SOUTHERN CALIFORNIA EDISON COMPANY
SAN ONOFRE NUCLEAR GENERATING STATION
NUCLEAR TRAINING DIVISION

COURSE UNIT 1 OPERATOR REQUALIFICATION

TOPIC GENERAL AND SPECIFIC OPERATING CHARACTERISTICS

LENGTH OF LESSON 8 HOURS

OT-1062

INSTRUCTIONAL MATERIAL

Revised By: ____________
M. J. Kirby

Reviewed By: ____________
P. R. Kuhner

Reviewed and
Approved By: ____________
M. J. Kirby

REFERENCES

1. USNRC PTS Audit - June 3-4 Preliminary Results.

2. Baskin to USNRC - May 26, 1982.

3. INPO, SOER, Pressurized Thermal Shock.

4. Westinghouse Lesson Plan B-4, Fission Product Poisoning Effects.

5. SCE Engineering Notes: Net Reactivity Effect of Sm^{149} and Pu^{239} Buildup on Load Change.

6. SONGS 1 Operating Instruction SO1-3-6, Plant Operation with Natural Circulation.

7. Westinghouse, Mitigating Core Damage.

8. Westinghouse Handout on Natural Circulation Operation.

OBJECTIVES

1. To familiarize the operator with the history of PTS events.

2. To review results of USNRC PTS Audit.

3. To reinforce the effects of fission product poisoning on Normal Reactor Operations.

4. To review the behavior of the plant during Natural Circulation conditions both normally and during cooldown.

INTRODUCTION	INSTRUCTOR/TRAINEE ACTIVITY
A. Establish contact.	Introduce self; write name on board. Write topic on board; hand out attendance sheet, as applicable. Have student fill out. Explain coffee mess.
B. Create interest.	Create interest.
C. Overview	
1. Objectives	Ask questions as to student understanding of objectives.

PRESENTATION

INSTRUCTOR/TRAINEE ACTIVITY

I. STATUS OF PRESSURIZED THERMAL SHOCK

A. Review June 3 & 4 Audit Preliminary Results

1. Operators interviewed: 2 SRO"s, 2 RO's, and 1 STA.

2. Operators had a good understanding of PTS and the instrumentation used to mitigate a PTS event. They had a good priority system, i.e., core cooling vs. PTS.

3. The operators were not quizzed on procedures due to major procedure revisions that they were being trained on concurrently with NRR's audit.

4. The operators exhibited three areas of weakness.

a. They were weak on past PTS events both in the industry and at SONGS 1.

b. They were not aware of problems involved with cold leg injection vs. mixing and cold water on contact with the vessel wall.

c. They all felt that repressurization was necessary to challenge vessel integrity.

5. Procedures:

a. New procedures were very good and very thorough. NRR was very pleased that they had been based on plant specific analysis (best estimate). Procedures provided adequate direction to prevent PTS.

b. NRR felt that some direction should be provided to terminating charging to stagnate loops. They also felt more human factors review of procedures was needed.

6. Training:

a. The auditors felt that the training outline and lesson plan were comprehensive and thorough. The evaluation of the operators through oral and written exams was adequate, the upcoming control room walkthroughs with the new EOI's was good and that the simulator training was adequate to insure understanding of PTS events.

b. Training needs to be upgraded in the areas of weakness demonstrated by the operators in their evaluations (see above).

7. Overall:

a. The overall assessment was good but it was emphasized that it was preliminary and further review, particulary of procedures, was needed.

B. History of PTS Events

1. 3 classes of PTS events.

a. SBLOCA.

b. Overfeeding Transient.

c. Steam Line Break.

2. Worst case examples in the industry for these events:

a. Rancho Seco - (excess feedwater transient). On March 20, 1978, the Rancho Seco plant RCS was cooled from 582 degrees F to about 285 degrees F. in slightly more than one hour (approximately 300 F./hr.), while RCS pressure was about 2000 psig. The transient was initiated by an inadvertent short in a DC power supply causing a loss of power to the plant's non-nuclear instrumentation (NNI). Loss of NNI power caused the loss of most control room instrumentation and the generation of erroneous signals to the plant's Integrated Control System (ICS). The ICS reduced main feedwater, causing the reactor to trip on high pressure. The cooldown was initiated when feedwater was readmitted to one steam generator by the ICS (auxiliary feedwater was automatically initated) and by the operators (main feedwater was restored). The cooldown caused system pressure to drop to the setpoint (1600 psig) for the safety features actuation system which started the high pressure injection pumps and auxiliary feedwater to both steam generators. High pressure injection flow restored pressure to 2000 psig. With control room instrumentation either unavailable, or suspect for one hour and ten minutes (until NNI power was restored), operators continued auxiliary feedwater and main feedwater to the steam generators while maintaining RCS pressure with the high pressure injection pumps.

