------------------------ to obtain assistance	Operating practice		
3.	Notify Plant Security ------------------------ to obtain assistance	Procedure	Bomb threat	
4.	Communicate with Load Dispatcher ------------------------ to allow coordination of power grid	Operating practice		
5.	Plant appropriate actions ------------------------ to initiate response to threat	Procedure	Bomb threat	
6.	Declare Site Emergency ------------------------ to initiate appropriate on-site response	Procedure	Bomb threat	
7.	Inform supervisory personnel ------------------------ to report plant condition	Procedure	Bomb threat	

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Recognize that the cues indicate a possible fuel failure --- to identify plant condition	Off-gas high radiation alarm		Off-gas
2.	Operate the recirculation system --- to reduce reactor power	Off-gas radioactivity	OT-32 High Radiation Air Ejector Discharge	Recirculation
3.	Inform supervisory personnel --- to obtain assistance	Rise in off-gas radioactivity		
4.	Examine process radiation monitoring indications --- to determine if power reduction decreases radioactivity	Procedure	OT-32 High Radiation Air Ejector Discharge	Process Radiation Monitoring
5.	Communicate with Load Dispatcher --- to allow coordination of power grid	Decreasing power		
6.	Monitor rod blocks --- to ensure rod block setpoints are not exceeded	Operating practice		Rod Block Monitoring

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7.	Return generator voltage regulator to balanced condition ------------------------ to return equipment to normal operating condition	Annunciator		Generator
8.	Review pertinent procedures ------------------------ to identify appropriate actions	Operating practice	OT-2 High Radiation Air Ejector Discharge; GP-3 Normal Shutdown	
9.	Dispatch I&C ------------------------ to uprange chart recorder	Operating practice		
10.	Manually insert control rods ------------------------ to reduce reactor power	Off-gas radioactivity	OT-32 High Radiation Air Ejector Discharge	Reactor Manual Control
11.	Dispatch Shift Technical Advisor ------------------------ to calculate off-gas release	Procedure	OT-32 High Radiation Air Ejector Discharge	

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12.	Dispatch Health Physics to perform radiological survey ------------------------- to verify source, amount and type of radiation	Procedure	OT-32 High Radiation Air Ejector Discharge	
13.	Monitor reactor power ------------------------- to verify power reduction	Operating practice		Average Power Range Monitoring
14.	Manually transfer to off-site power ------------------------- to maintain vital loads	Intended shutdown		AC Electrical Distribution
15.	Communicate with Load Dispatcher ------------------------- to allow coordination of power grid	Intended shutdown		
16.	Start turbine bearing lift pumps ------------------------- to provide oil to turbine during coastdown	Procedure	GP-3 Normal Shutdown	Turbine Auxiliaries
17.	Start turning gear oil pump ------------------------- to provide oil to turbine while shutting down	Procedure	GP-2 Normal Shutdown	Turbine Auxiliaries

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
18.	Manually scram reactor ------------------------- to minimize danger of radiation release	High main steam line radiation		Reactor Protection
19.	Trip two feedwater pumps ------------------------- to remove non-essential equipment from service	Procedure	OT-2 Scram with Group 1 Isolation	Feedwater
20.	Operate the feedwater system ------------------------- to maintain reactor vessel level	Procedure	OT-2 Scram with Group 1 Isolation	Feedwater
21.	Monitor reactor parameters ------------------------- to assure performance as expected	Operating practice		Recirculation, Reactor Vessel
22.	Evacuate personnel ------------------------- to ensure personnel safety	Reactor bldg. high radiation alarm		
23.	Insert source range and intermediate range monitors ------------------------- to monitor reactor power	Procedure	OT-2 Scram with Group 1 Isolation	Source Range Monitoring, Intermediate Range Monitoring

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
24.	Operate nuclear instrumentation system --- to maintain monitoring ability	Procedure	OT-2 Scram with Group 1 Isolation	Intermediate Range Monitoring
25.	Secure condensate demineralizers --- to remove non-essential equipment from service	Procedure	OT-2 Scram with Group 1 Isolation	Condensate
26.	Shut down circulating water pumps --- to remove non-essential equipment from service	Procedure	OT-2 Scram with Group 1 Isolation	Circulating Water
27.	Shut down one condensate pump --- to remove non-essential equipment from service	Procedure	OT-2 Scram with Group 1 Isolation	Condensate
28.	Isolate main steam lines --- to minimize danger of radiation release	Procedure	OT-2 Scram with Group 1 Isolation	Main Steam
29.	Initiate Reactor Core Isolation Cooling --- to reduce pressure	Procedure	OT-2 Scram with Group 1 Isolation	Reactor Core Isolation Cooling

TASK SEQUENCE CHART

Plant: 98

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration (Radiological Emergency)

Operating Sequence: High Radiation Effluent

Operating Sequence ID: 24

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
30.	Initiate Emergency Plan -------------------------- to initiate emergency response actions	Procedure	(Procedure unavailable)	

4. PLANT 15

The data contained in this section are:

- Plant description (page 4-1)
- Panel layouts and designators (page 4-2)
- System nomenclature and numbering (page 4-4)
- Operating Sequence Overviews (page 4-9)
- Task Sequence Charts (page 4-16)

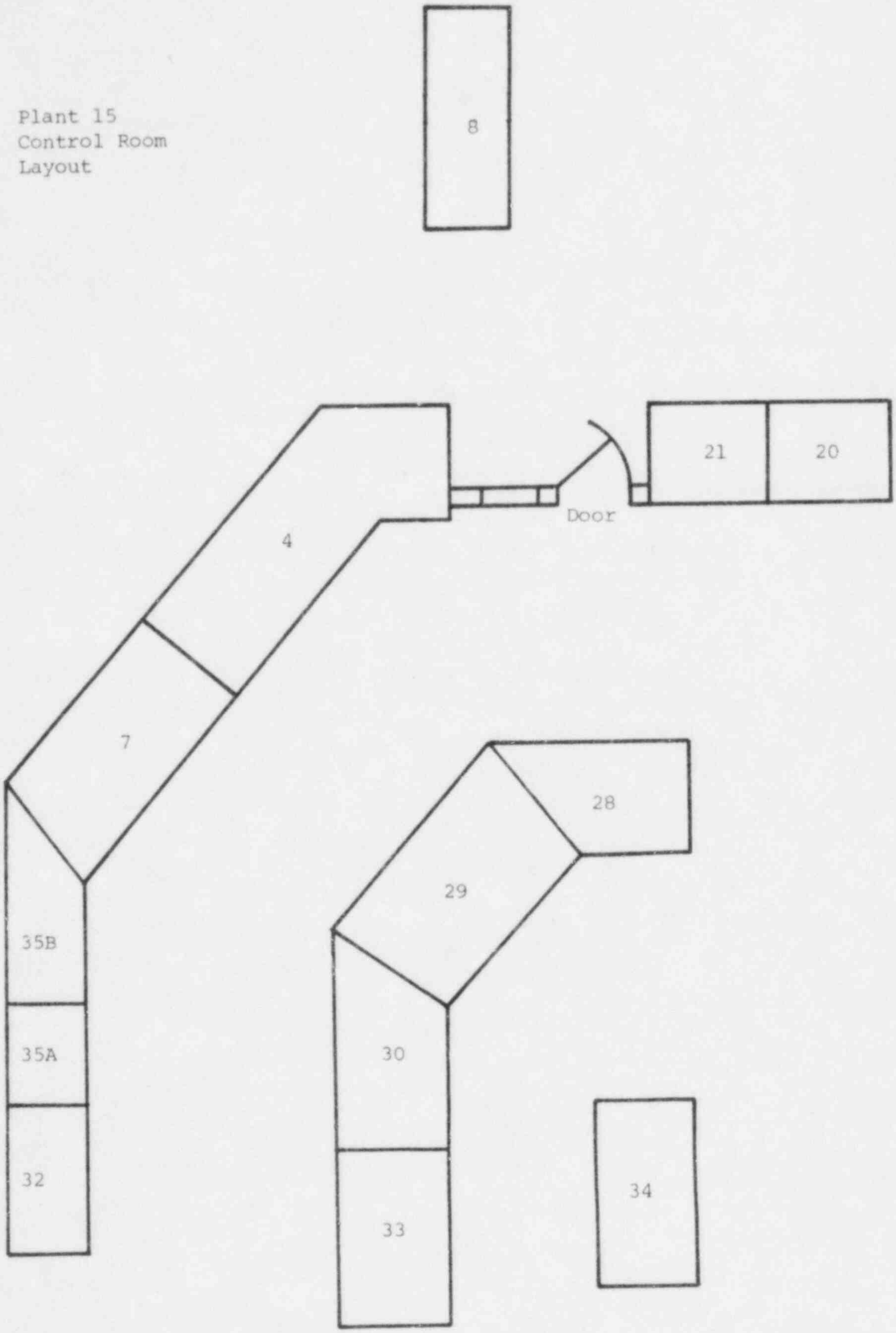
The following operating sequences were observed at Plant 15:

- 4 Startup From Hot Shutdown
- 9 High Pressurizer Level
- 10 Station Blackout
- 13 Steam Generator Tube Rupture
- 18 Auxiliary Feedwater Pump Operability
- 25 Radwaste Discharge Liquid
- 26 Maintain Reactor Coolant Pump Bus Protection Supply Breaker

Plant 15, Unit 1 is a Babcock and Wilcox pressurized water reactor with a Westinghouse turbine-generator. The architect-engineer is Bechtel. The plant received its operating license in 1975. The control room is a single-unit control room. The data were collected at a generic simulator and in the Unit 1 control room.

Plant 15 Panel/System	Number Assigned
Communications and Log Desk	34
Computer Console	33
Reactor Coolant System Console • Reactor Coolant MU & LTDN Control • PZR Control • Manual HPSI & LPSI • Manual Rx Bldg spray	30
Reactor Unit System Console (Rx & ICS) • Reactor control • Feedwater control • SG level, pressure control	29
Secondary Systems Console • Turbine generator supervisory • Aux. steam • Main turbine auxiliaries • Condensate	28
Plant Auxiliaries Panel	32
Engineered Safeguards Panel, Train A	35A
Engineered Safeguards Panel, Train B	35B
Reactor System Unit Panel	7
Turbine Generator Panel	4
Plant Cooling Water Panel	21
Electrical Control Panel	20
Radiation Monitoring • Process RMS • Area RMS	8

Plant 15
Control Room
Layout



Plant 15 System Name	ABBR.	INPO System Number and Name
Air ejector and gland steam system	--	46. Main turbine and steam generator feed pump steam seal system 55. Condenser air removal system
Annunciator system		
Auxiliary boiler	AB	44. Auxiliary steam generating system
Auxiliary feedwater system	AFW	61. Auxiliary/emergency feedwater system
Auxiliary gas system		
Auxiliary steam system	AS	42. Low pressure steam system
Borated water storage system	BWS	4. Chemical and volume control system
Boric acid concentrator system	--	68. Liquid rad waste system
Chemical waste system		
Chilled water system	--	88. Plant ventilation systems
Chlorine injection system	--	80. Chlorination system
Circulatiog cooling water system	CCW	75. Circulating water system
Condensate system	--	56. Condensate system
Condensate demineralizer system	--	57. Condensate demineralizer system
Condensate precoat filter system	--	58. Condensate precoat filter system
Condensate transfer and storage system	--	56. Condensate system
Condenser system	--	56. Condensate system
Containment	CTMT	103. Containment
Containment entry and exit	--	21. Containment entry and exit
Containment hydrogen control	--	28. Hydrogen recombiner and purge systems
Containment leak test system		

Plant 15 System Name	ABBR.	INPO System Number and Name
Containment purge system	--	29. Containment purge system
Control rod drive system	CRDS	1. Control rod drive system 14. Rod position indication system
Control rod drive cooling system	CRDCS	
Coolant and radwaste system	--	68. Liquid radwaste system
Cooling tower makeup and blowdown		
Core flood system	CF	6. Safety injection system
Decay heat removal system	DHR	5. Residual heat removal system
Demineralized water system		
Diesel fuel oil and transfer system		
Diesel generator system	DG	64. Emergency diesel generator system
Domestic water system		
Engineered safety features actuation system	ESFAS	13. Engineered safety features actuation system 40. Main steam isolation valve activating system
Exhaust hood spray system	--	51. Exhaust hood spray system
Extraction steam and heater drains system	ES	43. Extraction steam system
Feedwater control subsystem	FWC	59. Main Feedwater system
Feedwater heater vents and drain system	HVDS	60. Feedwater heater vent and drain system
Fire protection system	--	86. Fire protection system
Fluid block system	--	23. Containment isolation valve seal water system
Fuel and component handling	--	34. Fuel handling equipment
Generator bus duct cooling system	--	54. Generator bus duct cooling system
Generator seal oil system	GSO	50. Seal oil system
Heat tracing system	--	67. Electrical heat tracing system
HVAC- containment	--	22. Containment cooling system
Hydrogen purge system	--	28. Hydrogen recombiner and purge systems

Plant 15 System Name	ABBR.	INPO System Number and Name
In-core instrumentation	--	17. In-core temperature monitor
In-plant communications system	--	85. Communications system
Instrument air system	IA	78. Instrument air system
Integrated control system	ICS	41. Steam sump/turbine bypass control system (reactor regulating system/integrated control system)
Loose parts and vibration monitoring system	LPVM	18. Loose parts monitoring system
Lube oil storage, transfer and purification system	LDS	
Main and reheat steam system	MRS	39. Main and reheat steam system
Main feedwater system	FW	59. Main feedwater system
Main generator and exciter system	MG	45. Main turbine generator.
Main generator hydrogen and CO_2 system	--	52. Main generator hydrogen and carbon dioxide gas system
Main turbine	MT	45. Main turbine generator
Main turbine control oil system	EHC	48. Main turbine electro-hydraulic control system
Main turbine generator lube oil system	MLO	47. Main turbine generator lube oil system
Makeup and purification system	M&P	4. Chemical and volume control system 19. Boronometer
Meteorological instrumentation		
Misc. drains and sumps		
Misc. liquid radwaste system	--	69. Liquid rad waste system
Misc. waste concentrator system	--	69. Liquid rad waste system
Misc. water system		
New and spent resin system	--	69. Liquid rad waste system
Nitrogen system	--	82. Nitrogen system

Plant 15 System Name	ABBR.	INPO System Number and Name
Non-nuclear instrumentation system	NNI	16. Non-nuclear instrumentation system
Nuclear instrumentation system	NIS	15. Nuclear instrumentation system
Nuclear services cooling water system	NSCW	8. Component cooling system
Nuclear services raw water system		
Penetration cooling system	--	30. Penetration cooling system
Penetration pressurization system	--	31. Weld channel and containment penetration pressurization system
Plant computer	--	83. Plant computer
Plant cooling water and reservoir system	--	76. Service water system
Plant security		
Plant ventilation	HVAC	88. Plant ventilation systems
Pressurizer and pressure relief tank system	PZR	2. Reactor coolant system 7. Pressurizer relief/quench tank
Pressurizer level control system	PZRLC	11. Pressurizer level control system
Pressurizer pressure control system	PZRPC	10. Pressurizer pressure control system
Primary power generation and transmission system	PPGTS	62. AC electrical distribution system
Private offsite communications system	--	88. Communications system
Public offsite communications system	--	88. Communications system
Radiation monitoring system	RMS	20. Gross failed fuel detector 72. Area radiation monitoring system 73. Process radiation monitoring system
Reactor building spray system	--	26. Containment spray system

Plant 15 System Name	ABBR.	INPO System Number and Name
Reactor building spray system		27. Containment iodine removal units
Reactor coolant chemical and hydrogen addition system	--	9. Primary chemical addition system
Reactor coolant drain tank system	--	68. Liquid rad waste system
Reactor coolant pumps	RCP	3. Reactor coolant pump operation
Reactor coolant system	RCS	2. Reactor coolant system
Reactor protection system	RPS	12. Reactor protection system
Reactor sampling system	RSS	
Safety injection system	SI	6. Safety injection system
Seismic instrumentation	--	84. Seismic monitoring equipment
Service air system	SA	79. Station air system
Sewage treatment system		
Solid radwaste system		
Spent fuel pool cooling system	--	33. Spent fuel pool cooling
Stator cooling system	SC	53. Stator water cooling system
Steam atmospheric dump system	SADS	39. Main and reheat steam system
Steam generator system	SG	35. Steam generator system 38. Steam generator blow-down system
Turbine bypass control system	TBCS	41. Steam dump/turbine bypass control system
Turbine plant cooling water system	TPCW	74. Secondary equipment closed cooling system
Turbine plant sampling system	--	36. Turbine plant sampling system
Turbine steam seal and drain system	GS	46. Main turbine and steam generator feed pump steam seal system
Waste gas disposal system	--	71. Waste gas disposal system
Waste water disposal system		

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

NSSS/Type: B&W/PWR

Operating Sequence ID: 04

CR Type: Single

Operating Sequence: Startup from Hot Shutdown

Initial Conditions: The plant has been shut down to correct an equipment malfunction. The process of restart has begun. Plant pre-starting checks have been completed and the estimated critical position (ECP) has been calculated. The reactor is subcritical. No measurable thermal power is being produced. Reactor coolant system (RCS) pressure is being controlled at 2155 psig. The turbine bypass valves are in automatic and controlling once-through steam generator (OTSG) pressure at 885 psig. OTSG level is being controlled at the startup operating level. Boron concentration is the proper concentration for startup. The rod groups are fully inserted. The Load Dispatcher has been notified of the plant condition.

Sequence Initiator: Permission has been received to take the reactor to 100% power.

Progression of Action: The crew withdraws the safety and regulating rod groups to take the reactor critical. Criticality is achieved within the limits specified in the ECP calculation. The crew proceeds to take the reactor to the hot standby condition. The crew then increases reactor power to 10%, notifies the Load Dispatcher that the plant is coming on the line, parallels the generator on the grid, and proceeds to 100% power.

Final Conditions: The plant is operating at 100% power in the normal full power lineup.

Major Systems: Electrical Generation and Distribution System, Plant AC Auxiliary System, Integrated Control System (ICS), Main Feedwater System (FWS), Reactor Protection System (RPS), Condenser System, Circulating Cooling Water System (CCWS), Power Conversion System (PCS), Control Rod Drive System (CRDS), Makeup and Purification System (M&P), Primary Sampling, Nuclear Instrumentation System (NIS), Auxiliary Feedwater (AFW), Main Turbine (MT), Generator and Exciter System, Reactor Coolant System (RCS), Pressurizer Level Control System (PZR-LCS), Condensate System, Extraction Steam and Heater Drain System, Heater Drains and Vents System.

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

NSSS/Type: B&W/PWR

Operating Sequence ID: 09

CR Type: Single

Operating Sequence: High Pressurizer Level

Initial Conditions: The plant is operating at 90% power in a steady state condition with normal pressurizer (PZR) level and normal reactor coolant system (RCS) pressure and temperature.

Sequence Initiator: A transmitter in the PZR level control system fails low, causing the level control valve to open and giving a false low level readout in the control room. The PZR level controller also fails, so that the valve remains open and cannot be closed from the control room. A "PZR Level Extreme" alarm is received.

Progression of Action: The crew examines PZR parameters and indications to identify the condition. The level control valve is discovered to be full open. Excessive makeup is in progress with low level falsely indicated. The crew takes manual control of level controller and unsuccessfully attempts to close the valve. The crew closes the makeup isolation valve to stop flow into the PZR and adjusts letdown flow to control PZR level. The crew requests the Instrumentation and Controls Section to investigate the correct transmitter and controller malfunctions. When the malfunctions are corrected, the crew puts the PZR level control system back in automatic and re-establishes normal makeup and letdown.

Final Conditions: The plant continues to operate at 90% power. Normal PZR level has been established.

Major Systems: Pressurizer (PZR), Pressurizer Level Control, Pressurizer Pressure Control, Makeup and Purification (M&P), Reactor Coolant System (RCS).

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: B&W/PWR

Operating Sequence ID: 10

CR Type: Single

Operating Sequence: Station Blackout

Initial Conditions: The plant is operating at 100% power with a normal lineup. The integrated control system is in full automatic.

Sequence Initiator: Turbine generator and reactor trip concurrent with loss of offsite power.

Progression of Action: The crew verifies turbine generator trip, reactor trip, and electrical distribution system status. The diesel generators do not start as expected and cannot be started manually from the control room. A Plant Equipment Operator (PEO) is dispatched to investigate the problem and start the diesels. The crew verifies automatic start of the steam-driven auxiliary (emergency) feedwater pump and manually controls steam generator pressure within 200 psi of desired pressure. The crew verifies that natural circulation has been established and controls auxiliary feedwater to maintain steam generator water level at the natural circulation level and to limit excessive reactor coolant system shrinkage. Approximately 15 minutes into the event, the diesel malfunction is corrected. The crew starts the diesel generators, and the 4160 V emergency power busses are energized. The crew verifies that the equipment necessary to support reactor coolant system makeup is available, initiates makeup, and switches to the motor-driven emergency feedwater pump to continue the cooldown.

Final Condition: Reactor coolant system makeup flow has been restored. Heat removal from the primary system is under control. Engineered safety features and safeguard equipment are available. The plant is ready to commence cooldown to cold shutdown. Off-site power has not been restored.

Major Systems: Main Turbine (MT), 480 V Power, 4160 V Power, 220 V Power, 6900 V Power, Emergency Power, Makeup and Purification (M&P), Control Rod Drive System (CRDS), Nuclear Instrumentation System (NIS), Reactor Coolant System (RCS), Pressurizer Level Control, Pressurizer Pressure Control, Turbine Bypass Control System, , Main and Reheat Steam System (MRS), In-Plant Communications System, Auxiliary Feedwater (AFW), Steam Generators (SG), Steam Atmospheric Dump System (SADS), Generator Seal Oil System, Main Turbine Generator Lube Oil System, Main Feedwater (MFW), Reactor Coolant Pumps (RCP).

