B. Ralph Sylvia
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May 31, 1989
NRC-89-0115

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

References: 1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) Detroit Edison Letter to NRC, NRC-89-0052, "Proposed Operating License/Technical Specifications Change (License Amendment) - Cycle 2 Reload Submittal", dated April 3, 1989

Subject: Proposed Technical Specification Changes to Allow Operation with an Extended Operating Domain

Pursuant with 10CFR50.91 and 50.92, Detroit Edison hereby proposes to amend Operating License NPF-43 for the Fermi 2 plant by incorporating the enclosed changes into the Plant Technical Specifications. The proposed changes modify the Average Power Range Monitor flow biased rod block and scram limits to allow up to 100% power operation of Fermi 2 with core flow reduced to as low as 87% of rated with up to a 50°F reduction of rated final feedwater temperature. Appropriate changes to the Bases are also proposed.

Operation in the extended operating domain with either normal or reduced feedwater heating is supported by evaluations and analysis performed for Detroit Edison by GE Nuclear Energy. These analyses have been performed for Fermi 2's current operating cycle (Cycle 1) and for the upcoming Cycle 2. The analysis submitted for Cycle 2 in Reference 2 included operation in the expanded domain. However, the Technical Specification changes in Reference 2 did not include provisions for operating in the expanded domain. This submittal provides the needed Technical Specification provisions.

Attachment 1 provides the Summary, Description of Changes, Significant Hazards and Environmental Impact Considerations for Cycle 1 and Reference 2 extends this for operation in the upcoming Cycle 2 operation. Attachment 2 provides a summary listing of the proposed Technical Specification and Bases changes for operation in the extended domain for both Cycle 1 and Cycle 2, Reload 1. Attachment 3

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is a copy of the marked up Technical Specification and Bases pages for both Cycle 1 and Cycle 2, Reload 1. Enclosures 1 through 3 contain the GE Nuclear Energy analysis and supporting work.

Approval of these changes will provide Fermi 2 with greater operating flexibility and a greater capacity factor. Prompt review and approval of this proposal is requested for both Cycle 1 and Cycle 2, Reload 1.

Detroit Edison has evaluated the proposed Technical Specifications against the criteria of 10CFR50.92 and has determined that no significant hazards consideration is involved. The Fermi 2 Onsite Review Organization has approved and the Nuclear Safety Review Group has reviewed the proposed Technical Specifications and concurs with the enclosed determinations. In accordance with 10CFR50.91, Detroit Edison has provided a copy of this letter to the State of Michigan.

If you have any questions in this matter, please contact Mr. Glen Ohlemacher at (313) 586-4275.

Sincerely,

B Ralph Sylvia

Enclosure

cc: A. B. Davis
R. C. Knop
W. G. Rogers
J. F. Stang
Supervisor, Advanced Planning and Review Section,
Michigan Public Service Commission

I, B. RALPH SYLVIA, do hereby affirm that the foregoing statements are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

B Ralph Sylvia
B. RALPH SYLVIA
Senior Vice President

On this 31st day of May, 1989, before me personally appeared B. Ralph Sylvia, being first duly sworn and says that he executed the foregoing as his free act and deed.

Rosalie A. Armetta
Notary Public

ROSALIE A. ARMETTA
Notary Public, Monroe County, MI
My Commission Expires Jan. 11, 1992

ATTACHMENT 1

SUMMARY, DESCRIPTION OF

CHANGES, SIGNIFICANT HAZARDS

AND ENVIRONMENTAL IMPACT CONSIDERATIONS

INTRODUCTION

Chapters 4 and 15 of the Fermi 2 Updated Final Safety Analysis Report (UFSAR) describe the power/flow allowed operating domain. Because Boiling Water Reactor (BWR) operating experiences have long indicated that an expanded power/flow operating map can be very beneficial to the operation of a plant, Detroit Edison has determined the feasibility of such an expansion at Fermi 2. This larger operating domain will provide increased operational flexibility and improved capacity factor at Fermi 2. Specific benefits include:

1) Faster power ascension to rated power because it facilitates higher rod line patterns set during low xenon startups and flow compensation for xenon buildup.

