

# MILLSTONE UNIT 2

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*Waterford, CT*

**Owner:** Northeast Utilities

**Outage dates (duration):** February 20, 1996 to May 11, 1999 (3.2 years)

**Reactor type:** Pressurized water reactor

**Reactor age when outage began:** 20.2 years

**Commercial operations began:** December 26, 1975

**Fleet status:** Third oldest of five reactors owned by the company

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## Synopsis

Northeast Utilities (NU), the parent company for the Northeast Nuclear Energy Company (NNECo), voluntarily shut down Millstone Unit 2 in February 1996 when its workers determined that the plant was vulnerable to the same kind of problem the Institute of Nuclear Power Operations (INPO) had identified at Diablo Canyon in California. That discovery may not have resulted in the shutdown had NU not already been in the NRC's regulatory doghouse due to a lengthening series of events.

Shortly after this shutdown began, *Time* magazine featured a cover story about the problems at Millstone and the NRC's associated failures. NU made extensive management changes, physical plant modifications, and process improvements along the way to restarting Unit 2 more than three years later.

## Process Changes

The NRC's Systematic Assessment of Licensee Performance (SALP) process was replaced by the Reactor Oversight Process (ROP). Virtually all components of the ROP (inspection, assessment, and enforcement) represented a revamping of those components within the former SALP program. Equally important was the unprecedented manner in which the ROP was crafted and implemented—a lengthy, open process in which all stakeholders (internal and external) were both invited and encouraged to participate. In addition, the NRC recognized that the ROP was a work in progress and consequently built in formal annual reviews by internal and external stakeholders that would accommodate necessary mid-course corrections.

## Commentary

The best that can be said about the Millstone outage is that it triggered much-needed changes in the nuclear power industry and the NRC's oversight program—more changes, in fact, than any event other than the Three Mile Island accident.

Millstone illustrated the dilemma faced by the NRC when a company ignores its warnings. For years, the NRC had issued violations and fines to NU for problems at Millstone, and NU paid the fines, made empty promises about fixing the problems, and continued operating Millstone. In some respects, the NRC was a victim of its own processes. Under the SALP process, the lowest possible score on the three-tiered

rating system was defined as “performance that does not significantly exceed that needed to meet minimal regulatory requirements.”<sup>1</sup> This self-imposed trap made it hard for the NRC to confront a recalcitrant licensee like NU. The NRC could issue a SALP report with all low scores, but that still exceeded the minimal regulatory requirements.

Excuses aside, the NRC waited too long to address known safety problems at Millstone. As a direct consequence, people living around the plant were exposed to higher risk, ratepayers paid higher prices, and stockholders received lower returns than necessary.

## 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
10/1980	2	2	2	2	2	2	3	2	2	n/a	n/a
07/1982	1	2	1	1	1	1	2	1	1	n/a	n/a
01/1983	1	1	1	1	1	1	1	1	n/a	1	n/a
03/1984	2	1	1	1	1	2	1	1	n/a	1	n/a
05/1985	1	2	1	1	1	1	1	1	1	1	n/a
12/1986	1	3	2	1	1	n/a	1	1	1	1	2
07/1988	1	2	1	1	1	n/a	2	1	2	2	1
	Operations	Radiological Controls	Maintenance/Surveillance Testing		Emergency Preparedness		Security	Engineering and Technology		Safety Assessment and Quality Verification	
04/1990	1	2	1		1		1	2		1	
	Operations		Maintenance		Engineering			Plant Support			
05/1991	1		2		2			2/1/1			
08/1992	2		2		2			2/2/2			
10/1993	2		2		2			1/2/2			
08/1994	3		3		2			2			

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

*May 28, 1991:* The NRC sent its SALP report for Millstone to NU.<sup>2</sup>

*May 29, 1991:* NU announced the formation of three internal groups to evaluate programs at Millstone: the Allegation Root Cause Task Group; the Operability, Reportability, and Communications Task Group; and the Nuclear Engineering & Operations Performance Task Group.<sup>3</sup>

*June 1991:* Performance problems at Millstone were discussed during the NRC’s semi-annual senior management meeting, but no letter was sent to NU and Millstone was not placed on the agency’s Watch List.<sup>4</sup>

*August 14, 1991:* NU announced the formation of a fourth internal group, the Procedure Compliance Task Force, to conduct evaluations at Millstone.<sup>5</sup>