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: B&W/PWR

Operating Sequence ID: 13

Initial Conditions: The plant is operating at full power in a steady state condition. The integrated control system is in full automatic.

Sequence Indicator: A tube leak in steam generator "A" results in radioactive steam being supplied to the main condenser. The leak is greater than 1 gpm, but within the capacity of the makeup pump to control reactor coolant system pressure and pressurizer level. The crew receives a low pressurizer level alarm and observes both pressurizer level and make up tank levels dropping. The condenser air ejector off-gas monitor alarm and gland exhaust monitor alarm sound. Alarms on the main steam line detectors do not actuate.

Progression of Action: The crew examines radiation monitoring sysem indications and relevant system parameters to verify the alarms and to identify the plant condition. The crew operates the makeup and purifification system to maintain pressurizer and makeup tank levels. pressurizer level is maintained above 160 inches, makeup tank level is maintained above 18 inches, and the subcooling margin is maintained greater than 30°F. The crew commences a rapid orderly shutdown, the crew directs a Plant Equipment Operator to contain contaminated water on-site and notifies plant personnel of the emergency. The Shift Supervisor assumes the duties of Emergency Coordinator and implements the Emergency Plan. The crew identifiers and isolates the faulted steam generator.

Final Conditions: The faulted steam generator is identified and isolated. The turbine has been taken off the line, and the reactor is tripped. An orderly shutdown continues. The Emergency Plan continues in effect.

Major Systems: Main Feedwater (FW), Reactor Coolant System (RCS), Makeup and Purification (M&P), Containment (CTMT), Radwaste System, Radiation Monitoring System (RMS), Plant Communications System, Integrated Control System (ICS), Steam Generator (SG), 6.9 kV power system, 4.16 kV power system, Component Cooling Water System, Feedwater Heater Vents and Drains System (HVDS), Control Rod Drive System (CRDS), Nuclear Instrumentation System (NIS), AC Electrical Distribution System (ACED), Safety Injection System (CSI), Reactor Protection System (RPS), Main and Reheat Steam System (MRS), Main Turbine (MT), Main Generator and Exciter (MG).

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Test Equipment

NSSS/Type: B&W/PWR

Operating Sequence ID: 18

CR Type: Single

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Initial Conditions: The plant is operating at full power. The second auxiliary feedwater pump is operational. Test gauges have been installed by Instrumentation and Controls (I&C) personnel. Condenser hotwell and condensate storage tank levels are within normal operating bands.

Sequence Initiator: The quarterly surveillance test on the turbine/motor driven auxiliary feedwater pump is due. The surveillance scheduler delivers the paperwork. The Shift Supervisor (SS) directs crew to perform test.

Progression of Action: The Senior Reactor Operator (SRO) briefs the crew on test requirements. Miscellaneous flow to and from the condensate storage tank (CST) is determined and the auxiliary feedwater system is aligned using circulation from the CST to the hotwell. The pump is tested first using the motor drive and then using the turbine drive. Test runs are for a minimum of 15 minutes each. The pump is observed running normally. Test performance parameters are recorded and results are calculated. The pump is stopped and restored to normal standby service. Plant Equipment Operators are dispatched to perform dual independent verification lineups. Test results are submitted.

Final Conditions: The plant is operating at full power. The tested auxilary feedwater pump is in an operable condition and in a normal configuration.

Major Systems: Auxiliary Feedwater System (AFW), Main Steam System (MS), Condensate System, In-Plant Communications System.

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Coordinate Plant Support Activities/Administration-Radiological Emergency

NSSS/Type: B&W/PWR

Operating Sequence ID: 25

CR Type: Single

Operating Sequence: Radwaste Discharge

Initial Conditions: The plant is operating at 90% power. A grab sample form the retention basin showed activity within Technical Specifications release limits. Release from retention basis has been approved and is in progress.

Sequence Initiator: Retention basin trouble alarm is received in the control room.

Progression of Action: A Plant Equipment Operator (PEO) is directed to determine cause of alarm and reports that the radiation monitor is alarming and the release is still in progress. The Senior Reactor Operator (SRO) directs the PEO to terminate the release and determine retention basin level. The Chemistry Radiation Protection Section is notified to resample the retention basin and take downstream samples. The SRO notifies the Shift Supervisor. The Shift Supervisor declares an unusual event, and initiates the appropriate portions of the Emergency Plan. Sample results indicate the release is less than the Technical Specifications Limit. The Shift Supervisor terminates the unusual event status and the appropriate forms are initiated.

Final Conditions: The plant continues to operate at 90% power. The radioactive liquid waste release has been terminated. Downstream sample results have not been reported.

Major Systems: Plant Communications System, Radiation Monitoring System, Clean Drain System.

Operating Sequence Overview

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

NSSS/Type: B&W/PWR

Operating Sequence ID: 26

CR Type: Single

Operating Sequence: Maintain Reactor Coolant Pump Bus Protection Supply Breaker

Initial Conditions: The plant is operating normally at full power. The 5A Bus protection relays have been discovered to need preventive maintenance during a monthly surveillance test.

Sequence Initiator: A work request for implementation of electrical testing of the relays is received from the Electrical Maintenance Section.

Progression of Action: The Senior Reactor Operator (SRO) accepts the work request and makes out the clearance and danger tags. The Shift Supervisor authorizes the clearance. A Plant Equipment Operator (PEO) isolates and tags the affected bus supply breaker. The Electrical Maintenance Section Foreman is informed that the breaker is ready for work. Upon completion of maintenance, the danger clearance is lifted and a test tag is placed on the breaker, allowing the relays to be tested. The Electrical Maintenance Section tests the relays and returns the in-test hard copy test authorization form to the control room. Test tags are removed and the breaker is racked in.

Final Conditions: The plant continues to operate normally at full power. The Reactor Coolant Pump bus protection supply breaker is restored to a normal status.

Major Systems: 6.9 kV Electrical System, Diesel-Generator System, Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Funct'~n/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Reset protective relays ------------------------ to block reactor trip signal	Procedure	B.2 Plant heatup and startup	Reactor Protection System
2	Calculate expected increase in neutron count rate resulting from withdrawl of safety rod groups ------------------------ to permit verification of proper safety group performance	Procedure	B.2 Plant heatup and startup	Nuclear Instrumentation System
3	Communicate with plant personnel ------------------------ to allow coordination of station functions	Procedure	B.2 Plant heatup and startup	Plant Communications System
4	Communicate with Load dispatcher ------------------------ to allow coordination of power grid	Operating practice		Plant Communications System
5	Manually withdraw safety rod groups ------------------------ to initiate reactor startup	Procedure	B.2 Plant heatup and startup	Control Rod Drive Control System, Nuclear Instrumentation System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Compare observed and expected increase in neutron count rate ------------------------- to determine dilution is necessary to reach criticality	Procedure	B.2 Plant Heatup and Startup	Nuclear Instrumentation System
7	Examine once-through steam generator levels ------------------------- to assure adequate heat removal capabilities for startup	Operating practice		Once-Through Steam Generator System
8	Manually withdraw regulating rods ------------------------- to achieve criticality	Procedure	B.2 Plant Heatup and Startup	Control Rod Drive System, Nuclear Instrumentation System
9	Operate control rod drive system ------------------------- to raise power to 10-8 amps	Procedure	B.2 Plant Heatup and Startup	Control Rod Drive System
10	Document reactor critical conditions ------------------------- to verify accuracy of estimated critical position	Procedure	B.2 Plant Heatup and Startup	Reactor Coolant System, Nuclear Instrumentation System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Examine plant parameters --- to verify hot standby condition	Procedure	B.2 Plant Heatup and Startup	Reactor Coolant System, Main Feedwater System
12	Examine Reactor Coolant pumps, Main Turbine System and Auxiliary Feedwater System --- to verify plant conditions required for raising power	Procedure	B.2 Plant Heatup and Startup	Reactor Coolant System, Auxiliary Feedwater System
13	Examine integrated control system --- to verify correct system lineup for raising power	Procedure	B.2 Plant Heatup and Startup	Integrated Control System
14	Increase reactor power to 15 percent --- to continue approach to full power	Procedure	B.2 Plant Heatup and Startup	Control Rod Drive Control System, Nuclear Instrumentation System
15	Increase reactor power --- to achieve necessary condition for sychronizing generator to grid	Procedure	B.2 Plant Heatup and Startup	Control Rod Drive Control System, Nuclear Instrumentation System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Monitor plant parameters ------------------------ to assure plant response as expected	Operating practice		Reactor Coolant System
17	Observe turbine bypass valves ------------------------ to verifiy turbine header pressure in band	Operating practice		Main and Reheat Steam System
18	Adjust pressurizer level ------------------------ to maintain reactor coolant system inventory in band	Procedure	B.2 Plant Heatup and Startup	Pressurizer
19	Adjust letdown flow ------------------------ to maintain reactor coolant system inventory in band	Operating practice		Makeup and Purification System
20	Place diamond rod control in automatic ------------------------ to prepare for automatic control of plant	Reactor power greater than 10%	B.2 Plant Heatup and Startup	Control Rod Drive System
21	Place Main Feedwater regulating valves in automatic ------------------------ to provide adequate feedwater supply for higher power operation	Procedure	B.2 Plant Heatup and Startup	Main Feedwater System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22	Secure once through steam generator blowdown line-up ---------- to prevent sedimentation at low steam flow	Procedure	B.2 Plant Heatup and Startup	Secondary Sampling System
23	Align main turbine auxiliary equipment ---------- to prepare turbine for startup	Operating practice		Main Turbine
24	Examine main turbine system ---------- to verify lineup necessary for turbine start up	Procedure	B.2 Plant Heatup and Startup	Main Turbine
25	Perform manual trip test of governor, interceptor and reheat stop valves ---------- to verify proper operation of safety equipment	Procedure	A.46 Main Turbine System	Main and Reheat Steam System
26	Perform overspeed test test of governor, interceptor and reheat stop valves ---------- to ensure proper operation of safety equipment	Procedure	A.46 Main Turbine System	Main and Reheat Steam System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Generate Power

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
27	Place turbine in automatic ------------------------- to bring turbine under operator/automatic	Procedure	A.46 Main Turbine System	Electro-hydraulic Control System
28	Operate electro-hydraulic control system ------------------------- to initiate turbine start-up	Procedure	A.46 Main Turbine System	Electro-hydraulic Control System
29	Hold at turbine speed at 600 rpm ------------------------- to verify proper turbine operation	Turbine speed at 600 rpm	A.46 Main Turbine System	Main Turbine
30	Increase turbine speed to 1000 rpm ------------------------- to continue approach to full turbine speed	Procedure	A.46 Main Turbine System	Main Turbine
31	Increase turbine speed to 1700 rpm ------------------------- to continue approach to full turbine speed	Turbine at 1000 rpm	A.46 Main Turbine System	Main Turbine
32	Transfer turbine control from the throttle to governor valves ------------------------- to aline system for full power operation	Turbine at 1700 rpm	A.46 Main Turbine System	Electro-Hydraulic Control System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
33	Increase turbine speed to 1800 rpm ------------------------- to achieve turbine terminal speed	Procedure	A.46 Main Turbine System	Main Turbine
34	Perform manual trip test of governor, interceptor and reheat stop valves ------------------------- to assure proper operation of safety equipment	Turbine at 1800 rpm	A.46 Main Turbine System	Main Turbine
35	Increase turbine speed to 1800 rpm ------------------------- to achieve turbine terminal speed	Procedure	A.46 Main Turbine System	Main Turbine
36	Transfer turbine control from throttle valve to governor valves ------------------------- to prepare turbine for full operation	Turbine at 1800 rpm	A.46 Main Turbine System	Electro-hydraulic Control System
37	Observe turbine supervisory instruments ------------------------- to assure proper operation of turbine	Turbine speed 1800 rpm	A.46 Main Turbine System	Main Turbine
38	Shutdown turbine startup pumps ------------------------- to remove non-essential equipment from service	Procedure	A.46 Main Turbine System	Main Turbine

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
39	Prepare turbine exhaust hood spray for operation ------------------------ to ensure adequate cooling	Procedure	A.46 Main Turbine System	Main Turbine
40	Test turbine auto stop trips ------------------------ to ensure turbine protection	Procedure	A.46 Main Turbine System	Plant Communcations System
41	Examine generator & exciter & main turbine systems ------------------------ to verify conditions exist for main generator exciter field lineup	Turbine at 1800 rpm	A.46 Main Turbine System	Main Turbine, Generator and Exciter System
42	Test generator field for absence of ground ------------------------ to protect equipment	Procedure	A.46 Main Turbine System	Generator and Exciter System
43	Place generator under manual control ------------------------ to permit exciter field buildup	Procedure	A.46 Main Turbine System	Generator and Exciter System
44	Increase generator voltage ------------------------ to permit parallelling generator to grid	Procedure	A.46 Main Turbine System	Generator and Exciter System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
45	Test voltage regulator ------------------------ to ensure proper operator of equipment	Procedure	A.46 Main Turbine System	Generator and Exciter System
46	Bring generator under automatic voltage control ------------------------ to permit parallelling generator to grid	Procedure	A.46 Main Turbine System	Generator and Exciter System
47	Direct plant equipment operator to check generator excitation panel indication ------------------------ to assure normal operation of equipment	Procedure	A.46 Main Turbine System	Plant Communications System
48	Communicate with Load Dispatcher ------------------------ to allow coordination of power grid	Procedure	A.46 Main Turbine System	Plant Communications system
49	Match main generator and switchyard voltages ------------------------ to establish conditions for going on line	Procedure	A.46 Main Turbine System	Electrical Generation and Distribution System
50	Synchronize and close generator output breakers ------------------------ to bring on line	Procedure	A.46 Main Turbine System	Generator and Exciter Syster

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
51	Increase generator load using turbine demand ------------------------ to prepare to bring turbine under integrated control system control	Generator on line	A.46 Main Turbine System	Electro-hydraulic Control System
52	Place turbine under integrated control system control ------------------------ to allow centralized control of plant	Procedure	B.2 Plant Heatup and Startup	Integrated Control System
53	Communicate with Load Dispatcher ------------------------ to allow coordination of power grid	Procedure	B.2 Plant Heatup and Startup	Plant Communications System
54	Put power system stabilizer in service ------------------------ to provide automatic means of dealing with voltage fluctuations	Regulator trouble alarm sounds	B.2 Plant Heatup and Startup	Electrical Generation and Distribution System
55	Open Moisture separator reheater purge valves ------------------------ to purge non-condensibles from moisture separator reheaters	Generator load at 5%	B.2 Plant Heatup and Startup	Main and Reheat Steam System
56	Stop turbine oil pumps ------------------------ to remove non-essential equipment from service	Operating Practice		Main Turbine

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
57	Place throttle pressure control to IMPIN ------------------------ to provide turbine throttle control	Procedure	A.46 Main Turbine System	Electro-hydraulic Control System
58	Adjust reactor power ------------------------ to allow placing reactor under integrated control system control	Operating practice		Integrated Control System, Reactor Coolant System
59	Place reactor demand in integrated control system automatic ------------------------ to allow centralized control of plant	Reactor power greater 15%		Integrated Control System
60	Verify unit load setting ------------------------ to ensure setpoints are within limits for full power operation	Procedure	B.2 Plant Heatup and Startup	Integrated Control System
61	Place steam generator reactor demand in automatic ------------------------ to allow centralized control of plant	Procedure	B.3 Normal Operations	Integrated Control System
62	Place extraction steam valves in automatic ------------------------ to provide main steam to feedwater heaters	Procedure	B.3 Normal Operations	Extraction Steam and Heater Drain System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
63	Perform heat balance calculation ------------------------ to verify out-of-core nuclear instrumentation calibration	Procedure	B.3 Normal Operations	Plant Communications System
64	Determine whether control rod assemblies are within prescribed limits ------------------------ to determine whether boration is required	Procedure	B.3 Normal Operations	Control Rod Drive Control System
65	Operate the Makeup and Purification System ------------------------ to allow positioning of control rods within prescribed limits for full power operation	Procedure	B.3 Normal Operations	Makeup and Purification System
66	Operate the Integrated Control System ------------------------ to raise power to 92%	Power at 20%	B.3 Normal Operations	Integrated Control System
67	Close turbine drain valves ------------------------ to place turbine in normal operating mode	Generator at $\geq$ 20% load	B.3 Normal Operations A.46 Main Turbine System	Main Turbine
68	Compare power factor with necessary hyprogen pressure ------------------------ to verify generator hyprogen pressure to allow adequate cooling of generator	Procedure	B.3 Normal Operations	Generator and Exciter System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
69	Transfer 6.9KV bus A from startup transformer to unit auxiliary transformer ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.57 6.9KV Electrical System	Electrical Generation and Distribution System
70	Transfer 6.9KV bus B from startup transfer to unit auxiliary transformer ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.57 6.9KV Electrical System	Electrical Generation and Distribution System
71	Transfer 4.16KV bus C to normal power supply ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.57 6.9KV Electrical System	Electrical Generation and Distribution System
72	Transfer 4.16KV bus D to normal power supply ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.58 4.16KV Electrical System	Electrical Generation and Distribution System
73	Transfer 4.16KV bus 4E1 to normal power supply ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.58 4.16KV Electrical System	Electrical Generation and Distribution System
74	Transfer 4.16KV bus 4E2 to normal power supply ------------------------ to establish self-sustaining condition	Turbine load $\geq$ 30%	B.3 Normal Operation A.58 4.16KV Electrical System	Electrical Generation and Distribution System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
75	Place moisture separater reheaters in operation ----------------------- to assure adequate steam supply to turbine	Turbine load at 35%	B.3 Normal Operation A.46 Main Turbine System	Main and Reheat Steam System
76	Close reheat coil startup and extraction drains and vents ----------------------- to remove non-essential steam loads	Procedure	B.3 Normal Operation A.46 Main Turbine System	Heater Drains and Vents System
77	Start second-point heater drain pumps ----------------------- to recycle water into condensate system	Turbine load > 35%	B.3 Normal Operation A.53 Extract Steam, Reheater and Feed-water	Heater Drains and Vents System
78	Examine circulating cooling water system ----------------------- to verify required pumps are in operation	Plant power at 35-40%	B.3 Normal Operations	Circulating Cooling Water System
79	Examine condensate and feedwater systems ----------------------- to verify required pumps are in operation	Plant power at 35-40%	B.3 Normal Operations	Condensate System, Main Feedwater System
80	Start main feedwater pump ----------------------- to provide adequate feed-water supply for full power operation	Plant power greater than 50%	B.2 Plant Heatup and Startup	Main Feedwater System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and control plant operations/mitigate consequences of an accident

