FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2
EMERGENCY PROCEDURE NUMBER 2-0120041
REVISION 0
October 13, 1981

STEAM GENERATOR TUBE RUPTURE

REV	FRG
APPROVAL	PLT MGR

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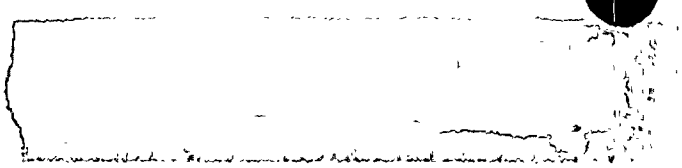

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1.0 SCOPE:

This procedure provides operator instruction for two conditions:

(A) S/G tube leak less than charging pump capacity

(B) S/G tube leak greater than charging pump capacity. This requires use of procedure 2-0030130 (RT/TT) concurrent with these instructions.

2.0 SYMPTOMS:

2.1 Unique to this incident:

2.1.1 S/G Blowdown Monitor Alarm
2.1.2 Condenser Air Ejector Alarm

2.1 Radiation monitoring system

NOTE: Any or all of the following may be evident due to a tube failure.

2.2 Decreasing PRZR level

2.2 Indications
BU Charging pump start
PRZR heaters de-energize

2.2 Alarms
H-17,H-18,H-25,H-26,H-29,H-30

2.3 Decreasing PRZR pressure:

2.3 Indications
BU heaters energize

2.3 Alarms
H-9,H-10,H-1,H=2,H-3,H-4

2.0 SYMPTOMS: (Cont.)

2.4	Initial increase in affected S/G level followed by return to programmed level	2.4 Dependent on size of tube leak LR-9011, 9012
2.5	Feed flow less than steam flow on affected S/G	2.5 Dependent on size of tube leak FR-8011/9011 FR8021/9021
2.6	Decreasing letdown flow	2.6 Caused by decreasing PRZR level FIA-2202
2.7	Increasing charging flow	2.7 Will cause VCT level to decrease LIC-2226 FIA-2212
		2.7 Alarms M-3

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3.0 AUTOMATIC ACTIONS:

3.1 LEAK < CHARGING PUMP CAPACITY

3.1.1 PRZR level controls close to minimum .

3.1.2 S/G blowdown and sample valves close on high radiation

3.2 LEAK > CHARGING PUMP CAPACITY

3.2.1 Reactor trip from TM/LP (variable)

3.2.2 SIAS when RCS pressure decreases to 1600 PSIA

3.2.3 CIS from initiation of SIAS

3.2.4 Turbine trip from reactor trip

3.2.4.1 FW Reg valves close and 15% bypass valves open to 5% flow position

3.2.5 PRZR level controls close to minimum

3.2.6 PRZR heaters de-energize on low low level

3.2.7 S/G blowdown and sample valves close on high radiation

3.2.8 PORV's open at 2400 PSIA

4.0 IMMEDIATE OPERATOR ACTIONS:

4.1 LEAK < CAPACITY OF CHARGING PUMPS

4.1.1 Ensure all required automatic actions have occurred

4.1.2 Start additional charging as necessary

NOTE: Backup charging pumps do not auto start on Unit #2

4.1.3 IF

EITHER

RCS leakage exceeds 1 GPM

OR

Specific activity of secondary system is > .1 MCI/GM dose equivalent I-131

THEN

Notify system dispatcher of impending load reduction and reactor shutdown

NOTE: Tech Specs require: Be in Hot Standby within 6 hours and Cold Shutdown within the next 30 hours

4.1.4 Determine affected S/G:

4.1.4.1 By comparing S/G levels	4.1.4.1 Increasing level indicates S/G tube leak
4.1.4.2 By Comparing S/G Steam Flow/ Feed Flow	4.1.4.2 Steam Flow > Feed Flow indicates S/G tube leak
4.1.4.3 By comparing S/G radiation monitors	4.1.4.3 High secondary radiation levels indicate S/G tube leak

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4.0 IMMEDIATE OPERATOR ACTIONS: (Cont.)

4.1 (Cont.)

