

**PSEG NUCLEAR L.L.C.  
SALEM/OPERATIONS**

**S1.OP-AB.ZZ-0002(Q) - REV. 3**

**FLOODING**

- ◆ Biennial Review Performed: Yes \_\_\_ No ✓
- ◆ Change Package(s) and Affected Document Numbers incorporated into this revision:  
DCP No. 80089441 DCP Rev. No. 3 AD No. P08 AD Rev. No. 0
- ◆ The following OTSC(s) were incorporated into this revision: None

**REVISION SUMMARY:**

The following changes were incorporated into this revision:

- ◆ Revised Attachment 1 to provide additional guidance regarding Calculated Flood Rate (gpm), Estimated Time to Submerge Vital Equipment (min) and Affected Equipment due to the installation of a Fire Protection Sprinkler System in the 64' Switchgear Area .  
The 64' Switchgear Area Fire Protection Sprinkler System was installed by DCP 80089441, S1 CO2 Replacement - 64', 78' and 84' Elevations. [80089441-0070]

**IMPLEMENTATION REQUIREMENTS**

Effective Date: 12/7/2007

- ◆ DCP 80089441, S1 CO2 Replacement - 64', 78' and 84' Elevations

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FLOODING

1.0 ENTRY CONDITIONS

DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

1.1 In plant flooding except containment as indicated by the following:

- ◆ Report from personnel of flooding from piping systems or tanks outside of Containment
- ◆ Unexpected sump alarms in the Auxiliary or Turbine Buildings

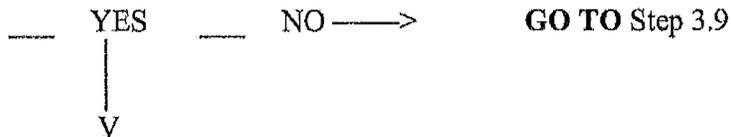
2.0 IMMEDIATE ACTIONS

2.1 None

3.0 SUBSEQUENT ACTIONS

\_\_\_ 3.1 **SEND** Operators to determine exact source and severity of flooding.

3.2 Is the Circulating Water System the source of flooding?



Time

\_\_\_ 3.3 **STOP** the affected Circulating Water Pump by depressing the Emergency Trip pushbutton.

**CAUTION**

**Operation of the flood sump pump or release of water to the environment, may cause a NJPDES violation. Shift Supervisor permission required prior to operating flood pump.**

\_\_\_ 3.4 **START** all available sump pumps and water removal equipment in affected area.

\_\_\_ 3.5 **NOTIFY** Site Services and Maintenance Department to assist in dewatering efforts and protection of personnel/equipment.

\_\_\_ 3.6 **ATTEMPT** to isolate the leak.

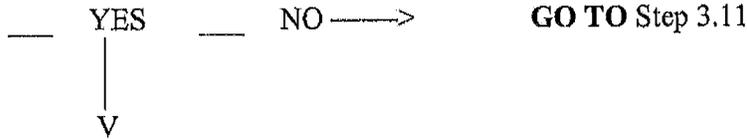
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\_\_\_ 3.7 **STABILIZE** the unit at the available Circulating Water System configuration.

\_\_\_ 3.8 **GO TO** S1.OP-AB.CW-0001(Q), Circulating Water System Malfunction.

3.9 Is the Service Water System the source of flooding?

Time



Time

\_\_\_ 3.10 **INITIATE** S1.OP-AB.SW-0001(Q), Loss of Service Water Header Pressure.

\_\_\_ 3.11 **REFER TO** the appropriate Attachment for the following affected areas:

C0361

- ◆ 64' Switchgear Room, Attachment 1
- ◆ Relay Room, Attachment 2
- ◆ Aux Bldg 84', Attachment 3
- ◆ Aux Bldg 122', Attachment 4
- ◆ Chiller Room, Attachment 5
- ◆ SW Pump Bays, Attachment 6
- ◆ Corridor adjacent to 84', Attachment 7  
Switchgear Room

\_\_\_ 3.12 **START** all available sump pumps in affected areas.

\_\_\_ 3.13 **NOTIFY** Operators at the scene to attempt to ISOLATE the leak.

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3.14 Is severe flooding occurring as indicated by any of the following?

