Docket No.: 50-410

FEB 0 5 1987

MEMORANDUM FOR: Elinor Adensam, Director
Project Directorate #3
Division of BWR Licensing

FROM: Gus C. Lainas, Assistant Director
Division of BWR Licensing

SUBJECT: SAFETY EVALUATION FOR OPERABILITY OF MODIFIED MAIN STEAM ISOLATION VALVES (MSIV) DURING FIRST FUEL CYCLE FOR NINE MILE POINT, UNIT 2

Reference: Memorandum Gus C. Lainas to Elinor Adensam, Dated October 27, 1986, Safety Evaluation for Operation of Main Steam Isolation Valves during First Fuel Cycle with Refurbished Seat and Ball

By letters dated October 21, November 17, December 8, December 16, 1986, and January 27, 1987, the licensee has provided information on the Nine Mile Point Unit 2 main steam isolation valve mechanical design and closure time problems, including corrective action and technical justification, and a commitment to perform additional confirmatory testing. The enclosed SER addresses these concerns in order to permit use of the modified MSIVs during the first fuel cycle.

We find that the modified MSIV actuator design and closure time operability are acceptable for use in providing primary containment isolation from the time of criticality to the end of the first fuel cycle. However, confirmatory information will be required to verify continued acceptable MSIV performance during this period. License conditions have been proposed in the referenced memorandum to obtain certain confirmatory data from the MSIV prototype test program and from specific operability tests to be performed during the initial fuel cycle of operation.

Our SALP input is also enclosed.

/S/

Gus C. Lainas, Assistant Director
Division of BWR Licensing

Enclosure:
As stated

CONTACT: J. Lombardo
X24478

*See next page for concurrences.

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We find that the refurbished MSIVs are acceptable for use in providing primary containment isolation from the time of criticality to the end of the first fuel cycle. However, confirmatory information will be required to verify continued acceptable MSIV performance during this period. License conditions have been proposed in the referenced memorandum to obtain certain confirmatory data from the MSIV prototype test program and from specific operability tests to be performed during the initial fuel cycle of operation.

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D C 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CONCERNING MAIN STEAM ISOLATION VALVE OPERABILITY

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT UNIT 2

DOCKET NO.: 50-410

1.0 INTRODUCTION

Two general problem areas were identified concerning the Nine Mile Point Unit 2 (NMP2) Main Steam Isolation Valves (MSIV). These problem areas can be categorized into MSIV leakage rates which exceeded the 6 SCFH Technical Specification (TS) limit and the MSIV closure time operability which exceeded the 3 to 5 second TS range. This evaluation only addresses the closure time operability issue.

By letters dated October 21, November 17, December 8, and December 16, 1986, and January 27, 1987, the licensee has provided information on the MSIV mechanical design and closure time problems, including corrective action and technical justification, and a commitment to perform additional confirmatory testing.

The operability of each 24-inch reduced-port, (21-inch) ball type NMP2 MSIV assembly depends ultimately on the ability of each MSIV actuator ball valve unit to demonstrate acceptable integrated MSIV system performance; i.e., each MSIV actuator must be operated with its associated 21-inch ball valve to demonstrate that the assembly will function reliably by repeated valve closing within 3 to 5 seconds, thereby preventing uncontrolled releases of radioactivity from the reactor vessel to the environment.

The October 21, 1986 submittal provided information pursuant to 10CFR 50.55 (e) to NRC's Region I concerning MSIV closure time problems. This report related to a cracked latching roller found on one MSIV actuator and excessive actuator trip times. A time-dependent phenomenon of increased latch tripping force with increased open time was noted.

The report describes the original faulty mechanical actuator design features and associated problems, presents the design modifications being implemented to resolve these problems, and discusses the testing performed to justify the resolution of the actuator problems. Justification for the corrective action is based on a design evaluation of the modified actuator, together with the testing results to date and the additional planned confirmatory testing.