4.1.5 Take manual control and close atmospheric steam dump on affected S/G.	4.1.5 PIC-08-1A for A S/G PIC-08-1B for B S/G
4.1.6 Ensure condenser air ejector vent is aligned to plant vent	NOTE: Plant conditions may necessitate implementation of the emergency plan

4.2 LEAK > CAPACITY OF CHARGING PUMPS

4.2.1 Ensure all required automatic actions have occurred	
4.2.2 Start additional charging pumps	NOTE: Backup charging pumps do not auto start on Unit #2
4.2.3 Notify system dispatcher of load reduction and reactor shutdown and start reducing turbine load	NOTE: Tech specs require: Be in hot standby within 6 hours and cold shutdown within the next 30 hours
4.2.4 Determine affected S/G:	
4.2.4.1 By comparing S/G levels	4.2.4.1 Increasing level indicates S/G tube leak
4.2.4.2 By comparing S/G Steam Flow/Feed Flow	4.2.4.2 Steam Flow > Feed Flow indicates S/G tube leak
4.2.4.3 By comparing S/G radiation monitors	4.2.4.3 High secondary radiation levels indicate S/G tube leak
4.2.5 Take manual control and close atmospheric steam dump on affected S/G	4.2.5 PIC-08-1A for A S/G PIC-08-1B for B S/G

4.0 IMMEDIATE OPERATOR ACTIONS: (Cont.)

4.2 (Cont.)

4.2.6 Ensure condenser air ejector vent is aligned with plant vent

4.2.7 Ensure reactor trip at TM/LP setpoint and perform Immediate Operation Actions for Reactor Trip/Turbine Trip, 2-0030130

NOTE: The NPS is responsible for implementing the Emergency Plan

5.0 SUBSEQUENT ACTIONS:

5.1 LEAK < CHARGING PUMP CAPACITY — CHECK

5.1.1 Refer to Reactor Trip/ Turbine Trip, 2-0030130 and ensure that all subsequent actions (Section 5) have been or are being performed _____

5.1.2 Commence turbine shutdown per OP 2-0030125 _____

5.1.3 Commence reactor shutdown per OP 2-0030128 _____

5.1.4 Commence reactor cooldown using manual control of steam dump to the condenser _____

5.1.5 Maintain no-load S/G level with feedwater control _____

5.1.6 At Approx 900 PSIA, RCS pressure:

5.1.6.1 Close HCV-08-1A or HCV-08-1B on affected generator _____

5.1.6.2 Ensure bypass valve MV-08-1A or MV-08-1B closed _____

5.1.6.3 Isolate feedwater to the affected S/G _____

5.0 SUBSEQUENT ACTIONS: (Cont.)

5.1 (Cont.)

	CHECK
5.1.7 Continue reactor cooldown to cold shutdown condition using the unaffected S/G	_____
NOTE: T_c higher than T_h may be observed in idle loop, due to small amount of reverse flow	
5.1.8 Verify cold shutdown Boron Concentration	_____
5.1.9 Take condensate system to determine activity level	_____
5.1.10 Take air particulate and gaseous samples for:	
5.1.10.1 Air ejector after condenser and gland steam condenser combined vent	_____
5.1.10.2 Steam driven aux feed pump exhaust	_____
5.1.11 Conduct radiation surveys and post radiation areas as necessary	_____

5.2 LEAK > CHARGING PUMP CAPACITY

5.2.1 Refer to Reactor Trip/Turbine Trip, 2-0030130 and ensure that all subsequent actions (Sectin 5) have been or are being performed	_____
5.2.2 IF: Safety Injection is caused by low RCS pressure:	
THEN: Verify CEA's inserted for > 5 seconds AND stop running RCP's	_____
5.2.3 Ensure HPSI flow to the core when RCS pressure is < pump shutoff head (1250 PSIA)	_____

5.0 SUBSEQUENT ACTIONS: (Cont.)

5.2 (Cont.)

		CHECK
5.2.4	Check the ESFAS bypass status board for malfunctioning equipment	_____
	Verify equipment operation per Table I, Safety Injection Actuation and Table II, Containment Isolation	_____
5.2.5	Stop any unnecessary running equipment including the emergency diesels if offsite power is available	_____
5.2.6	Maintain no load S/G levels with AFW to the non-affected S/G	_____
5.2.7	If steam driven pump is used, ensure steam supply is from the non-affected S/G	_____

NOTE: Use S/G levels, AFW header flow rate indicators to and recorders to verify feedwater flow

5.2.8	Ensure HPSI pumps and charging pumps restore PRZR level and pressure	_____

NOTE: PRZR pressure should stabilize @ approx 1175 PSIA and level @ approx 10%

5.2.9	Restore ICW to TCW heat exchangers, OPEN MV-21-2 and MV-21-3	_____
5.2.10	Close condenser hotwell reject LCV-12-5	_____
5.2.11	Commence RCS cooldown using SBCS. If not available, use atmospheric steam dump on non-affected S/G	_____

CAUTION: Do not exceed 75°/HR cooldown rate.

