U.S. NUCLEAR REGULATORY COMMISSION

REGION I

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EXECUTIVE SUMMARY

Ginna Nuclear Power Station
NRC Inspection Report 50-244/96-08

The NRC was unable to reach closure with respect to the Ginna motor operated valve (MOV) program because unfounded engineering assumptions caused the capability of certain MOVs to be questionable. Specifically, the valve factors for the residual heat removal (RHR) core deluge valves and the pressurizer power operated relief block valves were inadequately validated and justified. The Generic Letter 89-10 tracking and trending program was informal, and not effectively being utilized. Independent evaluation of the MOV program was minimal. While not required for program closure, the proposed periodic verification program appeared to be weak with respect to detecting age-related degradation.

The RHR core deluge valves were found to be undersized with respect to thrust capability, and most likely would not have operated under design basis conditions, including both the pumped flow and pressure-locked cases. Consequently, both trains of low pressure safety injection may have been inoperable, constituting an apparent violation of the Ginna Technical Specifications. RG&E shut down the plant (after this inspection) and modified the core deluge actuators, increasing their output capability. The failure to adequately validate and verify the use of a 0.3 valve factor was an apparent violation of 10 CFR 50, Appendix B, Criterion III, "Design Control."

Followup item 96-08-03 was opened to address interfacing system loss of coolant accident (ISLOCA) concerns in certain scenarios wherein only a single pressure isolation barrier (check valve 853) may exist between the low pressure RHR piping and the higher pressure reactor coolant system.

Report Details

E1 Introduction and Purpose

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," requesting licensees to establish a program to ensure that switch settings for safety-related motor-operated valves (MOVs) were selected, set, and maintained properly. Seven supplements to the GL have been issued to clarify the NRC request. NRC inspections of Rochester Gas and Electric's (RG&E's) actions have been conducted based on guidance provided in NRC Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10."

The NRC conducted the initial Part 1 program inspection at Ginna in April 1992, as documented in Inspection Report (IR) 92-80. A follow-up inspection (IR 94-03) was performed in April 1994. However, at that time, the program was not sufficiently developed to complete a full Part 2 inspection. Subsequently, by letter, dated May 27, 1994, the licensee requested an extension of their MOV program completion date. On August 9, 1994, the NRC approved the request, establishing a completion date of June 28, 1995. During the months of March and April 1995, the NRC performed a third, full Part 2 inspection as documented in IR 95-06.

On July 31, 1995, RG&E notified the NRC that the program was complete. The purpose of the current (fourth) inspection was to perform a closeout review of the Ginna GL 89-10 program.

E2 Summary Status of Generic Letter 89-10 Motor-Operated Valves

The inspectors reviewed procedures, test data, and design guides, which documented RG&E's GL 89-10 program at Ginna. There are 65 MOVs in the program and all had been statically tested, with 39 MOVs having had dynamic tests (under design basis differential pressure). RG&E excluded eighteen valves in low differential pressure (d/p) applications (e.g., less than 30 psi) from dynamic testing, since the low differential pressure probably would not yield usable test data.

RG&E had two valve groups with four valves in each group; two valves in each of these groups were dynamically tested. These consisted of four Service Water butterfly valves in one group and four containment spray double disc gate valves in the other group. Additionally, four other valves were considered not practicable to test: (a) RCS-MOV-515 and -516, the Power Operated Relief Valves (PORV) block valves; and (b) SI-MOV-852A and B, the residual heat removal (RHR) core deluge valves.

RG&E's methods for demonstrating MOV design-basis capability included: (1) valve-specific dynamic tests (60% of the valves) at, or near, design-basis conditions; (2) valve-specific tests, linearly extrapolated to design-basis conditions; (3) valve

grouping (note: only two groups were utilized) according to GL 89-10, Supplement 6; (4) valves with little or no d/p requirement deemed capable based on available margin, and (5) analytical calculation for valves that could not be tested.

The inspectors reviewed test results, and engineering evaluations in detail for the following MOVs:

RCS-MOV-515	PORV Block Valve
RCS-MOV-516	PORV Block Valve
SI-MOV-852A	RHR Loop Inlet (Core Deluge)
SI-MOV-852B	RHR Loop Inlet (Core Deluge)
SI-MOV-871A	SI Pump 1A to 1C Crossover Valve
CS-MOV-860C	1B Quench Spray Pump Discharge Valve

E2.1 MOV Sizing and Switch Settings

a. Inspection Scope

The inspectors reviewed the following: Mechanical Design Group (MDG) Procedure 22, "Safety-Related MOV Thrust Calculations," Engineering Work Request (EWR) 5111, "The Motor-Operated Valve Qualification Program Plan"; and EWR 5080, "Design Analysis Ginna Station GL 89-10 MOVs." The inspectors focused upon how RG&E developed and controlled MOV sizing and switch settings.

