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November 8, 2019 10 CFR 50.90
NRC-19-0054

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: License Amendment Request to Revise Technical Specifications to Change Surveillance Intervals to Accommodate a 24-Month Fuel Cycle

References:
1) NRC Generic Letter 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle, dated April 2, 1991

2) Letter from US Nuclear Regulatory Commission to DTE Electric Company (DTE), dated July 14, 2015, Issuance of Amendment Re: Revise Technical Specifications by Relocating Surveillance Frequencies to Licensee Control in accordance with Technical Specification Task Force Traveler 425, Revision 3 (ML15155B416)

In accordance with the provisions of 10 CFR 50.90, “Application for amendment of license, construction permit, or early site permit,” DTE Electric Company (DTE) requests an amendment to Appendix A, Technical Specifications of the Renewed Facility Operating License NPF-43 for Fermi Unit 2 (Fermi 2).

This submittal requests changes to the Technical Specifications (TS) to increase certain Surveillance Requirement (SR) intervals from 18 months to 24 months. Reference 2 relocated most TS SR intervals to a licensee controlled program governed by TS 5.5.15, Surveillance Frequency Control Program (SFCP). The proposed modification to TS 5.5.15 would review the requested SR interval increases in accordance with NRC Generic Letter (GL) 91-04 (Reference 1).

The submittal also proposes changes to TS 5.5.7, Ventilation Filter Testing Program (VFTP) and TS 5.5.14, Control Room Envelope Habitability Program to increase the current 18-month testing intervals to 24 months.

Enclosure 1 provides a detailed description and evaluation of the proposed changes, including an analysis of the significant hazards considerations using the standards of 10 CFR 50.92. DTE has concluded the changes proposed in this submittal do not result in a significant hazards consideration. Enclosure 2 provides the existing TS pages marked up with the proposed changes. Enclosure 3 provides revised (clean) TS pages. Enclosure 4 identifies that there are no TS Bases affected by the proposed TS changes. Enclosures 5, 6, and 7 provide the evaluation of the proposed SR interval changes and other information in accordance with the guidance in Generic Letter 91-04 (Reference 1).

In accordance with 10 CFR 50.91, DTE is notifying the State of Michigan of this application by transmitting a copy of this letter and enclosures to the designated Michigan State Official.

Approval of the proposed amendment is requested by November 30, 2020. Once approved, the amendment shall be implemented within 60 days.

No new commitments are being made in this submittal.

Should you have any questions or require additional information, please contact Mr. Jason R. Haas, Manager – Nuclear Licensing, at (734) 586-1769.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 8, 2019

Paul Fessler, Senior Vice President Nuclear Generation, for
Peter Dietrich, Senior Vice President and CNO

Enclosures:

1. Evaluation of the Proposed License Amendment
2. Proposed Technical Specifications Changes (Markup)
3. Technical Specifications Revised
4. Proposed Technical Specifications Bases Mark-up (For Information Only)
5. GL 91-04 Evaluation
6. Applicable Instrumentation
7. Instrument Drift Analysis Design Guide, DTE-18001, Revision 0

cc: NRC Project Manager
NRC Resident Office
Regional Administrator, Region III
Michigan Department of Environment, Great Lakes, and Energy

