ASSESSMENT REPORT

ON

THE NEED FOR A LEAKAGE CONTROL SYSTEM

FOR

NINE MILE POINT UNIT 2

March, 1987

[illegible]

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I. INTRODUCTION AND SUMMARY

This report provides Niagara Mohawk Power Corporation's evaluation of the necessity of installing a leakage control system for the Nine Mile Point Unit 2 Main Steam Isolation Valves (MSIVs). The results of our evaluation indicate that a leakage control system is not required at Unit 2. This assessment is based upon the following:

1. Nine Mile Point Unit 2 Main Steam Isolation Valves are equivalent in design to BWR Rockwell Valves used at other nuclear power plants. (See Section II)

2. The industry leak rate test data provides a basis to predict the leak rates at Unit 2 based upon the similarity of the Unit 2 valves to other Rockwell MSIVs used at BWRs. (See Section III)

3. Based upon the leak rate data shown on Table 3, the Unit 2 valves will meet the Technical Specification leak rate of 6 SCFH prior to initial critically and, maintain a relatively low leak rate throughout each operating cycle. About forty percent of all "as found" Type C leak data for the Rockwell type MSIV's were less than 6 SCFH. Eighty-five percent of all Rockwell data obtained (representing 378 valves) were less than 38 SCFH. An estimate for the "As Found" condition at the end of the first operating cycle for Unit 2, based upon industry weighted averages, is 16 SCFH. (See Section V)

4. The Niagara Mohawk evaluation of the allowable Main Steam Isolation Valve leakage was provided in a letter dated March 18, 1987. That report demonstrated that MSIV leakage values as high as 38 SCFH/line did not result in unacceptable dose values when evaluated in accordance with NUREG 1169 (See Section IV).

5. Evaluation of the maintenance record for Nine Mile Point Unit 1, which uses Atwood Morrill Valves, demonstrates that it is one of the better plants for Main Steam Isolation Valve leak rate performance. Additionally, a maintenance assessment was performed for the Rockwell valves by Niagara Mohawk personnel. Personnel from a number of the domestic plants with the best leak rates were contacted, as well as General Electric and the valve manufacturer. In addition, a literature review was made (See Section V). Based upon this assessment, a number of methods will be utilized to improve the Main Steam Isolation Valve leakage characteristics at Unit 2 (See Section 5).

Section II provides a comparison of Nine Mile Point Unit 2 to other plants using Rockwell valves. Section III provides an analysis of industry leak rate test data. Section IV provides a radiological evaluation of the allowable leak rate values. Section V discusses enhanced maintenance activities for the Main Steam Isolation Valves. Section VI provides an overall conclusion.

II. COMPARISON OF UNIT 2 ROCKWELL VALVES TO OTHER PLANTS WITH ROCKWELL VALVES

A. DEVELOPMENT OF PERTINENT MSIV FEATURES

A list of pertinent valve features which could affect the leak tight integrity of the Rockwell valves was developed by General Electric for Unit 2 MSIVs. A list of the Boiling Water Reactors (BWRS) using Rockwell valves was also developed. The list includes the domestic BWRs and Tokai 2, a Japanese plant, using Rockwell MSIV's. The data is compiled in Table 1.

B. EVALUATION OF UNIT 2 ROCKWELL FEATURES ON TABLE 1

Table 1 provides a comparison of the pertinent design features of Unit 2 (Y-Pattern) MSIV's, and those of the same basic style. The design features identified are those considered necessary to compare the equivalency of the NMP2 MSIV design to those which are currently in-service. The following discussion describes the information on Table 1. The organization of the discussion is the same format as Table 1.

1. VALVE RELATED PHYSICAL FEATURES

The MSIV Information from Table 1 demonstrates that:

(a) The NMP2 MSIV valve manufacturer and basic valve style is the same as for MSIV's used in at least 13 other BWR operating plants.

(b) The nominal valve sizes identified range from 18 to 26 inches. Four other operating plants use the same 26 inch size valve as does NMP2.

(c) The NMP2 MSIV design is in compliance with the ASME Section III, Class 1 design and manufacturing requirements. The applicable codes and standards for the other plants are identified on Table 1.

(d) The NMP2 MSIV design pressure and temperature is 1375 psig at 586°F which is 10% higher than for the other plants identified because the NMP2 MSIV's were originally designed and manufactured for Black Fox Nuclear Power Plant requirements.

(e) The minimum wall thickness identified is consistent with the minimum stress analysis criteria, corrosion allowance and valve supplier design.

