

APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-267/89-15

Operating License: DPR-34

Docket: 50-267

Licensee: Public Service Company of Colorado (PSC)
P.O. Box 840
Denver, Colorado 80201-0840

Facility Name: Fort St. Vrain (FSV) Nuclear Generating Station

Inspection At: FSV Nuclear Generating Station, Platteville, Colorado

Inspection Conducted: June 23-27, 1989

Inspectors:

for R. P. Mullikin
P. W. Michaud, Resident Inspector

7/11/89
Date

Approved:

for R. P. Mullikin
T. F. Westerman, Chief, Project Section B
Division of Reactor Projects

7/11/89
Date

Inspection Summary

Inspection Conducted June 23-27, 1989 (Report 50-267/89-15)

Areas Inspected: Nonroutine, unannounced inspection of circumstances and events associated with the operation of FSV above the authorized maximum power level of 82 percent of full power.

Results: Within the area inspected, one violation was identified (paragraph 2). The licensee's failure to control inputs to the secondary heat balance calculation caused a power excursion above 82 percent power for 4 hours. The lack of control exercised and the failure to revise procedures are viewed as having the potential for serious safety consequences.

DETAILS1. Persons Contacted

M. Block, Systems Engineering Manager
A. Crawford, Vice President, Nuclear Operations
M. Denniston, Superintendent of Operations
D. Evans, Operations Manager
C. Fuller, Manager, Nuclear Production
M. Joseph, Reactor Support Supervisor
F. Novachek, Nuclear Support Manager
W. Rodgers, Nuclear Computer Services Manager

The NRC inspector also contacted other licensee personnel during this inspection.

2. Followup of Onsite Events (93702)

At 11:20 a.m. MDT on June 23, 1989, the licensee informed the NRC inspector that reactor power had apparently exceeded 82 percent. In discussions with licensee management, the NRC inspector was informed that power had exceeded 82 percent from approximately 10:30 p.m. MDT on June 22, 1989, until 2:30 a.m. MDT on June 23, 1989. The maximum actual power level was calculated to be 83.6 percent for a short time. The licensee is limited to 82 percent power by an NRC order dated July 2, 1987.

The following is a description of the event as determined from a review of records, computer printouts, chart recorders, and personnel interviews:

- ° The licensee had completed repairs to a helium circulator speed control valve, reduced power to below 30 percent, recovered the helium circulator, and began a power ascension to return to 80 percent power at 10 a.m. MDT on June 22, 1989. At 7 p.m. MDT, with the reactor at 55 percent power, cold reheat steam attemperation was placed in service. This was performed in accordance with Step 18 of Overall Plant Operating Procedure OPOP-IV, "Plant Operation Between 30% and 100% Power." Step 19 of this procedure instructs the reactor operators to "restore attemperation flow input on computer screen 2278," which was also performed. Attemperation (desuperheating) is necessary at higher power levels to control hot reheat steam temperature at 1000°F, due to the reheater sections of the steam generators being oversized to allow for tube plugging, if necessary. Attemperation consists of injecting relatively cooler feedwater into the cold reheat steam lines upstream of the steam generator reheaters. This flow must be accounted for in the secondary heat balance calculation. At the time of the overpower event, Data Logger Display 2278 had to be manually updated to reflect whether attemperation was in service.

- ° The data logger computer displays reactor power level as determined from the linear power channels of nuclear instrumentation, secondary heat balance calculations, and primary heat balance calculations. The primary heat balance is utilized, along with the linear power channels, until "boilout" of the steam generators is complete, which corresponds to approximately 26 percent reactor power. This is generally when the turbine is placed on line and superheated steam conditions exist, making the secondary heat balance calculation valid and a more accurate indication of reactor power. Operations Order 87-10, which was in effect at the time of the overpower event, instructed the operators to maintain power below 82 percent as indicated by the average linear power channel or secondary heat balance indications, since primary heat balance was not accurate at that power level.
- ° In January 1989, the licensee began a program to improve both the primary and secondary heat balance calculations. Two new primary heat balance calculations, PRI-1 and PRI-2, were installed to provide a more accurate indication of reactor power over the entire range of operation. The difference between them is in the manner in which core bypass flow is accounted for, with PRI-1 being more accurate between 0 and 50 percent power and PRI-2 more accurate between 50 and 100 percent power. Improvements to the secondary heat balance calculation added the ability to calculate power levels with saturated steam conditions, providing a greater range and accuracy of the secondary heat balance calculation.
- ° A new data logger display, No. 2274, was created to implement the improved secondary heat balance inputs. On March 22, 1989, the inputs to the secondary heat balance calculation were changed to Display 2274 from Display 2278, the old secondary heat balance display. Training was provided on the use and features of this new display, and the old display was retained as a second check feature. It is not apparent that proper administrative controls were in place to ensure that the reactor support group revised all affected procedures. Hence, Procedure OPOP-IV, Step 19, was not revised to reflect the changes made to the plant computer software. When the operators followed Procedure OPOP-IV on increasing power, Display 2278, which had the old secondary heat balance inputs, was updated as required by the procedure. No instructions or procedure existed to require updating Display 2274, which had the actual secondary heat balance inputs. The secondary heat balance was, therefore, being calculated without accounting for attemperation flow, which caused it to indicate a lower than actual power level.
- ° Power was raised to 80 percent as indicated on the average linear power channel indication at approximately 9:45 p.m. MDT on June 22, 1989. Secondary heat balance indicated approximately 79.2 percent. The primary heat balance, which was not to be utilized at these power levels per Operations Order 87-10, indicated approximately

82.6 percent. Due to its inaccuracy at higher power levels, the primary heat balance indication has historically indicated higher than secondary or linear power indications.