2) Rated power can be maintained longer without adjustment of control rods by using the additional flow range to compensate for reactivity reduction from fuel burnup. This will improve the capacity factor since control rod adjustments must be performed at reduced power levels due to fuel limitations.

3) Improved fuel utilization and consequently enhanced fuel cycle economics by use of the flow control spectral shift operating strategies.

Normal power range operation is along or below the 102% flow control line and the 100% core thermal power line (see Figure 1, attached). The current power/flow map is described in UFSAR Section 4.4.3.3 (UFSAR Figure 4.4-4) and UFSAR Section 15.0.3.3.3 (UFSAR Figure 15.0-3) of the Fermi 2 UFSAR. The proposed expanded region is referred to herein as the Extended Load Line Limit Region (ELLLR) and is bounded at the top by a new APRM (Average Power Range Monitor) Rod Block line (0.58W + 50%) up to 100% power/87% flow, the 100% thermal power line, and the 100% flow line. W is the per cent recirculation drive flow. The left and right side of the power/flow map remain unchanged. The proposal requires that two present operating constraints remain: 1) feedwater temperature reduction up to 50°F of rated feedwater temperature and 2) core inlet subcooling must be less than 45 Btu/lbm. These restrictions are presently assured by plant procedures. The core inlet subcooling requirement was made in response to a concern uncovered in the Enclosure 1 analysis.

This proposal changes the slope and intercept of the flow biased APRM rod block and scram lines (Table 2.2.1-1, Specification 3/4.2.2, and Table 3.3.6-2) to allow operation in the Extended Load Line Limit Region (ELLLR). An addition in the MCPR Bases (B

3/4.2.3) section states that the K_f curves are still valid for the extended domain even though they were derived using the 100% flow control line.

EVALUATION

Detroit Edison's evaluation of this proposal is based on the results of a General Electric Nuclear Energy (GE) Fermi 2 specific analysis which fully bounds the ELLLR. This analysis (Enclosures 1 through 3) evaluates the extension of the operating domain to include the entire Maximum Extended Load Line Limit Region (MELLLR) with continued operation for either normal or reduced feedwater heating (up to a 150°F reduction) for Cycle 1. The proposal requires that two present operating constraints remain: 1) feedwater temperature reduction up to 50°F of rated feedwater temperature and 2) core inlet subcooling must be less than 45 Btu/lbm. These restrictions are presently assured by plant procedures. The core inlet subcooling requirement was made in response to a concern uncovered in the Enclosure 1 analysis.

The MELLLR is bounded by the 100% power line for the flow range of 75% to 100% of rated, its corresponding power/flow constant line, and the 100% rod line. Detroit Edison is presently pursuing neither the expansion of the allowable feedwater heating range beyond the 50°F reduction of rated feedwater temperature currently allowed by the Cycle 1 analysis in the normal operating domain nor the full MELLLR domain as evaluated by GE; however, the analysis results and impact evaluation for the full MELLLR domain with reduced feedwater heating are conservatively applicable to operation in the proposed ELLLR domain. The evaluation for application to Cycle 2, Reload 1 is included in Reference 2. The evaluations for the ELLLR extended operating domain include:

1. Transient Performance
2. Overpressure Protection
3. Loss of Coolant Accident Peak Cladding Temperature
4. Containment Pressure Temperature and Hydrodynamic Loads
5. Thermal Hydraulic Stability

Transient Performance

All anticipated and abnormal operational transients described in Chapter 15 of Fermi 2 UFSAR were examined in the ELLLR.