Operating Sequence: Startup from Hot Shutdown

Operating Sequence ID: 04

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
81	Place feedwater pump in automatic ------------------------ to allow centralized control of plant	Plant power greater than 40%	B.3 Normal Operations	Main Feedwater System
82	Close seat drain valves on feedwater pump turbines ------------------------ to place feedwater pump turbines in normal operating mode	Plant power greater than 40%	B.3 Normal Operations	Main Feedwater System
83	Verify closure of feedwater pump low pressure steam casing regulators ------------------------ to permit supply of feedwater pump turbines by low pressure reheat steam	Plant power greater than 45%	B.3 Normal Operations	Main Feedwater System
84	Hold power at 92% ------------------------ to assure conformance to Technical Specifications	Reactor power at 92%	B.3 Normal Operations	Integrated Control System
85	Compare xenon level with Technical Specification limit ------------------------ to assure that xenon in limits to allow increase to 100% power	Procedure	B.3 Normal Operations	
86	Operate the integrated control system ------------------------ to raise power to 100%	Power maneuvering limits met	B.3 Normal Operations	Integrated Control System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Examine pressurizer level control system status ---------- to identify plant condition	PZR level extreme alarm	Emergency Procedures; D-15 Pressurizer System Failure	Pressurizer Level Control System
2.	Close pressurizer level control valve ---------- to stop makeup flow to pressurizer	Excessive PZR makeup	Emergency Procedures; D-15 Pressurizer System Failure	Pressurizer Level Control System
3.	Close pressurizer makeup isolation valve ---------- to stop makeup flow to pressurizer	Inability to regulate PZR makeup by controller	Emergency Procedures; D-15 Pressurizer System Failure	Makeup and Purification System
4.	Communicate with Shift Supervisor ---------- to identify appropriate follow-up actions	Operating practice		
5.	Dispatch Instrumentation and Controls Technician ---------- to restore equipment availability	Operating practice		In-Plant Communications System
6.	Monitor plant parameters ---------- to ensure safe operation	Operating practice	Emergency Procedures; D-11, Loss of Coolant Makeup and Letdown	Reactor Coolant System, Makeup and Purification System Pressurizer Level Control System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7.	Review Emergency Procedures and Technical Specifications --- to assure performance of required actions	Operating practice	Emergency Procedures; D-11, Loss of Reactor Coolant Makeup and Letdown	
8.	Test faulted pressurizer level transmitter --- to confirm diagnosis	Operating practice		Pressurizer Level Control System
9.	Energize pressurizer heaters --- to test operability of equipment potentially affected by malfunction	Operating practice	Emergency Procedures; D-11, Loss of Reactor Coolant Makeup and Letdown	Pressurizer Level Control System
10.	Operate letdown isolation valve --- to test operability of equipment potentially affected by malfunction	Operating practice	Emergency Procedures; D-11, Loss of Reactor Coolant Makeup and Letdown	Makeup and Purification System
11.	Test faulted pressurizer level transmitter --- to assure performance as expected after repair	I&C report: transmitter problem corrected		Pressurizer Level Control System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12.	Test pressurizer level controller operability --- to confirm diagnosis	Operating practice		Pressurizer Level Control System
13.	Close letdown orifice block valve --- to protect equipment when letdown is reduced	PZR level decreasing	Emergency Procedures; D-11, Loss of Reactor Coolant Makeup and Letdown	Makeup and Purification System
14.	Adjust letdown --- to control pressurizer level	PZR level decreasing	Emergency Procedures; D-11, Loss of Reactor Coolant Makeup and Letdown	Makeup and Purification System
15.	Test pressurizer level controller operability --- to assure performance as expected after repair	I&C report: controller problem corrected		Pressurizer Level Control System
16.	Establish normal makeup and letdown --- to restore plant to normal operating condition	Controller operability verified		Makeup and Purification System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Recognize that cues indicate loss of offsite power ------------------------ to identify plant condition	Annunciators; loss of normal control room lighting		Reactor Protection System, Main Turbine
2.	Examine turbine generator indications ------------------------ to verify turbine generator trip	Procedure	Emergency Procedures: D-2, Turbine Trip	Main Turbine
3.	Isolate letdown ------------------------ to maintain reactor coolant system inventory	Procedure	Emergency Procedures: D-3, Reactor Trip	Makeup and Purification System
4.	Examine electrical system indications ------------------------ to identify plant condition	Annunciators, loss of normal control room lighting	Emergency Procedures: D-1, Load Rejection	AC Electrical Distribution
5.	Examine reactor indications ------------------------ to verify reactor trip	Procedure	Emergency Procedures: D-3, Reactor Trip	Control Rod Drive Control System, Nuclear Instrumentation System
6.	Examine reactor coolant system parameters ------------------------ to identify plant condition	Procedure	Emergency Procedures: D-3, Reactor Trip	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7.	Attempt to start diesel generators manually --- to provide electrical power for plant operation	Diesel generators fail to start automatically	Emergency Procedures: D-1, Load Rejection	Diesel Generator System
8.	Close turbine bypass valves --- to maintain reactor coolant system temperature	Procedure	Emergency Procedures: D-2, Turbine Trip; D-3, Reactor Trip	Turbine Bypass Control System
9.	Dispatch plant equipment operator to examine diesel generators --- to restore equipment availability	Diesel generators cannot be started from control room		In-Plant Communications System
10.	Examine auxiliary feedwater system indications --- to verify auxiliary feedwater flow initiated	Procedure	Emergency Procedures: D-3, Reactor Trip	Auxiliary Feedwater System
11.	Operate the auxiliary feedwater system --- to maintain reactor coolant system inventory	RCS pressure decreasing	Emergency Procedure: D-1, Loss of Load; D-3, Reactor Trip	Auxiliary Feedwater System, Steam Generating System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
12.	Operate the steam atmospheric dump system in manual ------------------------ to maintain reactor coolant system inventory	RCS pressure decreasing	Emergency Procedure: D-1, Loss of Load; D-3, Reactor Trip	
13.	Declare site emergency ------------------------ to initiate appropriate on- and off-site response	Procedure	Emergency Plan Implementing Procedure	In-Plant Communications System
14.	Review Emergency Procedures and Technical Specifications ------------------------ to identify appropriate follow-up actions	Operating practice		
15.	Examine DC emergency oil pumps indications ------------------------ to verify automatic startup	Operating practice		Generator Seal Oil System, Main Turbine Generator Lube Oil System
16.	Operate the plant computer ------------------------ to determine in-core thermocouple temperatures	Operating practice		Plant Computer
17.	Monitor primary system parameters ------------------------ to assure heat removal and heat source balance	Operating practice	Emergency Procedures: D-1, Loss of Load; D-3, Reactor Trip	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
18.	Stop reactor coolant pump seal injection ------------------------ to protect equipment	Procedure	Emergency Procedures: D-1, Loss of Load; D-3, Reactor Trip	Makeup and Purification System
19.	Place integrated control system controllers in manual ------------------------ to assure control of equipment on return of power	Operating practice		Integrated Control System
20.	Isolate main feedwater flow ------------------------ to realign system	Operating practice		Main Feedwater System
21.	Close pressurizer level control valve ------------------------ to prevent high makeup flow when makeup pump is started	Operating practice		Pressurizer Level Control System
22.	Start diesel generators ------------------------ to supply power to vital auxiliaries	PEO report: diesel problem corrected	Emergency Procedures: D-1, Loss of Load	Diesel Generator

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23.	Start makeup pump ------------------------ to restore reactor coolant system makeup flow	Emergency power restored	Emergency Procedures: D-11, Loss of Reactor Coolant Makeup and Letdown	Makeup and Purification
24.	Place pressurizer level controller in automatic ------------------------ to maintain pressurizer level	Procedure	Emergency Procedures: Loss of Reactor Coolant and Reactor Coolant Pressure	Pressurizer Level Control System
25.	Energize pressurizer heaters ------------------------ to test equipment operability	Operating practice	Emergency Procedures: D-5, Loss of Reactor Coolant and Reactor Coolant Pressure	Pressurizer Pressure Control System
26.	Operate pressurizer heaters ------------------------ to maintain reactor coolant system pressure	Operating practice	Emergency Procedures: D-5, Loss of Reactor Coolant and Reactor Coolant Pressure	Pressurizer Pressure Control System, Reactor Coolant System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
27	Start motor-driven auxiliary feedwater pump ------------------------ to allow shutdown of steam driven pump	Operating practice	Emergency Procedures: D-1, Load Rejection	Auxiliary Feed-water System
28	Shutdown steam-driven auxiliary feedwater pump ------------------------ to limit cooldown	Operating practice	Emergency Procedures: D-1, Load Rejection	Auxiliary Feed-water System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Monitor pressurizer pressure and level ------------------------ to assess plant conditions	Operating practice		Reactor Coolant System
2	Examine makeup tank level ------------------------ to assess plant conditions	Makeup tank level not in band		Makeup & Purification System
3	Isolate letdown ------------------------ to maintain reactor coolant system inventory	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Makeup & Purification System
4	Examine containment parameters ------------------------ to verify reactor coolant system integrity	Operating practice		Containment
5	Review procedures ------------------------ to verify immediate actions carried out	Operating practice	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Supply primary grade water to makeup tank --- to assure adequate reactor coolant system inventory	Operating practice		Makeup & Purification System Radwaste System
7	Monitor makeup tank level --- to assure reactor coolant system inventory	Operating practice		Makeup & Purification
8	Examine secondary plant radiation indications --- to verify reactor coolant system to secondary side integrity	High radiation alarms		Radiation Monitoring System
9	Examine containment radiation indications --- to verify reactor coolant system integrity	Operating practice		Radiation Monitoring System
10	Dispatch plant personnel to take area radiation readings locally --- to identify faulted steam generator	Procedure	Emergency Procedures Section D.3 Loss of Reactor Coolant/Reactor Coolant Pressure	Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Recognize that cues indicate a steam generator tube leak ------------------------ to identify appropriate procedures and follow-up actions	Decreasing Pressurizer level and makeup task level		
12	Dispatch plant personnel to sample and test steam generator air and water ------------------------ to identify faulted steam generator	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Plant Communications System
13	Communicate with Load Dispatcher ------------------------ to allow coordination of power grid	Operating practice		Plant Communications System
14	Operate the integrated control system ------------------------ to reduce reactor power and turbine load	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Integrated Control System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
15	Monitor reactor coolant system parameters ------------------------ to assure reactor coolant system integrity	Operating practice		Reactor Coolant System
16	Monitor secondary plant parameters ------------------------ to assure reactor coolant system to secondary side integrity	Operating practice		Main Feedwater System, Main Turbine, Main and Reheat Steam System
17	Monitor steam generator levels ------------------------ to identify faulted steam generator	Operating practice		Steam Generator
18	Implement Emergency Plan ------------------------ to identify appropriate on-site response	Procedure	Emergency Plan	Plant Communications System
19	Dispatch plant personnel to shutdown/realign effluent paths ------------------------ to contain contaminated water on-site	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/Reactor Coolant Pressure	Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
20	Transfer 6.9 kV Bus A from auxiliary transformer to start up transformer --- to allow turbine generator trip	Reactor power/ turbine load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	6.9 kV Power
21	Transfer 6.9 kV Bus B from auxiliary transformer to start up transformer --- to allow turbine generator trip	Reactor power/ turbine load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	6.9 kV Power
22	Transfer 4.16 kV Bus C from auxiliary transformer to start up transformer --- to allow turbine generator trip	Reactor power/ turbine load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	4.16 kV Power
23	Transfer 4.16 kV Bus D from auxiliary transformer to start up transfer --- to allow turbine generator trip	Reactor power/ turbine load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	4.16 kV Power

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
24	Transfer 4.16 kV Bus 4E1 from auxiliary transformer to start up transformer ------------------------ to allow turbine generator trip	Reactor Power/ Turbine Load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	4.16 kV Power
25	Transfer 4.16 kV Bus 4E2 from auxiliary transformer to start up transformer ------------------------ to allow turbine generator trip	Reactor Power/ Turbine Load 30%	Operating Procedures Section B-3 Plant shutdown and cooldown	4.16 kV Power
26	Dispatch plant personnel to monitor polisher radiation ------------------------ to limit danger of exposure to plant personnel	Operating practice		Plant Communications System
27	Line up letdown cooler ------------------------ to provide additional letdown capacity	Operating practice		Makeup & Purification System Component Cooling Water
28	Shut off heater drain pumps ------------------------ to reduce non-essential loads	Procedure	Operating Procedures Section B-3, Plant Shutdown and Cooldown	Feedwater Heater Vents and Drains System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
29	Shut off one feedwater pump --- to reduce non-essential loads	Procedure	Operating Procedures, Section B-3, Plant Shut-down and Cooldown	Feedwater System
30	Start auxiliary boiler --- to provide steam heating to condensate and feed-water system	Procedure	Operating Procedures, Section B-3, Plant Shut-down and Cooldown	Plant Communi-cations System
31	Observe turbine super-visory instruments --- to prevent equipment dam-age	Operating practice		Main Turbine
32	Place atmospheric relief valves in manual --- to prevent atmospheric release of radioactivity	Operating practice		Main and Reheat Steam System
33	Shut off condensate pump --- to reduce non-essential loads	Procedure	Operating Procedures Section B-3, Plant Shut-down and Cooldown	Condensate System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
34	Reduce turbine load ------------------------ to prepare to take turbine off line	Procedure	Operating Procedures Section B-3, Plant Shut-down and Cooldown	Main Turbine
35	Reduce reactor power ------------------------ to prepare to trip the reactor	Operating practice		Control Rod Drive System
36	Take generator off line ------------------------ to prevent equipment dam-age	Load at 50 MW	Operating Procedures Section B-3, Plant Shut-down and Cooldown	AC Electrical Distribution, Main Generator and Exciter
37	Reduce turbine speed ------------------------ to prevent atmospheric release	Operating practice		Main Turbine
38	Adjust feedwater pump speed ------------------------ to match feed flow to re-duced steam flow	Procedure	Operating Procedures Section B-3 Plant Shut-down and Cooldown	Feedwater Sys-tem
39	Trip turbine ------------------------ to continue towards cold shutdown	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Main Turbine

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Rupture Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
40	Close feedwater block valves --- to maintain steam generator level in band	Operating practice		Feedwater System
41	Align safety injection --- to maintain reactor coolant system inventory	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Safety Injection System
42	Trip reactor --- to continue towards cold shutdown	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Reactor Protection System
43	Adjust turbine bypass valves --- to prevent atmospheric release	Turbine trip		Main and Reheat Steam System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Rupture Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
44	Isolated faulted steam generator ------------------------ to limit radioactive release	Faulted steam generator identified	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Steam Generator
45	Monitor faulted steam generator ------------------------ to verify correct isolation	Procedure	Emergency Procedures Section D.5 Loss of Reactor Coolant/ Reactor Coolant Pressure	Steam Generator

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1.	Brief crew on test requirements --- to coordinate operating crew activities	Operating practice		
2.	Direct plant equipment operators to isolate condensate reject and normal and emergency hotwell makeup --- to minimize flow to and from condensate storage tank	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and In-service Test	In-Plant Communications System
3.	Direct plant equipment operators to determine miscellaneous flow to and from condensate storage tank --- to allow accurate calculation of auxiliary feedwater flow during test	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
4.	Start auxiliary feed-water pump motor --- to initiate surveillance test	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Auxiliary Feedwater System
5.	Direct plant equipment operators to conduct surveillance test of auxiliary feedwater pump with motor drive --- to verify adequate feedwater flow	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
6.	Direct plant equipment operators to monitor and record auxiliary feed-water pump parameters during motor-drive test --- to verify proper pump operating condition	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7.	Direct plant equipment operators to verify other auxiliary feedwater pump shaft is not turning ------------------------ to assure proper seating of discharge check valve	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
8.	Monitor test performance parameters ------------------------ to assure performance as expected	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Condensate System, Auxiliary Feedwater System
9.	Stop auxiliary feedwater pump ------------------------ to conclude surveillance of motor drive	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Auxiliary Feedwater System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
10.	Review motor driven auxiliary feedwater pump test data forms ------------------------ to verify test results meet acceptance criteria	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Sur- veillance and Inser- vice Test	In-Plant Communications System
11.	Examine condenser hotwell and condensate storage tank levels ------------------------ to verify tank levels re- main within normal oper- ating band during test	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Sur- veillance and Inser- vice Test	Condensate System
12.	Start turbine drive of auxiliary feedwater pump ------------------------ to initiate surveillance test	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Sur- veillance and Inser- vice Test	Auxiliary Feedwater

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13.	Direct plant equipment operators to conduct surveillance test of auxiliary feedwater pump with turbine ------------------------- to verify adequate feedwater flow	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
14.	Direct plant equipment operators to monitor and record auxiliary feedwater pump parameters during turbine drive test ------------------------- to verify proper pump operating condition	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
15.	Direct plant equipment operators to verify other auxiliary feedwater pump shaft is not turning ------------------------- to assure proper seating of discharge check valve	Procedure	SP 210.01A Quarterly and Annual Turbine/Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16.	Monitor test performance parameters --- to assure performance as expected	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Condensate System, Auxiliary Feedwater System
17.	Test steam lines to the turbine drive of the auxiliary feedwater pump --- to ensure equipment operability	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Main and Reheat Steam System
18.	Stop turbine drive to auxiliary feedwater pump --- to conclude test	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	Auxiliary Feedwater System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
19.	Direct plant equipment operator to close recirculation valve ------------------------ to restore system to normal operating status	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
20.	Review turbine driven auxiliary feedwater pump test data forms ------------------------ to verify test results meet acceptance criteria	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System
21.	Dispatch plant equipment operators to realign auxiliary feedwater system to standby condition ------------------------ to restore system to normal operating status	Procedure	SP 210.01A Quarterly and Annual Turbine/ Motor Driven Auxiliary Feed Pump, P-318 Surveillance and Inservice Test	In-Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Test Auxiliary Feedwater Pump Operability

Operating Sequence ID: 18

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22.	Notify Shift Supervisor that test is complete ------------------------ to report plant condition	Operating practice		

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Coordinate Plant Support Activities/Administrative-Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Respond to retention basin trouble alarm ------------------------ to determine cause of alarm	Annunciator		Radiation Monitoring System
2	Notify Shift Supervisor ------------------------ to allow coordination of on-site response	Operating practice		
3	Direct Plant Equipment Operator to terminate release ------------------------ to prevent further radioactive release	PEO Report		Clean Drain System
4	Determine volume and activity of release ------------------------ To determine environmental impact of release	Operating practice		
5	Declare unusual event ------------------------ To initiate appropriate on-site response	Procedure	Emergency Plan Implementing Procedure	Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Coordinate Plant Support Activities/Administrative-Radiological Emergency

Operating Sequence: Radwaste Discharge

Operating Sequence ID: 25

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Terminate emergency status ------------------------- To return to normal administrative and communication status	Activity of release less than Technical Specification limits		Plant Communications System
7	Fill out forms ------------------------- To comply with regulations	Operating practice		

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Reactor Coolant Pump Bus Protection Supply Breaker

Operating Sequence ID: 26

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Determine time required to complete maintenance ------------------------ To ensure conformance to technical specifications	Work request from Electrical Maintenance Section		
2	Prepare clearance and tags ------------------------ To ensure proper isolation of equipment	Procedure	AP.4 Administrative Clearance Procedure	
3	Dispatch PEO to isolate 6.9 kV bus protection supply breaker ------------------------ To allow maintenance to be performed safely	Procedure	AP.4 Administrative Clearance Procedure	Plant Communications System
4	Communicate with Maintenance Section ------------------------ To authorize maintenance	Return of clearance authorization form to control room	AP.4 Administrative Clearance Procedure	Plant Communications System
5	Remove maintenance clearance ------------------------ To prepare for test of 6.9 kV bus protection supply breaker	Completion of maintenance	AP.4 Administrative Clearance Procedure	Plant Communications System

TASK SEQUENCE CHART

Plant: 15

Operator Function/Subfunction: Maintain Plant Systems and Equipment/Implement Maintenance

Operating Sequence: Maintain Reactor Coolant Pump Bus Protection Supply Breaker

Operating Sequence ID: 26

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Prepare test tagout ------------------------ To permit test to be performed safely	Request from Electrical Maintenance Section Foreman	AP.4 Administrative Clearance Procedure	
7	Communicate with Maintenance Section ------------------------ To authorize test	Tags hung	AP.4 Administrative Clearance Procedure	Plant Communications System
8	Remove test tags and rack in breaker ------------------------ To restore equipment to service	Completion of Electrical testing and return of test authorization form	AP.4 Administrative Clearance Procedure	6.9 kV Electrical System, In-Plant Communications System
9	Fill out Control Room Operator's Log and Shift Relief Sheet ------------------------ To comply with administrative procedures	Procedure	(Procedure unavailable)	

5. PLANT 45

The data contained in this section are:

- Plant description (page 5-1)
- Panel layouts and designators (page 5-2)
- System nomenclature and numbering (page 5-5)
- Operating Sequence Overviews (page 5-10)
- Task Sequence Charts (page 5-13)

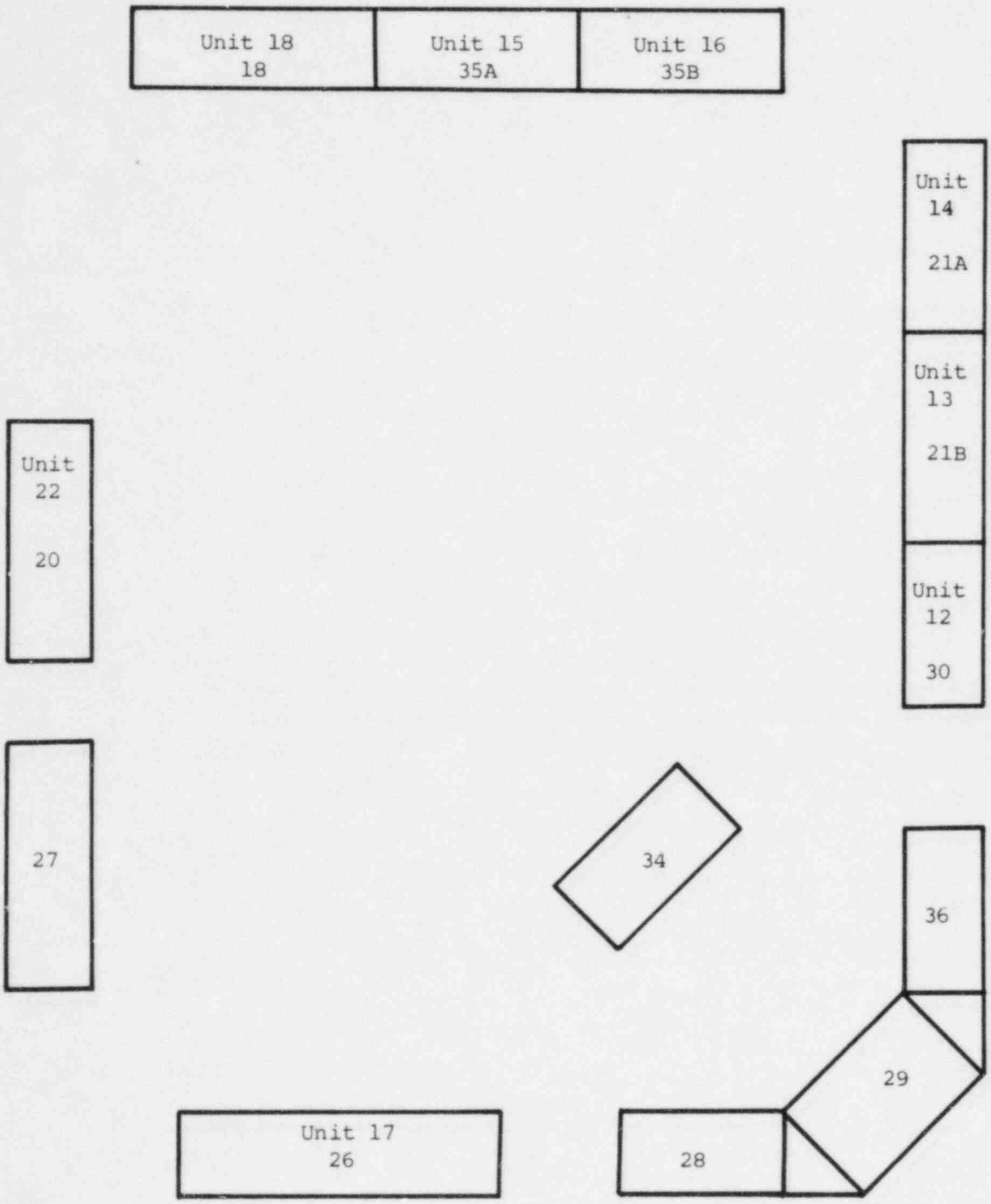
The following operating sequences were observed at Plant 45:

- 9 High Pressurizer Level
- 10 Station Blackout
- 13 Steam Generator Tube Rupture

Plant 45, Unit 1 is a Babcock and Wilcox pressurized water reactor with a Westinghouse turbine-generator. The architect-engineer is UE&C. The plant is under construction. The control room is a single-unit control room. The data were collected at the Unit 1 simulator.

