U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-341/95010(DRS)

Docket No. 50-341 License No. NPF-43

Licensee: Detroit Edison Company
2000 Second Avenue
Detroit, MI 48226

Facility Name: Fermi 2

Inspection At: Fermi Site, Newport, Michigan

Inspection Conducted: September 11 - 15, 1995

Inspectors: Sonia D. Burgess
S. D. Burgess — Date: 10-12-95

Sonia D. Burgess
J. G. Guzman — Date: 10-12-95

NRC Consultant: Richard Cain, INEL

Approved By: John M. Jacobson
J. M. Jacobson, Chief
Engineering Branch 1 — Date: 10-12-95

Inspection Summary

Inspection conducted September 11-15, 1995 (Report No. 50-341/95010(DRS))
Areas Inspected: Announced safety inspection of the licensee's response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance," (2515/109) and the licensee's self-assessment in this area.

Results:

- The inspectors verified completion of the licensee's commitments to Generic Letter 89-10.
- Fermi had satisfactorily established the design-basis capability of all program MOVs, including those that had not been tested at or near design-basis conditions.
- Grouping of valves for comparison of test results met the guidelines of Generic Letter 89-10, Supplement 6 (Section 3.2.2).

- Although potentially viable, Fermi's degraded voltage capability verification method had not been validated through testing or through the peer review process seen by industry standards as IEEE-1290. Using standard industry methods, seven MOVs had insufficient capability to trip the torque switch under degraded voltage conditions. This was considered an open item (Section 3.2.7).

- Potential MOV overloading due to handwheel operation was inadequately considered in Fermi's calculation review process (Section 3.2.8).

- Appropriate diagnostic system measurement inaccuracies were properly incorporated into the program (Section 3.3).

- Progress made in evaluating all MOVs for pressure locking/thermal binding was considered minimal since the Part 2 inspection, but work completed was adequate for program closure (Section 3.4).

- Fermi's periodic verification program satisfied GL 89-10. The staff will review the licensee's periodic verification program in more detail as part of its evaluation of the licensee's response to a new generic letter on periodic verification of MOV design-basis capability (Section 3.5).

- The MOV trending program was considered a strength (Section 3.7).

- The self-assessment process was adequate in evaluating the MOV program (Section 4.0).

TABLE OF CONTENTS

DETAILS

1.0 Persons Contacted

Detroit Edison Company

* P. Fessler, Plant Manager
* R. Bryer, Senior Plant Engineer
* S. Booker, Maintenance Assistant Superintendent
* E. Cavey, MOV Maintenance Coordinator
* G. DePalma, Technical Superintendent
* K. Howard, Mechanical & Civil Engineering Supervisor
* J. Hugles, General Superintendent Site Maintenance
* A. Nayakwadi, MOV Program Manager
* R. Newkirk, Licensing Supervisor
* M. Offerle, Licensing Principle Engineer

U. S. Nuclear Regulatory Commission (NRC)

* N. O'Keefe, Resident Inspector

* Denotes those attending the exit meeting on September 15, 1995.

2.0 Licensee Action on Previous Inspection Findings

(Closed) Inspection Followup Item 50-341/92021-06(DRP): Degraded voltage calculation for valve E4150F008 did not address all design basis operational modes. Calculation DC 4943 was revised satisfactorily to account for minimum battery voltages if the valve was called upon to realign while in test mode. This item is closed.

(Closed) Unresolved Item 50-341/93003-05(DRS): Use of Kalsi Report for actuator overthrust allowances was pending NRC review of industry documents. Fermi's use of the Kalsi report overthrust allowances was appropriate and the report's provisions were properly implemented into the MOV program. This item is closed.

(Closed) Inspection Followup Item 50-341/93003-06(DRS): Torque measurement was not routinely taken. The licensee had purchased and used Torque Thrust Cells (TTC), spring pack calibration kits, and stem strain gauge sensors. The licensee performed 18 static tests with the TTC and intended to measure both torque and thrust during upcoming periodic verification tests. This item is closed.

(Closed) Unresolved Item 50-341/94005-05(DRP): Inadequate coordination and management oversight of MOV test program. In April 1994, the licensee formed an MOV program improvement task force to address the overall program implementation and an MOV test team assigned to oversee the performance of GL 89-10 testing during RF04. Based on the overall program improvement found during this inspection and GL 89-10 program completion, this item is closed.