(f) Two NMP2 MSIV's located inside primary containment on the outboard main steam lines are rolled about 20° from the vertical. This rolled orientation is less than the 42°, 35° and 30° rolled positions used at other BWR's using the Rockwell MSIV's. Based upon operating experience at other BWR plants, the NMP2 MSIV 20° rolled position is not considered a significant factor for leak tightness. For example, the Cooper Nuclear Plant, which has the best in-service leak tightness record, also has a high (35°) rolled angle orientation.

(g) The latest Rockwell design (including NMP2) utilizes a 60% valve stroke (of the main seat bore diameter). This streamlines the flow past the main disc and thus minimize the effects of the flow induced vibration on the valve internals. There have been no reported flow induced vibration problems on MSIV's having the same valve stroke to main seat bore ratio as NMP2 (which is 60%).

2. VALVE RELATED DESIGN FEATURES FOR LEAK TIGHTNESS

The MSIV information from Table 1 demonstrates that:

2.2.1 Configuration

The general configuration and valve related design features for leak tightness presented in Table 1 show that the Unit 2 valves are essentially a duplicate of other industry valves. The basic seat configuration selected by the valve manufacturer, for this style of valve, is of the "Conical" geometry. The conical geometry (a) provides a mechanical load advantage which allows contact sealing stress to be developed with limited imposed forces, (b) resists lateral motion due to induced external vibration when seated, and (c) incorporates vendor past experience to assure adequate performance. The other specific detail design features identified in Table 1 is consistent with the vendor's valve design practice for conical seat geometry.

2.2.2 Sealing Force(s)/Load(s)

The MSIV design uses all available sources of force (e.g., spring force, preumatic actuator force, and fluid media pressure loading) to maximize MSIV leak tightness capability.

2.2.3 Valve Stroke(s)

The stroke(s) selected by the valve vendor is provided to assure compliance with MSIV pressure drop requirements for the balanced disc design. Recent vendor evaluations have indicated that the reduced main disc stroke (as used at NMP2) will streamline the flow, thus reduce the potential for flow induced vibration effects on the valve trim. Valve closure speed is controlled by the adjustable hydraulic control valve. There have been no reported flow induced vibration problems on MSIV's having the same MSIV valve stroke ratio as NMP2 (which is 60%).

2.2.4 Clearance/Alignment

The NMP2 MSIV disc-piston assembly clearance to the body-bore inside-diameter is consistent with all other BWR MSIV's having a 60% valve stroke to the main seat bore ratio. The clearance was increased from some of the earlier manufactured MSIV's to enhance valve open/close function to reduce the potential for foreign material entrapment between the two surfaces.

2.2.4 Materials

The materials used for the main disc, stem-disc and the hardfaced seating areas are identified on Table 1. The difference in main disc (carbon/alloy steel) and stem-disc (carbon/alloy steel) base materials is a vendor-selected design based upon material availability and valve design. The base material(s) are chosen such that they can be properly hardfaced with the Stellite 21 material. The Stellited disc and seat surfaces, when properly mated and loaded, assure a leak tight closure. Stellite 21 hardfacing was selected by the valve vendor based upon its evaluation and successful experience in attaining a leak tight valve for steam service applications. The wear surfaces (surfaces subject-to-relative motion) are also Stellite 21 hardsurfaced. These sliding surface hardfaced areas minimize the potential for galling.

Summary

As discussed above, the Rockwell valves shown in Table 1 demonstrate the similarities between the Unit #2 valves and those in other BWRs. The Unit 2 MSIV design is almost a duplicate of the LaSalle 1 & 2, Hanford 2, Tokai 2 and Hatch MSIV's. The characteristics of MSIV's on older plants are consistent with NMP2 MSIV's.

C. AN INDUSTRY EXPERIENCE ASSESSMENT ON THE ROCKWELL DESIGN MSIV's FOR BWR SERVICE

Niagara Mohawk has performed an assessment of the industry's experience with the Rockwell designed MSIV's for BWR service. This assessment was based upon information provided by other BWR operating plants, the valve supplier (Rockwell), the General Electric Company, and evaluation of I.E. Bulletins, Notices and Circulars applicable to NMP2 MSIV's.

Table 2 (attached) provides information on Rockwell MSIV changes that evolved with time and the Unit 2 MSIV implementation status. Niagara Mohawk incorporates all design changes identified on Table 2 with a single exception as discussed below.

Information Notices, Bulletins and Circulars were reviewed for applicability. Seventeen Information Notices, four Bulletins and one Circular were identified as potentially impacting the MSIV's. Each of the documents was reviewed in detail for any necessary plant specific responses and actions. Specific responses or actions on each recommendation have been developed for NMP2. Two Information Notices, 81-28 and 84-48, describe a condition which may require a modification package to be implemented for the attachment of the stem disc to the stem, and the main disc to the piston. This change was evaluated and is discussed further in the paragraphs below. The applicable recommended actions in the other Information Notices, Bulletins and Circulars are being implemented.