Program Plan EWR 5111 was the guidance document for the Ginna MOV program. Program document EWR 5080 identified the MOVs that were to be included in the GL 89-10 program and described the maximum differential pressure each MOV must overcome while operating to perform its safety function. A series of "lower tier" procedures, including MDG-22, provided the methodology for setting and selecting the torque switch settings.

b. Observations and Findings

RG&E used standard industry equations for MOV sizing and switch settings. A stem friction coefficient of 0.20 was assumed to convert torque into thrust. For initial control switch settings, the licensee assumed valve factors of 0.30 for flexible wedge gate valves, 0.20 for parallel disc gate valves, and 1.1 for globe valves. The MOV program required adjustment of the valve factors and stem friction coefficients if the results of in-situ testing dictated that a larger value was required. A factor of 25% was added to target thrust values, in the open and closed directions, to account for the effects of load sensitive behavior and MOV degradation (for all MOVs). Equipment errors, such as torque switch repeatability and diagnostic system accuracies, were combined in a "square root sum-of-the-squares" methodology.

c. Conclusions

RG&E appropriately considered the effects of torque switch repeatability and diagnostic system inaccuracy. However, as outlined in sections E2.2, E2.3 and E2.4 of this report, the NRC concluded RG&E's design assumptions for valve factor, load sensitive behavior, and stem friction coefficient were not supported through analysis and/or test results.

E2.2 Valve Factor and Grouping

a. Inspection Scope

The inspectors reviewed MOV Program Plan EWR 5111, Engineering Procedure (EP), 3-P-121, "Design Criteria," Mechanical Design Group (MDG) Procedure 22, "Safety-Related MOV Thrust Calculations," and the results from dynamic testing to determine how RG&E developed the valve factors used in the MOV program. The inspector also discussed the valve grouping methodology with MOV engineers.

b. Observations and Findings

RG&E dynamically tested a significant fraction (39 out of 65) of valves. Therefore, only a limited number of valves needed to be grouped. The groups consisted of four butterfly valves and four Anchor-Darling double disc gate valves. The valve grouping met the recommendations of GL 89-10, Supplement 6, with two valves in each group being dynamically tested.

EWR 5111 stipulated use of the valve factors contained in the Limitorque MOV Manual, except where subsequent test results indicated more conservative factors. The Limitorque MOV Manual recommended a generic 0.30 valve factor for flexible wedge gate valves, and a generic 0.20 valve factor for parallel disc gate valves. The MOV program plan, EWR 5111, was not followed for the core deluge and PORV block valves. Up to this NRC inspection, RG&E had assumed a valve factor of 0.30 for the core deluge valves and a factor of 0.50 for the PORV block valves. These factors were utilized in capability calculations, despite in-situ results of actual dynamic tests of other Ginna MOVs that suggested valve factors as high as 0.57 for flexible wedge gate valves (e.g., SW-4615), and as high as 0.717 for parallel disc gate valves (e.g., RHR-857B).

10 CFR 50, Appendix B, Criterion III, Design Control, is implemented in Section 3 of the Ginna Station Quality Assurance (QA) Manual. This states, in part, that "measures shall be established to assure the design basis for structures, systems or components are correctly translated into specifications, drawings, procedures and instructions. Changes from approved design inputs, including the reasons for the changes, shall be identified, approved, documented and controlled." Valve factors represent design inputs used to calculate the performance characteristics of MOVs. RG&E performed MOV design calculations in accordance with Procedure (EP) 3-P-121, that states, in part, "...design inputs shall be specified and approved on a timely basis and to the level of detail necessary to permit the design activity to be

carried out in a correct manner and to provide a consistent basis for making design decisions." Had RG&E strictly followed this engineering procedure, the aforementioned in-situ test results obtained from SW-4615 and RHR-857B should have been applied (or at least considered) to the RHR core deluge and PORV block valves. Instead, RG&E used the outdated "default" valve factors contained in the Limitorque manual for the RHR core deluge valves.

These deficiencies were also not identified as part of the licensee's second level review (or design verification) of the calculations. Consequently, non-conservative valve factors were utilized to calculate the performance requirements of the RHR core deluge valves. The design calculations for the MOVs in question did receive an independent verification. The inspector interviewed the engineer who performed the verification and determined that the engineer verified only that the valve calculations required by MDG-22 were complete. The engineer did not ensure that valid design inputs were used, nor were the full calculations evaluated.

c. Conclusions

RG&E did not adhere to the MOV Program Plan (EWR 5111) when choosing valve factors for the RHR core deluge and PORV block valves. Instead, RG&E used outdated and unjustified generic factors, which were contrary to well-established industry test results as well as in-situ Ginna results. Finally, contrary to Procedure EP-3-121, RG&E did not justify why the valve factors were used in lieu of the valve factors obtained from in-situ testing.

RG&E did not establish appropriate controls to ensure correct design inputs were used to calculate the performance requirements for the RHR core deluge valves. It should be noted that: (1) the original 0.3 valve factor, (2) the 0.44 valve factor upon which the licensee's recent operability determination was based, and (3) the as-modified 0.55 valve factor were, as of the conclusion of this inspection, not fully justified (refer to Section E.2.7). Further, the independent review of the associated capability calculations was cursory and ineffective. Consequently, RG&E did not adequately validate the valve factors for the RHR core deluge valves, resulting in an incorrect design. This is an apparent violation (EEI 96-08-01) of 10 CFR 50, Appendix B, Criterion III.