Plant 45 Panel/System	Number Assigned
Unit 22 - Station Auxiliary Power Supply Panel ● 230 KV ● 25KV ● 13.8 KV ● 4.16 KV ● 480 volts	20
Unit 18 - Class 1E Emergency Power ● Diesel Generators	18
Unit 15 - Engineered Safety Features Panel "A" Side ● Active Safety Injection Systems "A" - High Pressure Safety Injection "A" - Low Pressure Safety Injection "A" - Containment Spray "A" ● Safety Equipment Status	35A
Unit 16 - Engineered Safety Features Panel "B" Side ● Active Safety Injection Systems "B" - High Pressure Safety Injection "B" - Low Pressure Safety Injection "B" - Containment Spray "B" ● Safety Equipment Status	35B
Unit 14 SCI Panel X ● Passive Safety Injection System - Safety Injection Tanks ● Safety Systems and Support Systems - Component Cooling - Decay Heat Removal - Make Up and Purification - Post Accident Monitoring	21A
Unit 13 SCI Panel Y ● Low Pressure Safety Injection System - Safety Injection Tanks ● Safety and Support Systems - Component Cooling - Decay Heat Removal - Make Up & Purification - Post Accident Monitoring	21B

Plant 45 Panel/System	Number Assigned
Unit 12 Primary System • Safety and Support Systems - Reactor Coolant Pumps - Make Up & Purification - N_2/H_2 addition - Nuclear Cooling Water	30
Control Console Left • Make Up and Purification - Reactor Coolant System - Changing and Letdown - Boric Acid - Pressurizer Control	36
Left Wedge • Nuclear Instruments • Reactor Coolant System	29
Control Console Center • Reactor Control • Integrated Control System • Reactor Coolant System • Feedwater • Main Steam	29
Right Wedge • Main Feedpump Trip Switches • Safety Equipment Status	29
Control Console Right • Turbine Generator System • Turbine Generator Supervisory	28
Unit 17 Turbine Generator Console • Main Steam • Extraction Steam • Feedwater • Turbine Gen. Supervisory	26
Secondary Plant Systems • Condensate • Auxiliary Steam • Cooling Water • Circulating Water	27
Supervisors Console • Plant Monitoring CRT • Communications	34



Plant 45 Simulator Layout

Plant 45 System Name	ABBR	INPO SYSTEM NUMBER & NAME
Area radiation monitoring system	ARMS	72. Area radiation monitoring system
ASHE substations		62. AC electrical distribution
Auxiliary boiler system		44. Auxiliary steam generating system
Auxiliary feedwater system	AFW	61. Auxiliary/emergency feedwater system
Auxiliary power network 120/125-250V AC/DC	APN	63. DC electrical distribution system
Auxiliary power network 120/125-250V AC/DC	"	62. AC electrical distribution system
Auxiliary power network 4160V, 480V	"	62. AC electrical distribution system
Auxiliary power network 13.8KV	"	62. AC electrical distribution system
Auxiliary steam system	AS	42. Low pressure steam system
Auxiliary steam system		44. Auxiliary steam generating system
BOP service water system	SW	65. Service water system
Boron recovery system	BR	68. Liquid rad waste system
Chemical addition and boron recovery system		9. Primary chemical addition system
Chemical feed system		56. Condensate system
Circulating water chlorination and chemical treatment system		80. Chlorination system
Circulating water chlorination and chemical treatment system	CWS	75. Circulating water system
Communications system		85. Communications system
Component cooling system	CCW	8. Component cooling system
Condensate polishing system		57. Condensate demineralizer system
Condensate system		56. Condensate system

Plant 45 System Name	ABBR	INPO SYSTEM NUMBER & NAME
Condenser air removal system	CAR	55. Condenser air removal system
Containment entry and exit		21. Containment entry and exit
Containment equipment		7. Pressurizer relief/quench tank
Containment spray system		26. Containment spray system
Control rod drive cooling	CRDCS	8. Component cooling system
Control rod drive system	CRDS	1. Control rod drive system
Core flood system	CF	6. Safety injection system
Decay heat removal system	DHR	5. Residual heat removal system
Decontamination system		69. Liquid rad waste system
D/G fuel oil system		64. Emergency diesel generator system
D/G jacket cooling system		64. Emergency diesel generator system
D/G lube oil system		64. Emergency diesel generator system
D/G starting air system		64. Emergency diesel generator system
Electrical heat tracing system		67. Electrical heat tracing system
Emergency diesel generator system	DG	64. Emergency diesel generator system
Emergency shutdown service water system		76. Service water system
Engineered safety features actuation system	ESFAS	13. Engineered safety features actuation system
Exhaust hood spray system		51. Exhaust hood spray system
Extraction steam system	ES	43. Extraction steam system
Failed fuel detection system		20. Gross failed fuel detector
Feedwater heater vent and drain system		60. Feedwater heater vent and drain system
Fire protection system		86. Fire protection system

Plant 45 System Name	ABBR.	INPO SYSTEM NUMBER & NAME
Fuel handling equipment		34. Fuel handling equipment
Generator bus duct cooling system		54. Generator bus duct cooling system
High pressure steam trap release system		60. Feedwater heater vent and drain system
High volts network 500KV, 230FV, 25KV	HVN	62. AC electrical distribution system
Hydrogen and carbon dioxide systems		81. Hydrogen gas storage system
Hydrogen control system		28. Hydrogen recombiner and purge systems
In-core temperature monitor		17. In-core temperature monitor
Instrument air system	IA	78. Instrument air system
Integrated control system	ICS	41. Steam dump/turbine bypass control system (reactor regulating system/integrated control system)
L.P. steam trap return system		60. Feedwater heater vent and drain system
Liquid rad waste system	LRW	68. Liquid rad waste system
Loose parts monitoring system		18. Loose parts monitoring system
Main feedwater system	FW	59. Main feedwater system
Main generator hydrogen and carbon dioxide gas system		52. Main generator hydrogen and carbon dioxide gas system
Main steam	MS	39. Main and reheat steam system
Main turbine electro-hydraulic control system	EHC	48. Main turbine electro-hydraulic control system
Main turbine generator	MTG	45. Main turbine generator
Make up and purification	M&P	4. Chemical and volume control system
Make up and purification	M&P	19. Boronometer

Plant 45 System Name	ABBR.	INPO SYSTEM NUMBER & NAME
Make up water demineralization system		58. Condensate precoat filter system
Make up water pretreatment system		76. Service water system
Moisture separator-reheater drains and vents		60. Feedwater heater vent and drain system
Nitrogen blanketing system		82. Nitrogen system
Nuclear instrument air system	NIA	78. Instrument air system
Nuclear instrumentation system	NIS	15. Nuclear instrumentation system
Nuclear services water systems	NSWS	8. Component cooling system
Once-through steam generator system	SG	35. Steam generator system
OTSG heat-up circulating system		38. Steam generator blowdown system
Plant computer		83. Plant computer
Plant ventilation systems		88. Plant ventilation systems
Pressurizer relief/quench tank		7. Pressurizer relief/quench tank
Primary gas supply system		82. Nitrogen system
Process radiation monitoring system	PRMS	73. Process radiation monitoring system
Radioactive gaseous waste		71. Waste gas disposal system
Radioactive solid waste system		
Radioactive vents and drains system vent discharge		
Reactor coolant pump operation	RCP	3. Reactor coolant pump operation
Reactor coolant system	RCS	2. Reactor coolant system
Reactor coolant system instrumentation	RCSI	16. Non-nuclear instrumentation system
Reactor coolant system instrumentation	RCSI	11. Pressurizer level control system
Reactor coolant system instrumentation	RCSI	10. Pressurizer pressure control system

Plant 45 System Name	ABBR.	INPO SYSTEM NUMBER & NAME
Reactor protection system	RPS	12. Reactor protection system
Rod position indication system	RPIS	14. Rod position indication system
Seal oil system		50. Seal oil system
Seismic monitoring equipment		84. Seismic monitoring equipment
Service air system	SA	79. Station air system
Service water system		74. Secondary equipment closed cooling system
Shutdown cooling water	SCW	8. Component cooling system
Spent fuel pool cooling and purification		33. Spent fuel pool cooling
Turbine/bypass control system	TBCS	41. Steam dump/turbine bypass control system
Turbine cross around steam	MTG	39. Main and reheat steam system
Turbine gland seal and exhaust system	GS	46. Main turbine and steam generator feed pump steam seal system
Turbine lube oil purification and transfer system	LOT	47. Main turbine generator lube oil system
Turbine plant sampling system		36. Turbine plant sampling system
Vital power network 120/125V AC/DC		62. AC electrical distribution system

Operating Sequence Overview

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

NSSS/Type: B&W/PWR

Operating Sequence ID: 09

CR Type: Single

Operating Sequence: High Pressurizer Level

Initial Conditions: The plant is operating at 90% power, in a steady state condition, with normal pressurizer (PZR) level and normal reactor coolant system (RCS) pressure and temperature.

Sequence Initiator: The PZR level control valve fails open due to a controller malfunction, causing a rapid increase in PZR level. A "Normal Makeup Flow High" alarm is received.

Progression of Action: The crew examines parameters to assess the alarm condition. The crew takes manual control of the PZR level control valve and attempts unsuccessfully to close it. The crew closes the PZR makeup isolation valve to stop flow. A Reactor Operator (RO) is dispatched to the instrument room to investigate the controller problem. The crew adjusts letdown flow from the control room to reduce PZR level in a controlled manner. The RO finds a controller module loose in the rack. An instrumentation and control (I&C) technician replaces the module, correcting the problem. The crew reestablishes makeup flow, places the PZR level control system back in automatic, and increases letdown to restore the system to normal operating status.

Final Conditions: The plant continues to operate at 90% power. Normal PZR level has been reestablished. The PZR level controller is functioning properly in automatic. Normal makeup and letdown have been reestablished.

Major Systems: Pressurizer (PZR) Level Control, PZR Pressure Control, Makeup and Purification (M&P), Reactor Coolant System (RCS), In-Plant Communications System, Off-site Communications System.

Operating Sequence Overview

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: B&W/PWR

Operating Sequence ID: 10

CR Type: Single

Operating Sequence: Station Blackout

Initial Conditions: The plant is at 90% power with a normal line-up. All safety and required auxiliary systems are operable.

Sequence Initiator: Turbine generator trip concurrent with a loss of off-site power.

Progression of Action: The crew verifies the turbine trip and reactor trip. The crew verifies loss of off-site power by noting loss of normal control room lighting and illumination of emergency lights, and loss of power to bus. The crew verifies that an auxiliary (emergency) feedwater (AFW) pump starts automatically. the crew monitors auxiliary feedwater flow to ensure that steam generator (SG) pressure is maintained to within 100 pounds of desired pressure. Fifteen seconds into the sequence, the crew observes that the diesel generators have not started. Manually starting the diesels from the control room is unsuccessful. A Plant Equipment Operator (PEO) is dispatched to diesel room to attempt to start generators, and a second PEO is dispatched to monitor AFW system operation. The Shift Superintendent declares a site alert. When the diesel generator problem has been repaired, a Reactor Operator (RO) is dispatched to start the generators in the diesel room.

The crew begins evaluating primary system status and important secondary plant conditions (e.g., emergency bearing oil pump, turning gear engaged). The crew verifies that natural circulation has been established and steam generator water level is being maintained in a normal band.

Six minutes into the accident, the crew successfully starts the diesels, the 4.16-kv emergency power busses are energized, and load sequencing begins. The crew verifies that all engineered safety features (ESF) equipment has started.

Final Conditions: Reactor coolant system makeup flow has been restored. Heat removal from the primary system is under control. ESF and safeguard equipment is available and the plant is ready to commence cooldown to cold shutdown. Off-site power has not been restored.

Major Systems: Main Turbine Generator (MTG), Reactor Protection System (RPS), Diesel Generator Systems (DG), Control Rod Drive System (CRDS), Auxiliary Feedwater System (AFW), Reactor Coolant System (RCS), Generator Seal Oil System, Main Turbine Generator Lube Oil System, Makeup and Purification System (MUP), 4.16kV Power, High Voltage Network (HVN), Steam Dump Control System (SDCS), Reactor Coolant System Instrumentation (RCSI).

Operating Sequence Overview

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: B&W/PWR

Operating Sequence ID: 13

CR Type: Single

Operating Sequence: Steam Generator Tube Rupture

Initial Conditions: The plant is operating at 90% power in a steady state condition. The integrated control system is in full automatic.

Sequence Initiator: A tube rupture in steam generator "A" results in radioactive steam being supplied to the main condenser. The leak is considerably greater than 1 gpm (2200 gpm), but within the capacity of the makeup pump to control reactor coolant system pressure and pressurizer level. The crew is initially alerted to the problem by the radioactive gas effluent monitor trouble alarm. The condenser vacuum pump discharge alarm comes in shortly thereafter.

Progression of Action: The Shift Supervisor dispatches an Auxiliary Operator (PEO) to examine radiation monitoring system indications in-plant, while the crew examines relevant system parameters to verify alarms and identify the plant condition. Recognizing that a steam generature tube rupture has occurred, the crew commences an orderly shutdown and cooldown at the maximum allowable rate. The Shift Supervisor notifies the Shift Superintendent of the emergency, who then assumes the duties of Emergency Coordinator, notifies plant personnel, and implements the Emergency Plan. Pressurizer level falls, but is maintained above 160 inches through high pressure injection from the borated water storage tank. Letdown is isolated, and makeup tank level is maintained above 40 inches by injecting through the boric acid pumps and the rad waste pumps. The subcooling margin is maintained at greater than $50^{o}F$. The turbine is taken off the line and the reactor is tripped. The crew identifies and isolates the faulted steam generator.

Final Conditions: The faulted steam generator has been isolated and the turbine has been taken off the line. Normal shutdown and cooldown continue. The Emergency Plan continues in effect.

Major Systems: Area Radiation Monitoring System (ARMS), Process Radiation Monitoring System (PRMS), Reactor Coolant System (RCS), Reactor Coolant System Instrumentation System (RCSI), Makeup and Purification System (MUP), Integrated Control System (ICS), Main Turbine Generator System (MTG), Nuclear Instrumentation System (NIS), Rod Position Indication System (RPIS), Main Steam (MS), Steam Generating System (SG), Control Rod Drive Control System (CRDS), Main Feedwater (MFW), Steam Dump Control System (SDCS), Decay Heat Removal System (DHR), Eletro-hydraulic Control System (EHC).

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine pressurizer level control parameters ------------------------- to determine plant condition	Normal makeup flow high alarm		Makeup & Purification System, Reactor Coolant System Instrumentation System
2	Operate pressurizer level controller in manual ------------------------- to reduce makeup flow	Apparent controller malfunction in automatic		Reactor Coolant System Instrumentation
3	Close pressurizer makeup isolation valve ------------------------- to stop makeup flow	Inability to control excessive makeup flow		Makeup and Purification System, Reactor Coolant System Instrumentation System
4	Communicate with Shift Supervisor ------------------------- to report plant condition	Operating practice		Communications System
5	Monitor pressurizer parameters ------------------------- to assure parameters stabilize	Operating practice		Reactor Coolant System, Instrumentation System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Dispatch reactor operator to investigate controller malfunction ---------- to diagnose condition	Operating practice		
7	Communicate with load dispatcher ---------- to allow coordination of power grid	Operating practice		Communications System
8	Reduce letdown flow ---------- to control reduction of pressurizer level	Pressurizer level decreasing		Makeup and Purification System
9	Operate pressurizer level controller in manual ---------- to test equipment operability	RO-2 report: control module replaced		Reactor Coolant System Instrumentation System
10	Close pressurizer level control valve ---------- to prevent makeup when makeup isolation valve is opened	Operating practice		Reactor Coolant System Instrumentation System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: High Pressurizer Level

Operating Sequence ID: 09

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Open pressurizer makeup isolation valve -------------------- to restore system to normal operating status	Pressurizer level reduced to desired level; controller operability restored		Makeup and Purification System, Reactor Coolant System Instrumentation System
12	Operate pressurizer level controller in manual -------------------- to verify flow control	Operating practice		Reactor Coolant System, Instrumentation System
13	Place pressurizer level controller in automatic -------------------- to restore system to normal operating status	Operating practice		Reactor Coolant System Instrumentation System
14	Increase letdown flow -------------------- to restore system to normal operating status	Operating practice		Makeup and Purification System, Reactor Coolant System Instrumentation System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate a loss of off-site power ------------------------ to identify plant conditions	Annunciators		Reactor Protection System, Main Turbine Generator, High Voltage Network
2	Verify reactor trip ------------------------ to assure automatic safety features actuation	Procedure		Control-Rod Drive Control System, Nuclear Instrumentation System
3	Examine turbine generator indications ------------------------ to verify turbine generator trip	Operating practice		Electro-Hydraulic Control System, Main Steam System
4	Start D.C. emergency oil pumps ------------------------ to prevent equipment damage	Procedure		Main Turbine Generator Lube Oil System, Generator Seal Oil System, Main Feedwater System
5	Recognize that diesel generators fail to start ------------------------ to determine need for manual activation of diesel gneerators	Control room lighting not restored		Diesel Generator System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Examine Main Steam System indications ------------------------- to verify that atmospheric steam dump valves open	Procedure		Main Steam System
7	Isolate letdown system ------------------------- to maintain water inventory in the primary system	Procedure		Makeup & Purification System
8	Verify isolation of 4.16 kV buses from normal and standby sources of power ------------------------- to prevent equipment damage when diesel starts	Procedure		Auxiliary Power Network 4160V
9	Verify auxiliary feedwater flow ------------------------- to ensure adequate heat sink for primary system	Procedure		Auxiliary Feedwater System
10	Attempt to manually start diesel generators ------------------------- to assure power to vital systems	Procedure		Diesel Generator System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Verify acceptable containment radiation levels ------------------------- to assure that fuel has not been damaged	Operating practice		Area Radiation Monitoring System
12	Shut seal return valve ------------------------- to protect reactor coolant pump	Procedure		Makeup and Purification
13	Monitor plant parameters ------------------------- to verify adequate core cooling	Operating practice		Reactor Coolant System Instrumentation, Main Steam System
14	Inform plant personnel of unit status ------------------------- to initiate proper emergency response and dispatches	Procedure		Plant Communications System
15	Dispatch a plant equipment operator ------------------------- to respond to diesel generator failure	Inability to manually start DG in CR		Diesel Generator System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Dispatch PEO to monitor operation of auxiliary feedwater system ------------------------ to assure proper operation	Operating practice		Plant Communications System
17	Verify auxiliary feedwater operation ------------------------ to assure adequate heat sink for primary system	Procedure		Auxiliary Feedwater System, Main Steam System
18	Communicate with load dispatcher ------------------------ to allow coordination of power grid	Operating practice		Plant Communications System
19	Declare site alert status ------------------------ to coordinate emergency operations	Procedure		
20	Review pertinent procedures ------------------------ to verify correct immediate actions taken	Operating practice		
21	Direct Reactor Operator to start diesel generators locally ------------------------ to restore power to 4.16 kV buses	Generator problem has been corrected		