- ° The control room operators questioned the accuracy of the secondary heat balance indication since it usually indicates higher than linear power channel indication. The operators again verified that Display 2278 was updated and that all inputs were good, though they did not initially realize this display now provided indication only. At 2:16 a.m. MDT on June 23, 1989, the licensee's shift supervisor realized that Display 2274 had not been updated to reflect attenuation flow. When this display was updated, the indicated secondary heat balance power changed from 79 percent to 82.3 percent. The reactor operators immediately reduced power to less than 82 percent.
- ° At this point, the operators and shift supervisor believed the excursion above 82 percent to have been of a sufficiently short duration to be allowable. They also continued to question the accuracy of the secondary heat balance indication, but maintained it below 82 percent.

When licensee management arrived onsite at approximately 7 a.m. MDT on June 23, 1989, they were informed that there may be a problem with the secondary heat balance and that power may have exceeded 82 percent. The licensee investigated this and informed the NRC inspector at 11:20 a.m. MDT on June 23, 1989, that they had confirmed that corrected secondary heat balance calculations indicated power exceeded 82 percent at 10:29 p.m. MDT on June 22, 1989 (indicated secondary heat balance was 78.3 percent and average linear power channels was 79.4 percent). The corrected secondary heat balance calculation showed power remained above 82 percent until 2:28 a.m. MDT on June 23, 1989. The maximum calculated power level during this period was 83.6 percent, and the integrated power level for this period was 83.1 percent. The maximum integrated power level for an 8-hour period, which includes the 4-hour excursion, was 81.9 percent. The maximum integrated power level for a 24-hour period, which includes the 4-hour excursion, was 75.5 percent.

- ° The licensee reported this as a 1-hour nonemergency event in accordance with 10 CFR 50.72 (b)(1)(ii)(A). At 12:10 p.m. MDT on June 23, 1989, an orderly power reduction from 80 percent to 65 percent was begun in order to provide extra margin while a followup investigation was performed by the licensee.

The licensee established a team to review the event, establish root causes, and determine corrective actions to be taken to prevent a recurrence. This comprehensive review was completed and corrective actions were reviewed and approved by the plant operations review committee (PORC) on June 24, 1989. The licensee concluded the root cause of the event to be a failure to administratively control heat balance

calculations. The licensee reviewed all power operations since January 1989, when work was begun on the new heat balance calculations, and verified that at no other time did power exceed 82 percent. Corrective actions taken as a result of this event were:

- ° A new Operations Order, No. 89-05, was issued which superseded No. 87-10. This order clarifies administrative controls and instructions which apply to the 82 percent power limit. Power is now administratively limited to 80 percent as indicated on the highest of average linear power, primary heat balance, or secondary heat balance indications (previously, only linear power or secondary heat balance). In addition, operations management must be notified immediately if any of the three indications exceed 82 percent.
- ° The data logger will now automatically switch to Display PRI-2 with primary heat balance indication at 50 percent and increasing power, and return to PRI-1 primary heat balance indication at 50 percent and decreasing power. This provides more accurate primary heat balance indication throughout the operating range, since it is now used along with secondary heat balance and average linear power indications to limit the maximum operating power.
- ° Audible alarms on the data logger will activate if either the primary heat balance, secondary heat balance, or average linear power indication exceeds 81 percent. An audible data logger alarm will also actuate if any input into the secondary heat balance is bad.
- ° Attemperation flow will automatically be inserted into and removed from the secondary heat balance calculation when the system is placed in or removed from service.
- ° Procedure OPOP-IV, Step 19, was revised to reflect the correct display number, No. 2274, and to instruct the operators to verify the automatic change of attemperation flow status has occurred.

The above actions were completed at 6 p.m. MDT on June 24, 1989. The licensee reviewed these actions with the NRC inspector prior to increasing power above 65 percent. The plant was returned to 80 percent power at 10:20 p.m. MDT on June 24, 1989.

As a followup action, the licensee is performing an audit of all operating procedures to verify that any referenced data logger display numbers are correct.

After a review of the information gathered during this inspection, the NRC considers the licensee's failure to control the secondary heat balance calculation inputs and the procedure used to verify these inputs an apparent violation of NRC regulations (267/8915-01). This failure to provide adequate administrative controls to ensure that safety-related changes made to the plant by the reactor support group, including

software changes, had been properly incorporated into plant procedures is viewed by the NRC as having the potential for serious safety consequences.

3. Exit Meeting

The findings of this inspection were discussed with Mr. Crawford and Mr. Fuller during the course of this inspection.