5.0 SUBSEQUENT ACTIONS: (Cont.)

5.2 (Cont.)

		CHECK
5.2.12	If RCP operation is not possible, refer to Appendix A, Natural Circulation Cooldown	_____
5.2.13	Stabilize RCS, T_c @ 505°F	_____

NOTE: This will ensure adequate NPSH to allow Four (4) pump operation with RCS pressure @ 900 PSIA.

5.2.14	When PRZR level is > 30%, energize PRZR htrs	_____
5.2.15	Throttle HPSI pp. discharge valves to maintain PRZR level @ approx 35%	_____
5.2.16	When RCS is @ 900 PSIA, which can be achieved via PRZR spray, isolate affected S/G. Close applicable MSIV and bypass.	_____
5.2.17	Ensure feedwater to the affected S/G is isolated	_____

NOTE: When a S/G has been isolated, Tc > T_h may be observed in the idle loop. This is due to a small amount of reverse flow.

5.2.18	Continue RCS cooldown using SBCS or Atmospheric steam dump on non-affected S/G	_____
5.2.19	Block MSIS @ 600 PSIA S/G Press	_____
5.2.20	Establish and maintain 50°F sub cooling in the RCS. Use all available indications for this determination.	_____
5.2.21	Sample each S/G for activity	_____

5.0 SUBSEQUENT ACTIONS: (Cont.)

5.2 (Cont.)

	CHECK
5.2.22 Sample RCS to determine fuel failure and verify shutdown Boron Concentration	_____
5.2.23 Sample condensate system for radioactivity levels	_____
5.2.24 Conduct radiation surveys and post areas as required, being especially mindful of any steam exhausts to atmosphere	_____

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TABLE I

SAFETY INJECTION ACTUATION SYSTEM (SIAS)

CONDITION	CHECK	
(2) CCW PPS 2A, 2B, or 2C	ON	
(2) CCW to Fuel Pool HX Isolation Valves MV-14-17, MV-14-18	Closed	
(4) CCW Hdr Non-essential Isolation Valves HCV-14-8A, HCV-14-8B, HCV-14-9, HCV-14-10	Closed	
(2) CCW Outlet from Shutdown HX 2A, HX-2B, Valves, HCV-14-3A, HCV-14-3B	Open	
(2) LPSI Pumps	On	
(2) HPSI Pumps	On	
(4) LPSI Disch to Loops HCV-3615, HCV-3625, HCV-3635, HCV- 3645	Open	
(8) HPSI Disch to Loops HCV-3617, HCV-3627, HCV-3637, HCV-3647 - A Header HCV-3616, HCV-3626, HCV-3636, HCV-3646 - B Header	Open	
(2) HPSI Hot Leg Leak Drain V3572, V3571	Closed	
(2) SI Test to RWT I-SE-03-2A, I-SE-03-2B	Closed	
(4) SIT Isolation Valves V3614, V3624, V3634, V3644	Open	
(4) SIT Fill/Drain Valves I-SE-03-1A, I-SE-03-1B, I-SE-03-1C, I-SE-03-1D	Closed	
(4) SIT Check Leakoff Valves HIC-3628, HIC-3618, HIC-3638, HIC-3648	Closed	

TABLE I (SIAS) (Cont.)

CONDITION	CHECK	
(4) S/G Feed Pump Discharge ISOL Valves HCV-09-1A, HCV-09-2A, HCV-09-1B, HCV-09-2B	Closed	_____
(4) CCW To/From RCP's HCV-14-1, HCV-2, HCV-7, HCV-6	Closed	_____
(2) Contain Sump Isolation LCV-07-11A, LCV-07-11B	Closed	_____
(1) BA Makeup Valve V2512	Closed	_____
(2) BA Gravity Feed V2509, V2508	Open	_____
(1) VCT Discharge V2501	Closed	_____
(2) Letdown Isolation V2516, V2515	Closed	_____
(2) ICW Pumps 2A, 2B, or 2C	On	_____
(3) ICW Isolation Valves MV-21-3, MV-21-4, MV-21-2	Closed	_____
(2) Diesel Generators 2A, 2B	On	_____
(4) RAB Main Supply and ECCS Exhaust Fans 2HVS-4A, 2HVE-9A, 2HVS-HB, 2HVE-9B	On	_____
(4) Containment Fan Cooler 2HVS-1A, 2HVS-1B, 2HVS-1C, 2HVS-1D	On (Slow Speed)	_____
(8) ECCS Isolation Dampers D5A D6A, D9A, D12A - A Train D5B, D6B, D9B, D12B - B Train	Closed	_____
(2) Rx Support & Cavity Cool Fans 2HVS-2A, 2HVS-2B, 2HVE-3A, 2HVE-3B	Off	_____