*August 26, 1991:* NU submitted the Allegations Root Cause Task Group Final Report and the Operability, Reportability, and Communications Task Group Final Report to the NRC along with a request that the allegations report be withheld from public disclosure per Title 10 of the Code of Federal Regulations (CFR) Part 2.790.<sup>6</sup>

*September 26, 1991:* NU submitted the NE&O Performance Task Group Final Report to the NRC along with a request that it be withheld from public disclosure per 10 CFR 2.790.<sup>7</sup>

*October 4, 1991:* NU submitted the Procedure Compliance Task Force Final Report Summary to the NRC along with a request that it be withheld from public disclosure per 10 CFR 2.790. The report indicated that workers followed approved procedures only 50 to 70 percent of the time.<sup>8</sup>

*December 23, 1991:* NU submitted the Procedure Compliance Review Group II Final Report to the NRC. The report indicated that workers followed approved procedures 99 percent of the time.<sup>9</sup>

*January 1992:* Performance problems at Millstone were discussed during the NRC's senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>10</sup>

*March 1992:* NU implemented a Performance Enhancement Program (PEP) at Millstone.<sup>11</sup>

*April 14, 1992:* In response to an NRC-identified violation, NU committed itself to completing a setpoint verification program, a Design Basis Reconstitution program, and an Updated Final Safety Analysis Report (UFSAR) verification program. The Design Basis Reconstitution program would cover approximately 30 systems and was expected to be completed by April 1993. The UFSAR verification program would progress in parallel with the Design Basis Reconstitution program.<sup>12</sup>

*May 1992:* The NRC established its Millstone Assessment Panel (MAP).<sup>13</sup>

*June 1992:* Performance problems at Millstone were discussed during the NRC's senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>14</sup>

*December 30, 1992:* The NRC proposed a \$62,500 fine on NU for two violations at Millstone Unit 3 involving the auxiliary building ventilation filter system. Dampers within the ventilation ducts were found positioned such that the system would have been unable to draw and maintain a vacuum inside the containment building as required following an accident. In addition, tests of the system conducted during a 1986 startup had failed to identify this non-conforming condition.<sup>15</sup>

*January 1993:* Performance problems at Millstone were discussed during the NRC's senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>16</sup>

*February 4, 1993:* The NRC notified plant owners about a design flaw revealed at Millstone Unit 2 by an event on July 6, 1992. Unit 2 was in a refueling outage with the entire reactor core offloaded into the spent fuel pool. A false "loss of normal power" signal and a false initiation signal for the emergency core cooling system were generated when an operator opened an electrical breaker prior to the planned maintenance. The single emergency diesel generator operable at the time automatically started, but its output breakers would not close to allow the generator to supply power to vital loads. Investigation determined that a modification to the electrical circuit made back in 1978 produced a continuous load-shedding signal during this event.<sup>17</sup>

*May 24, 1993:* Workers identified a leak in the body-to-bonnet gasket on valve 2-CH-442, a two-inch valve in the letdown piping of the chemical and volume control system upstream from the containment isolation valve. Between June 4 and August 5, leak sealant was injected approximately 30 times to try to stop the leak.<sup>18</sup>

*August 5, 1993:* Workers injecting sealant into valve 2-CH-442 prior to welding a clamp across the body-to-bonnet joint noted that the leak had grown to a 10-foot-long jet of steam. The increased leak rate prompted a decision to shut down the reactor. The maximum leak rate was reported to be 4.3 gallons per minute.<sup>19</sup>

*December 1, 1993:* The NRC notified plant owners about the repeated, futile attempts to repair valve 2-CH-442 at Millstone Unit 2, stating:

*“The repeated attempts to seal the valve at Millstone Unit 2 indicated that an adequate engineering evaluation was not performed. The licensee evaluation did not adequately consider the effects of the sealing process and the borated water on the fasteners. Also, the evaluation did not adequately consider the amount or effect of sealant entering the system after repeated injections. Further, the evaluation did not adequately consider the operational and safety consequences of structural failure of the component or the fasteners during and after the leak-seal attempts. In addition, management and quality assurance oversight did not identify the failures to follow procedures, the failures to adhere to engineering documents and the lack of weight given to personnel safety considerations.”*<sup>20</sup>

*January 1994:* Performance problems at Millstone were discussed during the NRC’s senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>21</sup>