E2.3 Load-Sensitive Behavior

a. Inspection Scope

Load sensitive behavior is defined as a change in MOV output thrust due to a change in internal valve frictional forces under dynamic conditions. The inspectors reviewed test results and the MOV Program Plan to assess how RG&E accounted for load sensitive behavior.

b. Observations and Findings

To account for the effects of load sensitive behavior and degradation, RG&E increased the required valve thrust in the open and closed directions by 25%. A review by the NRC inspectors of RG&E's in-situ test results indicated that load sensitive behavior was present from as low as -25% for CCW-738B to as high as +17.2% for SW-4616. Thirty-nine (39) dynamic tests were performed; for these MOVs, RG&E could verify that the 25% margin was adequate to accommodate the effects of load sensitive behavior. However, RG&E did not have data to determine whether the 25% margin would bound changes in load sensitive behavior and/or stem lubricant degradation.

c. Conclusions

RG&E had sufficient plant-specific data to demonstrate that a 25% margin was adequate to account for load sensitive behavior, alone. The margin for degradation should be considered separately as part of the long-term MOV program.

E2.4 Stem Friction Coefficient

a. Inspection Scope

The inspectors reviewed MOV Program Plan EWR 5111 and MOV thrust calculations to assess how a stem friction coefficient was established. Further, the inspectors performed independent calculations of RG&E's test results to ensure RG&E's design assumptions were valid.

b. Observations and Findings

RG&E assumed a stem friction coefficient of 0.20 to convert torque to thrust during initial setting of MOV control logic. RG&E subsequently obtained calculated a stem friction coefficient from open and closed dynamic test data. In the closed direction, the stem friction coefficient varied from 0.02 to 0.22, with an average of 0.12. In the open direction, the stem friction coefficient varied from 0.014 to 0.729. However, the inspectors did not find analyses or calculations (performed by RG&E) which, in retrospect, corroborated that the assumed stem friction coefficient of 0.20 enveloped the in-situ Ginna test data. The high value for stem friction coefficient from the licensee's data in the open direction is questionable.

The inspectors performed a statistical analysis of the Ginna test data using the Student-t approach to ensure the assumed stem factor was conservative. The Student-t approach is used in statistical analysis to develop a confidence level that an event or number will occur. Using the Student-t calculation methodology and the RG&E test data, the inspectors verified (at a 95% confidence level) that the stem friction coefficient in the closing direction was between 0.079 to 0.144.

Therefore, a value of 0.20 (closing) was conservative. In the open direction, the inspectors calculated a 95% confidence range of 0.158 to 0.3664. Therefore, with the licensee's data, a stem friction coefficient of 0.20 (opening) might be nonconservative and the data needs to be reevaluated.

c. Conclusions

Based on the inspectors' independent evaluation, a stem friction coefficient of 0.20 for the closed direction was technically acceptable. However, RG&E had not performed their own analyses to justify this coefficient in either direction. Moreover, the NRC's independent evaluation indicates potential non-conservative results in the open direction. The licensee should evaluate the reliability of the open test data for stem friction coefficient.

E2.5 Linear Extrapolation

a. Inspection Scope

The inspectors reviewed RG&E's methodology for extrapolating test data described in EWR-5111, Attachment 6.

b. Observations and Findings

Linear extrapolations were accomplished by tests at two lower differential pressures to enhance the extrapolation accuracy. If this could not be done, EWR 5111 imposed certain restrictions on extrapolation: (1) the required minimum differential pressure had to be at least 50% of the design-basis pressure; and once the thrust was obtained from extrapolation to design-basis differential pressure, (2) additional thrust margin was added based on the percentage of extrapolation required to reach design-basis pressure. The inspectors reviewed test data and found the lowest case in which results were extrapolated was from 59% d/p (valve SW-4663), with the majority of extrapolated cases from more than 80% of full design pressure.

c. Conclusions

RG&E's methodology of linear extrapolation was technically adequate, consistent with industry practice and acceptable for program closure.

E2.6 MOV Design-Basis Capability

a. Inspection Scope

The inspectors reviewed MOV program documents EWR 5080 and EWR 5111, valve matrix sheets containing open and closed valve limitations and margins, and diagnostic test documents for selected MOVs. The inspectors also reviewed RG&E's two valve groups, each containing four valves.

b. Observations and Findings

The required torque for the service water butterfly valves in one group was 192 ft-lbs; dynamic testing revealed capability well in excess of that required (viz., 356 ft.-lbs). The second group included Containment Spray Pump Discharge valves CS-MOV-860A, B, C, and D. Valves 860 A and D were dynamically tested, and the results indicated the valves' limit and torque switch settings were adequate. Therefore, the inspectors concluded the valves had adequate design margin.