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2.0 DISCUSSION

In the original mechanical latch design, the hydraulic fluid was used only to pressurize the hydraulic cyclinder, thereby moving the piston and compressing the springs to open the MSIV. The fluid performed no function while the main steam isolation valve was in the open position as the hydraulic system was de-energized and the mechanical latch held the valve open. The modified actuator design removes the mechanical latch (actuator device) assembly and modifies the existing actuator's hydraulic system to perform the function of holding the MSIV in the open position instead of the mechanical latch mechanism. Although the hydraulic fluid is now constantly under pressure when the valve is open, the increased duty on the fluid will have no adverse effect on the actuator's ability to perform.

The MSIV actuator with the modified hydraulic system continues to use the canister assembly springs to provide the force for MSIV closure; it also uses the hydraulic system to open the MSIV. The two solenoid spring plungers as well as the mechanical latch mentioned above have been eliminated. The hydraulic system associated solenoid operated valves (SOVs) are retained. The SOVs in the original hydraulic design were closed (energized) only when the MSIV was being opened and then put in the normally open (deenergized) position. Their function is revised in the modified design as they are maintained in the closed (energized) position during normal operation with the MSIV open. The hydraulic system being pressurized provides the force via the hydraulic cylinder to open the MSIV and hold it open against the closing force of the canister assembly springs. When the MSIVs are required to close, the SOVs are opened (deenergized), the hydraulic system is depressurized, and the fluid in the hydraulic cylinder which holds the MSIV open is exhausted into the reservoir allowing the spring canister assembly to close the MSIV.

The new hydraulic system requires the following additional and/or redesigned equipment to enable the hydraulic system to perform the latching and tripping functions by depressurizing the system rapidly:

- new jockey hydraulic pump and hydraulic accumulator - to maintain hydraulic system pressure while reducing cycling times on the much larger main hydraulic pump;
- new pressure switch and controls - to maintain pressure by cycling the jockey pump;
- modified low leakage hydraulic cylinders - to minimize hydraulic fluid losses and associated system pressure decay via modification to existing cylinder design specifically adding a piston lip seal for minimizing jockey pump cycling, and a mechanical stop to establish MSIV full open position;
- change of hydraulic system related SOVs' normal operating mode to one of being closed (energized) while the MSIV is open;
- modification of the SOVs - to rapidly open under hydraulic pressure by modification to existing SOV design via a spacer to increase the spring force and the combination of a graphite filled teflon backup ring added over the EP rubber O-ring on the seat disc to avoid sticking of rubber O-ring seals;

- modification of both 2-inch diameter SOVs' electrical supplies - to enhance reliability of both SOVs, supply will be from either of the two RPS uninterruptable power supplies through appropriate auctioneering circuitry loss; a loss of either supply will not open (deenergize) either SOV;

- new control room MSIV hydraulic system related instrumentation - to allow detection of abnormal operation and alert the operator; and

- automatic stop by both hydraulic pumps on receipt of an emergency MSIV closure signal - to prevent an attempt to pressurize the hydraulic system which might deter or slow down MSIV closure.

The proposed qualification of the redesigned and modified actuator consisted of three steps as follows:

During the first step, overall adequacy of the actuator assembly was attempted. Data from the previous dynamic testing performed at Wyle Laboratories were submitted as applicable, since the modifications did not result in changing the previously defined seismic/dynamic requirements nor did they appreciably affect the stiffness/mass characteristics of the operator/actuator.

The second step consisted of evaluating the structural integrity of the added non safety related components, jockey pump and hydraulic accumulator. This was accomplished by analysis, demonstrating structural integrity during a seismic/dynamic event. The peak accelerations used in this analysis were derived from the required response spectra used for the actuator qualification.