*June 1994:* Performance problems at Millstone were discussed during the NRC’s senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>22</sup>

*January 1995:* Performance problems at Millstone were discussed during the NRC’s senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>23</sup>

*February 28, 1995:* The NRC notified plant owners that Millstone workers had determined that containment sump recirculation motor-operated gate valves might not open as required following an accident due to a vulnerability to pressure locking.<sup>24</sup>

*June 1995:* Performance problems at Millstone were discussed during the NRC’s senior management meeting, but no letter was sent to NU and Millstone was not placed on the Watch List.<sup>25</sup>

*August 21, 1995:* Millstone engineer George Galatis and the nonprofit group We The People submitted a 10 CFR 2.206 petition to the NRC requesting that the operating license for Unit 1 be revoked for 60 days because NU “knowingly, willingly and flagrantly operated Millstone Unit 1 in violation of its operating license for approximately 20 years.”<sup>26</sup>

*November 30, 1995:* The NRC’s chairman directed agency staff to “explore whether oversight processes need improvement or new processes need to be developed which would have produced earlier NRC recognition of and action on Millstone Unit 1 noncompliance with its FSAR [Final Safety Analysis Report].”<sup>27</sup>

*December 1, 1995:* The NRC notified plant owners that NU had been conducting refueling operations at Millstone Unit 1 in a manner inconsistent with the reactor’s design and licensing bases.<sup>28</sup>

*December 8, 1995:* The NRC sent NU its inspection report on steps undertaken at Millstone in response to a series of worker harassment and intimidation complaints, concluding:

*“On the basis of responses from Millstone employees and managers and review of NSCP [nuclear safety concerns program] controls, the inspectors concluded that effective progress had been made by NNECo towards receiving employee concerns while protecting them from retaliation.”<sup>29</sup>*

December 21, 1995: The NRC’s Office of the Inspector Generator (OIG) released a report on its inquiry into the way NRC staff regulated activities at Millstone, concluding:

*“The OIG investigation determined that generally the NRC Region I resident inspectors were aware of NU’s practice of offloading the entire core at Millstone Unit 1 during refueling outages; however, resident inspectors did not realize that this practice was inconsistent with the normal discharge scenario outlined in the Final Safety Analysis Report.*

*“The investigation determined that the NRC headquarter’s [sic] staff had several opportunities to review the Millstone Unit 1 refueling practices and the heat removal capability of the spent fuel pool cooling system; however, the staff did not conduct an adequate evaluation related to the capabilities of the spent fuel pool cooling system.”<sup>30</sup>*

January 1996: Performance problems at Millstone were discussed during the NRC’s senior management meeting and the plant was placed on the Watch List.<sup>31</sup>

January 11, 1996: NU terminated approximately 102 employees at Millstone, reportedly as part of a cost-cutting program.<sup>32</sup>

February 8, 1996: After receiving allegations from 23 individuals who claimed to have been terminated based on past involvement in protected activities, the NRC asked NU to explain the terminations.<sup>33</sup>

February 15, 1996: NU provided the NRC with the requested information.<sup>34</sup>

February 20, 1996: Operators manually shut down Unit 2 following the discovery of a potential common-mode failure that could disable the high-pressure safety injection system. After reviewing a recent INPO report that found the throttle valves in the high-pressure safety injection pipes at Diablo Canyon could become clogged with debris in the water drawn from the containment sump during an accident, Millstone workers determined that the high-pressure coolant injection system at Unit 2 had this same vulnerability.<sup>35</sup>

February 22, 1996: NU completed an internal investigation into the issues raised in the Galatis and We The People petition.<sup>36</sup>

March 4, 1996: Time magazine featured a cover story on the plight of George Galatis and colleague George Betancourt in getting their safety concerns addressed.<sup>37</sup>

March 5, 1996: Congressman Edward Markey wrote NRC Chairman Shirley Jackson, asking several questions about the agency’s oversight of Millstone (in light of the Time article) and broader nuclear safety issues.<sup>38</sup>

March 7, 1996: The NRC issued a letter to NU requiring it to provide information, pursuant to 10 CFR 50.54(f), on actions it would take to ensure future operation of Millstone Unit 2 would conform to the terms and conditions of its licenses.<sup>39</sup>