b. Crystal River 3 - (small break LOCA transient). On February 26, 1980, the Crystal River 3 plant experienced a small break LOCA transient when a power operated relief valve (PORV) was inadvertently opened. The resulting transient caused a decrease in RCS temperature of about 90 degrees F. in 30 minutes (approximately 200 F./hr.) with a system pressure of about 2400 psig. The transient was initiated when an electrical short in a DC power supply for the plant's NNI caused a pressurizer PORV to open, a loss of most control room instrumentation, and the generation of erroneous signals to the plant's ICS. The ICS caused a reduction in feedwater flow and a withdrawal of control rods. RCS pressure initially increased, tripping the reactor on high pressure, and then decreased as coolant discharged through the open PORV. The high pressure injection pumps started at 1500 psig and repressurized the RCS to about 2400 psig. The PORV block valve was closed, but flow out of the RCS continued through the pressurizer safety valves. After approximately 30 minutes, the high pressure injection pumps were throttled back, but RCS pressure was maintained at about 2300 psig for the next one and a half hours. The RCS temperature decreased by about 90 degrees F. in the first 30 minutes and was thereafter brought to cold shutdown conditons by normal operating procedures since NNI power had been restored.

c. Borssele - (steam line break transient). On March 2, 1981, an inadvertent opening of a main steam safety valve at the Borssele plant (located in the Netherlands) caused one steam generator to boil dry and resulted in a primary system temperature decrease from 446 degrees F. to 284 degrees F. in about 20 minutes with primary system pressure above 2000 psig. Opening of the steam safety valve was caused by a maintenance error when the cable connectors of two solenoid pilot valves controlling the steam safety valve were interchanged. When power to the solenoids was switched on during plant startup, the safety valve opened. Operators disconnected the power supply to the pilot valves, but the safety valve remained open because the piston of one of the pilot valves stuck in its open position. For about 25 minutes, steam was released through a main steam safety valve into the atmosphere causing a blowdown of one steam generator until it boiled dry. The primary system teperature decreased at a rate of about 550 F./hr. for 20 minutes. The primary system pressure dropped from 2234 psig to 2060 psig.

3. There have been 3 potential PTS at SONGS 1. They are summarized below:

a. April 30, 1972. On April 30, 1972, with the unit at 55 MWe during startup from an outage, a failure of the "C" feedwater controller resulted in a reactor trip on high "C" steam generator level. Overfilling this generator caused average RCS temperature to fall from 550°F. to about 460°F. in 18 minutes and pressure fell from 2035 to 1550 psig. The event was terminated when the safety injection setpoint of 1685 psig was reached and safety injection initiated. No actual flow from the safety injection system was added to the reactor coolant system. Nine minutes after actuation the safety injection system was secured.

b. October 21, 1973. On October 21, 1973, unit load was being gradually reduced from 450 MWe to perform plant maintenance when a turbine trip and resulting reactor trip occurred. AT that time, the feedwater regulating system was programmed to open the regulating valves to 80% open on any trip. This resulted in a rapid filling of the steam generators and cooldown of the RCS from 548°F. to 470°F. in about eight (8) minutes. Initiation of Safety Injection at 1685 psig terminated the event. As a result of this event, the feedwater regulating system was reprogrammed to provide 5% flow on a reactor trip, thereby preventing a recurrence of this event.

c. September 3, 1981. On September 3, 1981, with the unit operating at 390 MWe, a failure in the #1 Regulated Power Supply caused several alarms and the loss of several plant parameter indications. As a result, the operator manually tripped the plant, but feedwater flow continued, resulting in an overfilling of the steam generator. This resulted in RCS temperature falling from 550°F. to 480°F. and pressure falling from 2077 to 1700 psig in about five (5) minutes. Safety Injection which terminated the event was automatically initiated at the new setpoint of 1735 psig. As a result of this event, Westinghouse was consulted about the cooldown of the vessel. They confirmed that vessel shock was not a concern in this event.

C. PTS Concerns Over Mixing Phenomena

1. Worst case can be when no mixing takes place between cold injection water and water in the loop. This places coldest water in contact with vessel wall and hence most severe thermal transient. This can occur when loop stagnates which Westinghouse says has minimum possibility of occurance at San Onofre due to no MSIV's.

PRESENTATION

INSTRUCTOR/TRAINEE ACTIVITY

2. Also there are no RTD's in downcomer region of vessel and SI injects downstream of loop Tc RTD's so that actual water temp. in downcomer is not known. Therefore the operator needs to be cognizant of this actual temperature difference.

D. "New" PTS Definition

1. Original PTS concerns required repressurization to present challenge to vessel integrity. Further analysis has shown that temperature alone can be sufficient to challenge vessel integrity. Westinghouse has come out with a graph that depicts areas of temp vs. pressure that vessel integrity is challenged. This is preliminary and will be finalized later this year.

Overhead of Westinghouse PTS Curve.

E. Current PTS Status with NRC

1. NRC to come out with interim requirements for PTS. Now expected for Oct. 1982.

2. Interim criteria based on RT_{NDT} value being argued between NRC and owners groups.

3. More to come!