Three limiting events were analyzed in detail. They were:

1. Turbine/Generator Trip with Bypass Failure (T/GTNBP)

2. Feedwater Flow Controller Failure (FWCF)

3. 100°F Loss of Feedwater Heating (LFWH)

The evaluation has been performed at bounding power/flow operating points outside the ELLLR with normal and reduced feedwater heating. The evaluation showed that the transient performance in the ELLLR with up to 50°F reduction of rated final feedwater temperature is bounded by the transient performance in the normal operating power/flow map. It is concluded that the results of the current UFSAR Chapter 15 transient analysis adequately bound the transient performance for ELLLR.

The Rod Withdrawal Error (RWE) transient is mitigated by the Rod Block Monitor System (RBM) setpoint. The transient severity of a RWE in the ELLLR is bounded by the current UFSAR analyses with the existing RBM setpoints. For operation in the ELLLR extended operating domain, the rod block will occur sooner; therefore, resulting in a less severe transient.

Overpressure Protection

The slightly lower initial steam flow and operating pressure when operating in the ELLLR with either normal or reduced feedwater heating provide better overpressure protection for the analyzed most limiting Main Steam Line Isolation Valve (MSIV) closure flux scram event. Therefore, the UFSAR Chapter 6 overpressure protection analysis adequately bound operation in the ELLLR.

Loss of Coolant Accident Peak Cladding Temperature

Operation in the ELLLR results in operation on a higher rod line which will permit a higher power (higher initial stored energy in the fuel) at a given flow. This increases the probability of losing nucleate boiling at the highest power axial node prior to the time of jet pump uncovery. This phenomenon is called early boiling transition (BT) and could affect the calculated Peak Cladding Temperature (PCT).

There are two parameters which play a major role in determining the calculated PCT that are affected by the higher core power at lower core flow: (1) the time of boiling transition at the high power axial node of the limiting fuel

assembly and (2) the calculated core uncovery duration. Early boiling transition results in a less efficient removal of the initial stored energy from the fuel, which tends to increase the calculated PCT. Lower initial core flow tends to decrease the calculated PCT. This occurs because increased subcooling in the downcomer and lower plenum at lower core flows increases the initial system inventory. The increased system inventory leads to a shorter core uncovery duration and lower calculated PCT.

The variation of the bundle inlet flow during a LOCA event is determined by a number of parameters, including the break size, the water inventory in the reactor at the start of the event, and the steady-state core power and flow conditions. The first of these is accounted for in the current UFSAR LOCA analysis. The effect of variations in the remaining two was accounted for by performing an analysis at the limiting power flow point along the ELLLR boundary. The initial MCPR is also an important parameter in determining whether or not early boiling transition will occur at the high power axial node. Credit was taken for the Technical Specification requirement on MCPR versus core flow (K_f) with an additional 2% conservatism added to satisfy 10CFR50 Appendix K.

A LOCA analysis was performed for Fermi-2 at the 102% power and 75% flow condition outside the ELLLR to bound the ELLLR. This condition was selected because it is the lowest core flow at which Fermi-2 can operate with a unadjusted MCPR operating limit. The results of this calculation show that early BT does not occur. Thus, the calculated PCT is less than that of the UFSAR case. Therefore, it is concluded that the current UFSAR Chapter 6.3 calculated PCT adequately bound the ELLLR results.

A 50°F reduction of final feedwater temperature results in increased system mass in the vessel due to increased subcooling and decreased break flow rate at most times during a LOCA due to lower initial vessel pressure and steam production. The increased system mass and the decreased break flow act together to result in a delay in the time of dryout, an increase in the time between dryout and lower plenum flashing, and a delay in the time to core uncovery. As a result, the peak cladding temperature for operation with reduced feedwater temperature is lower than when operating at rated feedwater temperature. This conclusion applies for operation in both the normal and ELLLR operating domain.