March 18, 1996: The NRC notified plant owners that NU had been operating Millstone Unit 1, and perhaps Units 2 and 3, in a manner inconsistent with its design and licensing bases. This discovery resulted from efforts undertaken in response to the Galatis and We The People petition.<sup>40</sup>

March 27, 1996: The NRC's chairman responded to Congressman Markey:

*"The NRC staff has spent significant resources in recent years inspecting and evaluating technical and personnel areas at this [Millstone] and other NU facilities. The fact that issues continue to be raised about Millstone indicates that adjustments are needed in our approach to this facility and perhaps to some aspects of our program as a whole."*<sup>41</sup>

March 30, 1996: Millstone Unit 3 was shut down after findings from an NRC inspection showed that the containment isolation valves for the auxiliary feedwater (AFW) turbine-driven pump did not comply with NRC regulations. Shortly after the shutdown, workers at Unit 3 identified errors in the stress calculations for piping and supports in the recirculation spray system. Both sets of problems existed since Unit 3's initial startup.<sup>42</sup>

April 4, 1996: The NRC issued a letter to NU requiring it to provide information, pursuant to 10 CFR 50.54(f), on actions it would take to ensure future operation of Millstone Unit 3 would conform to the terms and conditions of its licenses.<sup>43</sup>

April 19, 1996: The NRC task force created to examine the January layoffs at Millstone informed NRC senior management that NU may have targeted whistleblowers. NRC senior management directed the task force not to draft a report.<sup>44</sup>

April 30, 1996: The NRC met with NU regarding activities being taken at Millstone in response to the agency's 10 CFR 50.54(f) concerns about conformance with design and licensing bases. The meeting "disclosed that the licensee was not adequately managing the program or tracking progress."<sup>45</sup>

May 1, 1996: The NRC notified plant owners that NU voluntarily shut down Millstone Unit 2 after determining that throttle valves in the high-pressure safety injection system might become clogged with debris in the water drawn from the containment sump during an accident.<sup>46</sup>

May 31, 1996: The NRC's OIG issued a report on its investigation into the way NRC staff handled four self-assessments conducted at Millstone in 1991 (which it submitted to the NRC but withheld from the public). The OIG reported:

*"The NRC Executive Director for Operations, the Director of Nuclear Reactor Regulation, and the Region I Regional Administrator advised OIG that given the indicators of poor performance at Millstone, the NRC should have taken more aggressive action including placing the Millstone site on the NRC watch list as early as 1993."*<sup>47</sup>

June 20, 1996: NU notified the NRC that it would give restart priority at Millstone to Unit 3. NU identified 881 design and configuration deficiencies discovered at the plant since February, and informed the NRC that 378 of these deficiencies would be corrected prior to restarting Unit 3.<sup>48</sup>

June 27, 1996: NRC commissioners directed agency staff to place Millstone in Watch List Category 3, which required each reactor to remain shut down until commissioners authorized their restart.<sup>49</sup>

July 2, 1996: NU updated the NRC on the number of design and configuration deficiencies discovered at Millstone since February, noting that 1,187 items had now been identified, with 597 items requiring resolution prior to restarting Unit 3.<sup>50</sup>

*August 12, 1996:* NRC staff announced the invocation of Manual Chapter 0350 to govern the restart process.<sup>51</sup>

*August 14, 1996:* The NRC ordered NU to provide independent verification of the company's efforts to fix corrective action processes at Millstone, stating:

*"It is necessary to ensure that the Licensee's programs to correct design control failures at Millstone Units 1, 2 and 3 are effective and that identification of degraded and non-conforming conditions and implementation of corrective actions are satisfactory and can effectively preclude repetition of these failures. For this reason, the NRC requires an independent verification of the adequacy of programs currently being implemented by the Licensee which are directed at resolving existing design and configuration management deficiencies."*<sup>52</sup>

*September 1996:* The NRC released a report on its special inspection of engineering activities at Millstone, stating:

*"The team concluded that taken collectively, these concerns reflected a lack of understanding of and respect for the preservation of the design and licensing bases for the given units. The team was particularly concerned that in many of the instances above, the licensee had the opportunity to either identify, or more promptly and comprehensively achieve, issue resolution.*

*"The team found several instances in which the licensee failed to identify existing degraded or nonconforming conditions or other deficiencies."*<sup>53</sup>

*September 4, 1996:* Bruce D. Kenyon took over as president and chief executive officer of NNECo and its subsidiaries.<sup>54</sup>

