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May 5, 1997
NRC-97-0056

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

References: Fermi 2
NRC Docket No.50-341
NRC License No. NPF-43

Subject: Fermi 2 Actions Taken for 480V Fused Disconnect Switches

Based on conversations with NRC Region III Staff, this letter is being submitted to document the actions Detroit Edison has taken to eliminate a failure mechanism related to 480-Volt motor control center (MCC) fused disconnect switches.

On March 19, 1997, the disconnect switch for MCC 72E-5A, Position 3CR (Core Spray pump minimum-flow recirculation isolation valve) opened unexpectedly and would not reclose when the rotary actuator was placed in the "ON" position. A review of this event determined that there have been similar events on other ITE HDS (heavy duty switch) disconnect switches used in the ITE Series 5600 MCCs in the past (Reference DER 95-0846). There had been 5 documented occurrences of unexpected opening of the fused disconnect switches prior to the Fifth Refueling Outage (RFO5). One of these occurrences involved a safety related application. There are approximately 1000 of these disconnect switches in service at Fermi 2 and they have been in service since plant construction, approximately 15 years ago. This unexpected opening occurs when this switch's operating mechanism is not fully latched and vibration from any source either causes the switch operating mechanism to move to the closed-and-latched position or results in the opening of the switch mechanism.

The seismic qualification of these switches requires them to be in either the closed-and-latched position or the full open position as these were the positions during the testing that was originally performed to seismically qualify the switches. It is important that the disconnect switches, when operated manually as intended, move smoothly from the fully open to fully closed (latched) position. On April 10, 1997, a four-hour non-emergency notification was made to the NRC as a potential condition

that alone could have prevented the fulfillment of a safety function of structures or systems that are needed to mitigate the consequences of an accident (LER 97-008 will be submitted by May 12, 1997 to document this event).

The cause of this condition, confirmed by disassembly of a fused disconnect switch, is less than adequate preventive maintenance to ensure the fused disconnect switches operate properly. This lack of adequate preventive maintenance resulted in binding of the disconnect switch operating mechanism. Detroit Edison believes that the main contributor to the binding is a drying of the grease to a "hardened" condition compared to fresh grease, due to aging and lack of the mechanism being exercised on a periodic basis. The dry grease in the disconnect switch operating mechanism pivot points causes the lubricating properties to be degraded. In addition, dust in the area of the pivot points also contributed to the loss of lubrication and subsequent binding of the disconnect switch operating mechanism.

The disposition for DER 95-0846 in November 1995 determined that cleaning and lubrication was an acceptable corrective action for the binding of the fused disconnect switches, as outlined in Maintenance Procedure 35.306.008. This disposition included the approval for use of CRC Industries (CRC) quick drying (QD) contact cleaner and CRC Siloo silicone lubricant as the cleaning and lubricating agents. These fluids were determined to be compatible with the disconnect switch materials (Reference TSRs 27592 & 28433). On April 11, 1997, Detroit Edison determined that this cleaning and lubrication would be implemented for all in service safety-related and balance-of-plant 480V MCC ITE HDS fused disconnect switches (a population of approximately 1000 load positions, of which approximately 300 are safety-related) prior to startup from Forced Outage 97-01 to provide reasonable assurance of the proper future operation of these switches.

A technical justification for the adequacy of the cleaning and lubricating process was conducted. This technical justification included, but was not limited to: evaluation of the compatibility of the existing grease, cleaner and silicone lubricant; accelerated aging of a fused disconnect switch that was cleaned and lubricated in the same manner that Detroit Edison used for restoring the fused disconnect switches; an evaluation of the effectiveness of special operator training on recognizing a fully latched condition; an evaluation of the effectiveness of recent cleaning and lubrication activities; and a confirmation of the seismic qualification of the as-left configuration.

The evaluation of the compatibility of the various solvents and lubricants present in the operating mechanism pivot points was performed by the Detroit Edison Engineering Support Organization. This evaluation determined that the various solvents and lubricants would not interact in a detrimental manner for the continued reliable operation of the fused disconnect switches. The use of the silicone lubricant is expected to improve the lubrication of the pivot areas containing dry grease and that silicone lubricants used in areas similar to this application (e.g., hinges, locks) has provided satisfactory service. The silicone lubricant provides a film on top of the dry grease and other surfaces and will stay in place if not chemically or physically removed.

Detroit Edison contracted with Farwell & Hendricks to determine the qualified life of the relubrication procedure being used for the fused disconnect switches. A fused disconnect switch that would not reclose in the as-found condition was sent to Farwell & Hendricks. The switch was subjected to an insulation resistance test which demonstrated its electrical integrity, cleaned and lubricated using Fermi 2 maintenance procedures, then subjected to accelerated aging. This accelerated aging determined that the fused disconnect switch, after being cleaned and lubricated using the Fermi 2 maintenance procedures, has a qualified life of at least 679 days. This 679 day period is an interpolation of the Farwell & Hendricks 24 hours of thermal aging data to the highest Fermi 2 normal service condition of 92 degrees Fahrenheit in accordance with the environmental qualification files for the 480V MCCs. Additional testing (currently in progress) to age the lubricant for a longer period of time will likely establish a longer lubricant lifetime. The qualified life will be limited to the established life of the lubricant. This qualified life may be revised in accordance with the additional testing mentioned.