NOTE: Any spare equipment that is running, and not needed for controlling this incident should be STOPPED

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TABLE II

Containment Isolation Actuation Signal (CIAS)

	CONDITION	CHECK
(2) SIT to RWT/VCT I-SE-03-2A, I-SE-03-2B	Closed	
(5) SIT Sample Isolation Valve FCV-03-1A, FCV-03-1B, FCV-03-1C, FCV-03-1D, FCV-03-1E	Closed	
(4) S/G Blowdown Isolation Valves FCV-23-3, FCV-23-5, FCV-23-4, FCV-23-6	Closed	
(2) Containment Sump Isolation Valves LCV-07-11A, LCV-07-11B	Closed	
(6) RCS & PRZR Sample Isolation Valves V5200, V5201, V5202, V5203, V5204, V5205	Closed	
(1) Primary Water Isolation HCV-15-1	Closed	
(1) Instrument Air Isolation HCV-18-1	Closed	
(1) N_2 Supply Isolation V6741	Closed	
(2) Waste Gas Isolation V6750, V6718	Closed	
(2) RCP Bleed-Off Isolation V2505, V2524	Closed	
(2) RX Drain TK Isolation V6341, V6342	Closed	
(3) Letdown Isolation Valves V2516, V2522, V2515	Closed	
(2) Diesel Generator 2A, 2B	On	
(2) Shield Bldg. Ventilation Fan 2HVE-16A Control Room Fan 2HVE-13-A	On	
(4) Control Room Isolation Valves FCV-25-24, FCV-25-17, FCV-25-18, FCV-25-16	Closed	

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TABLE II (CIAS) (Cont.)

	CONDITION	CHECK
(2) Shield Bldg. Ventilation Fan 2-HVE-16B Control Room Filter Fan 2HVE-13B	On	
(4) Control Room Isolation Valves FCV-25-25, FCV-25-14, FCV-25-15, FCV-25-19	Closed	
(2) Containment Purge Exhaust Fans 2-HVE-8A, 2-HVE-8B	Off	
(6) Containment Purge Isolation Valves FCV-25-1, FCV-25-3, FCV-25-5, FCV-25-6, FCV-25-4, FCV-25-2	Closed	
(3) Continuous Containment H_2 Purge Isolation FCV-25-20, FCV-25-26, FCV-25-21	Closed	
(2) Shield Bldg. Vent Isolation Valves FCV-25-32, FCV-25-33	Open	
(2) Fuel Bldg. Emerg. Vent Isolation Valves FCV-25-30, FCV-25-31	Closed	
(6) Containment Sample Isolation Valves (on RTGB 206) FCV-26-2, FCV-26-4, FCV-26-6, FCV-26-1, FCV-26-3, FCV-26-5	Closed	

6.0 PURPOSE/DISCUSSION:

6.1 The purpose of this procedure is to list the indications that will enable the operator to identify a Steam Generator Tube failure and to provide the action to be taken to control the accident and minimize radioactive release to the environment.

This procedure provides instructions for two cases, "Leak Within the Capacity of the Charging Pumps" and "Tube failure" (exceeds Charging Pump Capacity).

6.2 Discussion:

A Steam Generator Tube Failure causes leakage of reactor coolant into the steam system. If the leakage exceeds the capacity of the charging pumps, pressurizer pressure will decrease rapidly, causing a thermal margin/low pressure trip. The subsequent cooldown following the reactor trip combined with the continued leakage of reactor coolant into the Steam Generator will cause a further reduction in pressurizer pressure and level, resulting in initiation of safety injection and containment isolation. The tube rupture will cause a reduction in reactor coolant system volume and due to reactor coolant leakage into the steam generator, the affected steam generator level will continue to increase after the feedwater block valves are closed by SIAS. The resulting decrease in RCS pressure and volume will result in the RCS briefly being at saturation conditions. The possibility the exists for void formation in the reactor coolant system.