(Closed) Inspection Followup Item 50-341/94009-02(DRP): Improper set-up of butterfly valve T4804F606B resulted in a disengaged worm gear. To address the generic implications, the licensee inspected 21 butterfly valves to ensure

that the HBC worm gear was centered on the HBC worm. Valve T4804F602B was the only valve found outside of the inspection acceptance criteria, but within the operational range. The licensee planned to adjust the valve during the next outage. Based on the actions performed to date and the scheduled work for valve T4804F602B during the September 1996 outage, this issue is closed.

3.0 Generic Letter 89-10 Program Implementation

The focus of this inspection was to evaluate Fermi's process for qualifying the design-basis capability of MOVs and closure of GL 89-10. The inspection concentrated on evaluating MOVs that were tested only under static or low differential pressure (dP) conditions. A valve sample that included several methods used by Fermi was selected to verify design-basis capability. The inspectors reviewed design-basis documents, thrust calculations, test packages, and engineering evaluations for the following MOVs:

E4150F001	HPCI turbine steam supply isolation valve
E4150F006	HPCI main pump outlet to feedwater
E5150F046	RCIC lube oil cooler cooling water supply isolation valve
P4400F603A	RBCCW division I supply isolation valve

3.1 Program Scope

The program scope consisted of 147 MOVs (88 gate valves, 41 globe valves, 14 butterfly valves, and 4 ball valves). All valves were tested statically and 42 were tested dynamically. Since the Part 2 inspection, one HPCI test return line valve was removed from the program after the motor operator was replaced with air operated controls.

3.2 Design-Basis Capability Verification

3.2.1 Sizing and Switch Settings

Fermi's thrust and torque calculations utilized the standard industry equations using mean seat diameter and a stem friction coefficient of 0.15. The valve factor used for each valve depended on valve size and group. Torque switch trip (TST) was adjusted for diagnostic system inaccuracies and torque switch repeatability. Fermi included a margin of 5% for stem lubrication degradation, 5% margin for spring pack relaxation for newly installed spring packs, and a 15% margin for load sensitive behavior. For the initial setup, the adjusted TST was compared to the minimum required thrust and the maximum allowable thrust. For subsequent testing, the minimum required thrust was adjusted higher by increasing the valve factor (VF) by 5% to account for potential valve degradation. No concerns were raised with the switch setting method.

3.2.2 Valve Factor and Grouping

Fermi divided MOVs into 12 valve groups based on valve manufacturer, type, and ANSI pressure class rating. In-plant data was utilized first and then industry data for VF justification for non-dynamically tested MOVs. Fermi intended to use the Electric Power Research Institute (EPRI) performance prediction model (PPM) to validate VFs and valve operability for those non-testable valves where plant and industry data was not available. The following valve groups were potential concerns because none of the valves

within the group were dP testable and matching industry data was not available.

- Valve group E were non-testable 6 and 10 inch, 900 lb, Powell flexible wedge gate valves that used a VF of 0.50 (steam medium) and 0.512 (steam and water) based on industry test data for a different size valve which indicated a VF of 0.45. However, Fermi used a 0.40 VF in the opening direction for valve E4150F001 even though the valve could support the higher VF with reduced margin.

- Valve group H were miscellaneous non-testable gate valves and was not a group as defined by GL 89-10 Supplement 6. The group consisted of two 28 inch, Lunkenheimer flexible wedge gate valves and four 24 inch, 900 lb, Velan flexible wedge gate valves. Fermi used a valve factor of 0.50 for the Lunkenheimer valves and 0.724 for the Velan valves. The lowest margin on the Lunkenheimer valves was 26% with 85% for the Velan valves. The Lunkenheimer valve with 26% margin was scheduled for retest in the next outage.

Based on a review of available thrust margins, the planned testing, and the use of EPRI's PPM for these valve groups, the inspectors considered the licensee's valve grouping to be adequate for program closure.

3.2.3 Valve Conditioning Load

Static traces that showed an abnormal or unusual change prior to seating were quantified and described as valve conditioning load (VCL). The VCL thrust value was added to the minimum required thrust. This method potentially underestimated the VF if the unquantified dynamic VCL is greater than the static VCL. The inspectors reviewed Fermi's program using standard industry methods for determining VFs and margin and confirmed that a minimum valve factor of 0.50 for gate valves and 1.1 for globe valves was used regardless of the VCL. Fermi's VCL is similar to what EPRI has defined as parasitic load, which will be addressed in the SER review of EPRI's PPM. Fermi will be expected to review the SER discussion on parasitic loads and take action as necessary.