Further evaluation and discussions with both the vendor and the General Electric Company regarding the potential for stem to disk separation indicate that the potential for such an anomaly to occur on the NMP2 MSIV has been minimized for the following reasons:

(a) The valve stroke as a percent of the mainseat bore diameter has been reduced to 60 percent. This shorter stroke enables the MSIV's to (1) still meet its low pressure drop requirement and (2) streamline the flow past the main disc and thus minimize the potential for flow induced vibration problems.

(b) No stem/disc separation problems have been experienced at four other operating plants (La Salle 1 & 2, Hanford 2 and Tokai-2) which incorporated the 60 percent valve stroke (to main seat diameter) ratio. The MSIV's at these plants are almost the exact design duplicate as the NMP2 MSIV's.

Based upon items (a) and (b) above, Niagara Mohawk has concluded that the NMP2 MSIV's will not experience disc/stem separation anomalies which was previously experienced on earlier versions of the Rockwell MSIV design.

III. COMPARISON OF INDUSTRY LEAK RATE DATA

A. DESCRIPTION OF DATA BASES

Niagara Mohawk Power Corporation obtained MSIV Type C leakage test results from 9 out of 11 domestic BWR reactors having Rockwell

manufactured valves (Brunswick 1 and 2 were in an outage and data could not be obtained). As shown on Table 1, four of those plants have 26" valves as does NMP2. The amount of data available varied from plant to plant due to the differences in the time they have been operating. Some of the data goes back to 1973. Various statistical analyses were made on "as found" and "as left" Type C test results data. Recent (1983 and later) upgraded maintenance and test procedures and tooling show improved "as left" leakage results; however, there is too little "as found" data reflecting equipment and procedural improvements to make a positive assessment on subsequent "as found" leakage. Consequently, as shown on Table 3, the statistical analysis used all available "as found" data, a conservative approach.

Most plants perform leakage tests on a steam line or penetration and only test individual valves when excessive leakage is discovered. The "as found" analysis uses these steam line totals. There were 189 line tests (representing 378 valves) which yielded numeric data. In 9 other instances, the person recording the data characterized the leakage as "excessive, gross, or high." This fact is noted in the data summary but were not included in the plant or weighted averages.

A weighted overall plant average leakage of 27.14 SCFH per steam line was calculated which represents 189 leakage tests involving 378 valves. A tally of individual tests indicates that 77 (39%) were 6.0 SCFH or below; an additional 92 (169 cumulative total) were 38 SCFH or under. Cumulatively, 85% of all tests fall within 38 SCFH.

In conclusion, operating experience indicates that NMP2 has a high probability of meeting a 6 SCFH "as found" limit and an excellent likelihood of MSIV leakage not exceeding 38 SCFH per line throughout the operating cycle. Adoption of the recent BWR Owners Group recommendations as to test method, procedures, and equipment will give additional assurance of reduced MSIV leakage.

B. ANALYSIS OF THE DATA

The leak rate data presented in Table 3 was impacted by three main factors that influence valve leakage performance:

1. Most data were obtained by testing with pressure between the inboard and outboard seats, rather than through the valve in the direction of flow. This increases the leakage rates because the pressure tends to unseat the inboard valve which reduces the valve seating force by a factor of two.

2. Plants other than Unit 2 have a higher Technical Specification acceptance criterion (about 11.5 SCFH per valve versus 6 SCFH for Unit 2). Presumably, a utility would not refurbish a valve with a leakage rate between 6 and 11.5 SCFH; therefore, the average "as left" and subsequent "as found" values in Table 3 are higher than they would have been if all plants had to meet 6 SCFH. Some plants such as LaSalle have a limit of 100 SCFH for all four lines. The "as left" value for such plants has been as high as 66 SCFH in a line. These higher limits increase the weighted average.

3. The effect of new maintenance practices, which will be implemented at Unit 2 as discussed in Section V, and which are based upon the BWR Owner's Group recommendations, and the use of the new Rockwell lapping tool are just now affecting (improving) the results. Therefore, future leakage rate data are expected to improve.

The effect of these three factors cannot be determined quantitatively, but it is expected that improved MSIV leakage rates will be achieved by implementing improved techniques, using the Rockwell lapping tools, and improving procedures to further reduce leakage. Niagara Mohawk contacted some of the utilities with better leakage rate experience, and identified improved maintenance practices which are discussed in Section V.

IV. RADIOLOGICAL CONSEQUENCE ASSESSMENT OVERVIEW

Niagara Mohawk has submitted a radiological analysis that demonstrates that a leakage control system is not required. This conclusion is based on the results of a radiological analysis, comparison of the Unit 2 design features to those identified in NUREG 1169, and the conservatism of the Main Steam Isolation Valve leakage limits determined by the design basis accident radiological assessment.