Containment Responses and Loads

Operation in the ELLLR extended operating region leads to a higher core inlet subcooling and consequently to a higher LOCA blowdown flow rates, compared with those presented in the containment analysis section of the UFSAR, for certain time periods following the double-ended guillotine break of a recirculation suction line. However, an analysis has been performed to show the peak drywell pressure, temperature and peak suppression pool pressure are all within the design values reported in Chapter 6.2 of UFSAR.

An evaluation was also performed to determine the impact of operation in the ELLLR with reduced feedwater heating on LOCA containment hydrodynamic loads. The containment hydrodynamic loads including pool swell, condensation oscillation, chugging and vent system thrust loads are all within their corresponding design values provided inlet subcooling is less than 45 BTU/lbm. At the present time Detroit Edison is administratively controlling operations so as to remain under 45 BTU/lbm subcooling at the reactor pressure vessel inlet. Furthermore, Detroit Edison is not proposing a relaxation of current final feedwater temperature constraints.

Thermal Hydraulic Stability

Operation in the ELLLR results in operating on a higher control rod line which could potentially reduce stability margin. However, the stability compliance of all licensed GE fuel designs have been demonstrated on a generic basis for operation in the normal as well as the ELLLR operating domain with or without reduced feedwater heating. In NRC evaluation reports, the Staff concluded that GE fuel designs meet the stability criterion set forth in 10CFR50, General Design Criteria 10 and 12, provided that the BWR utility has in place operating procedures and Technical Specifications which are consistent with the recommendations of GE SIL-380 to assure detection and suppression of global and local instabilities. Since Fermi 2 Technical Specifications and procedures are consistent with SIL-380 recommendations, operation in the ELLLR will meet all stability criteria.

Both the GE SIL-380 recommendations and the more conservative GE interim corrective actions, which have resulted from recent thermal-hydraulic instabilities, have been included in the Fermi 2 operating procedures. Regions of restricted operation defined in Attachment 1 to NRC Bulletin No. 88-07 Supplement 1, are applicable to Fermi 2 Cycle 1 and Reload 1, Cycle 2.

SIGNIFICANT HAZARDS EVALUATION

In accordance with 10CFR50.92, Detroit Edison has reviewed the attached proposed Technical Specification and has concluded that it does not involve a significant hazards consideration. The basis for this conclusion is that the criteria of 10CFR50.92(c) are not compromised. All anticipated and abnormal transients described in the Fermi 2 UFSAR Chapter 15 were examined for operation in both the MELLLR (Maximum Extended Load Line Limit Region) and the normal operating power/flow map. Evaluations were performed at two power/flow operating points (102% power/75% flow and 102% power/100% flow) with rated feedwater temperature reduction of 150°F.

The proposed amendment allows operation in a smaller ELLLR operating domain. This ELLLR operating domain is bounded at the top by the proposed new APRM (Average Power Range Monitor) Rod Block line (0.58W + 50%) up to 100% power/87% flow, the 100% thermal power line, and the 100% flow line. W is the per cent recirculation drive flow. The proposal requires that two present operating constraints remain: 1) feedwater temperature reduction up to 50°F of rated feedwater temperature and 2) core inlet subcooling must be less than 45 Btu/lbm. These restrictions are presently assured by plant procedures.

1. The amendment **does not** involve a significant increase in the probability or consequences of an accident previously evaluated.

   Operation in the ELLLR (Extended Load Line Limit Region) with the specified feedwater temperature reduction and core inlet subcooling operational constraints has no effect on the **probability** of occurrence of any transient because plant equipment and systems still operate within their design limits.

   The following transients were potentially limiting under the proposal but were determined to be bounded by the UFSAR analysis (refer to Enclosure 1, Chapters 1 and 2). The delta CPR (Critical Power Ratio) analysis took credit for the Technical Specification requirement on MCPR (Minimum Critical Power Ratio) versus core flow K_f factor with an additional 2% conservatism.