Enclosure 1 to
NRC-19-0054

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

Evaluation of the Proposed License Amendment

Evaluation of the Proposed License Amendment

Contents

Acronym List

24 MFC	24 Month Fuel Cycle
AC	Alternating Current
ATWS-RPT	Anticipated Transient Without Scram Recirculation Pump Trip
AV	Allowable Values
BWR	Boiling Water Reactor
CRE	Control Room Envelope
CREF	Control Room Emergency Filtration
CREHP	Control Room Envelope Habitability Program
CFR	Code of Federal Regulations
DC	Direct Current
DTE	DTE Electric Company
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EECW	Emergency Equipment Cooling Water
EESW	Emergency Service Cooling Water
EPRI	Electric Power Research Institute
ESF	Engineered Safety Feature
GL	Generic Letter
GSE	Gland Seal Exhauster
LLS	Low-Low Set
MVP	Mechanical Vacuum Pump
NRC	Nuclear Regulatory Commission
PAM	Post Accident Monitoring
PCIV	Primary Containment Isolation valve
RCIC	Reactor Core Isolation Cooling
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RTP	Rated Thermal Power
SCIV	Secondary Containment Isolation Valves
SDV	Scram Discharge Volume
SFA	Surveillance Failure Analysis
SFCP	Surveillance Frequency Control Program
SGT	Standby Gas Treatment
SLC	Standby Liquid Control
SR	Surveillance Requirement
SRV	Safety Relief Valve
TIP	Traversing In-Core Probe
TRM	Technical Requirements Manual
TS	Technical Specifications
TSTF	Technical Specifications Task Force
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
VFTP	Ventilation Filter Testing Program

1.0 SUMMARY DESCRIPTION

In accordance with the provisions of 10 CFR 50.90, DTE Electric Company (DTE) is submitting a request for an amendment to the Technical Specifications (TS) for Fermi 2.

The proposed amendment would modify the Fermi 2 TS to support a 24 Month Fuel Cycle (24 MFC) in accordance with the guidance of NRC Generic Letter 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle, dated April 2, 1991. In 2015, DTE adopted the Surveillance Frequency Control Program (SFCP) (Reference NRC Accession Number ML15155B416) which relocated most TS SR intervals to a licensee controlled program governed by TS 5.5.15, SFCP. Since the affected 18-month SR intervals are controlled by the SFCP, the proposed TS change revises TS 5.5.15, SFCP. This change, in conjunction with NRC review of the supporting justification, would increase the SR intervals from 18 to 24 months for SR intervals controlled by the SFCP. Specifically, the proposed TS change modifies TS 5.5.15.b. as follows:

> "The one-time 24 MFC related Surveillance Requirement Frequency changes approved by the NRC in License Amendment XXX are not subject to this provision. Subsequent changes are subject to the Surveillance Frequency Control Program."

Additionally, the proposed TS changes modify TS 5.5.7, Ventilation Filter Testing Program (VFTP), and TS 5.5.14, Control Room Envelope Habitability Program, to increase the frequency of current 18-month testing requirements to 24 months.

The supporting technical justification for the proposed TS changes addresses the information requested by Generic Letter 91-04.

Once the amendment is approved, the associated NRC Safety Evaluation (SE) documenting review of the supporting GL 91-04 technical justification will provide the basis for incorporating the revised SR intervals into the SFCP list required by TS 5.5.15.a. Any future changes to the revised SR intervals will be governed by TS 5.5.15.

2.0 BACKGROUND

DTE plans to transition Fermi 2 from the current 18-month operating cycle to a 24 MFC. This transition necessitates corresponding changes to SR intervals from 18 to 24 months to accommodate SRs that must be performed while the plant is shutdown.

On September 16, 2014, DTE requested an amendment to the Fermi 2 TS to implement Nuclear Regulatory Commission (NRC) approved TS Task Force (TSTF) Change Traveler, TSTF-425, Revision 3, Relocate Surveillance Frequencies to Licensee Control - RITSTF [Risk-Informed TSTF] Initiative 5. (NRC Accession No. ML14259A564). By letter dated July 14, 2015, the NRC issued Amendment No. 201 which approved the requested TS

changes (ML15155B416). Amendment No. 201 incorporated TS 5.5.15, Surveillance Frequency Control Program (SFCP) into the Fermi 2 TS. At that time, DTE was not contemplating transitioning Fermi 2 to a 24 MFC.

