

DAVIS-BESSE

Oak Harbor, OH

Owner: Toledo Edison Company

Outage dates (duration): June 9, 1985 to December 24, 1986 (1.5 years)

Reactor type: Pressurized water reactor

Reactor age when outage began: 6.9 years

Commercial operations began: July 31, 1978

Fleet status: Only reactor owned by the company

Synopsis

The outage began with an operational event; namely, a loss of feedwater caused in part by a known design problem. Subsequent investigations by plant workers and NRC inspectors revealed maintenance and testing program deficiencies that caused the known design problems to be challenged and fail. The outage length was originally dictated by the time required to correct the design, maintenance, and testing program problems. The outage's length was protracted several months when the failure of a reactor coolant pump shaft at the Crystal River nuclear power plant prompted the look for, and discovery of, cracks in the reactor coolant pump shafts that required replacements before restart.

Process Changes

The NRC developed its Incident Inspection Team as a rapid response to plant events from its experience at Davis-Besse. The NRC also developed its Performance Assessment Team as a vehicle for evaluating whether programmatic weaknesses caused or contributed to safety margin erosions at nuclear plants. Both teams are still in operation today, but under different names.

Commentary

The June 9, 1985, operational event that triggered this extended outage would have been avoided had either Toledo Edison or the NRC responsibly dealt with a known design problem with the auxiliary feedwater system instead of passively tolerating it. But had this operational event been avoided, the ensuing inquiries that revealed serious breakdowns in the maintenance and testing programs at Davis-Besse (manifested by nearly 300 new and revised testing procedures required to remedy the situation) might not have occurred before an even worse operational event happened.

The public should not rely on one serious problem leading to the discovery of other serious problems. The NRC's oversight process must become rigorous and thorough enough to find and fix all serious problems in a timely manner.

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
12/1980	2	2	2	2	3	2	3	2	2	n/a	n/a
9/1982	2	1	3	2	1	2	2	1	3	2	n/a
10/1983	2	1	3	2	2	2	2	1	n/a	2	n/a
12/1984	2	1	3	2	3	3	2	1	3	2	3
9/1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6/1988	2	1	2	3	2	3	1	1	2	2	2
	Operations	Radiological Controls	Maintenance/Surveillance Testing		Emergency Preparedness	Security		Engineering and Technology		Safety Assessment and Quality Verification	
7/1989	2	2	2		1	1		2		2	
11/1990	2	2	2		1	1		2		2	
	Operations		Maintenance		Engineering			Plant Support			
4/1992	2		1		2			2/1/1			
9/1993	2		1		1			2/1/1			
3/1995	1		1		1			1			
3/1997	2		1		1			1			

NOTE: A rating of 1 designated a superior level of performance where NRC attention may be reduced. A 2 rating designated a good level of performance with NRC attention at normal levels. A rating of 3 designated an acceptable level of performance where increased NRC attention may be appropriate.

Details

November 4, 1983: NRC directed Toledo Edison to take steps to improve effectiveness of management controls and the corrective action program at Davis-Besse.¹

June 9, 1985: An Unusual Event was declared after one main feedwater pump tripped and the second tripped when the main steam isolation valves were inadvertently isolated. The steam generators boiled dry after operators manually initiated the auxiliary feedwater system but both of the turbine-driven pumps failed to function.²

June 10, 1985: NRC Executive Director for Operations William Dircks dispatched a team of experts having no prior involvement with the plant to the Davis-Besse site to investigate what went wrong. The NRC subsequently created the Incident Investigation Team (IIT) as a tool to use following future mishaps.³

June 13, 1985: The *New York Times* reported NRC Senior Manager Harold R. Denton as saying in a telephone interview, "When we last looked at this plant, we said that performance and operations were declining, with a large number of unnecessary alarms and personnel errors."⁴

June 21, 1985: NRC Regional Administrator James Keppler testified before Congress about the restart of Davis-Besse: "I really don't have a good guess for you, but it's not going to be soon."⁵

June 25, 1985: Toledo Edison Company and Cleveland Electric Illuminating Company announced they would merge.⁶

