Peter Dietrich
Senior Vice President and Chief Nuclear Officer

DTE Electric Company
6400 N. Dixie Highway, Newport, MI 48166
Tel: 734.586.4153 Fax: 734.586.1431
Email: peter.dietrich@dteenergy.com

DTE

October 23, 2020 TRM 5.2.1
NRC-20-0062

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Fermi 2 Power Plant
NRC Docket No. 50-341
NRC License No. NPF-43

Subject: Submittal of the Startup Report for Cycle 21

In accordance with the Fermi 2 Technical Requirements Manual (TRM), DTE Electric Company (DTE) hereby submits the Startup Report for Cycle 21.

TRM Section 5.2.1.a states that a "summary report of plant startup and power escalation testing shall be submitted following: … 3. Installation of fuel that has a different design or has been manufactured by a different fuel supplier…". During the recently completed twentieth refueling outage (RF20), DTE loaded GNF3 fuel assemblies which have a different design than previously used. Per TRM Section 5.2.1.b, the startup report addresses applicable tests identified in Subsection 14.1.4.8 of the Fermi 2 Updated Final Safety Analysis Report (UFSAR) and includes a description of the measured values of the operating conditions or characteristics obtained during the test program and a comparison of these values with design predictions and specifications. As required by TRM Section 5.2.1.c.2, this report is being submitted within 90 days of the resumption of power operation for Cycle 21 (i.e., entry to MODE 1), which occurred on August 3, 2020.

No new commitments are being made in this submittal.

Should you have any questions or require additional information, please contact Ms. Margaret M. Offerle, Manager – Nuclear Licensing, at (734) 586-5076.

Sincerely,

Peter Dietrich
Senior Vice President and Chief Nuclear Officer

Enclosure: TRM 5.2.1 Startup Report for Cycle 21

cc: NRC Project Manager
NRC Resident Office
Regional Administrator, Region III

Enclosure to
NRC-20-0062

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

TRM 5.2.1 Startup Report for Cycle 21

TRM 5.2.1 Startup Report for Cycle 21

1.0 Summary

This report is submitted in accordance with the requirement of the Fermi 2 Technical Requirements Manual (TRM) Section TR 5.2.1, "Startup Report." TRM Section TR 5.2.1.a states that a "summary report of plant startup and power escalation testing shall be submitted following: … 3. Installation of fuel that has a different design or has been manufactured by a different fuel supplier…". During the recently completed twentieth refueling outage (RF20), Fermi 2 loaded 176 GNF3 fuel assemblies which have a different design than previously used. The GNF3 fuel is manufactured by Global Nuclear Fuel (GNF), which is the same manufacturer as the remainder of the fuel in the core. This report summarizes plant startup and power ascension testing following completion of RF20. Per TRM Section TR 5.2.1.b, the startup report addresses applicable tests identified in Subsection 14.1.4.8 of the Updated Final Safety Analysis Report (UFSAR) and includes a description of the measured values of the operating conditions or characteristics obtained during the test program and a comparison of these values with design predictions and specifications.

1.1 Purpose

As described in the TRM, the startup report addresses each of the tests identified in Subsection 14.1.4.8 of the Fermi 2 UFSAR. The report includes a description of the measured values of the operating conditions and characteristics obtained during the test program. This report summarizes the testing completed during power ascension after introducing GNF3 fuel during RF20.

1.2 Acceptance Criteria

Level 1 criterion is associated with the value of a process variable assigned in the design of the plant, component systems, or associated equipment. If a Level 1 criterion is not satisfied, the plant will be placed in a suitable hold condition until resolution is obtained. Tests compatible with this hold condition may be continued. Following resolution, applicable tests must be repeated to verify the requirements of the Level 1 criterion are satisfied.

Level 2 criterion is associated with expectations relating to the performance of systems. If a Level 2 criterion is not satisfied, operating and testing plans would not necessarily be altered. The measurements and analytical techniques used for the predictions would be investigated.

Acceptance criteria values have been verified against current Technical Specifications. Failure to meet established acceptance criteria must be documented within the Corrective Action Program (CAP).

1.3 Testing Requirements

Each of the tests listed in Subsection 14.1.4.8 of the Fermi 2 UFSAR were evaluated for applicability for the GNF3 new fuel introduction. Tests that were determined to be not applicable are listed in Section 2.0. Tests that were determined to be applicable are described, along with their results, in Section 3.0.