The inspectors also evaluated two valves, MOVs SI-MOV-841 (Accumulation Tank 1A Shutoff) and AFW-MOV-3996 (Turbine Driven Auxiliary Feedwater Pump Discharge) that were not grouped. Both valves had low differential pressure applications, but relatively large (80%) margin and, as such, were excluded from dynamic testing. The available valve factors were 3.8 and 0.73, respectively.

c. Conclusions

The design margins for grouped and low differential pressure valves were adequately supported.

E2.7 RHR Core Deluge Valves

a. Inspection Scope

The inspectors reviewed various documents concerning the design-basis capability of the RHR core deluge valves (MOV852A/B). The valves are normally closed, six-inch 1500 psi-rated Velan flexible wedge gate valves with SMB-1 Limitorque actuators. Both valves are located within the containment structure in two parallel lines that discharge into the reactor vessel. The valves are of high risk worth, and also serve a pressure isolation function as one of the two pressure barriers between the 2235 psi reactor coolant system and the 600 psi-rated RHR system. Swing check valves (853A/B) constitute the second barrier, and are located between the reactor vessel head and the core deluge MOVs. Section 6.3 of the Ginna Updated Final Safety Analysis Report (UFSAR) states that the RHR core deluge valves are required to open within 27 seconds upon receipt of a safety injection (SI) signal, to allow the injection of water from the RHR system at rated flow into the reactor vessel.

b. Observations and Findings

The RG&E design analysis for the RHR core deluge valves as outlined in MOV program document EWR 5080 assumed the maximum opening differential pressure for both valves was 2250 psi. Because of the system configuration, RG&E could not dynamically test the valves. Both valves received static tests, most recently during the Spring 1996 refuel outage. During original static testing, the actuator torque switches were set up assuming a 0.30 valve factor.

1996 Refuel Outage Testing

When statically retesting the core deluge valves after a packing adjustment during the Spring 1996 refuel outage, RG&E identified that the valves may not open when subject to degraded voltage, at 69% and 70% of nominal bus voltage respectively. RG&E had previously determined as well as set up the control logic such that MOV 852A would require 20,943 lbs of thrust to open, assuming a valve factor of 0.30. However, RG&E estimated that MOV 852A would develop only 11,845 lbs of thrust. Similar capability comparisons were also noted for MOV 852B. RG&E documented these findings in Action Reports (ARs) 96-0320 and 96-0338.

Despite the obvious discrepancy between the required and available thrust numbers, RG&E considered both RHR core deluge valves to be operable. RG&E based this determination partly on the use of a 1993 "stall test" performed on MOV 852A at 100% voltage. The stall test indicated that MOV 852A would develop more thrust (22,755 lbs) than required. The test consisted of mounting a load cell on top of the actuator and opening the MOV until reaching a stall condition. The thrust recorded from this test was used to evaluate the design basis capability of the core deluge valves. In the licensee's qualitative arguments justifying use of the test RG&E also concluded that, even if the valve did stall during a reduced voltage design basis condition, the duration would be short and the motor would not be adversely affected.

NRC Review of Action Report Disposition

During this inspection, the inspectors reviewed the licensee's disposition of ARs 96-0320 and 0338, and concluded they did not provide adequate assurance that the RHR core deluge valves could perform their safety function. Specifically, the inspectors noted that the method used to measure MOV stall capability - opening the MOV into a load cell - may not accurately predict actuator output. This is because it would be difficult to separate the thrust due to inertia in the static open direction test from the thrust due to motor stall capability. Also, under differential pressure conditions, the MOV may not develop the same inertial thrust when opening.

Since the 1993 results were based only on a single test, the inspectors could not determine if the data were consistent or reproducible. The inspectors also were concerned about the validity of RG&E's determination of the effect of degraded voltage on actuator output. Finally, if the RHR core deluge valves stalled during an event and remained partially closed, RG&E did not quantify how long they would remain in that condition.

RG&E Operability Determination

Based upon NRC concerns during this inspection regarding the capability of the RHR core deluge valves and the validity of the 1993 stall test, RG&E prepared an operability determination. The operability determination was initially based upon a

revised assumption that the maximum design-basis differential pressure across the core deluge valves was 1750 psi as opposed to the previous design basis pressure of 2250 psi. RG&E selected this lower pressure, in part, on a plot of reactor coolant system (RCS) pressure verses time for a six square inch break loss of coolant accident (LOCA). The plot indicated that RCS pressure dropped to approximately 1750 psi within the first few seconds of the transient. Using the information from the RCS pressure-verses-time plot, the licensee recalculated the voltage available at the motors, increasing it from 70% of nominal to 77%.

Based upon the revised degraded voltage, RG&E determined both valves would generate 17,155 lbs of available thrust. Since this thrust exceeded that required to open the valves against 1750 psi (by approximately 100 lbs for MOV 852A and 600 lbs for MOV 852B), RG&E determined both RHR core deluge valves were capable of operating (albeit marginal) under design basis conditions.

The inspectors ultimately rejected the lower (1750 psi) design pressure, and disagreed with this operability determination.

NRC Calculations

The inspectors used RG&E's revised differential pressure and degraded voltage values in the standard industry equations to independently calculate the available and required stem thrust for the RHR core deluge valves. A stem nut friction coefficient of 0.20 was used, the same as assumed by RG&E. Available stem thrust was calculated to be 18,396 lbs.