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22	Inform plant personnel that diesel generators have been started --- to prepare for automatic actuation of equipment	Operating practice		Plant Communications System
23	Examine electrical board indications --- to verify that emergency power has been restored	Diesel generator activation		Diesel Generator System, Auxiliary Power Network 4160V
24	Direct chemistry section to sample reactor coolant system --- to determine boron concentration	Operating practice		Plant Communications System
25	Examine makeup and purification system indications --- to verify power restored to vital equipment	Operating practice		
26	Verify automatic restoration of makeup flow --- to assure pressurizer level restored	Procedure		Makeup & Purification System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine radiation monitoring system indications ------------------------ to identify plant condition	Radiation monitoring system alarm	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Area Radiation Monitoring System, Process Radiation Monitoring System
2	Examine reactor coolant system indications ------------------------ to verify reactor coolant system integrity	Procedure	Emergency Procedures Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Reactor Coolant System
3	Recognize that cues indicate a steam generator tube rupture ------------------------ to identify appropriate procedures and follow-up actions	High radiation decreasing P2R level, P2R level control valve opening	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Reactor Coolant System, Reactor Coolant System Instrumentation System
4	Operate the integrated control system ------------------------ to reduce reactor power and turbine load	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Integrated Control System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Communicate with supervisory personnel ------------------------ to report plant condition	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Communications System
6	Calculate leak rate ------------------------ to determine size of leak	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Plant Computer
7	Implement Emergency Plan ------------------------ to activate emergency response teams	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Communications System
8	Examine pressurizer, reactor coolant system, and makeup parameters ------------------------ to estimate magnitude of tube rupture	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Reactor Coolant System, Makeup & Purification System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Communicate with Load Dispatcher ------------------------- to allow coordination of power grid	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Off-site Communications System
10	Provide alternate water Source to Reactor Coolant System ------------------------- to conserve makeup tank inventory	Operating practice		Reactor Coolant System, Makeup & Purification System
11	Dispatch plant personnel to sample and test steam generator air and water ------------------------- to identify faulted steam generator	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Communications System
12	Supply hydrogen gas to the makeup tank ------------------------- to ensure adequate makeup tank pressure	Operating practice		Makeup & Purification System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Monitor Makeup, pressurizer, and reactor coolant system parameters ------------------------ to assure parameters remain within normal limits for cooldown	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Reactor Coolant System, Reactor Coolant System Instrumentation System Makeup & Purification System
14	Isolate letdown ------------------------ to terminate radioactive release	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Makeup & Purification System
15	Transfer feedwater heater steam supply to main stream ------------------------ to ensure steam supply to feedwater heaters as turbine is brought off line	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Extraction Steam System Main Steam System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Close atmospheric dump valve on affected steam generator ------------------------ to limit radioactive release	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Steam Dump Control System
17	Monitor and compare steam generator parameters ------------------------ to confirm identification of the faulted steam generator	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Steam Generating System, Main Feedwater System
18	Dispatch Plant Equipment Operator to place auxiliary boiler in service ------------------------ to maintain source of steam	Procedure	Emergency Procedures, Section 5, Loss of Reactor Coolant/ Reactor Coolant Pressure	Communications System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
19	Manually Operate the Diamond Rod Control ------------------------ To allow controlled shutdown of reactor	Procedure	3.100.5 Plant Shutdown	Control Rod Drive System
20	Monitor secondary plant parameters ------------------------ to asssure that parameters remain within expected limits	Procedure	3.100.5 Plant Shutdown	Main Feedwater System, Main Steam System, Steam Dump Control System
21	Monitor steam generator parameters ------------------------ to assure parameters remain within normal limits for cooldown	Procedure	3.100.5 Plant Shutdown	Main Steam System, Main Feedwater System
22	Shut down one main feedwater pump ------------------------ To remove nonessential equipment from service	Power at 250 MW	3.100.5 Plant Shutdown	Main Feedwater System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23	Shut down a condensate pump ------------------------ To remove non essential equipment from service	Power at 250 MW	3.100.5 Plant Shutdown	Condensate System
24	Shut down one heater drain pump ------------------------ To remove nonessential equipment from service	Power at 250 MW	3.100.5 Plant Shutdown	Feedwater Heater Vent and Drain System
25	Trip the turbine ------------------------ To shutdown in a controlled manner	Procedure	3.100.5 Plant Shutdown	Electrohydraulic Control System
26	Trip the reactor ------------------------ To continue plant cooldown	Procedure	3.100.5 Plant Shutdown	Reactor Protection System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
27	Control pressurizer level ------------------------ To maintain adequate reactor coolant system volume	Procedure	3.100.5 Plant Shutdown	Makeup & Purification System
28	Reduce reactor coolant system pressure and temperature ------------------------ To continue plant cooldown	Procedure	3.100.5 Plant Shutdown	Reactor Coolant System
29	Verify source range monitoring system energized ------------------------ To assure performance as expected	Operating practice		Source Range Monitoring System
30	Trip reactor coolant system pumps ------------------------ To reduce heat load	Procedure	3.100.5 Plant Shutdown	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
31	Operate turbine bypass valves ------------------------ To increase cooldown rate	Operating practice		Main Steam System
32	Operate chemical addition and Boron Recovery System ------------------------ To supply Borated water to makeup Tank	Operating practice		Chemical Addition and Boron Recovery System Makeup & Purification System
33	Reduce feedwater valve differential pressure ------------------------ To maintain differential pressure within normal range	Procedure	3.100.5 Plant Shutdown	Main Feedwater System
34	Supply primary water to makeup tank ------------------------ To increase makeup tank inventory	Operating practice		Makeup & Purification System

TASK SEQUENCE CHART

Plant: 45

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Steam Generator Tube Rupture

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
35	Bypass high pressure safety injection ------------------------ To prevent inadvertent emergency safety features actuation	Procedure	3.100.5 Plant Shutdown	Engineered Safety Features Actuation System
36	Initiate auxiliary pressurizer spray to reduce reactor coolant system pressure and temperature	Operating practice		Reactor Coolant System, Decay Heat Removal System
37	Isolate the faulted steam generator ------------------------ To limit radioactive release	Procedure	Emergency Procedures Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Reactor Coolant System, Main Feedwater System, Main Steam System, Auxiliary Feedwater System
38	Monitor isolated steam generator ------------------------ To assure radioactive release has been terminated	Procedure	Emergency Procedures Section 5, Loss of Reactor Coolant/Reactor Coolant Pressure	Steam Generating System

6. PLANT 65

The data contained in this section are:

- Plant description (page 6-1)
- Panel layouts and designators (page 6-2)
- System nomenclature and numbering (page 6-5)
- Operating Sequence Overviews (page 6-7)
- Task Sequence Charts (page 6-10)

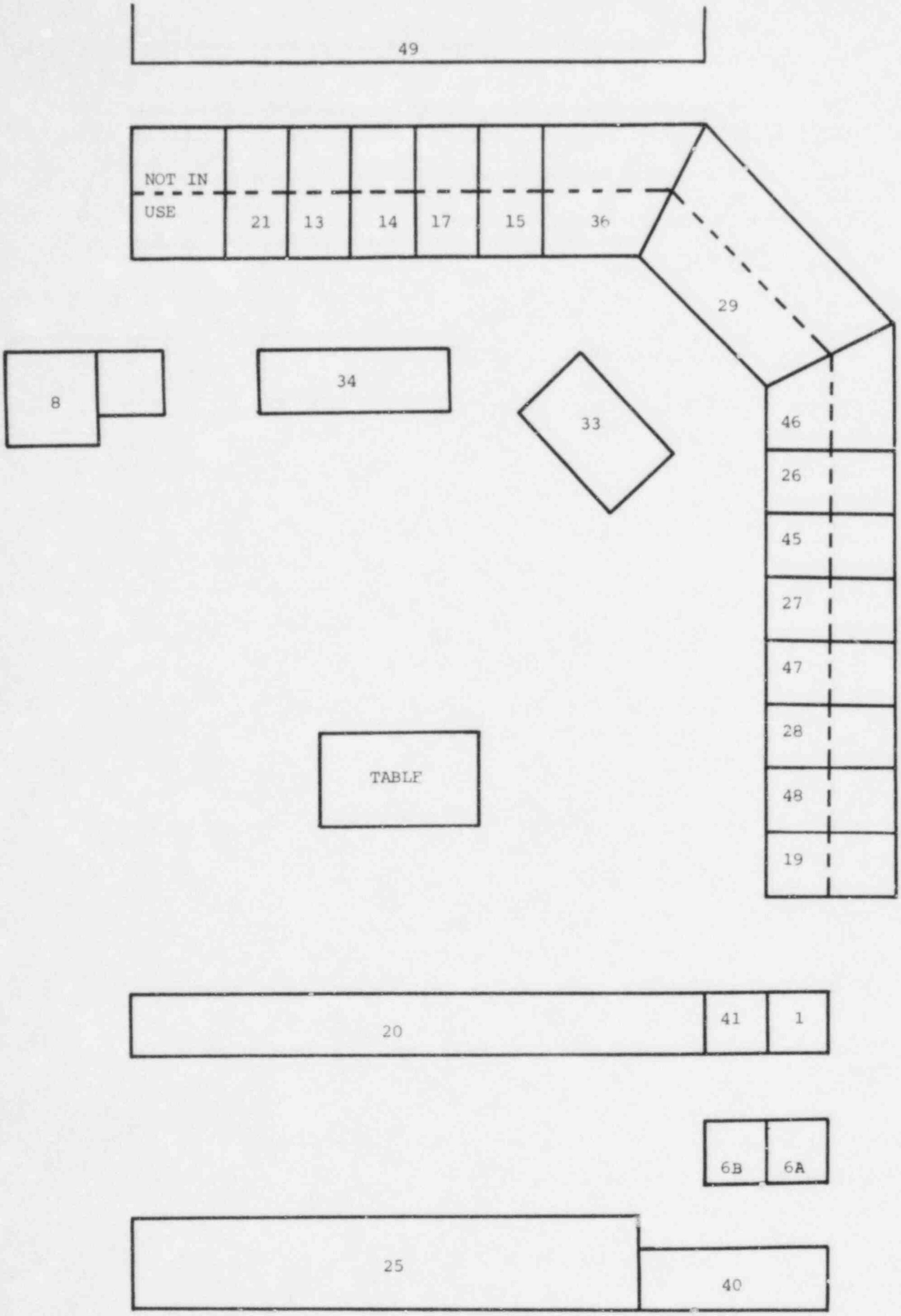
The following operating sequences were observed at Plant 65:

- 6 Nuclear Instrument Malfunction
- 13 Steam Generator Tube Rupture
- 15 Loss-of-Coolant Accident

Plant 65, Unit 1 is a Westinghouse pressurized water reactor with a General Electric turbine-generator. The architect-engineer is Bechtel. The plant is under construction with licensing estimated for 1984. The control room is a multiple-unit control room. The data were collected at the Unit 1 simulator.

Plant 65 Panel/System	Number Assigned
Cooling Water Systems • Circulating water system • Component cooling water • Nuclear service cooling water	21
Containment Systems	13
Containment Spray System	14
Safety Injection	17
Residual Heat Removal System	15
Chemical & Volume Control System	36
Reactor Control • Rod control system • Reactor coolant system • Pressurizer	29
Steam Control Systems • Steam generators • Steam dump control system • Main steam isolation valves	46
Feedwater System	26
Auxiliary Feedwater System	45
Condensate System	27
Main Turbine Steam • Main steam, reheat steam • Extraction steam and drains	47
Electrohydraulic Control System	28
Main Condenser	48
Main Generator	19
Radiation Monitoring System CRT	8
Computer Console	34
SS Desk/Computer Console	33
Electrical Distribution	20
System Status Monitoring Panel	41

Panel 65 Panel/System	Number Assigned
Radiation Monitoring System Status	1
Incore Instrumentation	6a
Core Thermocouples	6b
Nuclear Instrumentation Cabinets	40
Plant Heating and Ventilation Systems	25
Miscellaneous & Balance of Plant Equipment Monitoring	49



Plant 65 Control Room Layout

Plant 65 System Name	ABBR.	INPO System Number & Name
AC electrical distribution system	ACED	62. AC electrical distribution system
Auxiliary boiler system	AB	44. Auxiliary steam generating system
Auxiliary feedwater system	AFW	61. Auxiliary/emergency feedwater system
Chemical and Volume control system	CVCS	4. Chemical and volume control system
Circulating water system	CWS	75. Circulating water system
Component cooling water system	CCW	8. Component cooling system
Condensate system	COND	56. Condensate system
Condenser steam jet air ejectors/vacuum pump	CAR	55. Condenser air removal system
Containment system	CTMT	103. Containment system
Containment ventilation system	CVS	29. Containment purge system
Diesel generator system	DG	64. Emergency diesel generator system
Electro-hydraulic control system	EHC	48. Main turbine electro-hydraulic control system
Extraction steam system	ES	43. Extraction steam system
Feedwater heater vent and drain system	FHVD	60. Feedwater heater vent and drain system
Feedwater system	FW	59. Main feedwater system
Gland sealing steam system	GS	46. Main turbine and steam generator feed pump steam seal system
In-core instrumentation system	INCORE	17. In-core temperature monitor
Instrument air system	IA	78. Instrument air system
Main generator	MG	45. Main turbine generator
Main steam system	MS	39. Main and reheat steam system

Plant 65 System	ABBR.	INPO System Number & Name
Main Turbine	MT	45. Main turbine generator
Nuclear instrumentation system	NIS	15. Nuclear instrumentation system
Nuclear service cooling	NSCW	76. Service water system
Pressurizer and pressure relief system	PZR	2. Reactor coolant system 7. Pressurizer relief/quench tank
Pressurizer level control	PZR-LC	11. Pressurizer level control system
Pressurizer pressure control system	PZR-PC	20. Pressurizer pressure control system
Radiation monitoring system	RMS	72. Area radiation monitoring system 73. Process radiation monitoring system
Reactor coolant pressure and temperature instrumentation	RCI	16. Non-nuclear instrumentation system
Reactor coolant system	RCS	2. Reactor coolant system 3. Reactor coolant pump operation
Residual heat removal system	RHR	5. Residual heat removal system
Rod control system	--	1. Control rod drive system
Rod position indication system	RPIS	14. Rod position indication system
Safety injection system	SI	6. Safety injection system
Solid-state protection system	SSPS	12. Reactor portection system 13. Engineered safety features actuation system 40. Main steam isolation valve activating system
Steam dump control system	SDCS	41. Steam dump/turbine bypass control system
Steam generator blowdown system	SGBD	38. Steam generator blowdown system
Steam generator system	SG	35. Steam generator system
Steam generator water level control system	SGLC	59. Main feedwater system

Operating Sequence Overview

Plant: 65

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to a Safe Condition

NSSS/Type: W/PWR

Operating Sequence ID: 06

CR Type: Multiple

Operating Sequence: Nuclear Instrument Malfunction

Initial Conditions: The plant is in Mode 1 at 60% power. The rod control system is in automatic.

Sequence Initiator: Power range nuclear instrument channel N-43 fails high due to a lower detector failure.

Progression of Action: Responding to incoming alarms and automatic control rod insertion, the crew diagnoses a nuclear instrumentation system (NIS) channel failure and takes manual control of the rod control system. The failed NIS channel is placed in a tripped condition and the Instrumentation and Controls (I&C) Department is dispatched to investigate the cause of the failure. The crew stabilizes plant conditions and places the rod control system in automatic. To verify proper automatic operation of the rod control system the crew raises power to 70%. The I&C Department reports the cause of the malfunction is a failed lower detector and is directed to replace it. After the detector is replaced and the NIS channel tested, the crew takes manual control of the rod control system and returns the tripped channel to service. The rod control system is returned to automatic operation.

Final Conditions: The plant is in Mode 1 at 70% power. All four power range NIS channels are functioning. The rod control system is in automatic.

Major Systems: Nuclear Instrumentation System (NIS), Rod Control System, Main Turbine Control System (EHC), Main Generation System (MG), Feedwater System (FW).

Operating Sequence Overview

Plant: 65

Operator Function/Subfunction: Restore Plant to a Safe Condition/Mitigate Consequences of an Accident

NSSS/Type: W/PWR

Operating Sequence ID: 13

CR Type: Multiple

Operating Sequence: Tube Ruptures - Steam Generators

Initial Conditions: The plant is operating at full power with a normal line-up.

Sequence Initiator: A double-ended shear tube rupture in one steam generator resulting in a high radioactivity in the secondary plant and a rapid decrease in pressurizer pressure and level.

Progression of Action: Responding to incoming alarms, the crew establishes maximum charging flow and manually trips the reactor. The crew verifies the manual reactor trip and associated turbine-generator trip. Evaluating available indications, the crew diagnoses a tube rupture in one steam generator, then isolates the fualted steam generator, isolates letdown, and trips the reactor coolant pump in the affected loop. The crew depressurizes and cools down the reactor coolant system, using the steam dump system and pressurizer spray valves. The crew manually initiates safety injection. The crew begins a balance of plant shutdown. When plant conditions stabalize, the crew resets and terminates safety injection, establishes normal charging and letdown flows, trips all but one of the remaining reactor coolant pumps, performs a shutdown margin calculation, and begins a controlled cooldown to cold shutdown conditions.

Final Conditions: The reactor and turbine-generator are shutdown, one steam generator is isolated, plant cooldown in progress on the remaining three steam generators using the steam dump system, main condenser and the auxiliary feedwater system. Safety injection has been reset and terminated. Normal charging and letdown have been established. A balance-of-plant shutdown is in progress.

Major Systems: Reactor Coolant System (RCS), Steam Generating System (SG), Safety Injection System (SI), Auxiliary Feedwater System (AFW), Main Steam System (MS), Main Feedwater System (FW), Condensate System, Steam Dump Control System (SDCS), Pressurizer Pressure Control System, Pressurizer Level Control System, AC Electrical Distribution System (ACED), Main Turbine (MT), Main Generator (MG).

Operating Sequence Overview

Plant: 65

Operator Function/Subfunction: Restore Plant to a Safe Condition/Mitigate Consequences of an Accident

NSSS/Type: W/PWR

Operating Sequence ID: 15

CR Type: Multiple

Operating Sequence: Loss of Coolant Accident

Initial Conditions: The plant is operating at full power with a normal lineup.

Sequence Initiator: An unisolatable small break loss of coolant accident inside containment results in a rapid decrease in pressurizer pressure and level.

Progression of Action: The crew attempts to control the level and pressure transient by starting additional charging pumps and reducing power. When this action is unsuccessful, the crew trips the reactor and turbine. An automatic safety injection (SI) actuation on low pressure follows. The crew verifies the reactor and turbine trips and actuation of safety systems. Evaluating available indications, the crew diagnoses a small break loss of coolant accident inside containment. At the low pressure limit the crew trips all reactor coolant pumps and establishes natural circulation flow. When pressure stabilizes and pressurizer level returns to normal the crew prepares to cooldown and depressurize the plant by resetting and stopping SI and restarting one reactor coolant pump. The reactor cooldown and depressurization is started using the atmospheric steam dumps and pressurizer spray. The safety injection accumulators are isolated.

Final Conditions: Plant cooldown and depressurization to cold shutdown is in progress using manual control of auxiliary feedwater, atmospheric steam dumps and pressurizer spray. One reactor coolant pump is operating. Safety injection has been reset and stopped. The reactor and turbine-generator are tripped. Plant conditions are:

- o RCS pressure = stable at 1250 psig.
- o Pressurizer level = 40% and stable
- o Subcooling margin = above 50°

Major Systems: Reactor Coolant System (RCS), Safety Injection System (SI), Steam Generating System (SG), Auxiliary Feedwater System (AFW), Steam Dump Control System (SDCS), Main Turbine (MT), Main Generator (MG), Pressurizer Pressure Control System, Radiation Monitoring System (RMS), AC Electrical Distribution (ACED), Nuclear Instrumentation System (NIS), Solid State Protection System (SSPS).

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine nuclear instrumentation system indications ------------------------ to diagnose plant condition	Annunciator		Nuclear Instrumentation System
2	Operate the rod control system in manual mode ------------------------ to ensure control of control rod position	Automatic rod position	(Procedure unavailable)	Rod Control System
3	Operate the nuclear instrumentation system ------------------------ to bypass failed nuclear instrument channel	Procedure	(Procedure unavailable)	Nuclear Instrumentation System
4	Review procedure ------------------------ to identify appropriate actions	Operating practice	(Procedure unavailable)	

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Inform supervisory personnel ------------------------ to report plant condition	Operating practice		
6	Dispatch I & C ------------------------ to investigate cause of failure	Procedure	(Procedure unavailable)	
7	Place the rod control system in automatic ------------------------ to restore system to normal operating status	Operating practice		Rod Control System
8	Operate the turbine-generator ------------------------ to increase reactor power	Operating practice		Electro-hydraulic Control System
9	Monitor plant indications ------------------------ to verify plant response to power increase	Operating practice		Steam Generator Rod Control System Nuclear Instrumentation System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
10	Monitor plant indications ------------------------ to ensure equipment affected by failed channel continues to operate normally	Operating practice		Reactor Protection System Non-Nuclear Instrumentation System
11	Dispatch I & C ------------------------ to repair failed channel			
12	Fill out logs ------------------------ to comply with administrative procedures	Procedure	(Procedure unavailable)	
13	Operate the Feedwater pumps ------------------------ to compensate for changes occuring during power increase	Operating practice		Feedwater System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Restore plant to a Safe Condition

Operating Sequence: Nuclear Instrument Malfunction

Operating Sequence ID: 06

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
14	Operate the rod control system in manual mode ------------------------ to resume control of control rod position	Channel test completed	(Procedure unavailable)	Rod Control System
15	Operate the nuclear instrumentation system ------------------------ to place nuclear instrument channel in service	Channel repaired	(Procedure unavailable)	Nuclear Instrumentation System
16	Place the rod control system in automatic mode ------------------------ to return equipment to normal operating status	Channel in service	(Procedure unavailable)	Rod Control System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine radiation monitoring system indications ------------------------ to identify plant condition	Annunciator		Radiation Monitoring System
2	Examine reactor coolant system actions ------------------------ to diagnose plant condition	Operating practice		Reactor Coolant System
3	Examine pressurizer pressure & level indications ------------------------ to verify reactor coolant system integrity	Procedure	E-O Reactor Trip or Safety Injection	Pressurizer
4	Operate the chemical & volume control system ------------------------ to increase charging flow	Procedure	E-O Reactor Trip or Safety Injection	Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Manually trip the reactor ------------------------ to minimize the pressurizer pressure transient	Diagnosis of steam generator tube rupture	E-O Reactor Trip or Safety Injection	Solid State Protection System
6	Monitor pressurizer indications ------------------------ to identify appropriate follow-up actions	Operating practice		Pressurizer
7	Isolate the secondary side of faulted steam generator ------------------------ to minimize release of radioactivity	Procedure	E-3 Steam Generator Tube Rupture	Steam Generator
8	Block low pressure safety injection signal ------------------------ to prevent inadvertent actuation of automatic equipment	Procedure	E-3 Steam Generator Tube Rupture	Safety Injection

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Isolate letdown ------------------------ to minimize reactor coolant system inventory loss	PZR level decreasing	E-3 Steam Generator Tube Rupture	Chemical & Volume Control System
10	Operate the steam dump control system ------------------------ to cooldown the reactor coolant system	Procedure	E-3 Steam Generator Tube Rupture	Steam Dump Control System
11	Monitor steam generator indications ------------------------ to verify status of reactor coolant system cooldown	Operating practice		Steam Generator
12	Trip reactor coolant pump ------------------------ to isolate primary side of faulted steam generator	Procedure	E-3 Steam Generator Tube Rupture	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Operate pressurizer spray valves ------------------------ to depressurize reactor coolant system	Procedure	E-3 Steam Generator Tube Rupture	Pressurizer
14	Re-set electrical distribution controls ------------------------ to return controls to position consistent with operating state	Operating practice		AC Electrical Distribution
15	Shutdown condensate pumps ------------------------ to remove non-essential equipment from service	Operating practice		Condensate System
16	Shut down heater drain pumps ------------------------ to remove non-essential equipment from service	Operating practice		Feedwater Heater Vent & Drain System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
17	Monitor charging system indications ------------------------ to identify appropriate follow-up actions	Operating practice		Chemical & Volume Control System
18	Re-set main steam supply controls ------------------------ to return controls to position consistent with operating state	Operating practice		Main steam system
19	Monitor reactor coolant system temperature indicators ------------------------ to verify reactor coolant system cooldown	Operating practice		Reactor Coolant System
20	Manually initiate safety injection ------------------------ to ensure pressurizer pressure & level control	Procedure	E-3 Steam Generator Tube Rupture	Safety Injection

