Salem Unit 2

Salem, NJ

Owner: Public Service Electric & Gas Company

Reactor type: Pressurized water reactor

Commercial operations began: October 13, 1981

Outage dates (duration): June 7, 1995 to August 30, 1997 (2.2 years)

Reactor age when outage began: 13.6 years

Fleet status: Second oldest of three reactors owned by the company

Synopsis

Salem Unit 1 was manually shut down in May 1995 after the ventilation supply fans for the electrical switchgear rooms were declared inoperable. The shutdown came at a time of heightened NRC and Institute of Nuclear Power Operations (INPO) interest in declining performance trends at Salem. When Unit 2 tripped the following month, the NRC issued a Confirmatory Action Letter requiring the owner, Public Service Electric & Gas (PSE&G), to address certain issues prior to restarting either reactor.

The NRC also sent additional inspection teams to Salem. Their efforts culminated in the October 1995 issuance of a restart list detailing 43 technical issues and 21 programmatic issues that PSE&G had to resolve to the NRC's satisfaction prior to restarting Unit 1. The list eventually grew to 45 technical issues and 25 programmatic issues, and PSE&G needed until August 1997 to complete these items to the NRC's satisfaction.

Process Changes

Salem Unit 1 was one of seven U.S. reactors that were shut down throughout all of 1997; Unit 2 ended its two-year-plus outage in mid-1997. These extended outages were a reaction to problems in the nuclear power industry and NRC highlighted by a March 1996 *Time* magazine cover story. Collectively, Salem and her sister reactors caused the NRC to abandon its Systematic Assessment of Licensee Performance (SALP) process and introduce its Reactor Oversight Process in April 2000.

Commentary

How do you detect declining performance by a mediocre performer? Salem was never on anyone's list of top-performing nuclear plants, but it went from bad to worse when the NRC sent an Augmented Inspection Team (AIT) to the plant in each of four consecutive years (1991 to 1994). The agency dropped Salem's SALP scores in the areas of Operations and Maintenance from a 2 to a 3 in January 1995 (see table).

In March 1995, INPO identified a need for improvement across the board. Yet both reactors at Salem continued operating until Unit 1 was shut down in April due to problems with ventilation of the electrical switchgear rooms and Unit 2 tripped the following month. The NRC then developed a list of 43 items that PSE&G had to correct at Salem before it could restart the reactors, but as the U.S. Government

Accounting Office (GAO) definitively documented, the NRC had known about 38 of these items while the Salem reactors were operational—in one case for as much as six years before the shutdowns. The GAO reasonably asked, "If Salem could not be safely restarted until every one of these 43 items was corrected, how could Salem have safely operated with 38 of them known to exist?"

The NRC's inability to apply rational processes to Salem was clearly evident in the fact that the agency did not place either reactor on its Watch List until January 1997, nearly 18 months *after* both reactors entered extended outages. The could have added Salem to its Watch List in June 1995, January 1996, or June 1996, when both reactors had to be shut down to restore minimum safety levels.

NRC Systematic Assessment of Licensee Performance (SALP) History

Date	Operations	Radiological Controls	Maintenance	Surveillance Testing	Emergency Preparedness	Fire Protection	Security	Outage Management	Quality Assurance	Licensing	Training
10/1981	1	2	1	1	2	2	3	1	1	n/a	n/a
01/1983	2	1	1	1	2	2	3	1	n/a	2	n/a
01/1984	3	2	2	2	1	2	2	1	n/a	2	n/a
11/1984	3	2	2	2	2	3	1	2	n/a	2	n/a
12/1985	2	1	2	2	2	2	1	2	n/a	2	n/a
01/1987	2	1	1	2	1	n/a	1	2	2	2	2
06/1988	2	2	1	2	1	n/a	1	1	1	2	2

	Operations	Radiological Controls	Maintenance/Surveillance Testing	Emergency Preparedness	Security	Engineering and Technology	Safety Assessment and Quality Verification
09/1989	3	2	2	2	1	2	2
11/1990	2	2	2	1	1	2	2

	Operations	Maintenance	Engineering	Plant Support
05/1992	2	2	2	2/1/1
10/1993	2	2	2	1/1/1
01/1995	3	3	2	1
SALP suspended during outage				
09/1998	1	2	2	1

NOTE: A rating of 1 designates a superior level of performance where NRC attention may be reduced. A 2 rating designates a good level of performance with NRC attention at normal levels. A rating of 3 designates an acceptable level of performance where increased NRC attention may be appropriate. A rating of n/a was given in those areas that were not assessed on that date.

