U.S. NUCLEAR REGULATORY COMMISSION
REGION I

REPORT/DOCKET NO.	50-220/93-20
LICENSE NO.	DPR-63
LICENSEE:	Niagara Mohawk Power Company
FACILITY NAME:	Nine Mile Point Station Unit No. 1
INSPECTION AT:	Lycoming, NY and Salina Meadows, NY
INSPECTION DATES:	August 30 through September 3, 1993

INSPECTOR: A. Lohmeier — 12/29/93
A. Lohmeier, Sr. Reactor Engineer
Materials Section, DRS/EB
Date

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Engineering Branch, DRS
Date

Areas Inspected: (1) Evaluation of engineering and technical support effectiveness in primary system component transient operation monitoring including comparison of actual transient cycles with the numbers of cycles for which the reactor pressure vessel components were designed. (2) The possibility of corrosion residue in the torus obstructing flow in the reactor core spray and reactor containment spray raw water cooling systems.

Results: (1) A transient and operating cycle monitoring procedure consistent with TS Section 6.10.1.2(e) is being implemented to provide assurance that the primary system components and piping remain within the UFSAR design bases. NMPC has comprehensively evaluated the transient cyclic operation of reactor pressure vessel components to date. (2) Monitoring of the torus wall thinning is continuing, chemical analysis of the core and containment spray system water shows no change in water chemistry occurring, no strainer obstruction has been found due to rust accumulation, and no deleterious change was found in the system pump net positive suction head (NPSH).

DETAILS

1.0 SCOPE OF INSPECTION (Inspection Procedure 37700)

The scope of this inspection includes evaluation of engineering and technical support effectiveness in primary system component transient operation monitoring, including comparison of actual transient cycles with the numbers of cycles for which the components were designed. The inspection also reviewed torus shell wall thickness monitoring and the possibility of corrosion residue in the torus obstructing flow in the reactor core spray and reactor containment spray raw water cooling systems.

2.0 FINDINGS

2.1 Transient Operating Cycle Monitoring

2.1.1 Background

The primary system components are designed to meet the requirements of Section III of the ASME Boiler and Pressure Vessel Code for Nuclear Vessels. The Code requires a design by analysis approach to evaluate whether the components can sustain the prescribed steady state pressure and thermal loadings and the cyclic application of these loadings.

NMPC (owner of the components) specifies the types and numbers of application of loadings which are anticipated during the plant lifetime. Components are designed in accordance with these specifications. Therefore, in the case of cyclic loading, the specification will state the numbers and types of transient operation that can be anticipated throughout the plant life. These transients are described in the Updated Final Safety Analysis Report (UFSAR) for the nuclear power plant. Operation beyond the specified numbers of cycles is outside the design bases described in the UFSAR.

Since primary system components are designed to sustain limited numbers of transients, the plant technical specifications (TS) reflect the requirement that records and documents relating to the cyclic operation of the plant must be maintained throughout the plant lifetime. These data identify critical areas of the components subject to the operating transients for monitoring to determine whether the design fatigue life of the component has been expended.

The criteria for exhaustion of fatigue life are reflected in a cumulative usage factor (CUF), which is an integrated summation of the ratio of expected numbers of cycles at the applied strain range to the cycles at that strain range necessary to cause fatigue failure. An appropriate factor of safety in terms of strain level or cycles is utilized in the same sense as a factor of safety for stress level in relation to fracture stress.

2.1.2 Updated Final Safety Analysis Report and Technical Specification Requirements

The inspector reviewed the UFSAR for Nine Mile Point Unit 1. It specifies the number and types of reactor coolant system (RCS) transients for which each reactor vessel component has been designed over the duration of its 40 year operating license. The number and type of transients are listed in Section V, 4.0 of the UFSAR, Table V-2 (Operating Cycles and Transient Analysis Results). Transients included vessel head removal and reinstallation, 100F/hour heatup and cooldown, 300F/hour emergency cooldown, blowdown, and scram cycles.

For the given transients, a fatigue evaluation was performed on the feedwater nozzles, control rod drive penetrations, lower vessel head, vessel support skirt, core support cone, vessel wall, vessel nozzles, closure studs, and the basin seal skirt weld.

Review of the technical specification by the inspector indicated that Section 6.10.2 (f) requires that records of transient or operational cycles for those unit components designed for a limited number of transients or cycles shall be retained for the duration of the facility license.

2.1.3 Retention of Operational Cycle Records

The inspector examined the system used by NMPC to collect, retain, and disseminate operational data records. It was found that the NMPC independent safety engineering group (ISEG) had identified a failure to maintain a program to track and evaluate operating cycles and transients for components designed for limited numbers of operating transients. This was documented in a deviation/event report (DER) (1-93-0875), dated 3/31/93.

NMPC immediately initiated a corrective action program to correct the deficiency. The program included review of the thermal cyclic data logs, developing a procedure for logging and trending the operating transients, and design review by NMPC headquarters nuclear engineering.