2.0 UFSAR Subsection 14.1.4.8 Tests Not Required

2.1 Chemical and Radiochemical (UFSAR Subsection 14.1.4.8.1)

The principal objectives of this test are to secure information on the chemistry and radiochemistry of the reactor coolant, and to determine that the sampling equipment, procedures, and analytic techniques are adequate to supply the data required to demonstrate that the chemistry of all parts of the entire reactor system meet specifications and process requirements.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.2 Radiation Measurements (UFSAR Subsection 14.1.4.8.2)

The purpose of this test is to determine the background radiation levels in the plant environs prior to operation for base data on activity buildup, and to monitor radiation at selected power levels to ensure the protection of personnel during plant operation.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test nor does it appreciably change the background radiation levels, therefore this test was not required.

2.3 Source Range Monitor (SRM) Performance and Control Rod Sequence (UFSAR Subsection 14.1.4.8.6)

The purpose of this test is to demonstrate that the operational sources, source range monitor (SRM) instrumentation, and rod withdrawal sequences provide adequate information to achieve criticality and increase power in a safe and efficient manner. The effect of typical rod movements on reactor power will be determined.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.4 Water Level Reference Leg Temperature Measurement (UFSAR Subsection 14.1.4.8.7)

The purpose of this test is to measure the reference leg temperature and recalibrate the instruments if the measured temperature is different from the value assumed during the initial calibration.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.5 Intermediate Range Monitor Performance (UFSAR Subsection 14.1.4.8.8)

The purpose of this test is to adjust the intermediate range monitor (IRM) system to obtain an optimum overlap with the SRM and average power range monitor (APRM) systems.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.6 Local Power Range Monitor Calibration (UFSAR Subsection 14.1.4.8.9)

The purpose of this test is to calibrate the local power range monitor (LPRM) system.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.7 Average Power Range Monitor Calibration (UFSAR Subsection 14.1.4.8.10)

The purpose of this test is to calibrate the APRM system.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.8 Process Computer (UFSAR Subsection 14.1.4.8.11)

The purpose of this test is to verify the performance of the process computer under plant operating conditions.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.9 Reactor Core Isolation Cooling System (UFSAR Subsection 14.1.4.8.12)

The purpose of this test is to verify the proper operation of the reactor core isolation cooling (RCIC) system over its expected operating pressure range.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.10 High Pressure Coolant Injection System (UFSAR Subsection 14.1.4.8.13)

The purpose of this test is to verify the proper operation of the high pressure coolant injection (HPCI) system over its expected operating pressure range.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.11 Selected Process Temperatures (UFSAR Subsection 14.1.4.8.14)

The purposes of this test are to establish the proper setting of the low speed limiter for the recirculation pumps to avoid coolant temperature stratification in the reactor pressure vessel (RPV) bottom head region, to provide assurance that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operations, and to identify any reactor operating modes that cause temperature stratification.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.12 System Expansion (UFSAR Subsection 14.1.4.8.15)

The purpose of this test is to verify that major piping of the nuclear steam supply system (NSSS) and related auxiliary systems is free and unrestrained with regard to thermal expansion, and to verify that the thermal movement of the piping and associated support system components is consistent with the analytical predictions of the piping system stress analyses.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.13 Pressure Regulator (UFSAR Subsection 14.1.4.8.20)

The purposes of this test are to determine the optimum settings for the pressure control loop by analysis of the transients induced in the reactor pressure control system by means of the pressure regulators, to demonstrate the takeover capability of the backup pressure regulator on failure of the controlling pressure regulator and to set spacing between the setpoints at an appropriate value, and to demonstrate smooth pressure control transition between the control valves and bypass valves when the reactor generates more steam than is used by the turbine.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.14 Feedwater System (UFSAR Subsection 14.1.4.8.21)

The purposes of this test are to adjust the feedwater control system for acceptable reactor water level control, to demonstrate stable reactor response to subcooling changes, to demonstrate the capability of the automatic core flow runback feature to prevent low water level scram following the trip of one feedwater pump, to demonstrate adequate response to feedwater heating loss, and to determine the maximum feedwater runout capability.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.15 Turbine Valve Surveillance (UFSAR Subsection 14.1.4.8.22)

The purpose of this test is to demonstrate acceptable procedures and maximum power levels for surveillance testing of the main turbine control and stop valves without producing a reactor scram.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.16 Main Steam Isolation Valves (UFSAR Subsection 14.1.4.8.23)

The purposes of this test are to check functionally the main steam line isolation valves (MSIVs) for proper operation at selected power levels, to determine reactor transient behavior during and after simultaneous full closure of all MSIVs, and to determine isolation valve closure time.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.17 Relief Valves (UFSAR Subsection 14.1.4.8.24)

The purposes of this test are to verify that the relief valves function properly (can be opened and closed manually), to verify that the relief valves reseat properly after operation, and to verify that there are no major blockages in the relief valve discharge piping.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.18 Turbine Stop Valve and Control Valve Fast Closure Trips (UFSAR Subsection 14.1.4.8.25)

The purpose of this test is to demonstrate the response of the reactor and its control systems to protective trips in the turbine and generator.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.19 Shutdown From Outside the Control Room (UFSAR Subsection 14.1.4.8.26)

