

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 84-16

Docket No. 50-336

License No. DPR-65 Priority - Category C

Licensee: Northeast Nuclear Energy Co.

P.O. Box 270

Hartford, Connecticut

Facility Name: Millstone Unit #2

Inspection At: Waterford, Connecticut

Inspection Conducted: June 13- 15, 1984

Inspectors: C.H. Woodard
C. H. Woodard
Reactor Engineer

7/12/84
date

Approved by: C. J. Anderson
C. J. Anderson, Chief
Plant Systems Section
DETP

7/12/84
date

Inspection Summary:

Areas Inspected: Routine unannounced safety inspection of Millstone Unit 2 coolant charging pumps to investigate the causes of repeated failures. The inspection involved 8 hours onsite by one region-based inspector.

Results: No violations were identified.

Details

1. Key Persons Contacted

Northeast Nuclear Energy Company

- * R. Asafaylo, Quality Services Supervisor NNECO
- * R. Ayala, Station Services Engineering Supervisor NNECO
- * R. Bates, Engineer Unit 2 NNECO
- N. Bergh, Operations Assistant NNECO
- * K. Deslander, Engineer Unit 2 NNECO
- * T. Filburn, Engineer Unit 2 NNECO
- * R. Herbert, Station Services Superintendent
- M. Hornyak, QA Specialist NUSCO
- R. Kasich, Supervisor Operating Nuclear Plant Licensing NUSCO
- * J. Kelley, Superintendent Unit 2 NNECO
- * D. Leduc, Station Services Engineer NNECO
- C. Libby, Supervisor Design and Operating QA NUSCO
- G. Matchiodi, Training NNECO
- * G. Mroczka, Station Superintendent NNECO
- J. Naylor, Fire Protection Engineer NUSCO
- * R. Porlinieri, Operations Supervisor Unit 1 NNECO
- * P. Parulis, Engineer Unit 2 NNECO
- * W. Romberg, Superintendent Unit 1 NNECO
- J. Roncaioli, Supervisor Fire Protection Engineering NUSCO
- * M. Skorza, QA Engineer NUSCO

Nuclear Regulatory Commission (NRC)

- * Tom Shedlosky, Resident Inspector
- * Dave Lipinski, Resident Inspector
- * Ari Krasopoulos, Reactor Inspector
- * Carl Woodard, Reactor Inspector

* Denotes those present at the exit interview.

2. Coolant Charging Pumps Inspection Millstone Unit 2

Scope

This inspection was conducted in order to investigate the repeated failures of coolant charging pumps in Millstone Unit 2.

Background

10 CFR 21 Report May 25, 1984, Docket 50-336 B11207 reported the failure of three Millstone Unit 2 Reactor Coolant System Charging Pumps. Millstone Technical Specifications requires two of the three installed

pumps to be operational during plant operation. The pumps are Gaulin Corporation Model NP-18 3 cylinder positive displacement. The nature of the failure of the three pumps was the same. Each pump failed due to fracturing of one of the three high pressure cylinders. The Gaulin pumps replaced Armco model J-531-M6DF pumps which failed due to similar fracturing of the high pressure cylinders. The replacement/failure history follows:

"A" Pump

Gaulin replaced Armco November, 1980; failed August, 1982 and April, 1984.

"B" Pump

Gaulin replaced Armco April, 1980; failed February, 1984.

"C" Pump

Gaulin replaced Armco April, 1982; has not failed.

Discussion

The inspector discussed the pump failures with the licensee's representatives and the investigative actions taken by the licensee to determine the causes of the failures.

The licensee has concluded that the Gaulin pump failures are caused by cyclic stress fatigue with cracking originating from high localized stressed areas created by voids and/or inclusions in the cylinder blocks. The licensee's metallurgical consultant, Sylvester Associates, performed destructive testing evaluation of the "A" charging pump block that failed in August, 1982. Sylvester concluded "The fracture occurred due to fatigue which initiated at a flaw of approximately 0.025 inch size. The flaw may have been a pore or perhaps an unusually large inclusion. Such a flaw could not be detected by normal non-destructive procedures. It is unusual for such a small flaw to cause a failure, but the number of cycles of this part was also very large. It would be very worthwhile to perform a stress analysis of the pump at the fracture origin to determine if the normal loads are sufficiently large to cause propagation of such a small flaw. If so, then the pump is under designed; if not then it is likely that the fracture began due to an unusually large stress of unknown origin."

If the pumps do not have sufficient net positive suction head or if there is substantial quantities of dissolved gases in the coolant which change phase, the pumps could cavitate which could cause very large pressure peaks due to water hammer. Such high pressure excursions could cause unusually large stresses which could lead to pump cylinder failure.

The inspector found that the licensee had conducted dynamic analyses of the water head available to the pump suction and had concluded that a minimum of 25 psig head is available. Since the pump requires only 8 psig, water hammer was deemed to be not a likely cause of failure. However in order to fully rule out water hammer as a cause of failure, the licensee plans to instrument both the intake and exhaust pressures of a charging pump in order to record the pressure transients. The licensee has also performed stress calculations on the pump cylinder block to determine if the high pump pressure and large number of operating cycles could lead to fatigue failures of the block. The licensee reported that his calculations show that with a 0.05 inch flaw in a cylinder adjacent to the surface of the cylinder, projected block life is on the order of 500 hours. With the inclusion or flaw not at the surface or smaller, block life would increase accordingly. The licensee is of the opinion that these calculations appear to bear out the approximate 5000 hour life experienced in the 3 Gaulin pump block failures. The licensee has agreed to make these calculations available to the NRC.

Findings

The licensee continues to investigate the cause of pump failures and is taking some positive action with the manufacturer to lengthen pump life. The manufacturer has agreed to shot peen the cylinder blocks in the highly stressed areas. There is some disagreement between the manufacturer and the licensee as to the causes of pump failure. Until this matter is resolved, it will be carried as open unresolved item 50-336/84-16-01.

3. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, violations or deviations. Unresolved items disclosed during the inspection are discussed in paragraph 2.0.

4. Exit Interview

An exit interview was held on June 15, 1984 with members of the licensee staff as listed in paragraph 1.0. The inspector discussed the scope and findings of the inspection. At no time during this inspection was written material provided to the licensee by the inspector.