As a result of the DER corrective action, NMPC established a comprehensive system for the collection, retention, and dissemination of operational records. The responsibilities and controls for the collection, processing, storage and retrieval of quality assurance records are described in Reactor Engineering Procedure N1-REP-37, Plant Event Log. The purpose of the procedure is to maintain a log of events which significantly contribute to stress cycles on the reactor vessel components.

2.1.4 **Engineering Review of Transients**

The transient and operating cycle monitoring procedure is consistent with TS Section 6.10.2 (f). It is also consistent with the recommendation of the primary system component vendor in General Electric Service Information Letter (GE SIL) No. 318, December 1979, "BWR Reactor Vessel Cyclic Duty Monitoring" to monitor the duty cycles, cycle frequency rate and to extrapolate the duty cycles to a 40 year life. Monitoring of transient cycles provides assurance that the primary system components and piping remain within the UFSAR design bases by identifying those operating transients which approach or have exceeded the original design specification values.

NMPC retained a contractor in 1979 to evaluate the reactor vessel fatigue analyses of the reactor vessel vendor to determine a more realistic estimate of applied transients for the lifetime of the unit on the basis of operating experience to date. On the basis of this evaluation, the following transients were recommended for use in fatigue evaluation of reactor components over the 40 year license lifetime (MPR-629):

Transient Condition	Original Cycles	Revised Cycles
Head Removal	80	50
Head Installation	80	50
Normal Heatups	120	240
Normal Cooldowns	109	229
Emergency Cooldowns	10	10
Rapid Blowdown	1	1
Scrams	280	280

The inspector compared the numbers of cycles of the actually experienced transients with the number of cycles used in the design of reactor vessel components for 40 years operation. The results of this review are shown as follows:

Transient Condition	Revised Cycles	Cycles to Date
Head Removal	50	15
Head Installation	50	15
Normal Heatups	240	101
Normal Cooldowns	229	102
Emergency Cooldowns	10	0
Rapid Blowdown	1	0
Scrams	280	61

The operational life to date (24 years) is approximately 60% of the plant design life (40 years). The inspector found that the number of cycles after 24 years operation is less than that expected for 60% of the life of the plant. Therefore, if the frequency of occurrence of the transient condition continues at the same rate, the total number of cycles during 40 year operation of the plant will be within the number of cycles to which the reactor pressure vessel components have been designed.

2.1.5 Fatigue Usage Factors of Reactor Vessel Components

The NMPC contractor, in report MPR-568, computed the lifetime (40 year) fatigue usage for critical reactor pressure vessel components. Included in the fatigue evaluation were revised stress analyses upgrading the original reactor vendor stress analyses (CENC-1142).

The usage factors for critical reactor components for 40 year operation were reported by the contractor as follows:

Vessel Region	Calculated Usage Factor
Closure Studs	.487
Basin Seal Skirt Weld	.782
Feedwater Nozzles	
with repaired cavities	.489
without repaired cavities	.163
CRD Penetrations	.060
Lower Head, Support Skirt, Core Support Cone	.083

After review of the analyses results, the inspector found that NMPC reactor components usage factors will remain within the design limitations over the life of the license to operate the plant.

2.2 Toroidal Suppression Chamber Corrosion Evaluation

2.2.1 Background

As a result of nuclear power generation industry experience, both domestic and foreign, NRC reflected its concern in Information Notice 92-71, dated September 30, 1992, (Partial Plugging of Suppression Pool Strainers at a foreign BWR), and in Bulletin 93-02, dated May 11, 1993, (Debris Plugging of Emergency Core Cooling System (ECCS) Strainers). The issue related to partial plugging of Emergency Core Cooling System strainers due to maintenance activity allowing the introduction of fiberglass roughing filter material into the suppression pool, thereby providing for a high probability of the residual material plugging the ECCS strainers.

As part of the surveillance of NMPC corrective actions related to this issue, the inspector examined NMPC control of the cleanliness of the suppression chamber, such that materials would not be present to enter the suction piping for the core and containment spray systems and clog the strainers. While the presence of fibrous material in the chamber was unlikely, the possibility existed for toroidal shell corrosion products (rust) clogging components and restricting flow in the systems.

The inspector reviewed several indicators of the presence of corrosion products in the core and containment spray systems. These included a measurement of the volume of corrosive products available in the system to be carried through the pumps and strainers of the systems. Changes in the pressure drop across the strainers and changes in the net positive suction head of the pumps provided means to measure the clogging potential of the corrosion products. Sampling to determine the corrosion product content of the water also provided for an evaluation of system clogging potential.

2.2.2 **Torus Corrosion Monitoring**

NMPC is implementing a program to monitor suppression chamber torus wall thinning. During the recent outage, readings of wall thickness were taken and preliminary evaluation of the data indicated that measured wall thicknesses continue to remain above the required minimum wall.