- ◆ Safety Related equipment endangered or rendered inoperable
- ◆ Equipment important to safe plant operation endangered or rendered inoperable, including:
  - ◆ Control Air System
  - ◆ Electrical Power sources
- ◆ Flooding in excess of available water removal equipment

YES     NO →    **GO TO Step 3.16**  
       |  
       V

Time

3.15 **INITIATE** the appropriate Integrated Operating Procedures to place the unit in Mode as required by SM/CRS.

3.16 Is the flooding occurring in a Radiologically Controlled Area?

YES     NO →    **GO TO Step 3.18**  
       |  
       V

Time

3.17 **NOTIFY** Radiation Protection and Chemistry Department to sample flood water and calculate releases.

3.18 **NOTIFY** Site Services and Maintenance Departments to assist in dewatering efforts and protection of personnel/equipment.

3.19 **NOTIFY** Engineering and appropriate Maintenance Departments to assist in assessing equipment damage.

3.20 When the source of flooding is isolated, **SEND** Operators to inspect all areas adjacent to affected areas for flooding damage.

3.21 **NOTIFY** the SM/CRS to refer to Technical Specifications and the Event Classification Guide.

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4.0 Completion and Review

- 4.1 **CIRCLE** Entry Condition in Section 1.0,  
**OR EXPLAIN** Entry Condition in Comments Section of Attachment 8.
- 4.2 **COMPLETE** Attachment 8, Sections 1.0 and 2.0,  
and **FORWARD** this procedure to SM/CRS for review and approval.
- 4.3 **SM/CRS PERFORM** the following:
  - 4.3.1 **REVIEW** this procedure with Attachment 8 for completeness and accuracy.
  - 4.3.2 **COMPLETE** Attachment 8, Section 3.0.
  - 4.3.3 **FORWARD** completed procedure to Operations Staff.

**END OF PROCEDURE**

ATTACHMENT 6  
 (Page 1 of 2)

AOP TECHNICAL VERIFICATION  
 EVALUATION CRITERIA CHECKLIST

AOP #: Sl.OP-AB.ZZ-0002(Q)

Rev #: 3

Date: OSBANE

Evaluator: 9/2/07

CRITERIA	CONFORMANCE			
	Yes	No	N/A	Note
<b>1.0 Comparison Against Technical Guidelines</b>				
1.1 The AOP is correctly written for the event addressed (i.e., symptom based vs. event based)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 All entry conditions are appropriate for the conditions in which the AOP will be used.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1.3 Each AOP major action is documented in the AOP Technical Basis Document.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1.4 The AOP strategy does not conflict with EOP actions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>2.0 Setpoints and Quantitative Values</b>				
2.1 Setpoints and quantitative values are used in the AOP in accordance with the Technical Guidelines.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2 Setpoints and quantitative values are correctly calculated.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Numerical values stated in the procedure can be read to the required accuracy from the available instrumentation.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.4 The titles of figures and tables are descriptive of their content.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.5 The labeling of figure axes is appropriate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.6 The scale divisions on figures are appropriate for the intended use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.7 Numerical values stated in the procedure can be read to the required accuracy from the figures.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.8 Appropriate reference curves are provided on figures and appropriately labeled.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.9 The prohibited regions of figures are readily apparent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

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**ATTACHMENT 1  
(Page 1 of 1)**

**64' SWITCHGEAR ROOM**

**C0361**

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
DM 1 in. header	60	300 min	4160 VAC Vital Busses
FP Sprinkler System (*)	275	65 min	4160 VAC Vital Busses

(\*) Sprinkler activation causes alarm in Control Room

**NOTES**

1. Possible second source of flooding is from 84' Switchgear Room. See Attachment 7.
2. Floor drains are assumed closed.
3. 4160 VAC buses are considered disabled at 6 inches water level.
4. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
5. Assumes double ended rupture of piping to produce calculated flood rate.

ATTACHMENT 2  
(Page 1 of 1)

RELAY ROOM

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
DM 1 in. header	120	0 min	28 VDC Buses, 115 VAC Vital Inst Buses

NOTES

1. Time to submerge is zero due to cable routing under floor.
2. Floor drains are assumed closed.
3. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
4. Assumes double ended rupture of piping to produce calculated flood rate.