Regarding required thrust, the inspectors reviewed industry data for similar Velan valves, and found that valve factors between 0.55 and 0.61 were more appropriate. Using a valve factor of 0.55, actual packing load, the standard industry equation, and including diagnostic uncertainty, the inspectors independently calculated a required stem thrust of 17,825 lbs. This did not include any margin for load sensitive behavior. Further calculations performed using test information from the Idaho National Engineering Laboratory (INEL) and the Electric Power Research Institute (EPRI) predicted approximately 18 to 22,000 lbs to be required to operate those valves under similar conditions.

Based on the above information, the inspectors considered the valves to be questionable in their capability to operate under design basis conditions. Further, the inspectors did not agree with RG&E's operability determination. Specifically, both valves are required to open upon receipt of either a manual or automatic Safety Injection (SI) signal. During an event, operators may manually initiate SI before reactor pressure decreases to 1750 psi, and the inspectors therefore concluded 1750 psi did not correctly reflect the Ginna design basis.

Finally, the inspectors noted RG&E's operability determination for the core deluge valves still assumed a valve factor of 0.3. The 0.3 number was, however, not consistent with results obtained from RG&E's own in-situ testing or similar industry information.

Valve Modifications

After additional review of the capabilities of the RHR core deluge valves, RG&E shut down the plant on August 3, 1996, and modified the valves to increase the available thrust. Changes included replacing the 1800-rpm motor with a 3600-rpm motor, increasing the overall gear ratio from 27 to 60 and replacing the motor cable to increase the available voltage from 70 to 81%. Additionally, both valves' control logic was modified to close on the limit rather than the torque switch, principally for structural "weak link" considerations.

The inspectors reviewed the design changes and the associated calculations. The modifications increase the output capability of the actuator by approximately a factor of three. Additionally, by having the RHR core deluge valves close on the limit instead of the torque switch, RG&E significantly decreased the required valve unseating thrust, which has an important effect upon the ability to unwedge in a pressure-locked condition.

PORV Block Valves

The inspectors reviewed the design information for valves RCS-MOV-515 and 516, the Pressurizer Power Operated Relief Valves (PORV) block valves. These valves were 3-inch, 1500 psi-rated, Anchor-Darling, double disc, gate valves with Limitorque SMB-00 actuators. These valves could not be practicably tested in situ and were set up using static diagnostic testing; a valve factor of 0.50 was assumed for these valves.

RG&E chose a valve factor of 0.5 based upon industry information that suggested representative valve factors between 0.3 and 0.7. RG&E did not, however (during this inspection), have an adequate technical basis for assuming that the 0.5 valve factor was appropriate to the conditions at Ginna. The inspectors noted that the actuators for valves RCS-MOV-515 and 516 had considerable thrust margin, and could operate with a higher valve factor. Therefore, there was reasonable assurance the valves could operate in a design-basis event.

Use of Industry Information

RG&E did not effectively use available industry valve test information compiled at similar two-loop Westinghouse plants to obtain valve factors for the RHR core deluge valves. According to RG&E, the other two-loop plants did not have similar valves; therefore, that test information was not pursued. Upon further review, RG&E determined their original position was incorrect since the RHR core deluge valves at another plant were found to be essentially identical to the valves at Ginna. According to RG&E, a 0.55 valve factor was utilized for the similar valves.

Pressure Locking

In a February 14, 1996, response to Generic Letter 95-07, RG&E identified 26 valves that could be susceptible to pressure locking or thermal binding (PLTB). In a June 18, 1996, letter, the NRC asked RG&E to supply additional information concerning their submittal. Included in the letter was a request for additional information regarding the pressure locking analysis for the RHR core deluge valves.

After reviewing the thrust data for the RHR core deluge valves, the NRC concluded (during this current inspection) that the valves would likely have not opened under pressure locked conditions. The predicted force against which the valves are required to open under pressure-locked conditions well exceeded the thrust available prior to the modifications. Subsequently, as discussed previously, RG&E shut down the plant and modified the valves to increase their actuator output. Following implementation of the valve modifications, RG&E performed a reanalysis using the PRESLOK program, which was developed for the Westinghouse Owner's Group. RG&E concluded the RHR core deluge valves would require 34,407 lbs of thrust to open. Since the available thrust (following the August 1,996 modifications) was approximately 40,000 lbs, RG&E concluded the valves were capable of overcoming pressure locking forces. It should be noted that RG&E further assumed an 11% inaccuracy reduction, resulting in a final available thrust of 35,205 lbs, or only 2% margin.

The inspectors reviewed RG&E's pressure locking analysis entitled "Pressure Locking Evaluation for MOV's RHR 852A & B," DA-MA-96-076, Rev. 0, dated August 6, 1996. Although the inspectors identified minor inconsistencies in the calculation (such as use of closing valve factor), the overall available thrust was sufficient to open the valves. RG&E subsequently revised calculation DA-ME-96-076. However, in consideration of the relatively small margin, the need for modifications to preclude the susceptability to PLTB will be further evaluated by the NRC.

c. Conclusions

The inspectors concluded RG&E had performed a relatively large amount of in-situ dynamic testing (39 of 65 valves or 60%). The two valve groups met the recommendations of GL 89-10, Supplement 6. Further, grouped valves and valves used in low differential pressure applications had adequate design margin. However, RG&E did not adequately justify the design assumptions used for the nontestable PORV block and RHR core deluge valves, nor did they effectively use industry information to validate the design assumptions.