The purpose of this test is to demonstrate that the reactor can be brought from a normal, initial, steady-state power level to the hot shutdown condition and to verify that the plant has the potential for being safely cooled from hot shutdown to cold shutdown conditions from outside the control room using the remote shutdown panel.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.20 Flow Control (UFSAR Subsection 14.1.4.8.27)

The purposes of this test are to determine the correct gain settings for the individual recirculation controllers, to demonstrate plant response to changes in circulation flow in both local manual and master manual mode, and to set the limits of range of operation for the recirculation pumps.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.21 Recirculation System (UFSAR Subsection 14.1.4.8.28)

The purposes of this test are to verify that the feedwater control system can satisfactorily control the water level without a resulting turbine trip/scram and obtain actual pump speed/flow, to verify recirculation pump startup under pressurized reactor conditions, to obtain recirculation system performance data, and to verify that no recirculation system cavitation occurs in the operable region of the power flow map.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.22 Loss of Turbine-Generator and Offsite Power (UFSAR Subsection 14.1.4.8.29)

The purposes of this test are to determine the reactor transient performance during the loss of the main generator and all offsite power and to demonstrate acceptable performance of the station electrical supply system.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.23 Steady-State Vibration (UFSAR Subsection 14.1.4.8.30)

The purpose of this test is to determine the vibration characteristics of the primary pressure boundary piping and engineered safety feature piping systems for vibrations induced by recirculation flows, hot two-phase forces, and hot hydrodynamic transients; and to demonstrate that flow-induced vibrations, similar in nature to those expected during normal and abnormal operation, will not cause damage and excessive pipe movement and vibration.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.24 Recirculation System Flow Calibration (UFSAR Subsection 14.1.4.8.31)

The purpose of this test is to perform a complete calibration of the installed recirculation system flow instrumentation.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.25 Reactor Water Cleanup System (UFSAR Subsection 14.1.4.8.32)

The purpose of this test is to demonstrate specific aspects of the mechanical operability of the reactor water cleanup (RWCU) system.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.26 Residual Heat Removal System (UFSAR Subsection 14.1.4.8.33)

The purpose of this test is to demonstrate the ability of the residual heat removal (RHR) system to remove residual and decay heat from the nuclear system so that refueling and nuclear servicing can be performed.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

2.27 Piping System Dynamic Response Testing (UFSAR Subsection 14.1.4.8.34)

The purpose of this test is to verify that piping system structural behavior under probable transient loadings is acceptable and within the limit predicted by analytical investigations.

The GNF3 new fuel introduction does not affect the performance of systems needed to satisfy the objectives of this test, therefore this test was not required.

3.0 UFSAR Subsection 14.1.4.8 Tests Required

3.1 Fuel Loading (UFSAR Subsection 14.1.4.8.3)

Purpose

The purpose of this test is to load fuel safely and efficiently to the full core size.

Description

Prior to fuel loading, control rods and neutron sources and detectors are installed and tested. Fuel loading begins at the center of the core and proceeds radially to the fully loaded configuration. Control rod functional tests, subcriticality checks, and shutdown margin demonstrations are performed periodically during the loading.

Criteria

Level 1 – The partially loaded core must be subcritical by at least 0.38 percent Δk/k with the analytically determined strongest rod fully withdrawn.

Level 2 – Not applicable.

Results

The beginning of cycle shutdown margin calculated by the Fermi 2 fuel vendor was reported at 1.51 percent Δk/k. Core shuffle was conducted in accordance with approved instructions. Equipment required to be operable to ensure that shutdown margin is maintained was verified by various performances of Procedure 24.000.03, "Mode 5 Shiftly, Daily, and Weekly Surveillances," before and during core alterations. Post core alteration core verification was completed on June 19, 2020 in accordance with Procedure 82.000.04, "Refueling and Core Post-Alteration Verification." All fuel bundles were verified to be in their proper locations and properly oriented in the control cells. Therefore, all applicable test criteria were met.

3.2 Full Core Shutdown Margin (UFSAR Subsection 14.1.4.8.4)

Purpose

The purpose of this test is to demonstrate that the reactor is subcritical throughout the fuel cycle with any single control rod fully withdrawn.

Description

This test is performed in the fully loaded core in the Xenon-free condition. The shutdown margin is measured by withdrawing the control rods until criticality is reached.

If criticality is not reached with in-sequence control rods in the configuration corresponding to the required shutdown margin reactivity, the shutdown margin is satisfied. Additional in-sequence control rods are then withdrawn until the reactor is critical. The difference between the measured K_{eff} and the calculated K_{eff} for the in-sequence critical will be applied to the calculated shutdown margin to obtain the true shutdown margin.