*September 11, 1996:* The NRC task force created to assess the January 1996 layoffs at Millstone was directed by NRC senior management to prepare a written report.<sup>55</sup>

*September 19, 1996:* NNECo President Kenyon fired three vice presidents and brought in management teams loaned from other nuclear utility companies.<sup>56</sup>

*October 3, 1996:* The report prepared by the NRC task force looking into the January 1996 layoffs at Millstone was provided to a select group of senior agency officials.<sup>57</sup>

*October 18, 1996:* The NRC announced the establishment of a Special Project Office to oversee inspection and licensing activities at Millstone.<sup>58</sup>

*October 24, 1996:* The NRC ordered NU to arrange for independent, third-party oversight of the employee concerns program at Millstone.<sup>59</sup>

*December 1996:* The NRC administered initial senior reactor operator (SRO) license examinations to seven individuals at Millstone. Six of the seven failed the examination.<sup>60</sup>

*December 5, 1996:* The NRC conducted a pre-decisional enforcement conference with NU regarding apparent violations of federal regulations identified at Millstone—initially numbering 64 but later expanded to approximately 80.<sup>61</sup>

*December 17, 1996:* NU informed NRC commissioners that it was no longer prioritizing the restart of Millstone Unit 3, but was instead conducting parallel restart efforts across all three units and would let the progress of those efforts dictate which unit would be restarted first.<sup>62</sup>

*December 23, 1996:* NU proposed retaining Little Harbor Consultants, Inc. to provide the independent, third-party oversight of Millstone's employee concerns program required by the NRC.<sup>63</sup>

*January 30, 1997:* NU senior managers identified for NRC commissioners the four primary factors for performance declines at Millstone:

- "Failure to set and maintain high standards
- Failure to establish clear accountabilities
- Failure to develop efficient processes
- Failure to identify true root causes"<sup>64</sup>

*February 12, 1997:* NRC staff informed commissioners of changes to the regulatory process resulting from lessons learned at Millstone. The changes included requiring NRC inspectors to verify FSAR commitments, conducting a series of special design inspections at selected plants, and issuing 10 CFR 50.54(f) letters to all licensees requiring them to document existing processes and steps to be taken to ensure facilities operate within their design and licensing bases.<sup>65</sup>

*March 7, 1997:* The NRC issued a Confirmatory Action Letter to NU requiring the company to undertake steps to correct deficiencies identified in the operator training program during NRC-administered examinations in December 1996.<sup>66</sup>

*April 7, 1997:* The NRC approved NU's proposal to retain Sargent & Lundy as the independent party required by the agency to administer Millstone's Independent Corrective Action Verification Program.<sup>67</sup>

*April 7, 1997:* The NRC approved NU's proposal to retain Little Harbor Consultants, Inc. to provide independent, third-party oversight of Millstone's employee concerns program.<sup>68</sup>

*April 23, 1997:* NRC commissioners heard updates from agency staff, NU representatives, and others on the progress of recovery activities at Millstone.<sup>69</sup>

*May 28, 1997:* The NRC approved NU's proposal to retain Parsons Power Group Inc. as the independent party required by the agency to administer Millstone's Independent Corrective Action Verification Program.<sup>70</sup>

*June 24, 1997:* The NRC issued a report following its inspection of the corrective action program at Millstone, which found "only limited improvements in the corrective action process" and that the revision "of the condition report (CR) process was poorly implemented in that specific guidelines were not put in place to ensure the initiation and appropriate processing of CRs for conditions adverse to quality."<sup>71</sup>

*August 6, 1997:* NRC commissioners heard updates from agency staff, NU representatives, and others on the progress of recovery activities at Millstone.<sup>72</sup>

*August 7, 1997:* Minority owners of Millstone filed suit against NU for \$200 million in damages resulting from the extended shutdown.<sup>73</sup>

*August 19, 1997:* NU trustees appointed Michael G. Morris as NU's chairman and chief executive officer.<sup>74</sup>

*November 14, 1997:* NRC staff had closed 30 of 86 items required prior to restarting Unit 3, 11 of the 51 items related to Unit 2, and one of the 108 items related to Unit 1.<sup>75</sup>