Details

January 1990: Performance problems at Salem were discussed during the NRC's semi-annual senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[1]

January 1991: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[2]

1991: The NRC dispatched an AIT to Salem to review the catastrophic turbine failure on Unit 2.[3]

1992: The NRC dispatched an AIT to Salem to review the loss of control room annunciators.[4]

1993: The NRC dispatched an AIT to Salem to review repetitive failures of the control rod system.[5]

1994: The NRC dispatched an AIT to Salem to review an April reactor trip with subsequent plant response problems that complicated the shutdown.[6]

June 1994: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[7]

January 3, 1995: The NRC transmitted its SALP report for Salem to PSE&G, indicating that performance in the Operations and Maintenance areas each warranted the lowest ranking. The NRC justified these low ratings as follows:[8]

> *"The operators did not effectively assure that plant systems and equipment were always sufficiently maintained to perform as designed. Too often, the Operations organization accommodated long-standing equipment or safety problems that resulted in unnecessary challenges to operators and safety systems in normal and upset conditions. Further, the general lack of a questioning attitude by operators resulted in anomalous indications or conditions being unnoticed or not understood, and consequently, ineffectively resolved.*
>
> *"The Maintenance organization's performance was weak in the implementation of program and activities. Consequently, there were frequent problems involving procedure adherence, procedural adequacy, and control and oversight of work.… Weaknesses still prevail relative to the effectiveness of corrective actions, troubleshooting and resolution of recurring equipment problems, and management oversight of maintenance activities."*

January 1995: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[9]

March 1995: INPO assessed Salem's performance and concluded, "improvement was needed in a wide range of areas, with significant improvement required in areas such as equipment performance and plant materiel conditions, management and supervision, engineering activities and training."[10]

March 21, 1995: NRC senior management met with PSE&G senior management to discuss performance problems at Salem.[11]

April 1995: The NRC dispatched a Special Inspection Team to Salem to assess work implementation and scheduling, problem identification and resolution, and management oversight.[12]

April 12, 1995: The NRC proposed an $80,000 fine on PSE&G because Salem's general manager of operations had harassed and intimidated two safety review group engineers who raised safety concerns on December 3, 1992.[13]

May 16, 1995: Operators manually shut down the Unit 1 reactor because ventilation supply fans for the electrical switchgear rooms were inoperable.[14]

June 7, 1995: The Unit 2 reactor automatically tripped.[15]

June 9, 1995: The NRC regional administrator issued a Confirmatory Action Letter to PSE&G requiring

both Salem reactors to remain shut down until several items could be resolved. Among other things, the NRC required the company to conduct a "special team review of long-standing equipment reliability and operability issues, including corrective maintenance and operator work-arounds."[16]

June 1995: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[17]

July 9, 1995: The NRC established a Restart Panel to oversee the activities leading to the requested restart of Salem Units 1 and 2.[18]

October 1995: The NRC's Restart Action Plan for Salem Units 1 and 2 delineated 43 technical issues and 21 programmatic issues that needed to be resolved to the NRC's satisfaction before either reactor could be restarted.[19]

October 17, 1995: The NRC proposed a $600,000 fine on PSE&G for six violations:

1. Failing to maintain an operable residual heat removal system at Unit 2 between February 9 and June 7, 1995
2. Failing to maintain an operable switchgear ventilation supply fan at Unit 1 between December 12, 1994, and May 16, 1995
3. Failing to promptly correct a problem with the pressurizer overpressure protection system following notification by Westinghouse about the condition on March 15, 1993
4. Unauthorized changes in the design basis for the pressurizer overpressure protection system by incorrectly taking credit for a residual heat removal system relief valve to provide protection
5. Numerous other examples between May 8, 1990, and January 14, 1995, of failure to promptly identify and correct safety problems
6. Failing to properly position a valve in the common drain line for three pressurizer safety valves prior to the May 1993 startup of Salem Unit 2 and the subsequent misalignment of this valve until October 1994.[20]

November 24, 1995: PSE&G submitted its restart plan to the NRC.[21]

January 1996: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[22]

February 13, 1996: The NRC concurred with PSE&G'splans for restarting Salem.[23]

February 23, 1996: The NRC's regional administrator approved the Restart Action Plan for Salem.[24]

March 8, 1996: PECO Energy Company and Delmarva Power & Light Company filed suit in the U.S. District Court for the Eastern District of Pennsylvania charging PSE&G with breach of contract for its mismanagement of Salem Units 1 and 2. The suit claimed PSE&G failed to take adequate notice of numerous citations and warnings from the NRC and repeated warnings from INPO. PECO Energy owned 42.59 percent of Salem while Delmarva and Atlantic Electric owned 7.41 percent.[25]

June 1996: Performance problems at Salem were discussed during the NRC's senior management meeting, but no letter was sent to PSE&G and Salem was not placed on the Watch List.[26]

June 1996: The NRC issued an internal report titled "Engineering Evaluation Report Analysis of Allegation

Date" that indicated Salem experienced a disproportionate number of employee allegations in 1995 about violations of workers' rights and PSE&G's failure to follow procedures. The report also indicated that the number of employee allegations about harassment and intimidation during 1994 and 1995 ranked Salem among the worst 10 percent of nuclear power plants across the country.[27]

August 3, 1996: The NRC issued Revision 1 to its Salem Restart Action Plan.[28]

December 26, 1996: The NRC issued Revision 2 to its Salem Restart Action Plan.[29]