Independent NRC analysis of the RHR core deluge valves concluded the capability of these MOVs to operate under design basis conditions was questionable. Accordingly, to ensure the valves had an adequate margin, RG&E shut down the plant and modified both valves to increase actuator thrust. The inspectors concluded the modifications provided adequate assurance that the valves would operate under design basis conditions.

The switch settings that RG&E had established for the RHR core deluge valves (prior to August 1996) did not adequately ensure that the valves would operate under design basis conditions, including pressure-locking. Consequently, both trains of the RHR system may not have operated in the emergency core cooling injection mode of operation during a design basis event. This is an apparent violation (EEI 96-08-02) of Technical Specification (TS) 3.5.2, "Emergency Core Cooling Systems," which states, in part, the injection mode of the RHR system shall be operable at all times when the plant is in Modes 1, 2 and 3.

E2.8 Periodic Verification

a. Inspection Scope

The inspectors interviewed the MOV Program Engineer regarding "as-found" testing of MOVs to assess how RG&E will track potential degradation of stem lubrication and changes in valve factor. Further, the inspector reviewed various RG&E MOV program documents, including Maintenance Procedure M-1007, "Electrical Preventive Maintenance and Diagnostic Testing of Motor Operated Valves," to assess how RG&E will monitor MOV performance.

b. Observations and Findings

Periodic verification is intended to be accomplished by using static and dynamic testing. RG&E will place MOVs with a design margin of less than 10% in a pool of test candidates for dynamic testing. Static MOV diagnostic testing will be performed once every five years for high risk MOVs, and once every ten years for low risk MOVs.

As currently structured, the periodic verification program was not coordinated with the Ginna MOV preventative maintenance program. Accordingly, MOVs may receive maintenance before they are periodically tested. This program methodology would therefore eliminate "as found" data analysis of valve degradation.

c. Conclusions

As currently structured, RG&E's periodic verification process may not detect age-related degradation of MOV performance. Periodic verification will be reviewed as part of RG&E's response to GL 96-05.

E2.9 Tracking and Trending

a. Inspection Scope

Item (h) of GL 89-10 requested licensees to establish, in part, a monitoring and feedback effort to establish trends in MOV operability. The inspectors interviewed the MOV Coordinator to determine how RG&E tracked and trended MOV performance. Additionally, the inspectors performed a summary review of Action Reports (ARs) to determine if RG&E adequately dispositioned deficiencies.

b. Observations and Findings

RG&E described the parameters intended to be trended (e.g., thrust, torque, stem factor, valve factor, etc.) in Maintenance Procedure M-1007, "Electrical Preventive Maintenance and Diagnostic Testing of MOVs." However, the structure of the MOV trending program had not been formalized or implemented. Specifically, although RG&E had informally accumulated some MOV test information, how the data would be recorded and assessed had not been determined. Further, it was not apparent to the inspectors that the information had been placed in a readily retrievable format to meaningfully assess MOV performance. Although not in existence prior to this inspection, the licensee took steps to create a trending data sheet to be used in the implementation of the program.

MOV deficiencies in were described the licensee's corrective action system. The inspector selected the following action reports (ARs) created during the 1996 refuel outage for review:

96-0271 Starter Thread Stripped in One Actuator Hole
96-0276 Lower Guide Area in MOV-4008 Washed Away
96-0320 Control Switch Trip Thrust Greater Than Reduced Voltage Stall
96-0527 Unseating Torque Greater Than Reduced Voltage Stall Torque
96-0338 Control Switch Trip Thrust Greater Than Reduced Voltage Stall
96-0395 Closed Reduced Voltage Stall Torque Exceeded
96-0542 Action Report/NCR Closed With Interim Use Justification Open
96-0549 Unseating Torque Greater Than Reduced Voltage Stall Torque

The inspector determined, except for ARs 96-0320 and 96-0338 which documented deficiencies with the core deluge valves, RG&E had adequately dispositioned the ARs.

c. Conclusions

Although a trending program was described in Maintenance Procedure M-1007, the program had been neither formalized nor implemented as of the time of this inspection. The described program was, in fact, found to be fragmented, informal and effectively not being used.

E2.10 Pressure Isolation Valve Considerations

a. Inspection Scope

The NRC-Sponsored Reactor Safety Study (RSS), WASH-1400, identified failure of pressure isolation barrier(s) as a significant contributor to risk. The scenario of interest involves failure of the pressure isolation barriers between the high and low pressure piping, followed by overpressurization and rupture of the low-pressure piping outside of containment. This sequence of events is referred to as an interfacing system loss of coolant accident (ISLOCA).