*December 2, 1997:* The NRC conducted an enforcement panel meeting on four Office of Investigations (OI) reports looking into the January 1996 layoffs at Millstone. The enforcement panel concluded that three of the four cases did not substantiate allegations of harassment and intimidation, but the fourth case did—and warranted escalated enforcement action in the form of a Severity Level I violation and the associated civil penalty.<sup>76</sup>

*December 5, 1997:* The NRC OI Field Office Director informed the U.S. Department of Justice that two workers at Millstone had been discriminated against by NU's vice president of engineering and that the NRC was preparing to cite NU with two 50.7 violations, each carrying a \$100,000 civil penalty, and to bar the vice president of engineering from licensed activities.<sup>77</sup>

*December 10, 1997:* The NRC proposed a record \$2.1 million fine on NU for 33 apparent violations at Millstone, which it characterized as follows:

*“Many of the violations are categorized within two related programmatic areas, namely (1) longstanding deficiencies in engineering programs and practices, some of which led to safety equipment being inoperable or degraded for extended periods (these violations are described in Section I of the Notice); and (2) the failure to have effective corrective action programs and practices, which resulted, in many cases, in deficiencies previously identified by your staff not being corrected (these violations are described in Section II of the Notice). In addition to these two programmatic areas, a number of violations of your technical specifications (TS) were also identified, some of which were caused by inadequate engineering or inadequate corrective actions.”<sup>78,79</sup>*

*December 11, 1997:* In a closed briefing, NRC commissioners were informed that the OI enforcement panel had concluded that NU's vice president of engineering had discriminated against two workers and the staff was considering a Severity Level I violation and the associated civil penalty.<sup>80</sup>

*December 12, 1997:* NRC commissioners heard updates from agency staff, NU representatives, and others on the progress of recovery activities at Millstone. NU informed the commissioners that 101 licensee event reports (LERs) had been submitted to the agency since January 1996 for problems at Unit 3, with 92 having low safety significance, five having moderate safety significance, and four having high safety significance. NU additionally reported the results of configuration management programs at Units 2 and 3. In all, NU identified the following number of changes required prior to restarting these units:<sup>81</sup>

	<b>Unit 2</b>	<b>Unit 3</b>
Updated Final Safety Analysis Report	694	464
Procedures	205	195
Technical specifications	14	22
Drawings	315	138
Calculations	467	74
Physical plant modifications	107	216

*January 13, 1998:* NU suspended restart work on Millstone Unit 1 for financial reasons.<sup>82</sup>

*March 16, 1998:* Workers installing a temporary modification to the A loop of the recirculation spray system (RSS) on Unit 3 noticed that the upstream sleeve liner on the expansion joint was missing. Subsequent examination of the expansion joints in the other three loops determined they had failed also.

During the extended outage, a flow-restricting orifice had been installed between the RSS pump and the expansion joints in each of the four loops. Loops B, C, and D passed post-modification testing, but loop A failed when the vent line broke due to excessive vibration. While attempting to mitigate this problem, workers discovered the failed expansion joint sleeve liner. The subsequent investigation into this event concluded, “The post-construction testing did not detect the sleeve liner failures directly, thus this event could have had a safety significance.”

Millstone management knew that placing a flow-restricting orifice upstream from a device like the expansion joints was atypical, but no cavitation analysis was performed. When this proposed modification was reviewed by Millstone’s Plant Operations Review Committee, an NRC inspector questioned the potential for cavitation. The design team dismissed the question with a qualitative assessment. When the RSS pumps were started to test the modification, vibrations caused by cavitation damaged the expansion joint sleeve liners within hours.<sup>83</sup>

*May 1998:* The NRC OI investigator who concluded that NU’s vice president of engineering had discriminated against two Millstone workers retired from the agency. (See December 2, 1997, and June 9, 1998.)<sup>84</sup>

*May 1, 1998:* NRC commissioners were briefed by agency staff, NU representatives, and others on the proposed restart of Millstone Unit 3.<sup>85</sup>

*June 2, 1998:* NRC commissioners were briefed by agency staff, NU representatives, and others on the proposed restart of Unit 3. NRC staff reported that approximately 160,000 person-hours were expended by Sargent & Lundy conducting the Independent Corrective Action Verification Program (ICAVP) and that NRC staff had expended about 12,000 inspection-hours auditing it.<sup>86</sup>