On January 14, 1987 and March 18, 1987 Niagara Mohawk submitted a radiological analysis for Unit 2. The analysis demonstrates that with up to 1000 scfh leakage per line from the main steam system, using the methodology contained in NUREG 1169, the offsite doses remain within regulatory requirements. This conclusion is independent of the type of main steam isolation valve utilized.

Based on the NUREG 1169 comparison with NMP2, the isolated condenser path is the most probable scenario for calculation of radiological consequences. The allowable MSIV leakage was determined based upon a simplified main condenser model for the beta skin and whole body gamma doses, while a direct comparison ratio method was used to determine the thyroid doses. The beta and gamma dose evaluation model utilized holdup of the MSIV leakage in the main condenser and subsequent release of radioactivity to the environment. No credit was taken for the holdup of the noble gases in the main steam lines, drain lines or turbine building. Additionally, the volume reduction due to steam condensing in the piping or components prior to being released was not considered. The above conservative analysis provided results indicating that the most restrictive radiation limit was the Control Room beta dose. The analysis demonstrates that a MSIV leak rate of 150 scfh total for all steam lines (38 scfh/line) would not result in control room personnel doses in excess of regulatory limits. The maximum leakage rate could be increased to 500 scfh from the main steam lines (125 scfh/line) and meet control room habitability guidelines with appropriate beta shielding (such as overalls). A value as high as 1000 scfh/line would not produce offsite doses in excess of regulatory requirements.

V. MAINTENANCE ASSESSMENT

Niagara Mohawk has reviewed recent Rockwell MSIV in service experiences with personnel from Cooper, FitzPatrick and Vermont Yankee Nuclear plants as well as industry literature on MSIV experience, such as NEDO 25329, NUREG 1169, and the BWR owners group information. Niagara Mohawk actively participates in the BWR Owners Group regarding the MSIVs. This information, with the experience gained from Unit 1 MSIV testing and performance, provides valuable assistance in improving the leak testing of the Unit 2 MSIVs.

A. Industry Experience

Evaluation of the maintenance record for Nine Mile Point Unit 1 (which uses Atwood Morrill Valves) demonstrates that Niagara Mohawk is one of the better utilities for Main Steam Isolation Valve leak rate performance. Additionally, a maintenance assessment was performed by Niagara Mohawk personnel for the Unit 2 Rockwell valves. A number of utilities with a history of low leak rates were contacted, as well as General Electric and the valve manufacturer. Based upon this assessment, the following methods will be utilized to improve the Main Steam Isolation Valve leakage characteristics at Unit 2:

a. The Main Steam Isolation Valves will be tested in the direction of flow.

b. The Main Steam Isolation Valves will be closed in a "hot" condition (approximately 150 F) and tested as soon as practical.

c. The Main Steam Isolation Valves will be lapped in place, when necessary, with the Rockwell tool.

d. The seat angle and the disc seat angle will be maintained by appropriate maintenance procedures.

e. The actuator will be maintained with enhanced preventative maintenance procedures based upon industry experience.

The following discussion compares and establishes Niagara Mohawk's evaluation results regarding the NMP2 Rockwell designed MSIV's with the BWROG recommendations.

B. Technical Evaluation Review of BWR Owners Group Recommendations on MSIV Leakage

The BWR Owners Group identified that improper maintenance is a primary factor contributing to excessive MSIV leakage.

1. Maintenance

The BWR Owners Group indicated that care should be taken to ensure that maintenance equipment, procedures and personnel are effective in providing the services required to prevent latent detrimental effects on the valve. For example, equipment planned for use should be checked out thoroughly prior to use, procedures should be proven, and personnel should be trained adequately.

NMPC Evaluation Results

a. NMPC is procuring vendor recommended maintenance boring, grinding, and lapping tools for use on the MSIV.

b. NMPC is generating maintenance procedures based upon the MSIV instruction manual, vendor G.E. engineering recommendations.

c. NMPC maintenance practice is to utilize personnel who are trained and experienced in the preventative maintenance procedures. In-house NMPC personnel, vendor technical representatives and other sub-contractors are utilized depending upon the task and services required.

d. The existing MSIV's, recently procured from General Electric Company, were refurbished and upgraded by the vendor, (Rockwell), inspected by G.E. Quality Assurance prior to vendor shipment, and receipt inspected by NMPC Q.A. personnel. During the MSIV valve change-out, NMPC has obtained GE technical assistance. Valve vendor participation will be obtained as required.