Transient	Limiting Concern
Turbine/Generator Trip with Bypass Failure	delta CPR RPV Pressure
Feedwater Flow Controller Failure with Bypass Failure	delta CPR RPV Pressure
Feedwater Flow Controller Failure without Bypass Failure	delta CPR RPV Pressure
100°F Loss of Feedwater Heating	delta CPR
Main Steam Isolation Valve Closure	RPV Pressure
Loss of Coolant Accident	delta CPR Peak Clad Temperature

Containment (Enclosure 1/Chapter 5, Enclosure 2 and 3)

For Peak Drywell Pressure, operation in the MELLLR with reduced feedwater temperature of 150°F leads to higher LOCA blowdown flow rates following a double-ended guillotine break of recirculation suction line. The limiting condition for peak drywell pressure is the power/flow condition with highest core inlet subcooling in the MELLLR with reduced feedwater temperature. With a maximum feedwater temperature reduction of 50°F and under the limiting condition, peak drywell pressure will not exceed the UFSAR reported value of 56.5 psig (Enclosure 3). The maximum allowable pressure is 62 psig.

For the torus loads it was determined that during a LOCA, vent system thrust loads will likely be larger when initial operating conditions are in the ELLLR. An additional study (Enclosure 2) uncovered that stresses could exceed the maximum vent header capability when the core inlet subcooling exceeds 45 Btu/lbm. At the present time Detroit Edison is administratively controlling operations so as to remain under 45 BTU/lbm subcooling in the reactor pressure vessel.

The proposal requires that two present operating constraints remain: 1) feedwater temperature reduction up to 50°F of rated feedwater temperature and 2) core inlet subcooling must be less than 45 Btu/lbm. These restrictions are presently assured by plant procedures. Furthermore, Detroit Edison is not proposing a relaxation of current final feedwater temperature constraints.

All other containment parameters are fully bounded by the UFSAR analysis.

Vessel Internals (Enclosure 1/Chapter 7)

The major concern is acoustic loads for the vessel internals. These are lateral loads on the vessel internals that result from propagation of the decompression wave created by a sudden recirculation suction line break. Due to increased downcomer subcooling, these loads will increase relative to the UFSAR values, but there is enough design margin to handle the increased loading during operation in the ELLLR.

Detroit Edison concludes that the results of the current UFSAR transient analysis adequately bound the transient performance in the ELLLR with up to 50°F reduction of rated final feedwater temperature. Therefore, the amendment does not involve a significant increase in the **consequences** of an accident previously evaluated.

2. The amendment **does not** create the possibility of a new or different kind of accident from any previously evaluated.

Operation in the ELLLR has been evaluated with the initial condition of the extended region. There is no change to the plant design required to accommodate the extended region. All plant equipment and systems still operate within their design limits. The proposed APRM simulated thermal power scram and rod block configuration provide the same protection margin to the operating map as the current configuration. No new or different accident are therefore created by the extended domain.

Since operation at the higher rod lines does create the possibility of a slow recirculation flow runout event taking power above the rated core thermal power, the slow recirculation flow runout event was evaluated. The Recirculation Flow Control Failure with the Increased Flow transient is evaluated in the UFSAR Chapter 15.4.5. The slow flow increase case was reviewed with the initial conditions of the worst case conditions in the MELLLR (which bounds the ELLLR) and it was determined that the existing K_f factors remain bounding. The K_f factor is designed to maintain core thermal margins in the event of a recirculation flow runout event. That is, K_f defines a set of MCPR limits as a function of core flow such that a flow runout event initiated from any given power/flow point will result in a minimum CPR no less than the safety limit MCPR. Therefore, the slow recirculation

flow runout event does not create the possibility of a new or different kind of accident from any previously evaluated.

3. The proposal **does not** involve a significant reduction in a margin of safety.

The proposed expansion of the power/flow map has been evaluated to show that all safety criteria are met. The changes in APRM Rod Block and Trip Setpoint are only to accommodate the operating region. The new setpoints maintain the same maximum values (113.5% maximum for the STPM (Simulated Thermal Power Monitor) scram and 108% for the rod block) at rated power/flow conditions and the same margin (6%) between the STPM scram and rod block setpoints as the current Technical Specification. Furthermore, the transient performance in the ELLLR is bounded by the normal operating domain and all parameters remain within their design limits.