*June 9, 1998:* With little discussion, another NRC enforcement panel reversed the decision made on December 2, 1997, to issue NU a Severity Level I violation and the associated civil penalty for discriminating against two Millstone workers. NRC staff decided to take no action at all.<sup>87</sup>

*June 15, 1998:* NRC commissioners approved the restart of Millstone Unit 3.<sup>88</sup>

*June 29, 1998:* The NRC’s regional administrator authorized NU to restart Unit 3.<sup>89</sup>

*June 30, 1998:* Operators began withdrawing control rods from the Unit 3 reactor core at 12:45 pm, but shut down the reactor at 1:30 pm because an instrument monitoring the neutron flux level in the reactor core malfunctioned.<sup>90</sup>

*August 20, 1998:* The NRC announced that its Millstone Special Projects Office was closed and that regulatory oversight of Unit 3 operations and the Unit 2 restart would revert to the Region I office.<sup>91</sup>

*December 31, 1998:* Workers began reloading the Unit 2 reactor core. During the extended outage, the entire core had been offloaded into the spent fuel pool.<sup>92</sup>

*March 9, 1999:* NRC commissioners authorized agency staff to close the order requiring NU to provide independent, third-party oversight of Millstone’s employee concerns program.<sup>93</sup>

*April 27, 1999:* In response to a lawsuit filed by Fish Unlimited that operation of Millstone negatively affected the spawning of flounder in Long Island Sound, the Connecticut Superior Court issued a temporary restraining order preventing NU from restarting Unit 2.<sup>94</sup>

*April 29, 1999:* The NRC authorized NU to restart Unit 2.<sup>95</sup>

*May 7, 1999:* The Connecticut Superior Court lifted the restraining order barring the restart of Millstone Unit 2, blaming the drop in Long Island Sound's flounder population on overfishing. The court advised NU, however, to give strong consideration to building a fish return system or cooling tower for Unit 2.<sup>96</sup>

*May 11, 1999:* Unit 2 was connected to the electrical grid, ending its extended outage.<sup>97</sup>

## Notes

- <sup>1</sup> Nuclear Regulatory Commission (NRC). 1988. Historical data summary of the systematic assessment of licensee performance. NUREG-1214 Rev. 4, October. Washington, DC.
- <sup>2</sup> Office of the Inspector General (OIG). 1996. NRC staff actions to address Northeast Utilities System (NU) 1991 self-assessments. May 31. Washington, DC: Nuclear Regulatory Commission.
- <sup>3</sup> Ibid.
- <sup>4</sup> Ibid.
- <sup>5</sup> Ibid.
- <sup>6</sup> Ibid.
- <sup>7</sup> Ibid.
- <sup>8</sup> Ibid.
- <sup>9</sup> Ibid.
- <sup>10</sup> Ibid.
- <sup>11</sup> Ibid.
- <sup>12</sup> Opeka, J.F. 1992. Millstone Nuclear Power Station, Unit No. 1 status of programs. Letter to Nuclear Regulatory Commission, April 14. J.F. Opeka was executive vice president at Northeast Utilities.
- <sup>13</sup> OIG, 1996.
- <sup>14</sup> Ibid.
- <sup>15</sup> NRC. 1992. NRC staff proposes \$62,500 fine for alleged violations at Millstone Nuclear Power Station, Unit 3. Press release no. 92-192, December 30.
- <sup>16</sup> OIG, 1996.
- <sup>17</sup> NRC. 1993. Single failure vulnerability of engineered safety features actuation systems. Information Notice No. 93-11, February 4.
- <sup>18</sup> NRC. 1993. Unisolatable reactor coolant system leak following repeated applications of leak sealant. Information Notice No. 93-90, December 1.
- <sup>19</sup> Ibid.
- <sup>20</sup> Ibid.
- <sup>21</sup> OIG, 1996.
- <sup>22</sup> Ibid.
- <sup>23</sup> Ibid.
- <sup>24</sup> NRC. 1995. Susceptibility of containment sump recirculation gate valves to pressure locking. Information Notice No. 95-14, February 28.
- <sup>25</sup> OIG, 1996.
- <sup>26</sup> Hadley, E.C. 1995. Request for licensing actions 10 C.F.R. § 2.206 Northeast Utilities Millstone Unit 1. Letter to James Taylor, executive director for operations, Nuclear Regulatory Commission, August 21. Ernest C. Hadley was an attorney representing We The People, Inc. and George Galatis.
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