The BWR Owners Group also identified other factors that require maintenance attention:

1. LLRT pressurization method
2. Closing Procedure
3. Inadequate actuator loading
4. Valve damage

NMPC Evaluation Results

a. The Main Steam Isolation Valves will be tested in the direction of flow. In this configuration, the pressure during this test tends to seat the valve. Experience at Unit 1 indicates that testing between the inboard and outboard valves can cause unnecessary leak rate failures.

b. The Main Steam Isolation Valves will be closed in a "hot" condition (about or above 150°F) and tested as soon as practicable. Experience at Vermont Yankee indicates that test temperature and timing affect the test results.

c. The Main Steam Isolation Valves will be subjected to the following tests and inspections in accordance with approved procedures.

   (1) Initially, during each refueling outage at least two actuators (based upon actuator performance and experience) will be overhauled and preventative maintenance performed. Based upon conversations with Cooper nuclear plant personnel, actuator maintenance is critical to low leak rates.

   (2) Initially, during each refueling outage each actuator (based upon actuator performance and experience) will undergo a leak test on the air/hydraulic systems in accordance with preventative maintenance procedures. This procedure is also based upon conversations with Cooper nuclear plant personnel.

(3) During each refueling outage, any valve that needs to be refurbished, will be disassembled, inspected, reassembled and retested in accordance with mechanical maintenance procedures. Inspections will include specific attributes such as seat angle and disk seat angle, excessive seat to guide surface alignment clearance, incorrect disc to seat contact, contamination, concentricity of seat bore-to body guide surface, and minimum/maximum apparent seat band width (seat to disc). Further any lapping will be performed using the Rockwell tool, which results in superior leakage results.

Using the above practices, tools, and methods Niagara Mohawk estimates that the "as found" leakage value for each MSIV will be less than 16 scfh when tested at the first and subsequent refueling outages. This prediction is based in part on the industry data search and evaluation. As a part of that evaluation it was noted that new methods, procedures and lapping tools now being used will improve MSIV leak rates. Even though the Cooper valves are smaller than the Unit 2 valves, Niagara Mohawk believes that the leakage values experienced at the Cooper Station are obtainable at NMP2.

2. <u>Valve Orientation</u>: The BWR Owners' Group has recommended that in view of the increased risk of LLRT failure for rolled valves, care should be exercised to ensure correct poppet-to-seat alignment. If this alignment proves problematic, then compensation (i.e., modification of dimensions) should be considered.

NMPC Evaluation Results:

NMPC has compared the NMP2 MSIV rolled angular position of 20° to the industry MSIV rolled angular position of 35° and notes the following:

(a) The resultant (orientation) rolled angle of the NMP2 MSIV actuator and disc-piston assembly will be less than the resultant rolled angle existing on the Cooper MSIV's which have good leakage experience.

(b) The NMP2 MSIV actuator/stem/disc-piston assembly resultant compound rolled angle centerline is approximately 50°. When compared to the 45° centerline of a vertically installed MSIV, the differential of 5° is considered insignificant.

(c) The valve vendor has identified that the MSIV leak tightness capabilities will not be degraded provided the rolled angle does not exceed 35°.

(d) Review of Shoreham (35° rolled angle) and Cooper (35° rolled angle) "as found" MSIV leakage test results (See Table 3) indicates that a rolled angle on this type of MSIV design, not exceeding 35°, is capable of meeting leak tightness requirements.

3. Excessive Clearance/Seat-to-Guide Misalignment

The BWR Owners Group has recommended that in the event conditions indicate that excessive clearances or misalignments exist, accurate measurements should be taken to determine the extent of these conditions. Should it be determined from these measurements that, in fact such a problem exists, action should be considered to

establish optimum conditions. This should involve consultation with appropriate supplier or manufacturers.

NMPC Evaluation Results

(a) NMPC has consulted with both G.E. and the valve vendor to establish the minimum/maximum clearance required by the valve vendor as identified on Table 1. (Refer to valve related design features for leak tightness - See item 2.4)

(b) The vendor identified clearance range is considered adequate to assure proper seat-to-guide alignment as discussed previously in item 2.2.4.

(c) NMPC plans to measure the body bore inside diameter and the outside diameter of the disc-piston assembly during scheduled MSIV refurbishment or if an MSIV consistently indicates excessive leakage characteristics.

4. Lack of Concentricity, Incorrect Seat Contact, Excessive Co-Efficient of Friction/Corrosion:

The BWR Owners Group has made certain recommendations regarding the lack of concentricity, incorrect seat contact, and co-efficient of friction/corrosion. Due to the close interaction of these three items, they are being combined in this discussion. Due to the critical, indeed primary, nature of the interaction of these conditions, it is recommended that great care be taken in ensuring proper concentricity, providing correct seat contact and minimizing friction to the extent feasible.