Operator action should be directed toward prompt isolation of the affected Steam Generator, to minimize contamination of the steam system and prevent possible radioactive release to the environment. With the exception of a compound accident in which loss of power accompanies the Steam Generator Tube failure, steam is dumped to the condenser, rather than the atmosphere, to prevent gross release of contamination to the environment. Action must be taken to identify the affected Steam Generator as soon as possible and to isolate its feedwater flow to prevent water slugging the steam lines.

The Steam Generator Tube failure accident is most severe when it occurs at low power levels, due to the low inventory of water initially present in the pressurizer.

6.0 PURPOSE/DISCUSSION: (Cont.)

6.2 (Cont.)

If a controlled reactor shutdown is commenced, reduce plant load at a maximum rate which will not of itself cause a plant trip; a power reduction of approximately 5%/minute is recommended.

Minimize the use of the atmospheric steam dump valves. Any necessary releases that are made must receive appropriate authorization.

Use motor driven emergency or normal feedwater pumps to reduce the release of potentially radioactive steam from turbine driven pump exhausts.

Maintain reactor coolant pressure approximately equal to the affected steam

Do not exceed a maximum cooldown rate of approximately $75^{0}F/HR$

Condensate activity may be transferred to the service water circulating system by way of condenser tube leakage. The condenser should be isolated if vacuum is lost and the condenser is not being used for reactor plant cooldown.

To facilitate cooldown a main steam isolation signal may be avoided by bypassing the signal setpoint on each safety channel.

If reactor coolant pressure control is maintained, a safety injection actuation signal may be avoided by bypassing the signal setpoint on each pressurizer pressure safety channel, thus facilitating cooldown and depressurization.

Maintain the affected steam generator level below the maximum indicatable level by draining by way of the blowdown or sampling systems to the radioactive waste system.

Although it is possible in the long term to note an increasing steam generator level, automatic feedwater modulation keeps the steam generator level approximately constant during the short term.

After the faulted steam generator has been isolated and the cooldown is proceeding via natural circulation an inverted ΔT (i.e., T_c high than T_h) may be observed in the idle loop. This is due to a small amount of reverse heat transfer in the isolated steam generator and will have no effect on natural circulation flow in the intact steam generator.

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APPENDIX "A"

LOSS OF FORCED COOLING

CHECK

Cooldown using natural circulation which can be verified by observing: _____

(1) Loop T is < full power T (440_F) _____

(2) T_c is constant or decreasing _____

(3) T_h is stable, not steadily increasing _____

(4) No abnormal differences between T_h-RTD's and core exit thermocouples _____

When possible, restart (1) RCP in each loop to establish cooling in an isolated S/G. Use the following criteria. _____

(1) Unaffected S/G is removing heat from RCS _____

(2) PRZR. level & pressure are responding to contol _____

(3) RCS is __>__ 200 F Subcooled _____

(4) NPSH pressure is available to RCP's _____

An alternate method of enhancing natural circulation is to fill and drain (to the WMS) the isolated S/G

During RCS depressurization monitor for void formation as indicated by:

a) PRZR. level increase > expected _____

b) PRZR level decrease when charging pumps operated _____

c) With PRZR level control in "AUTO", unanticipated letdown flow > charging flow _____

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APPENDIX "A"
(Cont.)

LOSS OF FORCE COOLING	CHECK
If voiding in the RCS is indicated	
(1) Isolate letdown	_____
(2) Stop depressurization operations	_____
(3) Stop cooldown	_____
(4) Repressurize RCS to elimate voids by operating (a) Pressurizer heaters. (b) HPSI pumps. (c) Charging pumps.	

7.0 REFERENCES:

7.1 Instruction Manual - Steam Generators, St. Lucie Unit No. 1 8770-5008.

7.2 EBASCO Prints 8770-G-079, 080.

7.3 Accident Analysis, FSAR, Section 15.4.4, Steam Generator Tube Failure.

7.4 CEN 117, Inadequate Cooling.

8.0 Records Required:

8.1 Normal Log Entries.

8.2 Applicable Transient Recorder Charts

9.0 Approval:

Reviewed by: Plant Nuclear Safety Committee_____
Approved by: _____ For/Plant Manager_____

Revision __ Reviewed by FRG _____
Approved by: _____ Plant Manager_____

"L A S T P A G E"