The inspector noted, in calculations of the expected corrosion products, that tons of loose corrosion products (rust) lie in the bottom of the suppression chamber torus. From calculations of the average distribution of these products in the available water, the density of the water is changed very little. On that basis, there would appear to be little probability of system clogging. System flow tests show this to be true. On the other hand, the sudden and violent demand for water during a blow down accident could give rise to slugs of sludge entering the piping systems. The clogging effect of the sludge could not be tested in the normal flow testing during circulation in the core and containment spray systems.

The inspector reviewed results of performance tests of the core and containment spray system pumps. From review of these data, the inspector noted no reduction in net positive suction head indicative of blocking of flow to the pump inlet.

The inspector reviewed the results of water chemistry samples taken from the core and containment spray systems. The measurements included that of physical, chemical, and radiological content. The level of suspended solids in the samples were recorded. NMPC stated that the acceptance criteria for water sampling was related to changes, rather than specific levels of each test element. The physical, chemical, and radiological properties continued to show no changes. NMPC noted that the rust appeared in the form of a red powder.

The inspector reviewed reports of sampling and analysis of water systems for corrosion. The following inspection results were reported:

- 6/29/92 Containment spray heat exchanger was opened for maintenance and a red oxide was observed.

- 7/19/92 There was no observation of silt deposition, scaling, slime, mussels, or odors. Slight formation of orange oxide was observed with pitting, nodules, and tubercles.

- 3/8/93 Oxide formation was noted in the containment spray strainer.

- 3/14/93 The core spray strainer was clean with only small amounts of rust found in wall scrapings above the strainer. A brown oxide was formed in the core spray strainer. The system was run only two months previously.

The inspector examined photographs of the core spray and containment spray system gratings within the torus and noted little deterioration of the gratings in the torus wall had occurred due to corrosion. These photographs were taken during the previous outage inspection; no photographs were taken during the present outage. However, the cohesive nature of the sludge accumulated at the bottom of the torus was not determined. The clogging effect of the sludge under more violent flow condition (such as LOCA) could not be demonstrated under normal flow tests. It was indicated by the inspector that dip samples of the sludge taken from the bottom of the torus would allow determination of the cohesive nature of the sludge. This would allow determination of whether the sludge would accumulate on the system elements a cause clogging during a LOCA.

NMPC had not taken samples of the sludge at the bottom of the torus and believed the satisfactory performance of the system indicated that the accumulation of rust at the bottom of the torus did not affect the system performance. The testing revealed no decrease in NPSH at the pump inlet, and no accumulation of rust at the strainers.

On the basis of the NMPC torus monitoring program, the inspector finds that the monitoring of the torus wall thinning is continuing. Chemical analysis of the core and containment spray system water shows no change in water chemistry occurring. No strainer obstruction has been found due to rust accumulation, and no deleterious change in pump NPSH was noted.

3.0 SUMMARY OF FINDINGS

- A transient and operating cycle monitoring procedure consistent with TS Section 6.10.1.2(e) is being implemented to provide assurance that the primary system components and piping remain within the UFSAR design bases.

- NMPC has comprehensively evaluated the transient cyclic operation of the plant to date and recognized an issue in plant operation relating to startup and shutdown cycle frequency, provided for an engineering evaluation of the issue, and made appropriate recommendations to management for resolution of the issue.

- On the basis of the NMPC torus monitoring program, the monitoring of the torus wall thinning is continuing, chemical analysis of the core and containment spray system water shows no change in water chemistry occurring, no strainer obstruction has been found due to rust accumulation, and no deleterious change in pump NPSH.

4.0 MANAGEMENT MEETINGS

The inspector met with Nine Mile Point Unit 1 engineering and licensing personnel at the entrance meeting on August 30, 1993, and at the exit meeting on September 3, 1993, at the Nine Mile Point Unit 1 Station in Lycoming, New York. The names of personnel contacted during the inspection are shown on Attachment A. The findings of the inspection were discussed with management personnel at the September 3, 1993 exit meeting. The licensee did not disagree with the findings of the inspector.

ATTACHMENT A

The following persons were contacted at the entrance meeting on August 30, 1993, at the exit meeting on September 3, 1993, and during the course of the inspection:

Niagara Mohawk Power Company

*	M. Balduzzi	General Supervisor, Operations, Unit 1
*	P. Bartolini	Mechanical Design Engineer, Unit 1
*	C. Beckham	Quality Assurance Manager
*	J. Burgess	Quality Assurance Auditor
*	R. Close	Reactor Engineering Supervisor
*	J. Driscoll	Technical Support, Unit 1
	B. Eastman	Reactor Technology
*	B. Holloway	Chemistry, Unit 1
	L. McNeer	Senior Nuclear Engineer
*	A. Pinter	Site Licensing Engineer
	W. Rademacher	DPS Manager
	J. Spadafore	Independent Safety Evaluation Group
*	K. Sweet	Technical Manager, Unit 1
*	A. Zallnick	Site Licensing Supervisor

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*	W. Mattingly	Resident Inspector

An asterisk (*) indicates attendance at the exit meeting.