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
21	Operate auxiliary feedwater system ------------------------ to maintain steam generator levels	Procedure	E-3 Steam Generator Tube Rupture	Auxiliary Feedwater System
22	Inform supervisory personnel ------------------------ to report plant condition	Operating practice		
23	Examine turbine indications ------------------------ to verify correct shutdown line-up	Procedure	E-3 Steam Generator Tube Rupture	Main Turbine
24	Isolate safety injection accumulators ------------------------ to remove non-essential equipment from service	Procedure	E-3 Steam Generator Tube Rupture	Safety Injection

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
25	Monitor reactor coolant system parameters ------------------------ to verify sub-cooling margin	Procedure	E-3Steam Generator Tube Rupture	Reactor Coolant System
26	Re-set Feedwater System Controls ------------------------ to return controls to position consistent with operating state	Operating practice		Feedwater System
27	Review procedures ------------------------ to coordinate control room activities & identify appropriate follow-up actions	Operating practice	E-3 Steam Generator Tube Rupture	
28	Examine safety injection indications ------------------------ to verify system actuation & flow	Annunciator		Safety Injection

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
29	Operate the atmospheric steam release valves ------------------------ to cooldown the reactor coolant system	Main Steam isolation	E-3 Steam Generator Tube Rupture	Steam Generator
30	Examine emergency cooling water systems indications ------------------------ to ensure emergency cooling water to ESF equipment	Procedure	E-O Reactor Trip or Safety Injection	Nuclear Service Cooling Water System Component Cooling Water System
31	Shut down high head safety injection pumps ------------------------ to remove non-essential equipment from service	Operating practice		Safety Injection
32	Examine containment indications ------------------------ to verify containment isolation	Procedure	E-O Reactor Trip or Safety Injection	Containment

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
33	Examine electrical indications ------------------------ to verify emergency power available	Procedure	E-O Reactor Trip or Safety Injection	AC Electrical Distribution
34	Examine chemical & volume control system indications ------------------------ to verify letdown isolation	Procedure	E-3 Steam Generator Tube Rupture	Chemical & Volume Control System
35	Re-set safety injection ------------------------ to remove non-essential equipment from service	Pressure > 195 psig	E-3 Steam Generator Tube Rupture	Safety Injection
36	Examine auxiliary feedwater indications ------------------------ to ensure auxiliary feedwater actuation & flow	Procedure	E-O Reactor Trip or Safety Injection	Auxiliary Feedwater Sustem

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
37	Shutdown low head safety injection pumps ------------------------ to remove non-essential equipment from service	Pressure > 195 psig	E-3 Steam Generator Tube Rupture	Safety Injection
38	Transfer non-ESF electrical busses to alternate supplies ------------------------ to ensure power to balance-of-plant equipment	Operating practice		AC Electrical Distribution
39	Shut down circulating water pump ------------------------ to remove non-essential equipment from service	Operating practice		Circulating Water System
40	Shut down main condenser ------------------------ to remove non-essential equipment from service	Operating practice		Gland Sealing Steam System Condenser Air Removal System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
41	Operate the chemical & volume control system ------------------------ to re-establish letdown flow	Operating practice		Chemical & Volume Control System
42	Operate the chemical & volume control system ------------------------ to re-establish charging flow	Operating practice		Chemical & Volume Control System
43	Re-set containment isolation ------------------------ to permit necessary line-up changes	Procedure	E-3 Steam Generator Tube Rupture	Containment
44	Operate the instrument air system ------------------------ to restore air supply to equipment inside containment	Procedure	E-3 Steam Generator Tube Rupture	Instrument Air System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
45	Trip reactor coolant pumps ------------------------ to remove non-essential equipment from service	Procedure	E-3 Steam Generator Tube Rupture	Reactor Coolant System
46	Operate the chemical & volume control system ------------------------ to restore seal return flow	Procedure	E-3 Steam Generator Tube Rupture	Chemical & Volume Control System
47	Operate nuclear instrumentation system chart recorder NR-45 ------------------------ to verify reactor neutron flux level in the source range	Procedure	E-3 Steam Generator Tube Rupture	Nuclear Instrumentation System
48	Perform reactivity calculation ------------------------ to determine shutdown margin	Procedure	E-3 Steam Generator Tube Rupture	

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
49	Operate the chemical & volume control system ------------------------- to restore boronometer to service	Procedure	E-3 Steam Generator Tube Rupture	Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine pressurizer indications ------------------------ to determine cause of low pressure alarm	Annunciator		Pressurizer
2	Monitor reactor coolant system and pressurizer indications ------------------------ to identify appropriate actions	Operating practice		Reactor Coolant System Pressurizer
3	Start charging pumps ------------------------ to restore pressurizer level	PZR level decreasing		Chemical & Volume Control System
4	Operate the turbine electro-hydraulic control system ------------------------ to reduce turbine load	Procedure	E-O Reactor Trip or Safety Injection	Electro-hydraulic Control System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Examine containment pressure indications ------------------------ to identify appropriate actions	Annunciator		Containment
6	Manually trip the reactor ------------------------ to minimize the pressure & level transient	PZR pressure & level decreasing		Solid State Protection System
7	Examine turbine and generator indications ------------------------ to verify turbine-generator trip	Annunciator	E-O Reactor Trip or Safety Injection	Main Turbine Main Generator
8	Examine electrical distribution indications ------------------------ to verify power available to vital auxiliaries	Procedure	E-O Reactor Trip or Safety Injection	AC Electrical Distribution System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Monitor the steam dump control system ------------------------ to verify proper system operation	Procedure	E-O Reactor Trip or Safety Injection	Steam Dump Control System
10	Examine auxiliary feed-water indications ------------------------ to ensure Auxiliary Feed-water actuation & flow	Procedure	E-O Reactor Trip or Safety Injection	Auxiliary Feed-water System
11	Examine safety injection indications ------------------------ to verify safety injec-tion actuation	Procedure	E-O Reactor Trip Safety Injection	Safety Injec-tion
12	Monitor steam generator parameters ------------------------ to verify cooldown	Procedure	E-O Reactor Trip or Safety Injection	Steam Generator
13	Examine containment indications ------------------------ to verify containment isolation cooldown	Procedure	E-O Reactor Trip or Safety Injection	Containment

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
14	Examine emergency cooling water systems ------------------------ to ensure emergency cooling water to ESF equipment	Procedure	E-O Reactor Trip or Safety Injection	Nuclear Service Cooling Water System Component Cooling Water System
15	Examine Feedwater indications ------------------------ to verify feedwater isolation	Procedure	E-O Reactor Trip or Safety Injection	Feedwater System
16	Review procedures ------------------------ to verify actions taken were appropriate	Operating practice	E-O Reactor Trip or Safety Injection, E-1 Loss of Reactor Coolant	
17	Examine diesel generator indications ------------------------ to verify availability of emergency power	Procedure	E-O Reactor Trip or Safety Injection	Diesel Generator

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
18	Trip reactor coolant pump ------------------------ to protect equipment	Procedure	E-O Reactor Trip or Safety Injection	Reactor Coolant System
19	Monitor safety injection parameters ------------------------ to verify reactor coolant system inventory and pressure control	Operating practice		Safety Injection
20	Examine pressurizer pressure control indications ------------------------ to identify cause of pressure transient	Pressure 1950 psig	E-O Reactor Trip or Safety Injection	Pressurizer Pressure Control System
21	Monitor reactor coolant system temperature indications ------------------------ to verify Reactor Coolant System cooldown	Procedure	E-O Reactor Trip or Safety Injection	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
22	Inform supervisory personnel ------------------------ to report plant condition	Operating practice		
23	Examine refueling water storage tank indications ------------------------ to determine magnitude of LOCA	Procedure	E-1 Loss of Reactor Coolant	Safety Injection
24	Block low steam line safety injection signal ------------------------ to allow continuation of cooldown	Main steam pressure at block permissive setpoint		Safety Injection
25	Monitor containment sump levels ------------------------ to verify extent of cooldown	Procedure	E-1 Loss of Reactor Coolant	Containment

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
26	Examine main steam system indications ------------------------ to verify main steam isolation	Valves closed	E-1 Loss of Reactor Coolant	Main Steam
27	Reset safety injection ------------------------ to remove non-essential equipment from service	Procedure	E-1 Loss of Reactor Coolant	Safety Injection
28	Shut down low head safety injection pumps ------------------------ to remove non-essential equipment from service	Procedure	E-1 Loss of Reactor Coolant	Safety Injection
29	Operate the steam generator atmospheric relief valves ------------------------ to cooldown the Reactor Coolant system	Main Steam isolation	E-1 Loss of Reactor Coolant	Steam Generator

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
30	Re-set containment isolation ------------------------ to allow necessary changes in system line-ups	Operating practice		Containment
31	Transfer non-ESF electrical buses to alternate supply ------------------------ to ensure power to balance-of-plant equipment	Procedure	E-O Reactor Trip or Safety Injection	AC Electrical Distribution
32	Operate the auxiliary feedwater system ------------------------ to maintain steam generator level	Procedure	E-1 Loss of Reactor Coolant	Auxiliary Feedwater System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
33	Start one reactor coolant pump ------------------------ to achieve Reactor Coolant System pressure control	Procedure	ES-1.2 Post LOCA Cooldown & Depressurization	Reactor Coolant System
34	Examine reactor parameters ------------------------ to verify sub-cooling margin	Procedure	E-1 Loss of Reactor Coolant	Incore Instrumentation System
35	Re-set pressurizer heaters ------------------------ to re-establish pressure control	Procedure	E-1 Loss of Reactor Coolant	Pressurizer
36	Operate pressurizer spray valves ------------------------ to depressurize Reactor Coolant System	PZR pressure & level stabilized	ES-1.2 Post LOCA Cooldown & Depressurization	Pressurizer Pressure Control System

TASK SEQUENCE CHART

Plant: 65

Operator Function/Subfunction: Supervise & Control Plant OPerations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
37	Examine containment radiation indications ---------------------- to verify containment radiation levels	Operating practice		Containment
38	Examine pressurizer temperature indications ---------------------- to verify pressurizer level	Operating practice		Pressurizer
39	Isolate safety injection accumulators ---------------------- to remove non-essential equipment from service	Procedure	ES-1.2 Post LOCA Cooldown & Depressur-ization	Safety Injection
40	Shut down high head safety injection pumps ---------------------- to remove non-essential equipment from service	Procedure	ES-1.2 Post LOCA Cooldown & Depressur-ization	Safety Injection

7. PLANT 26

The data contained in this section are:

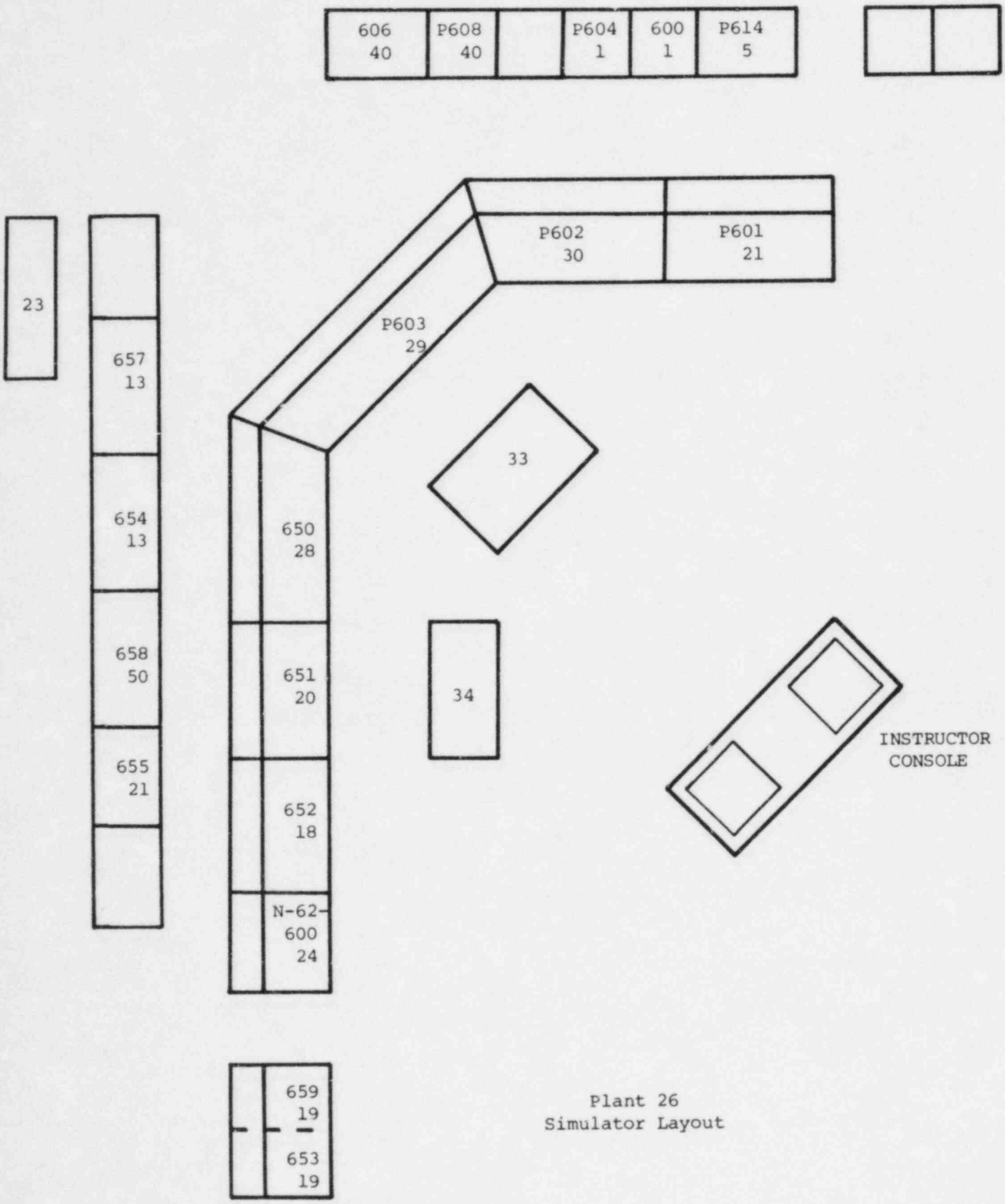
- Plant description (page 7-1)
- Panel layouts and designators (page 7-2)
- System nomenclature and numbering (page 7-4)
- Operating Sequence Overviews (page 7-7)
- Task Sequence Charts (page 7-10)

The following operating sequences were observed at Plant 26:

- 8 Reactor Vessel Level Control System Malfunction
- 10 Station Blackout
- 11 Anticipated Transient Without Scram

Plant 26, Unit 1 is a General Electric boiling water reactor with a General Electric turbine-generator. The architect-engineer is Bechtel. The plant received its operating license in 1978. The control room is a multiple-unit control room. The data were collected at the Unit 1 simulator.

Plant 26 Panel/System	Number Assigned
P601 - RCC and ISO Control	21
P602 - RWCU and Recirculation System	30
P603 - Reactor Control	29
650 - Main Turbine, Feedwater, and Condensate Control Console	28
651 - Main Generator and Station Services	20
652 - Electrical Auxiliary Power Control Console	18
N-62-600 - Reactor Off Gas System	24
659 - 500 kV Switching	19
653 - 230 kV Switching	19
Operator's Desk	33
Computer Console	34
P614 - Nuclear Steam Temperature Recorder	5
600 - Area & Process Radiation Monitoring	1
P604 - Process Radiation Monitoring	1
P608 - Power Range Monitoring	40
606 - SRM and IRM	40
Recombiner	23
657 - Ventilation and Drywell	13
654 - SBGT and Containment Ventilation	13
658 - Station Service	50
655 - Bearing Temperature & Battery Monitor	21



Plant 26
Simulator Layout

Plant 26 System Name	ABBR.	INPO System Number and Name
AC electrical distribution	--	62. AC electrical distribution system
Area radiation monitoring	--	72. Area radiation monitoring system
Auxiliary steam	--	44. Auxiliary steam generating system
Circulating water system	--	75. Circulating water system
Containment atmosphere monitoring system	--	103. Containment system
Core spray system	--	100. Core spray system
Condensate system	--	56. Condensate system
Control rod drive hydraulic system	--	93. Control rod drive system
Control rod drive (mechanism)	--	93. Control rod drive system
DC electrical system	--	63. DC electrical distribution system
Electrohydraulic control system	--	48. Main turbine electrohydraulic control system
Emergency core cooling systems	--	13. Engineered safety features actuation system
Fuel pool cooling and cleanup system	--	33. Spent fuel pool cooling system
Generator hydrogen	--	52. Main generator hydrogen and carbon dioxide gas system
High pressure coolant injection system	HPCI	97. High pressure coolant injection system
Hydrogen seal oil	--	50. Seal oil system
Instrument control air	--	78. Instrument air system
Intermediate range monitor	IRM	15. Nuclear instrumentation
Liquid radwaste	--	106. Liquid radwaste system (floor drain and waste neutralizer systems) 107. Liquid radwaste system (waste collector system 108. Liquid radwaste system (concentrator/evaporator operation

Plant 26 System Name	ABBR.	INPO System Number and Name
Low pressure coolant injection system	--	98. Low pressure coolant injection system
Main condenser	--	56. Condensate system
Main condenser air removal equipment	--	55. Condenser air removal system
Main generator	--	45. Main turbine generator
Main steam system	MS	105. Main steam system
Main turbine	MT	45. Main turbine generator
Off-gas	--	111. Off-gas system
Plant Service water system	--	76. Service water system
Power range monitor	PRM	15. Nuclear instrumentation
Primary containment	CTMT	103. Containment system
Process computer	--	83. Plant computer
Process radiation monitors	--	73. Process radiation monitoring system
Reactor building closed cooling water system	RBCCW	8. Component cooling system (primary equipment closed cycle cooling system)
Reactor core isolation cooling system	RCIC	94. High pressure (feedwater) coolant injection system
Reactor feedwater system	--	94. Reactor feedwater system
Reactor manual control system	RMCS	93. Control rod drive system
Reactor protection system	RPS	12. Reactor protection system
Reactor recirculation system	--	96. Recirculation system
Reactor vessel instrumentation	--	16. Non-nuclear instrumentation
Reactor water cleanup system	--	95. Reactor cleanup system
Reactor water level control	RWLC	94. Reactor feedwater system
Residual heat removal system	RHR	5. Residual (decay) heat removal (shutdown cooling) system
RHR service water system	--	5. Residual (decay) heat removal (shutdown cooling) system

Plant 26 System Name	ABBR.	INPO System Number and Name
RHR service water system	--	113. Emergency service water (high pressure service water) system
Secondary containment	CTMT	103. Containment system
Source range monitor	SRM	15. Nuclear instrumentation
Standby diesel generator system	--	64. Emergency diesel generator system
Standby gas treatment	--	110. Standby gas treatment system
Standby liquid control system	--	102. Standby liquid control (liquid poison) system
Station service air	--	79. Station air system
Stator bar cooling	--	53. Stator water cooling system
Turbine auxiliaries	--	47. Main turbine generator lube oil system (main lube oil system)

Operating Sequence Overview

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to Safe Condition

NSSS/Type: GE/BWR

Operating Sequence ID: 08

CR Type: Multiple

Operating Sequence: Reactor Vessel Level Control System Malfunction

Initial Conditions: The plant is operating at full power with a normal full power line-up.

Sequence Initiator: Loss of feedwater flow, due to steam flow instrumentation channel failure, results in a reactor water level low alarm.

Progression of Action: The crew diagnosis a channel failure and restores ability to feed the reactor by taking manual control of the feed pump turbines. Feedwater flow is increased in manual, restoring level to the normal band. When level has been restored, the single element mode is selected, and the reactor feedwater system is returned to automatic. The crew initiates actions to repair the malfunction.

Final Conditions: Plant is operating at full power. Reactor vessel level is being maintained at 37 inches with the feedpump turbine controllers in automatic. Repair of the malfunction is in progress by the Instrument and Control shop.

Major Systems: Reactor Vessel, Reactor Feedwater, Reactor Water Level Control (RWLC), Power Range Monitoring (PRM), Main Steam (MS), Reactor Manual Control System (RMCS).

Operating Seqeunce Overview

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: GE/BWR

Operating Sequence ID: 10

CR Type: Multiple

Operating Sequence: Station Blackout

Initial Conditions: The plant is at full power with normal plant line-up. Unit 1 is shutdown for refueling.

Sequence Initiator: Total loss of off-site power causes reactor scram and turbine trip.

Progression of Action: The operating crew verifies the reactor scram. The crew verifies loss of offsite power by noting bus and transformer voltage. An operator verifies automatic start of high pressure coolant injection and reactor core isolation cooling as level decreases. Twelve seconds into the sequence, the crew observes that the diesel generators have not started. Manually starting the diesels from the control room is unsuccessful, and an Auxiliary Operator is dispatched to start the diesels locally.

The crew maintains stable plant conditions by throttling high pressure coolant injection and reactor core isolation cooling to maintain vessel level. During this time, the crew evaluates system status and plant conditions.

Ten minutes into the incident, all diesels are started locally and critical loads are restored. The crew verifies that all safety equipment has started and places the residual heat removal system in the suppression pool cooling mode. The Shift Supervisor declares an alert status and initiates notification of appropriate personnel and agencies.