NMPC Evaluation Results:

(a) NMPC will assure that proper concentricity of the seating features is maintained. Some of these actions include the use of proper machining equipment, consultation with the valve vendor and dimensional inspection of those features which will affect concentricity, when necessary.

(b) The inherent design of both the MSIV's, conical seat and balanced disc features optimizes self alignment and proper seat contact. The body-to-disc-piston assembly clearance allows for minor misalignment in angularity just prior to disc-to-seat closure.

(c) Friction will be minimized by routine MSIV preventative maintenance inspection procedures as well as corrective maintenance.

5. Secondary Factors Contributing to Excessive MSIV Leakage:

Seat Geometry: The BWR Owners Group recommended that care should be taken to maintain the as-manufactured seat geometry. Any contemplated changes should be carefully assessed and analyzed to ensure that the changes will not be detrimental to valve performance.

NMPC Evaluation Results:

(a) NMPC intends to maintain the "as designed" nominal seat geometry during any subsequent MSIV refurbishment activities.

(b) Any future contemplated changes will be analyzed and will include consultation with the valve vendor and/or other knowledgeable entities. Should any such change be implemented, MSIV performance will be monitored to verify acceptability.

6. Leakage Sources Other Than Seat: The BWR Owners Group recommended that care should be taken to correct or isolate any identifiable leak paths before LLRTs are performed.

NMPC Evaluation Results:

(a) Potential leak paths other than the seats for this type MSIV design are (1) the body-to-bonnet joint, (2) stem packing and (3) LLRT equipment connections/joints attached to the valve/piping.

(b) LLRT instructions and procedures require that all potential external leak path joints be checked with the "Soap Bubble/Snoop" technique prior to commencing leak testing. If joint leaks are noted they are to be fixed prior to commencing testing. If leaks cannot be appropriately fixed, this fact will be recorded and brought to the attention of the responsible test engineer for resolution/disposition.

7. Poppet Rotation: The BWR Owners Group recommended that consideration should be given to preventing possible poppet rotation by installing an appropriate anti-rotational device to preclude possible guiding surface wear.

NMPC Evaluation Results:

The NMP2 MSIV design has a minimal tendency to rotate for the following reasons:

(a) The NMP2 MSIV disc stroke position is located in the flow path such that the tendency for disc rotation is minimized due to the streamlining effects of the fluid forces.

(b) There have been no reported induced vibration problems, which would imply a propensity for disc rotation, at other operating BWR plants (LaSalle 1 & 2, Hanford 2 and Tokai-2) that also use the 26 inch MSIV's having a 60% percent valve stroke position ratio.

(c) NMPC is evaluating the vendor's suggested new modified stem/stem-disc assembly design as a possible product improvement to further minimize any potential poppet rotation.

Maintenance Conclusions

Niagara Mohawk has reviewed both industry experience and BWR Owners Group recommendations. Nine Mile Point Unit 2 is implementing enhanced maintenance procedures and methods based upon this assessment which are expected to reduce MSIV leak rates.

VI. CONCLUSIONS

Niagara Mohawk has demonstrated that a leakage control system is not required. The basis for this conclusion are summarized as follows:

1. The Unit 2 Rockwell valves are similar to other BWR Rockwell Valves; therefore the industry inservice experience and leakage data is applicable.

2. The industry leakage data show that almost 40% of the "as found" data for Rockwell Valves were below 6 scfh, and 85% were less than 38 scfh, which is consistent with and below the Nine Mile Point Unit 2 NUREG 1169 radiological analysis values evaluated.

3. The NUREG 1169 analysis and design bases analysis show that the initial leak rate of 6 scfh and valve leakage status at the end of the operating cycle will be acceptable. The leakage value for the "as found" condition at the end of the first operating cycle for Unit 2 is expected to be less than 16 scfh.

4. The maintenance assessment shows that the Unit 2 implemented improvements in techniques, tools and procedures will provide assurance that industry average leak rates are met, and improved leakage values can be expected for Unit 2.