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**ATTACHMENT 3**  
**(Page 1 of 2)**

**AUXILIARY BUILDING 84'**

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
AFST 4 in. header	0	no damage	-----
AFST 6-10 in. header	740-6500	14-120 min	(1)
CCW 4-12 in. header	0-6700	no damage	-----
DM 1-2 in. header	0	no damage	-----
DM 4-8 in. header	500	180 min	(1)
FP 5 in. header	2800	30 min	(1)
RWST 4 in. header	0	no damage	-----
RWST ≥ 6 in. header	1100-36000	2-80 min	(1)
SF 8-10 in. header	4400-8300	10-20 min	(1)
SW ≤ 3 in. header	0	no damage	-----
SW 4 in. header	2000	no damage	-----
SW ≥ 6 in. header	14000-30000	3-6 min	(1)

(1) AFW Pumps, CCW Pumps, SJ Pumps, Charging Pumps, West Valve Vital Control, CS Pumps

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ATTACHMENT 3  
(Page 2 of 2)

AUXILIARY BUILDING 84'

NOTES

1. CCW flooding will not damage Safe Shutdown equipment due to insufficient volume.
2. Calculated flood rates above are in excess of estimated floor drain rate of 2500 gpm.
3. Equipment is considered disabled at 18 inches water level.
4. 13 AFW Pump can be affected by cross connected floor drains to pump cubicle.
5. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
6. Assumes double ended rupture of piping to produce calculated flood rate.

ATTACHMENT 4  
(Page 1 of 1)

AUXILIARY BUILDING 122'

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
CCW	2600	no damage	1B Air Cond Vital Control Center
DM 1 in. header	0	no damage	-----
DM 3 in. header	1000	75 min	1B Air Cond Vital Control Center

NOTES

1. CCW flooding will not damage Safe Shutdown equipment due to insufficient volume.
2. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
3. Equipment is considered disabled at 18 inches water level.
4. Assumes double ended rupture of piping to produce calculated flood rate.

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**ATTACHMENT 5  
(Page 1 of 1)**

**CHILLER ROOM  
(PENETRATION AREA 100')**

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
SW 4 in. header	4100	15 min	CH Pumps and Chillers, Ventilation Vital Control Centers
CH 5 in. header	340	no damage	-----

NOTES

1. CH flooding will not damage Safe Shutdown equipment due to insufficient volume.
2. Chiller Systems can be cross connected to other unit.
3. Equipment is considered disabled at 18 inches water level.
4. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
5. Assumes double ended rupture of piping to produce calculated flood rate.

ATTACHMENT 6  
(Page 1 of 1)

SW PUMP BAYS

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
SW 20-24 in. header	33000	1 min	SW Pumps in affected bay

NOTES

1. Single bay is affected by flooding, other bay and pumps remain available.
2. Pumps are assumed disabled at a water depth of 2 ft.
3. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
4. Assumes double ended rupture of piping to produce calculated flood rate.

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**ATTACHMENT 7**  
(Page 1 of 1)

**CORRIDOR ADJACENT TO 84' SWITCHGEAR ROOM**

C0361

Source of Water	Calc Flood Rate (gpm)	Est. Time to Submerge Vital Equipment	Equipment Affected
DM 8 in. header	2800	N/A	64' Switchgear Room by drainage
FP 8 in. header	4800	N/A	64' Switchgear Room by drainage

**NOTES**

1. This area provides a water source to 64' Switchgear Room only. No equipment in this area is required for Safe Shutdown.
2. Calculated Flood Rate is the difference between source flow rate and room drainage capacity, including door seals and other penetrations.
3. Assumes double ended rupture of piping to produce calculated flood rate.