Final Conditions: The plnat is in a stable condition; emergency equipment is available and plant is ready to commence cooldown to cold shutdown. The diesel generators are oprating and offsite power has not been restored.

Major Systems: Diesel Generators (DG), Main Steam System (MS), Reactor Protection System (RPS), Residual Heat Removal System (RHR), Main Turbine (MT), Plant Service Water, Nuclear Instruments (NIS), Containment (CTMT), Reactor Vessel, High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Reactor Building Closed Cooling Water System (RBCCW).

Operating Sequence Overview

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: GE/BWR

Operating Sequence ID: 11

CR Type: Multiple

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Initial Conditions: The plant is at 90% power with a normal system line-up.

Sequence Initiator: Turbine trip at power.

Progression of Action: The crew acknowledges annunciators and attempts to verify reactor scram. When the reactor does not scram, an operator generates additional scram signals, but the reactor still fails to scram. The automatic trip of the recirculation pumps, due to an interlock with the turbine trip, has reduced reactor power to 30%. The crew scrams the reactor by deenergizing the reactor protection system. The crew initiates torus cooling and starts the recirculation pumps. Reactor pressure is controlled through operation of safety relief valves, and level is controlled through operation of reactor core isolation cooling.

The Shift Supervisor declares an alert and notifies the appropriate on-site personnel.

Final Conditions: The plant is in a hot shutdown condition with torus cooling in progress; the control rods have been inserted and the recirculation pumps are running.

Major Systems: Reactor Protection System (PRS), Reactor Manual Control (RMCS), Recirculation, Main Steam (MS), Reactor Vessel, High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Residual Heat Removal (RHR), Residual Heat Removal Service Water, Primary Containment Isolation.

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate possible malfunction in reactor vessel level control ------------------------ to identify plant condition	Annunciator		Reactor Water Level Control Reactor Vessel
2	Operate reactor feed pump turbine master controller in manual mode ------------------------ to control reactor pressure vessel Level	Operating practice		Reactor Feedwater, Reactor Water Level Control
3	Determine casue of level control problem ------------------------ to identify appropriate follow up actions	Procedure	HNP-2-2214 Reactor Water Level Hi/Lo	Main Steam
4	Place reactor feed pump turbine master controller in automatic mode ------------------------ to return equipment to normal operating status	Operating practice		Reactor Feedwater, Reactor Water Level Control, Reactor Vessel

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operation/Restore Plant to Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Monitor reactor power ------------------------ to determine effects of operator actions on plant	Operating practice		Power Range Monitor, Reactor Manual Control
6	Monitor plant parameters ------------------------ to assure performance as expected	Operating practice		Reactor Vessel, Recirculation, Reactor Feedwater
7	Prepare a maintenance request ------------------------ to comply with administrative procedures	Procedure	HNP-2-30	
8	Dispatch Instrumentation and Control Section to repair level control system ------------------------ to return system to operation	Operating practice		

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Restore Plant to Safe Condition

Operating Sequence: Reactor Vessel Level Control System Malfunction

Operating Sequence ID: 08

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Fill out logs ------------------------ to comply with administrative procedures	Procedure	HNP-30	

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that the cues indicate a loss of normal and emergency power ------------------------ to identify plant condition	Loss of normal control room lighting		
2	Monitor vessel pressure and level ------------------------ to assure that pressure and level limits are not exceeded	Procedure	HNP-2-1912 Loss of Off-site Power	Reactor Vessel
3	Verify reactor scram ------------------------ to assure automatic reactivity insertion	Procedure	HNP-2-1912 Loss of Off-site Power	Reactor Protection System, Rod Position Indication, Control Rod Drive Hydraulics
4	Verify initiation of reactor core isolation cooling system ------------------------ to assure performance as expected	Decreasing level	HNP-2-2001B Reactor Scram	Reactor Core Isolation Cooling

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Balckout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
5	Verify initiation of high pressure coolant injection ------------------------ to assure performance as expected	Decreasing level	HNP-2-2001F ECCS Initiating	High Pressure Coolant Injection
6	Review electrical distribution system ------------------------ to verify loss of offsite power	Loss of emergency power		AC Electrical Distribution, DC Electrical Distribution
7	Recognize that diesels failed to auto start ------------------------ to identify corrective actions	Procedure	HNP-2-1912 Loss of offsite power	Emergency Diesel Generator
8	Dispatch Plant Equipment Operator to monitor reactor pressure vessel level indication ------------------------ to obtain valid indication of reactor pressure vessel level	Level off scale		Reactor Vessel

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
9	Attempt to start diesel generators ------------------------ to restore emergency power	Procedure	HNP-2-1912 Loss of Off-site Power	Standby Diesel Generator
10	Dispatch Plant Equipment Operator to start diesel generators ------------------------ to restore power	Procedure	HNP-2-1912 Loss of Off-site Power	Standby Diesel Generator
11	Operate reactor core isolation cooling system ------------------------ to maintain level	Operating practice		Reactor Core Isolation Cooling
12	Examine annunciator displays ------------------------ to evaluate plant condition	Operating practice		

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Verify proper operation of primary containment isolation --- to assure performance as expected	Procedure	HNP-2-1912 Loss of Off-site Power	Containment
14	Verify recirculation pumps tripped --- to assure performance as expected	Procedure	HNP-2-1912 Loss of Off-site Power	Reactor Recir-culation
15	Monitor reactor power --- to verify anticipated reactor response	Procedure	HNP-2-2001C Reactor Scram	Nuclear Instru-ments
16	Verify main steam isola-tion valve closure --- to assure performance as expected	Procedure	HNP-2-1912 Loss of Off-site Power	Main Steam
17	Manually operate relief valves --- to limit reactor pressure	High reactor pressure	HNP-2-2001C Reactor Scram	Main Steam

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
18	Line up main turbine after unit trip --- to place in shutdown condition	Procedure	HNP-2-2001C Reactor Scram	Main Turbine
19	Verify operation of emergency DC lube oil pumps --- to assure lubrication during equipment coast down	Procedure	HNP-2-1912 Loss of Off-site Power	Main Turbine
20	Place high pressure coolant injection in full flow test mode --- to reduce rate of coolant injection and remove heat from reactor pressure vessel	Operating practice		High Pressure Coolant Injection
21	Declare Alert Status --- to initate emergency notifications	Procedure		
22	Inform supervisory personnel --- to report plant condition	Procedure	HNP-2-1912 Loss of Off-site Power	

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23	Reset controls --- to return control to position consistent with operating state	Operating		
24	Communicate with site personnel --- to obtain assistance	Procedure	HNP-4522 Alert Emergency-Control Room Operators	
25	Monitor diesel operation --- to assure performance as expected	Operating practice		Standby Diesel Generator
26	Monitor drywell pressure --- to determine proximity to high pressure trip setpoint	Operating practice		Containment
27	Insert source range and intermediate range monitors --- to monitor neutron flux	Procedure	HNP-2-2001C Reactor Scram	Source Range Monitoring, Intermediate Range Monitoring
28	Verify start up of plant service water --- to assure cooling of vital equipment	Procedure	HNP-2-1912 Loss of Off-site Power	Plant Service Water

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
29	Reset load shed interlocks --- to ensure emergency power restored	Diesels operating		AC Electrical Distribution
30	Start Reactor building closed cooling water system --- to provide cooling to vital equipment	Procedure	HNP-2-1912 Loss of Off-site Power	Reactor Building Closed Cooling Water
31	Line up the plant service water system --- to supply cooling water to air compressors	Operating practice		Plant Service Water
32	Secure residual heat removal pumps --- to reduce electrical loads	Procedure	HNP-2-1912 Loss of Off-site Power	Residual Heat Removal
33	Secure core spray system --- to reduce electrical loads	Procedure	HNP-2-1912 Loss of Off-site power	Core spray

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate the Consequences of an Accident

Operating Sequence: Station Blackout

Operating Sequence ID: 10

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
34	Start drywell cooling system --- to remove heat from drywell	Procedure	HNP-2-1912 Loss of Off-site Power	Containment
35	Communicate with Load Dispatcher --- to restore off-site power	Procedure	HNP-2-1912 Loss of Off-site Power	
36	Place suppression pool cooling in service --- to maintain torus temperature within limits	Procedure	HNP-2-2001 Reactor Scram	Residual Heat Removal
37	Start air compressors --- to restore instrument air	Procedure	HNP-2-1912 Loss of Off-site Power	Service Air System

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Recognize that cues indicate turbine trip ------------------------ to identify plant condition	Annunciators		Main Turbine, Reactor Vessel
2	Monitor vessel pressure and level ------------------------ to ensure that pressure and level limits are not exceeded	Procedure	HNP-2-2001D Reactor Scram	Reactor Pressure Vessel
3	Recognize that the reactor did not scram ------------------------ to identify plant condition	Scram signal		Rod Position Indication, Control Rod Drive Hydraulic, Source Range Monitoring
4	Place mode switch in shutdown ------------------------ to avoid main steam isolation valve	Procedure	HNP-2-2001B Reactor Scram	Reactor Protection System
5	Manually scram reactor ------------------------ to generate reactor scram signal	Procedure	HNP-2-2001B Reactor Scram	Reactor Protection System

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Verify recirculation pumps tripped ------------------------ to assure reactor power is reduced as far as possible	Procedure	HNP-2-2001B Reactor Scram	Recirculation
7	Deenergize reactor protection system ------------------------ to cause rod insertion	Operating practice		Reactor Protection System
8	Verify initiation of reactor core isolation cooling ------------------------ to assure performance as expected	Procedure	HNP-2-2001B Reactor Scram	Reactor Core Isolation Cooling
9	Verify initiation of high pressure coolant injection ------------------------ to assure performance as expected	Procedure	HNP-2-2001B Reactor Scram	High Pressure Coolant Injection
10	Verify primary containment isolation ------------------------ to assure performance as expected	Procedure	HNP-2-2001C Reactor Scram	Containment, Main Steam

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Operate the safety relief valves ------------------------ to control reactor pressure	Pressure increasing		Main Steam
12	Verify swap over to reserve station ------------------------ to ensure power supply to station loads	Procedure	HNP-2-2001D Reactor Scram	AC Electrical Distribution
13	Line up turbine after trip ------------------------ to place in shutdown condition	Procedure	HNP-2-2001D Reactor Scram	Main Turbine
14	Align control board control devices ------------------------ to return control to position consistent with operating state	Operating practice		Instrumentation
15	Insert incore monitors ------------------------ to measure neutron flux	Procedure	HNP-2-2001B Reactor Scram	Incore Nuclear Instruments, Source Range Monitoring, Intermediate Range Monitoring

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
16	Verify control rods fully inserted ------------------------ to assure reactor is in shutdown condition	Operating practice		Reactor Manual Control
17	Examine annunciator displays ------------------------ to evaluate plant condition	Operating practice		Instrumentation
18	Close main steam isolation valves ------------------------ to prevent drywell pressurization by control air	Operating practice		Main Steam
19	Restart recirculation pumps ------------------------ to provide circulation of reactor pressure vessel	Procedure	HNP-2-2001B Reactor Scram	Recirculation
20	Declare alert status ------------------------ to initiate notification procedures	Procedure	HNP-4520 Alert Emergency Procedures	

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
21	Place the high pressure coolant injection system in full flow test mode --- to reduce coolant injection rate	RPV level is increasing		High Pressure Coolant Injection
22	Inform supervisory personnel --- to report plant condition	Procedure	HNP-2-1909 Inability to shutdown with control rods	
23	Communicate with site personnel --- to obtain assistance	Procedure	HNP-4511 Alert Emergency Control Room Operators	
24	Reset containment isolation --- to allow operator control of equipment	Operating practice		Primary Containment Isolation
25	Initiate suppression pool cooling --- to remove heat from the torus	Relief valves or HPCI in full flow	HNP-2-1934 1934 Torus Temperature Above 95^{o}F	Residual Heat Removal Service Water, Residual Heat Removal

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
26	Monitor nuclear instruments ------------------------ to assure performance as expected	Procedure	HNP-2-2001B Reactor Scram	Nuclear Instruments
27	Reset scram signal ------------------------ to terminate cold water injection through control rod drive mechanisms	Operating practice		Reactor Protection System
28	Start the reactor water cleanup system ------------------------ to allow operation of the recirculation system	Procedure	HNP-2-1435 Reactor Recirculation Pump M-G Sets	Reactor Water Cleanup
29	Operate reactor core isolation cooling ------------------------ to control reactor pressure vessel level	Procedure	HNP-2-2001C Reactor Scram	Reactor Core Isolation Cooling
30	Start condenser vacuum pump ------------------------ to prepare for plant cooldown			Main Condenser

TASK SEQUENCE CHART

Plant: 26

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Anticipated Transient Without a Scram, Following Turbine Trip

Operating Sequence ID: 11

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
31	Place reactor core isolation cooling in full flow test mode ------------------------- to reduce coolant injection rate	Operating practice		Reactor Core Isolation Cooling
32	Secure condensate pumps ------------------------- to remove unnecessary equipment from service	Operating practice		Condensate

8. PLANT 06

The data contained in this section are:

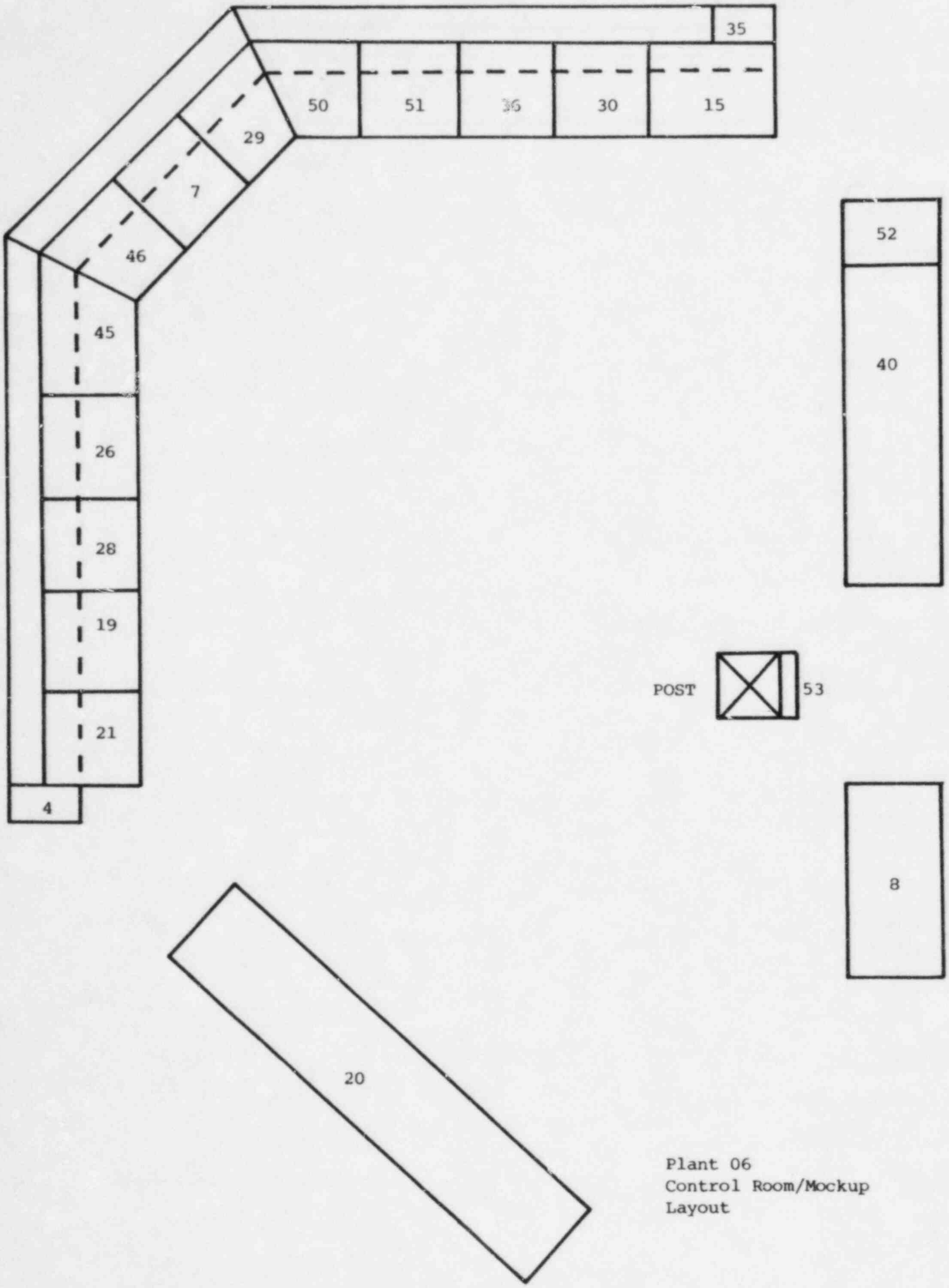
- Plant description (page 8-1)
- Panel layouts and designators (page 8-2)
- System nomenclature and numbering (page 8-4)
- Operating Sequence Overviews (page 8-6)
- Task Sequence Charts (page 8-9)

The following operating sequences were observed at Plant 06:

- 12 Chemical and Volume Control System Malfunction
- 13 Steam Generator Tube Rupture
- 15 Loss-of-Coolant Accident

Plant 06, Unit 1 is a Combustion Engineering pressurized water reactor with a Westinghouse turbine-generator. The architect-engineer is Stone and Webster. The plant received its operating license in 1973. The control room is a single-unit control room. The data were collected at the Unit 1 mock-up.

Plant 06 Panel/System	Number Assigned
Cooling Water Systems • Circulating water system • Service water system	21
Main Generator	19
Main Turbine/EHC	28
Auxiliary/Main Feedwater	45
Main Feedwater/Condensate	26
Steam Generating	46
Reactor Display	7
Reactivity Control	29
Post-Accident Monitoring	50
Pressurizer pressure & level control	51
Chemical & Volume Control System	36
RCS Loops	30
RHR/SI	15
Safeguards cabinet • SIAS • CIS • CSAS • RAS • CP • PSS	35
NIS/RPS Cabinets	40
AC Electrical Distribution	20
Radiation Monitoring System	8
Vibration & loose parts monitoring	52
Turbine supervisory	4
Controlled key locker	53



Plant 06
Control Room/Mockup
Layout

Plant 06 System	ABBR.	INPO Number & Name
AC electrical distribution system	ACED	62. AC electrical distribution system
Auxiliary feedwater system	AFW	61. Auxiliary/emergency feedwater system
Auxiliary steam system	AS	42. Low pressure steam system
Chemical & volume control system	CVCS	4. Chemical & volume control system
Chemical & volume control system	CVCS	19. Boronometer
Circulating water system	CWS	75. Circulating water system
Component cooling water system	CCW	8. Component cooling water system
Condensate system	CD	56. Condensate system
Containment system	CTMT	103. Containment system
Containment spray system	CS	26. Containment spray system
Control element assembly control system	CEACS	1. Control rod drive system
Control element assembly control system	CEACS	14. Rod position indication system
Diesel generator	DG	64. Emergency diesel generator system
Electrohydraulic control system	EHC	48. Main turbine electro-hydraulic system
Excore nuclear instrumentation	NIS	15. Nuclear instrumentation system
Heater drain & extraction steam system	ES	43. Extraction steam system
Heater drain & extraction steam system	ES	60. Feedwater heater vent and drain system
Incore instrument system	INCORE	17. In-core temperature monitor
Instrument air system	IA	78. Instrument air system
Main & reheat steam system	MS	39. Main & reheat steam system
Main feedwater system	FW	59. Main feedwater system

Plant 06 System	ABBR.	INPO Number & Name
Main generator system	MG	45. Main turbine generator
Main turbine system	MT	45. Main turbine generator
Pressurizer & pressure relief system	PZR	2. Reactor coolant system
Pressurizer & pressure relief system	PZR	7. Pressurizer relief/quench tank
Pressurizer level control system	PZR-LCS	11. Pressurizer level control system
Pressurizer pressure control system	PZR-PCS	10. Pressurizer pressure control system
Primary sampling system	PSS	
Radiation monitoring system	RMS	72. Area radiation monitoring system
Radiation monitoring system	RMS	73. Process radiation monitoring system
Reactor coolant system	RCS	2. Reactor coolant system
Reactor coolant system	RCS	3. Reactor coolant pump operation
Reactor protection system	RPS	12. Reactor protection system
Residual heat removal system	RHR	5. Residual heat removal system
Safety injection system	SI	6. Safety injection system
Safety injection system	SI	13. Engineered safety features actuation system
Service water system	SW	76. Service water system
Steam dump control system	SDCS	41. Steam dump/turbine bypass control system
Steam generating system	SG	35. Steam generator system
Steam generator blowdown system	SGBD	38. Steam generator blowdown system
Steam generator water level control system	SGWLC	59. Main feedwater system
Vacuum priming & air removal system	AR	55. Condenser air removal system

Operating Sequence Overview

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: C-E/PWR

Operating Sequence ID: 12

CR Type: Single

Operating Sequence: Chemical and Volume Control System Malfunction

Initial Conditions: Plant is operating at full power with a normal lineup. The chemical and volume control system (CVCS) is lined up for manual makeup to the volume control tank (VCT). The control element assembly control system (CEACS) is in manual control. Shift turnover has just occurred. The previous shift had made up to VCT. An earlier failure of the boric acid flow transmitter has gone undetected.

Sequence Indicator: Failure of the boric acid flow transmitter has resulted in a dilution of the VCT and a slow reactor coolant system dilution. This causes a mismatch in turbine and reactor power, causing a $T_{ave} - T_{ref}$ deviation and a high T_c.

Progression of Action: After evaluating available indications, the crew diagnoses a failure of the boric acid flow controller. The crew takes manual control of the malfunctioning controller and borates the reactor coolant system to restore T_c to normal. The Instrumentation and Control Section is dispatched to repair the controller. Following repair of the controller, the system is tested and returned to service.