The third step in the qualification of the actuator involved the 2-inch diameter hydraulic system SOVs which were part of the actuator dynamic testing performed at Wyle Labs in 1983. These SOVs were not required to function during the tests performed at Wyle. In the modified actuator design, the additional function of the hydraulic system requires that the SOVs remain in a closed position and open upon demand to enable the MSIV to close within 3 to 5 seconds. Demonstration of operability of these hydraulic system SOVs during and after a seismic/dynamic event is required. To accomplish this, the acceleration levels and equivalent static loadings on the SOVs were developed based on a combination of the data available from the accelerometers that were mounted at the base of an SOV during the dynamic testing performed at Wyle Labs and a finite element analysis of the actuator assembly. The SOVs were then qualified for the required accelerations and loads resulting from seismic/hydrodynamic events. A combination of analysis, dynamic testing of a similar SOV and a static operability pull test were performed on an identical SOV. The static operability testing identified the need to install a spring spacer in the SOV assembly to assure valve operability. This spacer has been installed in the SOVs that are part of the actuator assemblies at NMP2 and in the SOVs used in the prototype test program.

Testing to demonstrate performance of the modified MSIV actuator was conducted at Crosby Valve and Gage Company. This testing was done on the same actuator which underwent seismic/dynamic operability testing on a shake table at Wyle Labs. The following is a brief description of the testing performed:

On August 29, 1986, the hydraulic system was modified to perform the additional functions of holding the MSIV open and initiate MSIV closure. A small accumulator tank, jockey pump, flow control valve and pressure switch were added to the test actuator. The test actuator was held in the open position for 3 days. During this time it was noted that the hydraulic pressure dropped quickly, which required frequent cycling of the jockey pump.

On September 2, 1986, the actuator was tripped and a delay was noted between trip signal initiation and SOV opening. At this time the hydraulic cylinder and cap were replaced with one which included a mechanical travel stop to control the MSIV open position. Further testing continued which showed delays in SOV opening and frequent jockey pump cycling.

On September 11, 1986, the SOV was disassembled and the cause of SOV trip opening delay was determined to be sticking of the SOV O-ring. On September 15, 1986, representatives of the SOV manufacturer (Target Rock corporation) examined the SOVs and testing with alternate ring materials was initiated.

On September 17, 1986, the cause of the hydraulic system pressure drop and the resultant frequent jockey pump cycle times was identified as fluid leakage through the hydraulic cylinder. To alleviate this problem, a new piston with EP rubber lip seal was ordered.

On September 23, 1986, actuator testing began with SOV disc seals equipped with the current EP rubber O-ring/graphite filled teflon (TFE) backup ring combination.

On October 10, 1986, an enchanced piston lip seal was installed in the hydraulic cylinder on the test actuator, and on October 27, 1986 spring spacers were installed in the SOVs and testing continued.

According to the licensee, all of the tests at Crosby discussed in the preceding paragraphs were performed on a full size actuator. With the exception of the modified hydraulic cylinder and the previously discussed equipment which were added to facilitate the hydraulic latch, all of the equipment on the test actuator, including the SOVs are the same equipment which were seismically and dynamically qualified by shake table testing conducted at Wyle Labs in 1983, and reviewed by the NRC during the Pump and Valve Operability Review Team audit in 1985. The only changes from the previously qualified configuration were the elimination of the mechanical latch/spring components and expansion of the hydraulic system equipment and function.

The licensee's submittal dated December 16, 1986 provided additional actuator test results. These include twelve successful actuator trip tests since September 23, 1986, when the SOV disc seals were reported as being equipped with the EP rubber O-ring/graphite filled teflon (TFE) backup ring combination. The last test was successfully completed on December 4, 1986 after the actuator had been held in the open position by the hydraulic latch system for a period of thirty eight days. During the test period, the jockey pump had cycled only four times.

3.0 EVALUATION

From the October 21, 1986 submittal in plant testing revealed MSIV closure durations in excess of the 3 to 5 second TS requirements, and that the excessive closure time was related to the length of time the valve had been latched open. During preoperational testing, cracked latching rollers were also discovered in those actuators.

The problem of MSIV closure operability should not be considered fully corrected until the complete modified MSIV assembly is capable of repeated closures within the 3 to 5 second TS range, first in Operational Conditions 4 and 5, then in Operational Condition 3 and finally in Operational Conditions 2 and 1.* The MSIV assembly includes a 24-inch reduced port (21-inch) ball valve with a modified seat spring configuration and a recoated tungsten carbide ball combined with a modified hydraulic actuator as described in Section 1.0.