3.2.4 Stem Friction Coefficient

The licensee's 0.15 assumption for stem friction coefficient (SFC) bounded 89% of static test data. Although dynamic stem friction coefficients are generally higher than static stem friction coefficients, the licensee did not routinely measure torque during early GL 89-10 dynamic testing. The inspectors determined that Fermi's 15% margin for rate of loading (ROL) for all MOVs in both open and close direction compensated for the SFC assumption. Fermi has since obtained TTCs and a spring pack calibration test unit and intended to confirm the dynamic stem friction coefficient during future periodic verification testing. Based on available margin, SFC assumptions were sufficiently validated for program closure.

3.2.5 Rate of Loading

The licensee compiled data from 42 dynamic tests to justify a 15% ROL assumption. If an MOV was dynamically tested and the ROL was greater than 15%, that value was used for future MOV setup. Based on available margin, ROL assumptions were sufficiently validated for program closure.

3.2.6 Lack of Open Stroke Evaluations

Diagnostic data gathered during the open stroke of older dynamic tests was not used because the sensor was not calibrated in the open direction. Fermi assumed the opening VF was equivalent to the closing VF and verified that the peak unseating current was always less than the peak seating current. The inspectors were concerned that if a dynamic test was run at less than 100% dP, the extrapolated dP effects may be greater than the peak unseating forces. The inspectors did not find any traces where the peak unseating current was greater than the peak seating current or where the uncalibrated peak unseating force was less than the uncalibrated extrapolated opening dP force. Further, the inspectors noted that if the closing dP was greater than the opening dP, the larger pressure was used in the calculation to set the valve in the open direction. Recent dynamic tests used improved open calibration methods and provided sufficient validation of the open stroke evaluations.

3.2.7 Degraded Voltage Capability

Two degraded voltage (DV) capability concerns were raised:

- Sufficient capability for TST at DV for nine ac MOVs was available by substituting pullout efficiencies with run efficiencies in the standard Limitorque equation. The inspectors alerted Fermi that industry testing continues to indicate that use of run efficiency may not be conservative even when the valve has a close non-throttled function. Ongoing industry testing and reviews to determine appropriate efficiency factors continue. Upon industry resolution, Fermi will be expected to perform operability evaluations for these valves.

- For 21 dc MOVs, TST capability under DV conditions was in question when using the standard Limitorque capability equation. To demonstrate capability, Fermi verified that the amperage at TST was below the analytically determined amperage at stall under DV conditions. However, this method deviates from industry accepted methods that assess DV capability based on the torque yielded from the minimum amperage taken from the motor curve. Fermi's capability verification method may be viable, but it has not been validated through testing or through the peer review process seen by industry guidelines such as IEEE-1290.

  In response, Fermi reevaluated the dc MOVs using standard industry methods. This evaluation resulted in seven valves with insufficient capability to trip the TS under DV conditions. An engineering analysis was generated to address the operability of these valves. The seven valves were determined to be operable based on the valves' capability to close under design-basis conditions and the valves would not need to reopen. This is considered an inspection followup item pending NRC review (50-341/95010-01(DRS)).

3.2.8 Inadequate Evaluation of Maximum Handwheel Loads

Potential MOV overloading due to handwheel operation was inadequately addressed. Recent industry MOV failures reemphasized that certain MOVs, such as those with SMB-00 operators with a 4.38:1 handwheel ratio, can develop manual loads that readily approach valve or operator limits. Although guidance to evaluate MOV handwheel loads was given in Limitorque SEL-11 and EPRI Application Guide NP-6660-D, Fermi did not fully address this issue. For example, the torque/thrust calculation of MOV E5150F007 showed that the maximum handwheel thrusts exceeded the valve limits by over 3,000 lbs when applying the assumed design 0.15 SFC yet no action was taken to address potential overloading. Calculations by the NRC indicated that if applying the as-measured SFC value of 0.079, the valve limits were exceeded by over 15,000 lbs. Preliminary reviews indicated that the valve limits were conservatively based on either seismic or continuous loading limits; therefore, immediate operability was not a concern. However, DER 95-0699 was generated to further evaluate 11 MOVs identified as potentially susceptible to handwheel overload. A review of the maintenance and failure history of susceptible MOVs did not indicate past MOV damage and the evaluation to be completed via the DER was considered acceptable for program closeout. However, the lack of proper initial evaluation was considered a weakness in Fermi's calculation review process.