Final Conditions: The plant is operating at full power. CEACS is operating in manual with all control element assemblies fully withdrawn. CVCS is operating normally in manual makeup mode.

Major Systems: Reactor Coolant System (RCS), Chemical & Volume Control System (CVCS), Main Turbine (MT).

Operating Sequence Overview

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: C-E/PWR

Operating Sequence ID: 13

CR Type: Single

Operating Sequence: Tube Ruptures-Steam Generators

Initial Conditions: Plant is operating at full power with normal lineup.

Sequence Initiator: Double-ended shear tube rupture in one steam generator, resulting in low pressure reactor trip and safety injection.

Progression of Action: The crew verifies the reactor and turbine trips and safety injection actuation and flow. The crew then trips all reactor coolant pumps. After evaluating available indications, the crew diagnoses a steam generator tube rupture, then identifies and isolates the faulted steam generator. The crew notifies the Nuclear Regulatory Commission and initiates the Station Emergency Plan. The crew verifies natural circulation flow has been established. When control over pressurizer pressure and level have been established, the crew manually controls safety injection flow. The crew makes preparations to cooldown by starting the auxiliary feedwater pumps and stopping the main feedwater pump.

Final Conditions: The reactor and turbine generator are shut down. One steam generator is isolated. All reactor coolant pumps have been tripped and natural circulation established. Safety injection is running with flow under manual control. Preparations have been made to cooldown the reactor using the remaining two steam generators, natural circulation flow, auxiliary feedwater, and the steam bypass system to the condenser. A balance-of-plant shutdown is in progress.

Major Systems: Reactor Protection System (RPS), Main Turbine (MT), AC Electrical Distribution System (ACED), Feedwater System (FW), Auxiliary Feedwater System (AFW), Condensate System (CD), Safety Injection System (SI), Containment (CTMT), Radiation Monitoring System (RMS), Reactor Coolant System (RCS), Steam Generating System (SG), Vibration & Loose Parts Monitoring System (V & LPM), Main Steam System (MS).

Operating Sequence Overview

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

NSSS/Type: C-E/PWR

Operating Sequence ID: 15

CR Type: Single

Operating Sequence: Loss of Coolant Accident

Initial Conditions: The plant is operating at full power with a normal lineup.

Sequence Initiator: Small break loss of coolant accident inside the containment.

Progression of Action: Loss of coolant accident (LOCA) causes a rapid decrease in reactor coolant system (RCS) pressure and pressurizer (PZR) level. This results in a low pressure alarm followed by a low pressure reactor trip and safety injection. Responding to incoming alarms and indications, the crew verifies activation of safety functions and automatic reactor and turbine trips. Crew trips the reactor coolant pumps and establishes natural circulation flow in the reactor coolant system. Crew verifies a small break loss of coolant accident has occurred, and initiates the Station Emergency Plan. After RCS pressure is stabilized and PZR level restored, the crew overrides safety injection and manually controls flow. The crew makes preparations to cooldown the reactor by shutting down the feedwater system and starting the auxiliary feedwater system.

Final Conditions: The reactor and turbine-generator are shutdown. All reactor coolant pumps have been tripped and natural circulation established. Safety injection is running with flow under manual control. Preparations have been made to cooldown the reactor using natural circulation flow, auxiliary feedwater, and the steam bypass system to the condenser. A balance-of-plant shutdown is in progress.

Major Systems: Reactor Protection System (RPS), Reactor Coolant System (RCS), Main Turbine (MT), AC Electrical Distribution System (ACED), Main Generator (MG), Auxiliary Feedwater System (AFW), Safety Injection System (SI), Containment (CTMT), Radiation Monitoring System (RMS), Feedwater System (FW), Steam Generating System (SG), Pressurizer (PZR), Vibration & Loose Parts Monitoring System (V & LPM), Heater Drain and Extraction Steam System (ES).

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Chemical and Volume Control System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Examine reactor indications To verify reactivity anomaly	High reactor cold leg temperature		Reactor Coolant System
2	Examine main turbine indications To diagnose cause of reactivity anomaly	High reactor cold leg temperature		Main Turbine
3	Examine chemical and volume control system status To diagnose cause of reactivity anomaly	Normal Turbine Line-up		Chemical & Volume Control System
4	Isolate makeup to volume control tank To isolate possible cause of reactivity anomaly	Operating practice		Chemical & Volume Control System
5	Operate the boric acid flow controller To borate the reactor coolant system	Operating practice		Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/ Mitigate Consequences of an Accident

Operating Sequence: Chemical and Volume Control System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
6	Recognize that cues indicate a chemical and volume control system malfunction --- To identify appropriate procedures and follow-up actions	No indications of boric acid flow		
7	Manually borate the reactor coolant system --- To restore reactor coolant system temperature to normal	Diagnosis of boric acid flow controller malfunction		Chemical & Volume Control System
8	Manually adjust letdown flow --- To reduce reactor coolant system feed and bleed turnover time	Operating practice		Chemical & Volume Control System
9	Monitor reactor temperature indications --- To verify effectiveness of boron addition	Operating practice		Reactor Coolant System
10	Review Technical Specifications --- To identify appropriate procedure and follow-up actions	Operating practice		

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Chemical and Volume Control System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
11	Communicate with on-shift personnel To coordinate activities outside of the control room	Operating practice		Plant Communications System
12	Communicate with Operations Superintendent To allow coordination of station functions	Operating practice		Plant Communications System
13.	Communicate with Maintenance Section To restore equipment operability	Indications of no boric acid makeup flow in automatic		Plant Communications System
14	Communicate with Nuclear Regulatory Commission To meet reporting requirement	Procedure	(Procedure unavailable)	Plant Communications System
15	Adjust turbine power To match turbine with reactor	Change in T_c		Main Turbine
16	Perform batch blend to volume control tank To assure adequate reactor makeup volume	Operating practice		Chemical & Volume Control System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Chemical and Volume Controls System Malfunction

Operating Sequence ID: 12

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
17	Perform batch blend to volume control tank --- To test equipment operability	Report from maintenance section that controller is repaired		Chemical & Volume Control System
18	Operate chemical and volume control system --- To restore equipment line up to normal	Operating practice		Chemical & Volume Control System
19	Fill out logs --- To comply with administrative procedures	Procedure	(Procedure unavailable)	

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Manually trip the reactor To assure reactor trip following automatic trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Reactor Protection System
2	Examine reactor indications To verify reactor trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Reactor Protection System
3	Manually trip the turbine To assure turbine trip following automatic trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Main Turbine
4	Examine electrical indications To verify emergency power available	Procedure	EOP 2-70-0 Emergency Shutdown from Power	AC Electrical Distribution System
5	Examine turbine generator indications To verify turbine and generator trips	Procedure	EOP 2-70-0 Emergency Shutdown from Power	Main Turbine
6	Examine feedwater system indications To verify feedwater flow to all stream generators	Procedure	EOP 2-70-0 Emergency Shutdown from Power	Feedwater System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
7	Operate the auxiliary feedwater system To prevent activation of auxiliary feedwater pumps	Operating practice		Auxiliary Feedwater System
8	Stop condensate pump To remove non-essential equipment from service	Operating practice		Condensate System
9	Communicate with on-shift personnel To coordinate activities outside the control room	Operating practice		Plant Communications System
10	Communicate with Operations Superintendent To allow coordination of station functions	Operating Practice		Plant Communications System
11	Manually initiate safety injection To assure safety injection actuation following automatic actuation	Annunciator	EOP 2-70-1 Safety Injection	Safety Injection System
12	Examine safety injection indications To verify safety injection actuation and flow	Procedure	EOP 2-70-1 Safety Injection	Safety Injection System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
13	Trip reactor coolant pumps To prevent equipment damage	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
14	Examine containment indications To verify reactor coolant system integrity	Procedure	EOP 2-70-1 Safety Injection	Containment
15	Examine reactor temperature To diagnose event	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
16	Examine radiation monitoring system indications To identify location of leak	Procedure	EOP 2-70-1 Safety Injection	Radiation Monitoring System
17	Examine steam generator indications To diagnose event	Procedure	EOP 2-70-1 Safety Injection	Steam Generating System
18	Examine reactor coolant system indications To identify location of leak	Operating practice		Reactor Coolant System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
19	Examine vibration and loose parts monitoring system indications To identify location of leak	Operating practice		Reactor Coolant System
20	Recognize that cues indicate a steam generator tube rupture To identify appropriate procedure and follow-up actions	High radioactivity in condenser - CTMT normal		
21	Communicate with Nuclear Regulatory Commission To meet reporting requirements	Procedure	(Procedure unavailable)	Plant Communications System
22	Implement Emergency Plan To initiate emergency response actions	Procedure	EOP 2-70-3 Steam Generator Tube Rupture	Plant Communications System
24	Operate reactor coolant system loop isolation valves To isolate faulted steam generator	Procedure	EOP 2-70-3 Steam Generator Tube Rupture	Reactor Coolant System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
23	Communicate with Health Physics Section - - - - - - - - To identify faulted steam generator	Operating practice		Plant Communications System
25	Isolate services to isolated reactor coolant system loop - - - - - - - - To prevent inadvertant overpressurization or depressurization	Operating practice		Reactor Coolant System
26	Isolate secondary side of faulted steam generator - - - - - - - - To minimize release of radioactivity	Procedure	EOP 2-70-3 Steam Generator Tube Rupture	Main Steam System, Feedwater System
27	Monitor reactor coolant system temperature - - - - - - - - To verify secondary plant stable	Operating practice		Reactor Coolant System
28	Monitor steam generator parameters - - - - - - - - To identify follow-up actions	Operating practice		Steam Generating System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Tube Ruptures - Steam Generators

Operating Sequence ID: 13

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
29	Examine reactor coolant system parameters To verify natural circulation	Procedure	EOP 2-70-3 Steam Generator Tube Rupture	Reactor Coolant System
30	Manually override safety injection valves To establish control of safety injection flow	Procedure	EOP 2-70-1 Safety Injection	Safety Injection System
31	Operate safety injection system To maintain pressurizer pressure and level	Procedure	EOP 2-70-1 Safety Injection	Safety Injection System
32	Operate the auxiliary feedwater system To establish control of steam generator water level	Procedure	EOP 2-70-3 Steam Generator Tube Rupture	Auxiliary Feedwater System
33	Shutdown feed pump To remove non-essential equipment from service	Operating practice		Feedwater System
34	Fill out logs To comply with administrative procedures	Procedure	(Procedure unavailable)	

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
1	Manually trip the reactor To assure reactor trip following automatic trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Reactor Protection System
2	Examine reactor indications To verify reactor trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Reactor Protection System, Reactor Coolant System
3	Manually trip the turbine To assure turbine trip following automatic trip	Annunciator	EOP 2-70-0 Emergency Shutdown from Power	Main Turbine
4	Examine electrical indications To verify emergency power available	Procedure	EOP 2-70-0 Emergency Shutdown from Power	AC Electrical Distribution System
5	Examine turbine generator indications To verify turbine and generator trips	Procedure	EOP 2-70-0 Emergency Shutdown from Power	Main Turbine, Main Generator
6	Communicate with on-shift personnel To coordinate activities outside the control room	Operating practice		Plant Communications System
7	Communicate with operations superintendent To allow coordination of station functions	Operating practice		Plant Communications System
8	Operate auxiliary feedwater system To prevent activation of auxiliary feedwater pumps	Operating practice		Auxiliary Feedwater System
9	Manually initiate safety injection To assure safety injection actuation following automatic activation	Annunciator	EOP 2-70-1 Safety Injection	Safety Injection System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
10	Examine safety injection indications To verify safety injection activation and flow	Procedure	EOP 2-70-1 Safety Injection	Safety Injection System
11	Trip reactor coolant pumps To prevent equipment damage	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
12	Examine containment indications To diagnose event	Procedure	EOP 2-70-1 Safety Injection	Containment
13	Examine radiation monitoring system To diagnose event	Procedure	EOP 2-70-1 Safety Injection	Radiation Monitoring System
14	Recognize that cues indicate a loss of coolant accident To identify appropriate procedures and followup actions	High containment pressure, radiation, and sump level		
15	Monitor reactor coolant system parameters To ensure timely emergency response to plant conditions	Operating practice		Reactor Coolant System
16	Examine feedwater system indications To verify feedwater flow to all steam generators	Procedure	EOP 2-70-0 Emergency Shutdown from Power	Feedwater System
17	Communicate with Nuclear Regulatory Commission To meet reporting requirements	Procedure	(Procedure unavailable)	Plant Communications System
18	Implement emergency plan To initiate emergency response actions	Procedure	Emergency Plan	Plant Communications System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
19	Operate the feedwater system To maintain steam generator levels	SG level in-band		Steam Generating System, Feedwater System
20	Examine reactor coolant system parameters To verify natural circulation flow	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
21	Manually override safety injection valves To establish control of safety injection flow	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
22	Operate safety injection system To maintain pressurizer pressure and level	Procedure	EOP 2-70-1 Safety Injection	Safety Injection System
23	Examine reactor coolant system indications To identify location of leak	Procedure	EOP 2-70-1 Safety Injection	Reactor Coolant System
24	Examine vibration and loose parts monitoring system To identify location of leak	Operating practice		Vibration and loose parts monitoring system
25	Stop heater drain pump To remove non-essential equipment from service	Operating practice		Heater Drain and Extraction Steam System
26	Operate the auxiliary feedwater system To establish control of steam generator water level	Procedure	EOP-2-70-1 Safety Injection	Auxiliary Feedwater System
27	Shut down feed pump To remove non-essential equipment from service	Operating practice		Feedwater System

TASK SEQUENCE CHART

Plant: 06

Operator Function/Subfunction: Supervise and Control Plant Operations/Mitigate Consequences of an Accident

Operating Sequence: Loss of Coolant Accident

Operating Sequence ID: 15

Sequence Number	Task and Purpose	Cue	Procedure Name & Number	Plant Specific System Name
28	Fill out logs To comply with administrative procedures	Procedure	(Procedure unavailable)	

9. MASTER LIST OF PANEL CODES

Panel No.	Function
1	Process RMS, RMS status
2	FW heat cycle, FW Heaters
3	Condensate indications
4	TG supervisory
5	Nuclear steam system temp. recording & leak test*
6A	Incore instruments
6B	Core thermocouples
6	Traversing incore probe*
7	Control rod display
8	Area & process RMS recorder/CRT
9	MSIV leak control
10	Auto depressurization & relief valves*
11	Core spray (train A)*
12	RHR (train A)
13	Containment systems
14	Core spray (train B),* containment spray
15	RHR, RHR (train B)
16	Reactor core isolation cooling*
17	High pressure core injection,* safety injection
18	Emergency diesel generation
19	Plant elect. metering, main generator
20	ACED
21	Cooling water systems

*BWR systems.

Panel No.	Function
23	Recombiner
24	Off-gas,* gaseous rad. waste
25	HVAC
26	FW
27	Condensate
28	Main turbine & EHC
28B/28V	Main turbine & EHC ACED FW Cond. AFW SG SDCS CCW Lube oil Reheat steam
29	Reactor control console, RCS, PZR
30	Reactor circulation,* RCS
31	Plant service
32A	Heating and ventilation
32B	Operator computer peripheral
32	HVAC
33	Operator's computer console, supervisor's desk, communication console
34	Operator's computer console, operator's desk
35	ESF
36	CVCS, makeup & purification
37	RPS Core protection calculator ESFAS Cond.

*BWR systems.

Panel No.	Function
38	Miscellaneous & HVAC: AS CTMT purge Cooling tower CWS Gas radwaste Plant cooling water Instrument & service air Nuclear cooling water
39B/39V	Rod control RPI Rx temperature & pressure indications NIS displays PZR
40	NIS cabinets
41	System status monitoring panel
42	Boron recovery Waste gas
43	Liquid waste
44	Meteorological instruments
45	AFW
46	Steam generating SDCS MSIV controls
47	Main steam Reheat steam Extraction steam & drains
48	Main condenser
49	Balance of plant equipment monitoring & misc.
50	Post-accident monitoring, SPDS
51	Pressurizer pressure and level control
52	Vibration and loose parts monitoring
53	Controlled key locker

*BWR systems.

10. TASK DATA FORMAT DESCRIPTION (MAGNETIC TAPE)

The complete crew task analysis data represented on the Task Data Forms (see Volume 1, Sections 2 and 3) are contained in a computerized database described in Volume 1, Section 4. The Task Data Forms (TDFs) were the primary record of crew tasks observed within the context of the selected plant and operating sequence.

All final quality control and quality assurance activities were focused on the TDFs. Since data on the task sequence charts (TSCs) are contained in the TDFs, the TSCs in Volume 2 should be consulted only as guidance to the task level descriptors in the database. Thus, the eventual user of the crew task data should reference the database as the authoritative record in all cases.

The task analysis database was written to magnetic tape for record transport. The software routine created to perform this conversion from disk to tape is described below. The database was constructed to support SEEK retrieval and as such contains variable record lengths. Three basic delimiters are used to separate fields and values within each record. These are:

- Attribute (or field) mark CHAR (254)
- Value mark CHAR (253)
- Subvalue mark CHAR (252)

The basic structure of the data records is as follows:

(1) Each record contains 35 fields, each field delimited by an attribute mark. (See Table 2-1.) Note that some records may contain 42 fields if additional supplemental data have been added.

(2) Each field is described briefly below. The location field specified is the field number. Note that Field 1 contains information specific to SEEK and should not be used elsewhere. The display name and format information is used for display purposes only and included for completeness. The S M and ASSOC information displayed is important in deciphering the records.

- Fields may contain values, each delimited by a value mark. Additionally any value may contain subvalues delimited by subvalue marks. If a field is permitted to contain multiple values (and/or subvalues), then that field is marked with an "M" in the S M column.

- Fields 23 through 35 are all associated fields. This means that the first value in each of these fields is related to one association (in this case a particular task). Therefore, Fields 23 through 35 will all contain the same number of values (some may be null) within one record.

Table 2-1 Dictionary of task analysis database fields

Field Name	Location	Display Name	Format	S/M Valued
PLANT	2	Plant Name	14T	S
UNIT	3	Unit Number	13L	S
NSSSVEND	4	NSSS Vendor	40L	S
AE	5	A-E	21T	M
TGVEND	6	TG Vendor	40L	M
CRTYPE	7	CR Type	40L	M
OLDATE	8	OL Date	40L	M
OPSEQ	9	Operating Sequence	40T	S
OPSEQID	10	Operating Sequence ID	6L	S
OPFUNC	11	Operator Function	40L	M
OPSFUNC	12	Operator Subfunction	40T	S
COMM	13	Comments	40T	M
CUE	14	Cue	40T	M
TSKSTMT	15	Task Statement	40T	S
TSKPUR	16	Task Purpose	40T	S
TSKCODE	17	INPO Task Code	40T	M
TSKSEQNO	18	Task Sequence No.	20L	M
TSKDUR	19	Task Duration	24L	M
PROC	20	Procedures	27T	M
DATACOLAT	21	Data Collected At	40L	M
JOBCAT	22	JOBCAT	6T	M
LOC	23	LOC	3T	M
TIME	24	Time	9T	M
VERB	25	Verb	12T	M
COMP	26	Component	12T	M
PAR	27	Parameter	9T	M
STATE	28	State	8T	M
OTOBJ	29	Other Obj.	12T	M
SYS	30	System	6T	M
EQUIV	31	INPO	4T	M
MEANS	32	Means	9T	M
RFSP	33	Respond.	8T	M
RLOC	34	RLOC	5T	M
CONTENT	35	Content	12T	M

The records are converted to tape blocks of 8,000 characters using the following conventions:

(1) There is only one record per block; however, in some cases it may take two blocks or more to store one record.

(2) Blocks are padded to 8,000 characters with @ characters.

(3) ASCII format is used.

(4) Each block is assigned a sequential five-digit index number that is stored in the first five characters of each block.

(5) The first block of each record contains that record's ID number which is stored after the block index number (delimited by an attribute mark).

(6) If more than one block is needed to store a record, then the first block (and any subsequent blocks prior to the last block) will end in double start buffer marks (CHAR (251)).

(7) The record's ID is only stored in the first block for that record. However, each block will contain a sequential index number.

The above information provides the structure of the data as written on computer-readable magnetic tape. Conversion of the data from tape back to a database other than the PRIME/SEEK DBMS may require additional software.

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16. ABSTRACT (200 words or less) A task analysis of nuclear power plant control room crews was performed by General Physics Corporation and BioTechnology, Inc. for the Office of Nuclear Regulatory Research, US NRC. The task analysis methodology used in the project is discussed and compared with traditional task analysis and job analysis methods. The objective of the project was to conduct a crew task analysis that would provide data for evaluating six areas: (1) human engineering design of control rooms, (2) the numbers and types of control room operators needed with requisite skills and knowledges, (3) operator qualification and training requirements, (4) normal, off-normal, and emergency operating procedures, (5) job performance aids, and (6) communications. A generic structural framework for assembling the large task data base was employed from observations and videotaping of crew behaviors during 44 operating sequences conducted at 8 power plant sites. The results of the data collection effort were compiled in a computerized task database (SEEK). Six demonstrations for verifying the suitability of the analytical approach and for suitability analysis of each of the 6 areas were performed and described. Volume 1 details the Project Approach and Methodology, and Volume 2 provides the Data Results including a description of the computerized task analysis data format.

17. KEY WORDS AND DOCUMENT ANALYSIS — 17a. DESCRIPTORS

Human Factors	Training
Task Analysis	Operator Licensing
Job Analysis	Procedures
Control Room Crews	Job aids
Nuclear Power Plants	Communications
Crew Task Database	SEEK
Personnel Qualifications	PRIME

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