A silicone base fluid was chosen for the hydraulic system because of its thermal stability and its good oxidative behavior under radiation exposure. Dow Corning hydraulic fluid 510-100 was specified by the valve manufacture as being acceptable for use in the MSIV actuator.

The service life of the fluid in plant will be determined by periodic testing in accordance with Chemistry Maintenance Procedure N2-CSP-17. The shelf life of the fluid when kept at room temperature is indefinite. The effect of in-

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*Tech Specs (Table 2.1)

Operational Condition	Mode Switch Position	Average Reactor Coolant Temp.
1. Power Operation	Run	Any temperature
2. Startup	Startup/Hot Standby	Any temperature
3. Hot Shutdown	Shutdown	> 200°F
4. Cold Shutdown	Shutdown	≤ 200°F
5. Refueling	Shutdown or Refuel	≤ 140°F

service operation will be monitored during refueling outages in accordance with procedures to detect significant changes in viscosity and accumulation of particulates. The licensee has committed to a sampling and testing schedule to occur once each refueling outage based upon the following facts: 1) the fluid is essentially in a static condition, 2) a filter is provided to remove particulates, 3) the valve is tested monthly to ensure operability, 4) the main steam tunnel and primary containment are a high radiation area during normal operation, and 5) the fluid is qualified for the application.

Although no changes over the service life are expected based on testing performed by Dow Chemical, the surveillance testing of the hydraulic fluid is considered to be added assurance for proper actuator performance. The staff

According to the licensee the testing performed at Crosby has verified the capability of the hydraulic system SOVs to open as required. Since testing of the modified hydraulic system was initiated on August 29, 1986, in excess of 70 actuator trip tests were reported as being run. Eleven actuator trip tests were run using the EP rubber O-ring/TFE backing ring material combination which has been installed in the SOVs on the actuators at NMP2. The results of these eleven tests verified that every time this combination of SOV O-ring material was tested the actuator successfully closed within the required 3 to 5 seconds. There were no unsuccessful test results reported using this combination of O-ring materials. Based on the above analysis and tests the modified MSIV hydraulic actuator appears to be qualified to operate reliably by itself. Operability of the redesigned MSIV assembly will be determined during the Pre-op testing program.

The October 21, 1986 submittal, Section 6 states that "when the modifications discussed in the report are completed and the valves have passed their pre-operational tests, the MSIVs will be appropriate for normal operation of the plant." The report refers to the prototype test program on a NMP2 MSIV assembly which will duplicate the hardware and actual plant operating conditions to the extent possible. The initial prototype testing is scheduled to be completed by April 1, 1987 with the test report provided to the NRC by May 15, 1987. It is important to assess each closure time operability related test scheduled to be performed on each of the eight modified MSIVs installed in NMP2. The insitu MSIV operability test assessments are important to be identified and satisfactorily passed, especially until the prototype test program has been successfully completed to confirm MSIV closure time operability. **The staff finds this acceptable.**

A draft copy of Preoperational Test Procedure Number N2-POT-1-2 entitled "Main Steam Isolation Valves" was included in the review. This cold shutdown test document is designed to prove that the NMP2 MSIVs will perform per their design logic during plant operation. The preop tests provide baseline data for future operations and testing, and to determines the operational readiness of the MSIVs. During the preop test procedure, each of the eight MSIVs will be tested individually during fast closure with a 3-5 second requirement. Each MSIV will be tested four times with the results recorded. Note that the section entitled "MSIV Manual Isolation" of the Preop tests verifies several times that all the MSIVs close simultaneously but there are no requirements for fast closure of all MSIV together required prior to criticality and prior to reactor system heatup to normal operating pressure and temperature (approximately 1000 psia and 550°F).