3.3 Evaluation of Diagnostic Equipment Inaccuracies

The actions taken to address diagnostic equipment inaccuracies were considered adequate and sufficient to justify program closure of this area. As discussed in Section 3.2.6, the inspectors were concerned that early in the program, Fermi relied on a comparison between peak seating and peak unseating currents to evaluate the opening thrusts because the force sensor was not calibrated for opening thrusts. Later testing used improved open calibration methods and more accurate equipment (such as the TTC) and the resulting data allowed confirmation of assumptions and made a good argument for adequacy of the seating versus unseating amperage comparisons.

3.4 Pressure Locking and Thermal Binding (PL/TB)

The progress made by Fermi in evaluating valves for PL/TB susceptibility was weak. Although six injection valves were determined susceptible and action was in progress to address these valves, the weak overall evaluation, noted in the Part 2 inspection, for the remaining open-safety-function gate valves had not been updated. Fermi's intent was to re-evaluate all valves upon issuance of GL 95-07 (which was issued in August of 1995). During the inspection the plant was in the process of completing this re-review for susceptibility of all power operated valves. The staff's review of the GL 89-10 program can be closed in this area with a more detailed review to be conducted in the future under the guidance of GL 95-07.

3.5 Periodic Verification of Design-Basis Capability

Plans for periodic verification of MOV design-basis capability were determined to be acceptable for program closure. Valves were given a rank based on measured or calculated margin; risk, based on PRA; failure history; and location/environment. Test frequencies and methods were then based on overall ranking. The plan included periodic review on a refuel cycle basis to move

valves up or down in ranking based on improved or degraded performance. Fermi is also expected to evaluate valve performance degradation information promulgated by the industry, EPRI, and the NRC.

Static testing will be performed for all MOVs within the GL recommended frequency. To evaluate assumptions for age degradation, Fermi planned to diagnostically dP test six to eight of the testable MOVs every refuel cycle.

The NRC staff is preparing a generic letter on the periodic verification of MOV design-basis capability and will review the licensee's program in greater detail following issuance. The licensee should review its periodic verification program and consider the benefits (such as identification of decreased thrust output and increased thrust requirements) and potential adverse effects (such as accelerated aging or valve damage) when determining appropriate periodic verification testing for each GL 89-10 MOV.

3.6 Post-Maintenance Testing (PMT)

Post-maintenance testing requirements for MOV related maintenance activities were acceptable. The PMT guidelines required the performance of diagnostic testing following packing adjustments/replacements as well as dynamic diagnostic testing following valve replacement and valve internal work that could affect thrust requirements. The inspectors concluded that Fermi had satisfactorily addressed this area for program closure.

3.7 MOV Failure Trending and Corrective Actions

Fermi's trending program was considered to be an industry leader and a strength in the overall MOV program. The program was clearly established and capable of providing meaningful data for the purpose of maintaining design-basis capability. The program had already identified potential adverse trends that Fermi has responded to. For example, the formation of a team to investigate an increase in MCC-related failures and an improved packing program to decrease the number of leaking valves. Performance trending of valve testing data had been incorporated into the existing IST program with defined acceptance criteria for required action.

4.0 Licensee Self-Assessment

Recent self assessments were considered to be beneficial in improving the MOV program, especially the assessment performed by an independent MOV specialist from another plant. Corrective actions to the issues raised were addressed or were being considered for program enhancements.

5.0 Inspection Follow-up Items

Inspection follow-up items are matters that have been discussed with the licensee which will be reviewed further by the inspector and which involve some action on the part of the NRC or licensee or both. One inspection follow-up item was identified during this inspection and is discussed in Section 3.2.7.

6.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Section 1.0) on September 15, 1995. The inspectors summarized the inspection's purpose and scope and the findings. Also discussed was the likely informational content of the inspection report with regards to documents or processes reviewed during the inspection. The licensee did not identify any such documents or processes as proprietary.