July 8, 1985: The NRC informed owners of all other operating nuclear power plants of what happened at Davis-Besse on June 9.⁷

July 15, 1985: The NRC imposed a \$100,000 fine on Toledo Edison for three violations at Davis-Besse: (1) an April 24 incident involving a sleeping equipment operator, (2) a failure to promptly notify the shift supervisor that a fire detection computer was out of service, and (3) failure to maintain the reactor at its proper power level. The NRC stated that the normal fine of \$50,000 was doubled because it had fined Toledo Edison \$90,000 in February for similar violations at Davis-Besse.⁸

July 18, 1985: The NRC testified before a House subcommittee that “There are some indications that the company’s financial involvement in other nuclear projects necessitated budget restraints at Davis-Besse.” As an example, the NRC pointed to its post-Three Mile Island recommendation that Toledo Edison install a motor-driven feedwater pump to back up the four steam-driven feedwater pumps. In December 1981, Toledo Edison balked at that proposal, claiming it would cost \$1.2 million. Toledo Edison countered with a different approach costing only \$300,000. As of the June 9 incident, nothing had been actually done—at any cost—to correct the problem. A Toledo Edison spokesperson denied the NRC’s testimony, stating, “We refuse to compromise safety for economics.”⁹

July 22, 1985: *Inside NRC* reported NRC Senior Manager Harold Denton as warning: “I believe that the recent Davis-Besse event illustrates that, in the real world, system and component reliabilities can degrade below those we and the industry routinely assume in estimating core melt frequencies. Our regulatory process could require margins against such degradation and also to reflect the uncertainties in our PRA [probabilistic risk assessment] estimates.”¹⁰

July 29, 1985: The *New York Times* reported that the motor-driven feedwater pump being installed at Davis-Besse as a result of the June 9 incident was expected to cost \$1.8 million and the costs associated with the forced outage bring the total cost to \$13 million. Toledo Edison balked in December 1981 at the NRC’s recommendation to install the pump because of its excessive \$1.2 million cost.¹¹

August 14, 1985: The NRC required Toledo Edison to submit, under title 10 of the Code of Federal Regulations (10 CFR), part 50.54(f), its plans to resolve concerns stemming from the June 9 loss of feedwater event and also confirmed that Davis-Besse could not restart without specific NRC approval.¹²

September 6, 1985: During a test of the auxiliary feedwater system, a mis-positioned valve and operator inattentiveness allowed pressure on the secondary side of a steam generator to reach 1,050 pounds per square inch, far exceeding the 137 pounds per square inch limit imposed by the plant’s technical specifications.¹³

September 10, 1985: In response to the NRC’s August 14 letter, Toledo Edison submitted the Davis-Besse Course-of-Action detailing the steps it would take to correct problems at the plant.¹⁴

September 16, 1985: Toledo Edison forecast restarting Davis-Besse in November 1985.¹⁵

September 18, 1985: At a briefing of the NRC commissioners on the Davis-Besse event, the NRC staff blamed poor maintenance that allowed systems such as the auxiliary feedwater system to become unreliable. NRC inspectors found that portions of the auxiliary feedwater system had never been tested while functioning.¹⁶

October 2, 1985: Massachusetts Congressman Edward Markey remarked in his opening statement at a U.S. House subcommittee hearing on Davis-Besse: “While it is true that we have learned many unsettling things from and about this mishap, perhaps the most disturbing is the degree to which the NRC had prior knowledge of management problems and design defects at the plant and yet failed to take effective corrective action.”¹⁷

October 2, 1985: NRC Chairman Nunzio Palladino announced during a House subcommittee hearing that he had ordered the Office of Inspector & Auditor (the Office of Inspector General’s predecessor) to investigate the NRC’s role in the Davis-Besse incident.¹⁸

October 1985: A majority of the commissioners out-voted Chairman Nunzio Palladino and nixed his plans to have the Office of Inspector & Auditor investigate the NRC’s role in the Davis-Besse incident.¹⁹