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TABLE 1

COMPARISON OF NMP2 ROCKWELL MSIV FEATURES VS. OTHER BWR (ROCKWELL) MSIVS

FEATURES		NMP2	LaSALLE 1	LaSALLE 2	HANFORD 2	TOKAI 2	HATCH 2	COOPER	FITZ-PATRICK	SHOREHAM	VERMONT YANKEE	DUANE ARNOLD	BRUNSWICK 1	BRUNSWICK 2
1.0	(GENL MSIV INFO)													
1.1	VALVE MFGR	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell
1.2	BASIC SYTLE/FIG NO (Uni-Directional/ Bal Disc/Stop Vlv)	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612	JMMNTY Fig 1612
1.3	NOM VALVE SIZE (IN)	26	26	26	26	26	24	24	20	24	18	20	24	24
1.4	APPLICABLE CODE(S) (ASME SEC III-CL1: Y/N)	Yes	Yes	Yes	Yes	Yes	Yes	ANSI B16.5	ANSI B16.5	Yes	ANSI B16.5	ANSI B16.5	ANSI B16.5	ANSI B16.5
1.5	DESIGN PRESSURE/ TEMP (PSIG/°F)	1375/ 586	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575	1250/ 575
1.6	MIN WALL THICKNESS (INCHES)	1.74	1.58	1.58	1.58	1.58	1.48	1.74	1.74	1.74	1.468	1.468	1.74	1.74
1.7	INSTALLED VALVE ORIENTATION(S) (VERTICAL/ROLLED) (QTY) (DEGREES)	V-(6) 20°-(2) Inboard/ Outside	V-(All)	V-(All)	V-(All)	V-(All)	V-(6) 35°-(2) Inboard/ Outside	V-(6) 35°-(2) Inboard/ Outside	V-(6) 30°+42° Inboard/ Outside	V-(4) 17°(2) 35°-(2) Inboard/ Outside	V-(6) 30°-(2) Inboard/ Outside	V-(4) 30°-(4) Inboard/ Outside	V-(6) 30°-(2) Inboard/ Outside	V-(4) 30°(4) Inboard/ Outside
1.8	VALVE STROKE AS % OF MAIN SEAT BORE DIAMETER	60	60	60	60	60	85	85	85	85	74	85	85	85

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	NMP2	LaSALLE 1	LaSALLE 2	HANFORD 2	TOKAI 2	HATCH 2	COOPER	FITZ-PATRICK	SHOREHAM	VERMONT YANKEE	DUANE ARNOLD	BRUNSWICK 1	BRUNSWICK 2
2.0 VALVE RELATED DESIGN FEATURES FOR LEAK TIGHTNESS													
2.1 CONFIGURATION													
2.1.1 CONICAL/FLAT/ SPHERICAL (MAIN DISC/SEAT)	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical
2.1.2 MAIN SEAT BORE DIA (INCHES)	23.52	23.50	23.50	23.50	23.50	18.21	18.21	18.21	18.21	15.25	15.25	18.21	18.21
2.1.3 MAIN SEAT/DISC INCLUDED ANGLE- NOMINAL (DEGREES)	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
2.1.4 (MAIN SEAT)-SEAT BAND WIDTH (INCHES)	.136/ .130	.143/ .136	.143/ .136	.143/ .136	.143/ .136	.116/ .111	.116/ .111	.116/ .111	.116/ .111	.118/ .110	.118/ .110	.116/ .111	.116/ .111
2.1.5 FLEXIBLE MAIN DISC DESIGN (YES/NO)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2.1.6 STEM-DISC & SEAT CONFIG (CONICAL/ FLAT/SPHERICAL)	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical	Conical
2.1.7 STEM-DISC/MAIN DISC SEAT BORE DIA (IN)	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	4.56/ 4.55	2.505/ 2.500	2.505/ 2.500	4.56/ 4.55	4.56/ 4.55
2.1.8 STEM-DISC SEAT NOMINAL INCLUDED ANGLE (DEGRESS)	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
2.1.9 STEM-DISC'S SEAT-SEAT BAND WIDTH (INCHES)	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.203/ .183	.138/ .120	.138/ .120	.203/ .183	.203/ .183