Farwell & Hendricks also performed transitional force measurements demonstrating that the force required to move the fused disconnect switch operating mechanism is reduced after a switch with sluggish movement is cleaned with CRC QD and lubricated with CRC Siloo. Farwell & Hendricks also conducted a literature search to ensure that there were no outstanding maintenance or replacement issues for the fused disconnect switches that need to be implemented. Farwell & Hendricks confirmed the original vendor manual qualification summary report recommendation that the fused disconnect switches be exercised on an outage frequency.

As the cleaning and lubrication was implemented, the as-found operating condition of each fused disconnect switch was documented. The first aspect of this as-found condition determination was to defeat the door interlock mechanism that prevents opening of the load position in an energized position. Defeating the door interlock mechanism provides a significant disturbance to the switch rotary-to-toggle assembly, resulting in any fused disconnects that are not fully latching either snapping open or moving into the fully latched position. Three load positions unexpectedly opened while defeating the door interlock mechanism. Subsequent to defeating the door interlock mechanism, the as-found condition was determined by exercising the fused disconnect switch by manipulating the rotary actuator. The as-found condition was that approximately 78 percent of the switches operated smoothly with an immediate snap into the fully latched configuration, approximately 14 percent experienced sluggish operation, and approximately 7 percent would not reclose. These percentages are representative of the entire load position population and for the safety-related load positions independently. After the cleaning and lubrication process, ten (4 safety-related) of the fused disconnect switches would not reclose in a satisfactory manner, believed to be due to conditions other than lubrication (i.e., rotary actuator and door interlock problems). These switches were repaired or replaced with appropriately qualified smooth operating switches.

Trending of any future fused disconnect switch failures will be performed and failures of any type will be promptly evaluated to determine whether additional corrective actions are needed. At present, this trending will be in accordance with the Fermi 2 corrective action process.

In addition to the above corrective actions and as a conservative measure, training was completed for plant operators so that they recognize proper switch operation (only plant operators are allowed to operate MCC load switches). Surveys of operations personnel were completed to evaluate the human factors associated with disconnect switch operation. The surveys polled a number of operators concerning assurances of the switch being in the closed and fully latched position. The surveys verified that operators have a high comfort level for determining that the MCC load position is closed and latched. In addition, a majority of the operators surveyed believed that a physical check of the rotary actuator will provide additional assurance that the mechanism is latched and was incorporated into operating procedures. This "physical check" was performed on the MCC fused disconnect switches prior to startup from Forced Outage 97-01.

The training and qualification of personnel working on the Motor Control Centers was also reviewed and documented. Maintenance Personnel are required to complete a Lesson Plan, Laboratory Exercises and Proficiency Demonstrations before they are qualified to work on ITE Motor Control Centers. Disconnect switch operation is included in this training.

Subsequent to August 1995 (and prior to the present cleaning and lubrication), approximately 69 MCC positions had been cleaned and lubricated with the CRC QD contact cleaner and CRC Siloo Silicone lubricant. As of May 2, 1997, 61 of these MCC position have been evaluated to determine the effectiveness of the previous cleaning and lubrication activities (8 have not yet been evaluated against historical cleaning and lubricating activities). An evaluation was made of the as-found condition of these positions and for three of the cases, the as-found operational characteristics of the disconnect switches was categorized as not being smooth, but still fully latching when operated. For one other case, the fused disconnect would not reclose due to a rotary actuator problem. There were no conditions identified where the disconnect switch opened unexpectedly or would not reclose due to inadequate lubrication.

Disconnect switches that are removed from the MCC load position and re-installed are completed in a manner that maintains the original seismic integrity of the unit. Installation procedures were reviewed by Plant Support Engineering and found acceptable. Therefore, the seismic integrity is maintained when removals and reinstallations are necessary.

Detroit Edison requested that General Electric (GE) provide an independent technical evaluation of the program to address failures of the fused disconnect switches. The review included the root cause determination, corrective actions, maintenance process, and engineering related activities. GE concurred that based on the as-found

operation of the switches and a review of the disassembly findings, the failure mechanism was consistent with inadequate lubrication. This was supported by the fact that cleaning the switch mechanism and applying a new lubricant improves the condition and results in reliable latching of the mechanism. The dry grease phenomena is consistent with GE experience with switchgear and control equipment of similar vintage. Based on a review of the fused disconnect switches, which are not designed nor intended to be overhauled, GE concurred that cleaning and lubrication of the switches is an adequate solution to the lubrication issue. The trending program and operator training were also concluded to be prudent measures to confirm the reliability of the cleaning and lubrication methodology. The GE evaluation also concluded that the engineering process clearly identified and addressed the critical items necessary (i.e., compatibility of materials, switch function, and maintenance activities) for determining that the corrective actions are acceptable for insuring reliable operation of the fused disconnect switches.

The cleaning and relubrication maintenance effort to re-establish operational acceptability and lubricant lifetime data from the Farwell & Hendricks report provides the assurance that the entire in service population (approximately 1000) of fused disconnect switches will function as intended and therefore, will not represent a common mode failure mechanism. Since the 480 volt disconnect switches are demonstrated to operate properly to the fully latched position, which ensures power is supplied to plant equipment as designed, this improved maintenance program does not increase the probability of an accident.

The improved maintenance program discussed herein, provides reasonable assurance that the unexpected opening of an MCC fused disconnect switch will not be a common mode failure mechanism since the switch is in a seismically qualified and fully latched position. Therefore, any switch failure would be an isolated occurrence which does not increase the consequences, including radiological impacts, of an accident.

If you have any questions or need further assistance, please call Ken Riches at (313) 586-5529.

Sincerely,

cc: A. B. Beach
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Region III
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