The inspectors examined the interface between the Residual Heat Removal (RHR) piping and the Reactor Coolant System (RCS). The purpose of the review was to determine if the low pressure, 600 psi RHR deluge piping, was adequately protected from potential overpressurization due to exposure to the higher pressure 2235 psi reactor coolant system.

b. Observations and Findings

The RHR core deluge piping at RG&E consists of two parallel six-inch lines that branch off the RHR cold leg return piping in the containment structure and connect into the reactor vessel head. Each deluge line contains one normally closed motor-operated deluge valve, SI-MOV-852A/B, and an associated swing check valve, 853A/B located between the reactor vessel head and the respective MOV. When a safety injection actuator signal (SIAS) occurs, the core deluge valves are designed to open and allow RHR system water to discharge through swing check valves and into the reactor vessel. The design pressure of the piping between the MOV and the reactor vessel is 2485 psi; the design pressure of the upstream piping is 600 psi.

To reduce the probability of an inadvertent overpressurization due to a pressure barrier failure, the NRC issued an Order in April 1981 to include the swing check valves in a periodic leak test surveillance program, with a 5 gpm limit incorporated into the Technical Specifications. RG&E also discontinued quarterly MOV stroke testing. The inspectors reviewed the most recent seat leak test results for both the check valves and core deluge MOVs, and noted the leakage was significantly below the 5 gpm limit, although the testing is performed at pressures an order of magnitude below RCS pressure.

The swing check valves provide the first barrier for the lower pressure RHR piping. The second barrier is provided by the core deluge valves. In the event of an SIAS, the core deluge valves automatically open. During this opening, particularly in scenarios wherein RCS pressure remains above 600 psi, the check valves represent the only remaining barrier. The inspectors noted that manual SIAS conditions may likely be expected at pressures well above the 600 psi RHR design value, although the ultimate strength of this piping is typically more than two times above this specification. Limited overpressure protection for the RHR system piping is provided by relief valve (RV)-203; however, the capacity of RV-203 is limited.

Although relevant sections of the Ginna Individual Plant Examination (IPE) Report were reviewed, the inspectors did not have adequate information to determine if RG&E had adequately assessed the risk associated with an ISLOCA, specifically regarding the opening of the RHR core deluge valves during a transient. Preliminary surveys of similar plant designs (at other reactors) show that, in response to this risk vulnerability, licensees have made modifications such as: (1) inter-locking the MOV to prevent opening above 1100 psi, (2) adding an additional check valve, and (3) de-energizing the MOV in the open condition. Although the inspectors did not identify any deviations from the current licensing basis for the core deluge system configuration, Inspection Followup Item 96-08-03 will be opened to track NRC review of the acceptability from a risk standpoint of this piping configuration at Ginna.

E7 Quality Assurance of MOV Activities

a. Inspection Scope

The inspectors reviewed Quality Assurance (QA) surveillance reports to assess the quality of oversight of the Ginna MOV program. The inspector also interviewed personnel in the QA and line organizations.

b. Observations and Findings

Since 1994, RG&E performed limited independent oversight of the MOV program. This oversight was performed by the QA organization in the form of five surveillance activities.

Four QA surveillances audited that MOV personnel had correctly implemented portions of MOV procedures. Although one 1994 surveillance had compared the program to the guidance contained in Generic Letter 89-10, this review was a cursory examination of the Ginna MOV program attributes. The surveillance was not effective in the sense in that it did not ensure that program observations were followed through to completion. For example, the 1994 surveillance noted an MOV tracking and trending program had not been incorporated into the RG&E MOV program (refer to previous Section E.2.9). Two years following completion of the 1994 QA audit, a tracking and trending program had still not yet been formalized or implemented. None of the QA activities effectively probed more specific technical aspects, such as valve factor design assumptions used in the MOV program.

c. Conclusions

Since 1994, the MOV program received minimal independent oversight. The oversight was limited in both scope and depth, and was ineffective in self-identifying that key elements of the MOV program were incomplete, and that selected design inputs were not adequately supported.

E8 Miscellaneous Engineering Issues

The inspectors reviewed items identified during previous MOV inspections. The following issues were addressed:

E8.1 (Closed) Follow-up Item 50-245/95-06-01: design basis differential pressure. The inspectors reviewed MOV program documents EWR 5080 and 5111 regarding requirements for the calculation of design-basis differential pressure. The documents were consistent with GL 89-10 and the licensee reconciled the contradictions documented in NRC Inspection Report 50-244/95-06.

E8.2 (Open) Follow-up Item 50-244/95-06-02: margin justification for valve factor. As outlined in Section E2.2 of this report, RG&E did not adequately justify the valve factors used for the PORV block and RHR core deluge valves. Further, RG&E did not follow EWR 5111 and use valve factors obtained from in-situ testing. Accordingly, this item will remain open.

E8.3 (Closed) Follow-up Item 50-244/95-06-03: extrapolation of partial design basis test data. The inspectors reviewed RG&E's data extrapolation to evaluate MOVs under design-basis conditions to be adequate. Although RG&E has not compared these results with industry data as suggested by GL 89-10, the program itself has a sufficient amount of design-basis differential pressure test data to provide adequate comparisons.