November 1985: The NRC conducts, for the first time ever, a Performance Assessment Team (PAT) inspection at Turkey Point. The NRC developed the PAT inspection following the June 9 loss of feedwater event at Davis-Besse and a failure of all three auxiliary feedwater pumps during a transient at Turkey Point on July 21. The PAT inspection at Turkey Point logged 416 inspection-hours and 30 violations.²⁰

December 1985: The NRC proposed a record \$900,000 fine for Toledo Edison for eight violations related to the June 9 loss of feedwater event. Toledo Edison Chairman John Williamson immediately announced his company would not contest the fine.²¹

December 18, 1985: During a Commission briefing on Davis-Besse, company officials and NRC staffers agreed that the plant could be ready for restart in March 1986 if no new problems were revealed in the ongoing testing program.²²

March 1986: Prompted by the failure of a shaft in a reactor coolant pump at the Crystal River nuclear power plant and the discovery of significant cracks in the other three reactor coolant pump shafts, Toledo Edison inspected the shafts of all four reactor coolant pumps at Davis-Besse and determined they all needed to be replaced. Their replacement was forecast to extend the plant’s restart from late April 1986 to mid-October 1986.²³

March 1986: The NRC established a special review group to examine the NRC staff’s interactions with Toledo Edison before the event, the role played by risk assessments, and the efforts undertaken by the Incident Investigation Team. The special review group consisted of two members of the NRC’s Atomic Safety and Licensing Board panel, a representative from NASA, a representative from the Federal Aviation Administration, and a staffer from the NRC’s Office of Policy Evaluation. In forming the special review group, the Commission noted that its restart decision regarding Davis-Besse would not wait for the group’s report.²⁴

June 10, 1986: NRC staff issued NUREG-1177, “Safety Evaluation Report Related to the Restart of Davis-Besse Nuclear Power Station, Unit 1, Following the Event of June 9, 1985,” to document its review and acceptance of Toledo Edison’s Davis-Besse Course-of-Action plan.²⁵

June 27, 1986: NRC staff briefed the Advisory Committee on Reactor Safeguards on the Davis-Besse restart plan. Part of the plan entails extensive rework of the surveillance testing program with 172 revisions to existing tests and 106 new tests.²⁶

July 24, 1986: During a Commission briefing on Davis-Besse, the Toledo Edison senior vice president brought in to restart the troubled plant estimated the cost to exceed \$150 million.²⁷

September 30, 1986: An audit team hired by the Ohio Public Utilities Commission concluded that Toledo Edison management imprudence contributed to the June 9, 1985, loss of feedwater event.²⁸

November 21, 1986: The NRC commissioners voted 5-0 to allow Davis-Besse to restart. NRC Chairman Lando Zech stated, "There's been significant organizational changes."²⁹

December 10, 1986: Toledo Edison notified the NRC in writing that it had completed all of the items in NUREG-1177 required for the Davis-Besse restart.³⁰

December 19, 1986: The NRC staff notified Toledo Edison it concurred that Davis-Besse was ready to restart.³¹

December 22, 1986: Workers restarted the reactor, but it tripped hours later due to a feedwater system malfunction before being re-connected to the electrical grid.³²

December 23, 1986: The United States Court of Appeals for the Sixth Circuit denied a request by the State of Ohio attorney general for a stay on resumption of full-power operation at Davis-Besse. The attorney general filed a motion seeking to prevent full-power operation pending completion of a state task review of emergency plans. The state task force had been formed after the April 1986 disaster at the Chernobyl nuclear plant in Ukraine.³³

December 24, 1986: The reactor restarted and the plant was connected to the electrical grid to end the extended outage.³⁴

January 1, 1987: The reactor tripped when a plugged lubricating oil line caused a turbine bearing to fail.³⁵

February 12, 1987: The NRC reduced the \$900,000 fine proposed in December 1985 to \$450,000 citing "rapid commencement of corrective actions... [and] the magnitude and quality of the effort expended since that time to upgrade operations."³⁶