Criteria

Level 1 – The shutdown margin of the fully loaded core with the analytically determined strongest rod withdrawn must be at least 0.38 percent Δk/k plus an additional margin for exposure.

Level 2 – Criticality should occur within ±1.0 percent Δk/k of the predicted critical.

Results

The shutdown margin measured on July 30, 2020 in accordance with Procedure 54.000.01, "Shutdown Margin Check," was 1.441 percent. This was above the minimum required shutdown margin of 0.38 percent (no additional margin for exposure is required since minimum shutdown margin is predicted to occur at the beginning of Cycle 21). The difference between the period and temperature corrected eigenvalue at criticality and the predicted critical eigenvalue was determined to be 0.069 percent Δk/k. Therefore, all applicable test criteria were met.

3.3 Control Rod Drive System (UFSAR Subsection 14.1.4.8.5)

Purpose

The purposes of the control rod drive (CRD) system test are to demonstrate that the CRD system operates properly over the full range of primary coolant temperatures and pressures from ambient to operating, and to determine the initial operating characteristics of the entire CRD system.

Description

The CRD tests performed during the open vessel, heatup, and power test parts of the startup test program are designed as an extension of the tests performed during the preoperational CRD system tests. Thus, after it is verified that all CRDs operate properly when installed, they are tested periodically during heatup to ensure that there is no significant binding caused by thermal expansion of the core components.

Criteria

Level 1 – Each CRD must have a normal withdrawal speed less than, or equal to, 3.6 in./sec, indicated by a full 12-ft stroke in greater than, or equal to, 40 sec. The mean scram time of all operable CRDs with functioning accumulators must not exceed the UFSAR times (scram time is measured from the time the pilot scram valve solenoids are

deenergized). The mean scram time of the three fastest CRDs in a two-by-two array must not exceed the UFSAR times (scram time is measured from the time the pilot scram valve solenoids are deenergized).

Level 2 – Each CRD must have a normal insertion or withdrawal speed of 3.0 ± 0.6 in./sec, indicated by a full 12-ft stroke in 40 to 60 sec. With respect to the CRD friction tests, if the differential pressure variation exceeds 15 psid for a continuous drive-in, a settling test must be performed. In this case, the differential settling pressure should not be less than 30 psid, nor should it vary by more than 10 psid over a full stroke.

Results

The CRD performance was measured by performance of 27.106.05, "Control Rod Drive Timing Test and Adjustment," which was completed on July 2, 2020. The test assured CRD speeds are within the normal band. All CRDs were operated during the Cycle 21 startup proving the system operates properly over the full range of primary coolant temperatures and pressures from ambient to operating conditions. Therefore, all applicable test criteria were met.

3.4 Core Performance (UFSAR Subsection 14.1.4.8.17)

Purpose

The purposes of this test are to evaluate the core thermal power and core flow and to evaluate the following core performance parameters: maximum linear heat generation rate (MLHGR), minimum critical power ratio (MCPR), and maximum average planar linear heat generation rate (MAPLHGR).

Description

The core performance evaluation is employed to determine the principal thermal and hydraulic parameters associated with core behavior. These parameters are: core flow rate, core thermal power level, MLHGR, MCPR, and MAPLHGR. Those core performance parameters listed are evaluated as follows. Core flow rate is read from the total core flow recorder in the control room, and a correction curve is used if necessary. During some transients, core ΔP will be used as an indication of core flow. Core thermal power is determined from a detailed reactor heat balance. The MLHGR is determined using the LPRM system, axial power distribution information, and calculated fuel assembly local power distribution information. The value of MAPLHGR in the core shall be restricted to the limits given in the Technical Specifications. The MCPR of a fuel assembly depends on the fuel assembly flow, the total fuel assembly power, the fuel assembly average exposure, the core inlet subcooling, and the fuel assembly peak axial power factor and location.

Criteria

Level 1 – The MLHGR during steady-state conditions shall not exceed the allowable heat flux as specified in the Technical Specifications. The steady-state MCPR shall be

maintained greater than, or equal to, the value specified in the Technical Specifications. The MAPLHGR shall not exceed the limits given in the Technical Specifications. Steady-state reactor power shall be limited to full rated maximum values on or below the design flow control line. Core flow should not exceed its rated value.

Level 2 – Not applicable.

Results

During power ascension after RF20, core parameters were monitored frequently using the 3D-Monicore system. Core performance was documented in Procedure 54.000.07, "Core Performance Parameter Check," and Procedure 24.000.02, "Shiftly, Daily, and Weekly Required Surveillances," beginning on August 6, 2020. Offline comparisons of 3D-Monicore output and PANACEA output indicate the core is behaving as expected, with all thermal parameters within Technical Specification limits and core power and flow on or below rated values. Therefore, all applicable test criteria were met.