## FLOODING TECHNICAL BASES DOCUMENT

### 1.0 REFERENCES

#### 1.1 Technical Documents

- A. Salem Generating Station Updated Final Safety Analysis Report:
  - 1. Section 3.4, Water Level (Flood) Design
  - 2. Section 3.6, Protection Against Dynamic Effects Associated With Postulated Rupture Of Piping
  - 3. Section 9.2, Water Systems
- B. Salem Generating Station Technical Specifications Unit 1:
  - 1. 3.7.5, Flood Protection
  - 2. 6.9, Reporting Requirements
- C. Configuration Baseline Documentation - None
- D. Technical/Engineering Letters:
  - 1. NSR HPES S1-90-002, HPES Evaluation Of Valve Tagging Error That Resulted In Flooding And Contamination
  - 2. PSE&G PSLT NLR-I88007, Service Water Event Special Report to NRC
  - 3. S-C-A900-MEE-0158-0, Salem Engineering Evaluation - Internal Flooding of Power Plant Buildings
- E. Event Classification Guide:
  - 1. Section 8, Nonradioactive Leak/Release
  - 2. Section 18, Technical Specification/Plant Status Changes

1.2 Procedures

- A. S1.OP-AB.CW-0001(Q), Circulating Water System Malfunction
- B. S1.OP-AB.SW-0001(Q), Loss of Service Water Header Pressure
- C. Administrative Procedure NC.NA-AP.ZZ-0015(Q), Safety Tagging Program
- D. E&PB Department Manual, Procedure GM8-EMP-027, Safety Classifications - Salem
- E. E&PB Department Manual, Procedure GM8-EMP-009, Operation Design Change Control
- F. DE-PS.ZZ-0010(Q), Internal Hazards Program

1.3 Drawings - None

1.4 Conformance Documents

- A. C0361, INPO SOER 85-05, Internal Flooding Of Power Plant Buildings

1.5 Industry Concerns

- A. NRC IE Bulletin 80-24, Prevention of Damage due to Water Leakage Inside Containment
- B. INPO SOER 80-2, Plugging Of Floor Drains in Emergency Equipment Rooms
- C. NSAC-60, A Probabilistic Risk Assessment of Oconee Unit 3, June 1984
- D. INPO SER 07-88, Flooding Of Service Water Bay At Salem Unit 1
- E. INPO SER 15-89, Internal Flooding Resulting From Freeze Seal Failure
- F. INPO SER 32-85, Internal Flooding Of Plant Pump House Resulted in Loss of Circulating and Station Service Water for Two Units
- G. INPO SER 84-50, Internal Flooding of Power Plant Buildings

- H. INPO SER 81-2, Flooding Of RHR, Service Water, and Diesel Cooling Water Pumps
- I. INPO SER 86-04, Internal Flooding of an Emergency Core Cooling System Pump Room
- J. NRC INFO 83-44S1, Potential Damage To Redundant Safety Equipment as a Result of Backflow Through the Equipment and Floor Drain System
- K. NRC INFO 87-49, Deficiencies In Outside Containment Flood Protection
- L. INPO Guideline, Assessment of Internal Flood Vulnerability

## 2.0 DISCUSSION

- 2.1 This procedure provides the direction necessary for plant operation with in plant flooding other than flooding in the Containment. It is the intent of this discussion to provide the reasoning behind the logic and flowpath of the procedure. It is not intended to provide additional direction to the procedure.

Due to multiple and various industry events, procedures for in plant flooding are necessary to ensure proper corrective actions are performed and availability of Safe Shutdown Equipment is maintained. INPO SOER 85-05 requires that all Nuclear Facilities analyze for vulnerability of Safe Shutdown Systems to in plant flooding, and that procedures adequately address causes, sources of flooding, and equipment potentially affected. Salem Engineering Department performed Engineering Evaluation S-C-A900-MEE-0158-0 specifically to answer these requirements. Data from this evaluation is used extensively throughout this procedure. Assumptions used in this evaluation are extremely conservative to ensure all unanalyzed scenarios are enveloped by this safety analyses. These assumptions include:

- ◆ All piping breaks are double ended guillotine ruptures of the diameter specified in the appropriate attachment.
- ◆ Calculated flood rate is the rate of water entry into the affected area from the rupture minus the installed sump pump capacity minus the expected leak rate from any penetrations in the room or area.
- ◆ Any submersion of equipment renders that component inoperable.
- ◆ Only those flooding events which would cause or require a plant shutdown while the unit is in modes 1 or 2 were considered.