E8.4 (Closed) Follow-up Item 50-244/95-06-04: procedure modification. A weakness was identified in the completion and review of test data matrices before returning MOVs to service. To improve the criteria RG&E intends to include the matrix sheets in MOV field test procedure M-64.1.2, "MOVATS Testing of Motor Operated Valves." The inspectors reviewed procedure M-64.1.2 and noted the procedure provided detailed instructions for the acquisition and analysis of MOV diagnostic signatures. These signatures were used to determine if an MOV is functioning within design specifications. The inspectors verified the thrust verification and limitation data sheet was included in M-64.1.2. Furthermore, steps within M-64.1.2 required post-differential pressure (DP) test operability verification and engineering data feedback to the MOV Program Coordinator before returning a valve to service. The actions taken to address the issue were therefore adequate.

E8.5 (Closed) Follow-up Item 50-244/95-06-05: completion of MOV analysis procedures. The inspectors reviewed Attachment 4 of EWR 5111, MOV Qualification Program Plan and determined that RG&E has performed the analysis outlined in the attachment and incorporated the information into the individual MOV data packages.

E8.6 (Open) Follow-up Item 50-244/95-06-06: periodic verification of design basis assumptions. As noted in Section E2.8 of this report, the inspectors determined RG&E's periodic MOV verification process (as currently structured) would not necessarily ensure the MOV design assumptions remained valid. This item remains open pending the licensee's response to the recently issued generic letter on this subject.

E8.7 (Open) Follow-up Item 50-244/95-06-07: post-maintenance testing. RG&E does not currently perform a valve thrust verification test (either static or dynamic), following packing adjustment, if gland nut torque remains below the original diagnostic baseline value. The inspectors considered this position to be technically indeterminate as well as contrary to industry practice.

E8.8 (Closed) Follow-up Item 50-244/95-06-08: grouping methodology. As outlined in Section E2.2 of this report, the inspectors reviewed RG&E's grouping methodology and considered it acceptable.

E8.9 (Open) Follow-up Item 50-244/95-06-09: pressure locking and thermal binding of gate valves. The inspectors reviewed the status of RG&E's program for assessing the susceptibility of motor operated gate valves to pressure locking or thermal binding (PLTB). In Generic Letter 95-07, "Pressure Locking/Thermal Binding of Safety Related Power Operated Gate Valves," requested licensees to identify safety-related power-operated gate valves that may be susceptible and take appropriate compensatory actions. The inspectors did not identify any immediate safety or operability concerns regarding gate valves (other than the RHR core deluge MOV's discussed in Section E2.7 on page 11) susceptible to PLTB at Ginna. However, this item remains open pending NRR review of the February 14, 1996, RG&E submittal.

E8.10 Review of Updated Final Safety Analysis Report (UFSAR)

a. Inspection Scope

The inspector reviewed Sections 3.3, 5.5, 6.2 and 9.2 of the Ginna UFSAR to assess how RG&E had incorporated the UFSAR information into plant procedures.

b. Observations & Findings

A recent discovery of a licensee operating their facility in a manner contrary to the updated final safety analysis report (UFSAR) description highlighted the need for a review that compares plant practices, procedures, and/or parameters to the UFSAR descriptions. While performing the inspections documented in this report, the inspector reviewed containment isolation valves, auxiliary feedwater, RHR, service water systems and the applicable portions of the UFSAR that related to the areas inspected. The inspectors verified that the UFSAR wording was consistent with the observed plant practices and plant operating procedures. The inspectors did not identify any discrepancies.

V. Management Meetings

X1 Exit Meeting Summary

RG&E was informed of the scope and purpose of this inspection at an entrance meeting on July 22, 1996. The findings were discussed with RG&E representatives during the course of the inspection, and were formally presented during an exit meeting on August 9, 1996, at the RG&E corporate office. Based upon the deficiencies identified in this report, the inspectors informed RG&E the GL 89-10 MOV program would not be closed. The issues contained in this report were discussed again with RG&E in an October 4, 1996 telephone exit. No proprietary materials were reviewed during this inspection. RG&E did not dispute the inspection findings at the exit meeting.

PARTIAL LIST OF PERSONS CONTACTED

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LIST OF ACRONYMS USED

ARs	Action Reports
DP	differential pressure
EP	Engineering Procedure
EPRI	Electric Power Research Institute
EWR	Engineering Work Request
GL	Generic Letter
INEL	Idaho National Engineering Laboratory
IR	Inspection Report
LOCA	Loss of Coolant Accident
MDG	Mechanical Design Group
MOV	Motor-operated valve
PORV	Power Operated Relief block Valves
PLTB	pressure locking or thermal binding
PRT	pressure relief tank
QA	Quality Assurance
RCS	reactor coolant system
RSS	Reactor Safety Study
RV	relief valve
RHR	residual heat removal
RG&E's	Rochester Gas and Electric's
SI	safety injection
TS	technical specifications
TI	Temporary Instruction
UFSAR	Updated Final Safety Analysis Report