Notes

- ¹ U.S. General Accounting Office. 1986. Nuclear regulation: Oversight of quality assurance at nuclear power plants needs improvement. GAO/RCED/86-41. Washington, DC. January.
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- ³ Marshall, E. 1986. A SWAT team for nuclear accidents. *Science*, February 28.
- ⁴ Wald, M.L. 1985. Nuclear reactor near Toledo closed in accident. *New York Times*, June 13.
- ⁵ Associated Press. 1985. No restart in sight for Davis-Besse. *Chronicle-Telegram*, June 22.
- ⁶ Hicks, J.P. 1985. Ohio utilities to merge. *New York Times*, June 26.
- ⁷ NRC. 1985. Complete loss of main and auxiliary feedwater at a PWR designed by Babcock & Wilcox. Information Notice No. 85-50. Washington, DC. July 8.
- ⁸ Associated Press. 1985. NRC fines Toledo Edison for Davis-Besse violations, July 16.
- ⁹ Wald, M.L. 1985. Nuclear agency calls cost pinch a possible factor in Ohio reactor accident. *New York Times*, July 23.
- ¹⁰ *Inside NRC*. 1985. The Davis-Besse event shows risk studies cannot be relied on. July 22.
- ¹¹ Wald, M.L. 1985. Congress is told of reactor peril. *New York Times*, July 29.
- ¹² Denton, H.R. 1986. Resumption of power operations at the Davis-Besse nuclear power station. Letter to Paul Smart, president and chief operating officer, Toledo Edison Company, December 19. Harold R. Denton was director, nuclear reactor regulation at the NRC.
- ¹³ Ryan, M.L. 1985a. November restart eyed for Davis-Besse as utility installs backup pump. *Inside NRC*, September 16.
- ¹⁴ Denton, 1986.
- ¹⁵ Ryan, 1985a.
- ¹⁶ Ryan, M.L. 1985b. Davis-Besse fallout begins as NRC eyes AFW maintenance and reliability. *Inside NRC*, September 30.
- ¹⁷ *Nuclear News*. 1985. NRC commissioners reserving restart right. November.
- ¹⁸ Ryan, M.L., and E. Lindeman. 1985. NRC staff sets major regulatory shift after recent embarrassments. *Inside NRC*, October 14.
- ¹⁹ *Nuclear News*, 1985.
- ²⁰ Jordan, B. 1986. FP&L says any plant to Turkey Point's vintage can't survive PAT. *Inside NRC*, February 17.
- ²¹ Ryan, M.L. 1985c. NRC finds "aggregate" severity level I to levy record Davis-Besse fine. *Inside NRC*, December 23.
- ²² *Inside NRC*. 1985. Davis-Besse rehab program gets kudos from staff and commission, December 23.
- ²³ Jordan, B. and M.L. Wagner. 1986. Cracks found in coolant pump shafts to delay Davis-Besse restart. *Nucleonics Week*, March 20.
- ²⁴ *Inside NRC*. 1986. A special NRC review group will assess Davis-Besse licensing issues. March 31.
- ²⁵ Denton, 1986.
- ²⁶ NRC. 1987. Report to Congress on abnormal occurrences: April – June 1986, NUREG-0090, Vol. 9, No. 2. January.

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- ²⁷ Airozo, D. 1986. Toledo Edison may spend over \$150-million in Davis-Besse overhaul. *Inside NRC*, July 31.
- ²⁸ Airozo, D. 1986. Mismanagement may have contributed to the Davis-Besse loss of feedwater. *Nucleonics Week*, October 2.
- ²⁹ Abbott, C.J. 1986. NRC okays restart, utility vows diligence. United Press International, November 21.
- ³⁰ Denton, 1986.
- ³¹ Ibid.
- ³² Airozo, D. 1987. The two nuclear power plants located in Ohio moved one step closer. *Nucleonics Week*, January 8.
- ³³ Ibid.
- ³⁴ Ibid.
- ³⁵ Ibid.
- ³⁶ NRC. 1987. NRC staff reduces \$900,000 fine against Davis-Besse by \$450,000, Press Release No. 87-24. February 12.