- ◆ The following areas were investigated:
  - ◆ 64' and 84' switchgear rooms
  - ◆ Relay room
  - ◆ 84' and 122' Auxiliary building elevations
  - ◆ Service Water intake structure
  - ◆ Chiller room 100' elevation penetration area
  - ◆ Electrical penetration area
  - ◆ Control room area
  
- ◆ The following areas were excluded since they do not contain equipment necessary for plant shutdown FOLLOWING A FLOODING EVENT, or have no credible flow paths for flood propagation:
  - ◆ 78' and 100' piping penetrations
  - ◆ Turbine Building
  - ◆ Service Water System Vital Control Center rooms
  - ◆ RHR Pump rooms
  - ◆ Diesel Generator rooms

For more detailed information on Salem design criteria, and assumptions used in the flooding analyses, refer to S-C-A900-MEE-0158-0, Internal Flooding of Power Plant Buildings.

- 2.2 Entry Conditions - Entry conditions are based on a report of flooding being received or various sump high level alarms annunciating in the Control Room.

The symptoms available to the Operator are as follows:

- ◆ Report of flooding from personnel in field

- ◆ Sump Alarms:
  - ◆ OHA-B29, 11-13 SW PMP SUMP AREA LVL HI
  - ◆ OHA-B30, 14-16 SW PMP SUMP AREA LVL HI
  - ◆ OHA-C26, 11 RHR SUMP OVRFLO
  - ◆ OHA-C34, 12 RHR SUMP OVRFLO
  - ◆ OHA-G43, TURB AREA LVL HI PMP START
  - ◆ OHA-C33, RWST/PWST OVRFLO
  
- ◆ Related Alarms:
  - ◆ OHA-B13, 11 SW HDR PRESS LO
  - ◆ OHA-B14, 12 SW HDR PRESS LO
  - ◆ OHA-B15, TURB AREA SW HDR PRESS LO
  - ◆ OHA-G8, TAC EXP TK LVL HI OR LO
  - ◆ OHA-C35, SFP LVL LO
  - ◆ OHA-G32, TAC PMP DISCH PRESS HI OR LO
  - ◆ OHA-B48, SW VLV RM FLOODED
  - ◆ 1CC1 Alarm, CC Surge Tank Level Hi-Lo
  - ◆ 1CC2 Alarm, PWST Level Lo
  - ◆ 1CC2 Alarm, AFWST Level Lo, Lo-Lo
  - ◆ Panel 104 Alarms, Waste Hold Up Tank No 11/12 High/Lo Level
  - ◆ Panel 104 Alarm, Sump Tank Level High/Lo
  - ◆ Various Alarms on Auxiliary Alarm Typewriter

2.3 Immediate Actions - None

2.4 Subsequent Actions - Initially, Operators are sent to determine the exact source of flooding and to report on equipment endangered or affected. If it is determined that the flooding is severe enough to jeopardize continued safe operation of the unit, the Unit is placed in a Mode determined by the SM/CRS to ensure compliance with Technical Specifications.

If the Circulating Water System or the Service Water System is the source of flooding, the operator is directed to stabilize the Unit and go to S1.OP-AB.CW-0001(Q) for further actions. For flooding from other sources, the Operator is directed to refer to the Attachment for the specific areas affected to determine equipment potentially affected and possible sources of flood water. Dewatering assistance from Site Services and Maintenance Departments is started as soon as possible while Operators attempt to isolate the leak.

All available sump pumps are started and portable pumps are used as needed and provided by Site Services. If flooding is from the Service Water System, direction is given to initiate S1.OP-AB.SW-0001(Q). Attachments are referenced to evaluate room flooding and the appropriate sump pumps are started in attempt to keep up with the leak to minimize flooding in the area.

Equipment important to plant safety are checked for ability to safely shutdown the Unit. Initiation of the appropriate Integrated Operating Procedure is next to place the Unit in a Mode safe for operation depending on the location and severity of the leak.

For flooding in Radiologically Controlled Areas, samples are taken to calculate releases to the environment. Other Departments are notified to provide assistance in their areas of expertise where appropriate. All areas adjacent to the affected areas are inspected to ensure water damage has not occurred due to seepage or overflow.

The following departments are consulted for evaluation of potentially damaged equipment and restored or repaired as applicable:

- ◆ Site Services
- ◆ Maintenance
- ◆ Engineering

Technical Specifications and the Event Classification Guide is then referred to for applicable LCOs and classification of the event for notifications.

**END OF DOCUMENT**