January 1997: Performance problems at Salem were discussed during the NRC's senior management meeting and the plant was placed on the Watch List.[30]

May 1997: The GAO issued a report on the NRC's oversight of problem plants, reporting that:

> *"NRC's RAP* [restart action plan] *for Salem contained 43 technical restart issues (issues having to do primarily with equipment and procedures as opposed to management and human resource issues), of which all but 5 were known by NRC before the units shut down. According to Salem's current NRC Senior Resident Inspector, recurring problems had been prevalent at Salem for years. Two of the issues had been continuing problems for 6 to 7 years—the control air system and the circulating water traveling screen motor. One of the issues had been on NRC's information followup system since 1989 and was addressed in three separate inspection reports."*[31]

June 4, 1997: The NRC issued Revision 3 to its Salem Restart Action Plan.[32]

June 25, 1997: NRC commissioners heard presentations by agency staff and representatives of PSE&G regarding efforts underway to restart Salem Units 1 and 2.[33]

August 6, 1997: The NRC issued Revision 4 to its Salem Restart Action Plan.[34]

August 6, 1997: The NRC approved the restart of Salem Unit 2, having expended approximately 17,000 inspection hours (about 13,000 of which were devoted to reviewing licensing matters) during the extended outage.[35]

August 22, 1997: Operators took the Unit 2 reactor critical. PSE&G reportedly spent about $200 million ($248 million in 2006 dollars[36]) on upgrades to Unit 2 and another $175 million ($217 million in 2006 dollars[37]) on upgrades to Unit 1 during the extended outages.[38]

August 30, 1997: Unit 2 was connected to the electrical grid, ending its extended outage.[39]

[1] U.S. General Accounting Office (GAO). 1997. Nuclear regulation: Preventing problem plants requires

Notes

more effective NRC action. GAO/RCED-97-145, May.

[2] Ibid.

[3] Cooper, R. 1996. Salem restart action plan. Memorandum to Thomas T. Martin, regional administrator, Nuclear Regulatory Commission, and Roy Zimmerman, associate director for projects, Nuclear Regulatory Commission, February 23. Richard Cooper was director of reactor projects at the Nuclear Regulatory Commission.

[4] Ibid.

[5] Ibid.

[6] Ibid.

[7] GAO, 1997.

[8] Martin, T.T. 1995. Systematic performance [sic] of licensee performance (SALP) Report No. 50-272, 50-311/93-99. Letter to Leon Eliason, chief nuclear officer and president, nuclear business unit, Public Service Electric & Gas Company, January 3. Thomas T. Martin was regional administrator at the Nuclear Regulatory Commission.

[9] GAO, 1997.

[10] Airozo, D. 1995. Extended outage expected at Salem as NRC demands maintenance fixes. *Inside NRC*, June 26.

[11] Cooper, 1996.

[12] Ibid.

[13] Nuclear Regulatory Commission (NRC). 1995. NRC staff proposes to fine Public Service Electric & Gas Company $80,000 for alleged violation at its Salem Nuclear Generation Station. Press release no. 95-41, April 12.

[14] Airozo, 1995.

[15] Ibid.

[16] Ibid.

[17] GAO, 1997.

[18] Cooper, 1996.

[19] Ibid.

[20] NRC. 1995. NRC staff proposes to fine Public Service Electric & Gas $600,000 for six alleged violations of NRC requirements at Salem nuclear power plant. Press release no. 95-127, October 17.

[21] NRC. 1997a. NRC Region I administrator approves restart of Salem Unit 2. Press release no. I-97-100, August 6.

[22] GAO, 1997.

[23] NRC, 1997a.

[24] Cooper, 1996.

[25] *Electricity Daily*. 1996. Co-owners sue PSE&G for Salem plant mismanagement, March 8.

[26] GAO, 1997.

[27] Ibid.

[28] Linville, J.C. 1997. NRC restart action plan: Revision 6. Letter to Leon R. Eliason, chief nuclear officer

and president, nuclear business unit, Public Service Electric & Gas Company, April 1. James C. Linville was chief of projects branch 3 at the Nuclear Regulatory Commission.

[29] Ibid.

[30] GAO, 1997.

[31] Ibid.

[32] Linville, 1997.

[33] NRC. 1997b. Briefing on Salem. Transcript, June 25.

[34] Linville, 1997.

[35] NRC, 1997a.

[36] Bureau of Labor Statistics. 2006. Inflation calculator. Washington, DC: U.S. Department of Labor. Online at *http://data.bls.gov/cgi-bin/cpicalc.pl*.

[37] Ibid.

[38] Williamson, B. 1997. Salem-2 powering up to generate after two-plus years off grid. *Nucleonics Week*, August 28.

[39] Garchow, D.F. 1997. Monthly operating report: Salem Unit No. 2, docket no. 50-311. Letter to Nuclear Regulatory Commission, September 15. David F. Garchow was general manager of Salem operations at Public Service Electric & Gas Company.