		NMP2	LaSALLE 1	LaSALLE 2	HANFORD 2	TOKAI 2	HATCH 2	COOPER	FITZ-PATRICK	SHOREHAM	VERMONT YANKEE	DUANE ARNOLD	BRUNSWICK 1	BRUNSWICK 2
2.2	SEALING FORCE(S)/ LOAD(S) (APPARENT)													
2.2.1	DIRECTION OF APPLIED MEDIA (OVER DISC/ UNDER DISC)	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc	Over Disc
2.2.2	SPRING FORCE AT CLOSURE (LBS.)	8,050	8,050	8,050	8,050	8,050	7,100	7,100	7,100	7,100	3,200	4,200	7,100	7,100
2.2.3	PRESSURE FORCE ASSIST TO SEAL (YES/NO)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2.2.4	ACTUATOR MIN LOADING (PSIG)	90	90	90	90	90	90	90	90	90	90	90	90	90
2.3	VALVE STROKE(S)													
2.3.1	VALVE MAIN DISC STROKE (IN)(NOMINAL)	14.12	14.12	14.12	14.12	14.12	15.44	15.44	15.44	15.44	11.25	13.00	15.44	15.44
2.3.2	STEM-DISC STROKE (INCHES) (NOMINAL) (Free Lift)	1.00	1.00	1.00	1.00	1.00	.62	.62	.62	.62	.50	.62	.62	.62
2.3.3	CONTROLLED CLOSURE SPEED (YES/NO)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	NMP2	LaSALLE 1	LaSALLE 2	HANFORD 2	TOKAI 2	HATCH 2	COOPER	FITZ-PATRICK	SHOREHAM	VERMONT YANKEE	DUANE ARNOLD	BRUNSWICK 1	BRUNSWICK 2
2.4 CLEARANCES/ALIGNMENT													
2.4.1 CLEARANCES BETWEEN DISC-PISTON ASSY RIBS (O.D.) AND BODY BORE I.D. (IN)	.035/ .050	.035/ .050	.035 .050	.035/ .050	.035/ .050	.018/ .028	.018/ .028	.018/ .028	.018/ .028	.018/ .028	.018/ .028	.018/ .028	.018/ .028
2.5 MATERIALS													
2.5.1 MAIN DISC BASE MATERIAL	SA-350 (GR.LF2)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-105	SA-182 (F-11)	SA-105	ASTM A-182 (F-11)	SA-105	SA-185 (F-11)	SA-182 (F-11)
2.5.2 STEM-DISC BASE MATERIAL	SA-350 (GR.LF2)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-350 (GRLF-2)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)	SA-182 (F-11)
2.5.3 MAIN DISC/SEAT STELLITE MATERIAL	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21
2.5.4 STEM-DISC/SEAT STELLITE MATERIAL	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21	Stellite #21
2.5.5 SLIDING SURFACE MATERIALS STELLITED (YES/NO)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SUMMARY OF CURRENT ROCKWELL (BWR) MSIV DESIGN CHANGE EVOLUTION STATUS

DESCRIPTION	PURPOSE	NMP2 MSIV STATUS
(1) Disc-piston connection configuration changed from a spherical backseat to either a conical or flat backseat configuration.	Resolve disc to piston separation failure potential experienced at Nucleanor.	INCORPORATED
(2) Numatics air valves replaced with Norgren air valves.	Resolve sticking air valve spools at Nucleanor & Vermont Yankee.	INCORPORATED
(3) Improved stem/stem-disk and main disk/piston connection (joints).	Resolve stem/stem-disc and main disc to piston separation potential as experienced at Brunswick & Hatch-2.	INCORPORATED
(4) New modified stem/stem-disc assembly design.	Resolve potential stem/stem-disk cracking and separation as experienced at Confrentes & Kuo Sheng. (Due to flow induced vibration noted on designs with greater than 60% stroke lengths)	NMP2 MSIVs do not contain this new modified change suggested by the valve vendor as a product improvement. The NMP2 MSIVs have a 60% (percent) valve stroke position as an integral part of the design and manufacture which minimizes the tendency for disc rotation as a result of the streamlining effects of fluid forces. NMPC, however is in the process of evaluating the suggested product improvement.

SUMMARY OF CURRENT ROCKWELL (BWR) MSIV DESIGN CHANGE EVOLUTION STATUS

	DESCRIPTION	PURPOSE	NMP2 MSIV STATUS
(5)	Spring flange bronze bushings	Reduce propensity for galling/friction between yoke guide & tubes	INCORPORATED
(6)	NEW Spring Divider material	Reduce propensity for scoring/galling of the yoke guide tubes	INCORPORATED
(7)	Modified packing chamber design	To replace asbestos packing/enhance packing/stem leak tightness capability with graphite rings	INCORPORATED
(8)	NEW Limit switch trip arm design	For plants modifying original MSIV valve stroke to a shorter stroke (e.g. 60%)	NOT APPLICABLE TO NMP2 MSIV

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MSIV TYPE C "AS FOUND" LEAKAGE DATA

PLANT	LEAK RATE AVERAGE (3)	HI (3)	LO (3)	NO. OF LINE TESTS	YEARS
Cooper	8.4	20.0	0.8	48	1973-1986
LaSalle 2	9.9	44.8	0.8	12	1983-1987
Vt Yankee	11.7	46.0	1.0	44	1973-1985
WPPSS 2	13.4	29.9	0.7	8	1985-1986
FitzPatrick	14.4	Gross	0	16	1978-1985
Hatch	21.8	Gross	0	29	1980-1986
Duane Arnold (1)	80.2	318	0	16	1983-1985
LaSalle 1	225.8	854.3	5.5	8	1984-1985
Shoreham (2)	4.1	10.1	0.5	8	1985-1986

All Plant Weighed X = 27.14 for 189 Line Tests

(1) Valve Averages rather than line averages
(2) Valves have not seen steam loads
(3) Leak rate values in SCFH

[illegible]
[illegible]