In lieu of the NMP2 Startup Test Procedure drafts, NMPC provided associated FSAR startup test descriptions. According to Table 14.2-227 describing main steam isolation valves functional tests [Startup Test (SUT-25A)], "At 5 percent and greater power levels individual fast closure of each MSIV will be performed to verify their functional performance and to determine closure times." Also full individual closures will be performed between 40 and 55-percent power and again between 60 and 85-percent power. These latter tests will ultimately be used to determine the maximum power test condition that has ample margin to scram. The stated test objectives of SUT-25A are to determine isolation valve closure time at rated conditions and to functionally check the MSIVs for proper operation at selected power levels.

According to FSAR Table 14.2-228 describing full reactor isolation [Startup Test (SUT-25B)], " A test of the simultaneous full closure of all MSIVs is performed at greater than or equal to 95-percent of rated thermal power." The test objective of SUT-25B is to determine the reactor transient behavior that results from the simultaneous full closure of all MSIVs. The recorded MSIV full closure times must meet the 3 to 5 second criteria.

According to Regulatory Guide 1.68, Revision 2 entitled "Initial Test Programs for Water-Cooled Nuclear Power Plant," there is guidance in its Appendix A entitled "Initial Test Program" for MSIV fast closure testing as follows:

> Following initial criticality, appropriate low-power tests (normally at less than 5% power) will be conducted including "Demonstration of the operability including stroke times of main steam line and branch steam line valves and bypass valves used for protective isolation functions at rated temperature and pressure conditions."
>
> During power-ascension testing, verification of "operability and response times of main steam isolation valves and branch steam line isolation valves" is included. This latter testing is recommended to be performed at approximately 25-percent power level.

There is reasonable consistency between the NMP2 preop and startup test requirements and the guidance provided by Reg. Guide 1.68 regarding MSIV operability. While the Reg. Guide recommends low-power MSIV fast closure "normally at less than 5% power," NMP2 Startup Test (SUT-25A) MSIV fast closure tests are scheduled per the FSAR to be performed "at 5% and greater power". However, in the letter dated December 10, 1986 the licensee has committed to perform the tests at less than or equal to 5% power. It is important that the first fast closure tests be conducted as soon as practicable after the MSIVs reach normal operating temperature and pressure. The licensee has provided, and the staff finds it acceptable, the following schedule for fast closure testing between the preop and 100 hour warranty run:

Days After 1st Criticality	Power	Description
10	≤ 5%	Emergency (fast) close each MSIV individually for closure timing
47	10-20%	Fast close MSIVs following initiation of shutdown from outside the control room
111	50-55%	Fast closure of each MSIV individual for closure timing
119	60-65%	Fast close fastest MSIV for closure timing/ scram avoidance
121	90%	Fast close fastest MSIV for closure timing/ scram avoidance
124	94%	Fast close fastest MSIV for closure timing/ scram avoidance
136	95-100%	Initiate fast closure of all MSIVs to initiate reactor scram

4.0 CONCLUSION

On the basis of modified actuator testing to date and contingent on successful completion of the preoperational tests, and the Prototype Testing Program scheduled to be completed by April 1, 1987 (the test report to be provided by May 15, 1987), the staff concludes that the MSIVs are acceptable for plant operation up to the first refueling. The staff will evaluate the prototype program test results for the purpose of demonstrating long term operability prior to making a final decision on continued use of the modified MSIV assemblies beyond the first fuel reload.

ENGINEERING BRANCH
SALP Input For
NIAGARA MOHAWK POWER CORPORATION

Plant: Nine Mile Point, Unit 2
Licensing Activity: MAIN STEAM ISOLATION VALVE OPERABILITY-MECHANICAL DESIGN MODIFICATION

1. Management Involvement in Assuring Quality

   Overall rating for this attribute is category 2. The licensee exhibited evidence of prior planning and assignment of priorities to address the issue.

2. Approach to Resolution of Technical Issues

   Overall rating for this attribute is category 2. The licensee demonstrated understanding of the issues and provided a technically sound approach for resolution.

3. Responsiveness to NRC Initiatives

   Overall rating for this attribute is category 2. The licensee was generally responsive.

4. Enforcement History - N/A

5. Reporting and Analysis of Reportable Events - N/A

6. Staffing - N/A

7. Training - N/A