For Peak Drywell Pressure, operation in the MELLLR with reduced feedwater temperature of 150°F leads to higher LOCA blowdown flow rates following a double-ended guillotine break of a recirculation suction line. The limiting condition for peak drywell pressure is the power/flow condition with highest core inlet subcooling in the MELLLR with reduced feedwater temperature. With a maximum feedwater temperature reduction of 50°F and under the limiting condition, peak drywell pressure will not exceed the UFSAR reported value of 56.5 psig (Enclosure 3). The maximum allowable pressure is 62 psig.

For the torus loads it was determined that during a LOCA, vent system thrust loads will likely be larger when initial operating conditions are in the ELLLR. An additional study (Enclosure 2) uncovered that stresses could exceed the maximum vent header capability when the core inlet subcooling exceeds 45 Btu/lbm. At the present time Detroit Edison is administratively controlling operations so as to remain under 45 BTU/lbm subcooling in the reactor pressure vessel.

For the vessel internals the major concern is the acoustic loading. These are lateral loads on the vessel internals that result from propagation of the decompression wave created by a sudden recirculation suction line break. Due to increased downcomer subcooling, these loads will increase relative to the UFSAR values, but there is enough design margin to handle the increased loading during operation in the ELLLR.

Operation in the ELLLR results in operating on a higher control rod line which could potentially increase the probability of encountering thermal-hydraulic instability.

The NRC has concluded that GE fuel designs meet the stability criterion set forth in 10CFR50 Appendix A, General Design Criteria 10 and 12, provided that the BWR has in place operating procedures and Technical Specifications which are consistent with the recommendations of GE SIL-380 to assure detection and suppression of global and local instabilities. This NRC evaluation includes operation in the ELLLR. Since Fermi 2 Technical Specifications and procedures are consistent with SIL-380 recommendations, operation in the ELLLR will meet all stability criteria.

Both the GE SIL-380 recommendations and the more conservative GE interim corrective actions, which have resulted from recent thermal-hydraulic instabilities, have been included in the Fermi 2 operating procedures. Regions of restricted operation defined in Attachment 1 to NRC Bulletin No. 88-07 Supplement 1, are applicable to Fermi 2 Cycle 1 and Reload 1, Cycle 2 and have been implemented at Fermi 2.

Therefore, the proposal does not involve a significant reduction in a **margin of safety**.

For the proposed changes, it has been demonstrated that the criteria of 10CFR50.92 are satisfied, and so it is judged that no significant hazards considerations exist.

ENVIRONMENTAL IMPACT

Detroit Edison Company has reviewed the proposed Technical Specification changes against the criteria of 10CFR51.22 for environmental considerations. The proposed changes do not involve a significant hazards consideration, nor increase the types and amounts of effluent that may be released offsite, nor significantly increase individual or cumulative occupational radiation exposures. Based on the foregoing, Detroit Edison concludes that the proposed Technical Specification changes meet the criteria given in 10CFR51.22(c)(9) for a categorical exclusion from the requirement for an Environmental Impact Statement.

CONCLUSION

Based on the evaluation above: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the proposed amendments will not be inimical to the common defense and security or to the health and safety of the public.

These Technical Specification changes reflect the results of transient and accident analyses for both Cycle 1 and Reload 1, Cycle 2. The extended operating domain analysis was performed by GE Nuclear Energy with the NRC approved methodology described in GESTAR. The proposed Technical Specification changes ensure the plant conditions remain within the bounds of the initial conditions of the analyses.

Detroit Edison therefore believes that this proposal is acceptable and requests prompt consideration and approval.

Figure 1

EXTENDED POWER-FLOW MAP
(ELLLR)