The SFCP transferred most SR intervals from the TS to a licensee controlled program. As discussed during DTE's presentation to the NRC in the pre-submittal meeting held on December 4, 2018 (ML18337A025), DTE is requesting NRC approval of a 24 MFC License Amendment based on GL 91-04 in-lieu of the SFCP. TSTF-425 was not intended to address the wholesale SR interval changes associated with a transition to 24 MFC. DTE observes that all plants with 24 MFC used GL 91-04 as the basis for the 24 MFC SR interval changes.

GL 91-04, has been, and continues to be the basis for 24 MFC SR interval changes. Since 1991, 24 MFC license amendment requests included the information requested by GL 91-04.

Recent BWRs using GL 91-04 as the basis for the transition to 24 MFCs include: Grand Gulf (2013); Cooper (2012); River Bend (2010); Browns Ferry Unit 1 (2006); Clinton (2005); and Monticello (2005). Most recently, NRC issued a GL 91-04 based 24 MFC amendment for the H. B. Robinson plant on May 25, 2018. The GL 91-04 basis for 24 MFC SR interval changes is well established. As there is no prior experience with using the SFCP for the transition to 24 MFC, the Fermi 2 proposed 24 MFC SR interval changes utilize the GL 91-04 approach.

3.0 DETAILED DESCRIPTION

In accordance with the provisions of 10 CFR 50.90, DTE is submitting a request for an amendment to the Fermi 2 TS.

The proposed amendment would modify the Fermi 2 TS to support a 24 MFC. The proposed TS change revises TS 5.5.15, Surveillance Frequency Control Program. This change, in conjunction with NRC review of the supporting justification, would increase the SR intervals identified in section 3.1 from 18 to 24 months for TS SR intervals controlled by the SFCP.

As discussed in Section 2.0, DTE adopted TSTF-425. Adoption of TSTF-425 added TS 5.5.15, Surveillance Frequency Control Program and transferred most SR intervals from the TS to the licensee controlled list required by TS 5.5.15.a.
The list includes the SR intervals that are proposed to be changed to 24 months. TS 5.5.15 permits the licensee to change TS SR intervals in the licensee controlled list as provided by TS 5.5.15.b.

TS 5.5.15.b. states:

> “Changes to the Frequencies listed in the Surveillance Frequency Control Program shall be made in accordance with the NEI 04-10, "Risk-Informed Method for Control of Surveillance Frequencies," Revision 1.”

GL 91-04, has, and continues to be, the approach used as the basis for 24 MFC SR interval changes. Accordingly DTE proposes to add the following provision to TS 5.5.15.b.

> “The one-time 24 Month Fuel Cycle related Surveillance Requirement Frequency changes approved by the NRC in License Amendment XXX are not subject to this provision. Subsequent changes are subject to the Surveillance Frequency Control Program.”

This provision provides an exception to the TS 5.5.15.b, requirement to evaluate the 24 MFC SR interval changes using NEI 04-10, Revision 3. In conjunction with this change, DTE is submitting the technical justification requested by GL 91-04. The overall impact of this approach is that the process for changing SR intervals for Fermi 2 is the same as for previous plants including those identified in Section 5.2. DTE is requesting a license amendment to change the SR intervals using technical justification which addresses the information requested by GL 91-04. The difference between Fermi 2 and previous 24 MFC submittals is how the changes are reflected administratively in the TS.

Once the amendment is approved, the associated NRC Safety Evaluation (SE) documenting review of the supporting GL 91-04 technical justification will provide the basis for incorporating the revised SR intervals into the SFCP list required by TS 5.5.15.a. Any future changes to the revised SR intervals will be governed by TS 5.5.15.

There are three TS Section 5.5 programs that currently have periodic 18-month frequency requirements that are not within the scope of the SFCP. Accordingly, DTE proposes to change the 18-month periodic requirements to 24 months. Conforming changes are proposed for TS 5.5.7, Ventilation Filter Testing Program, and TS 5.5.14, Control Room Envelope Habitability Program, to extend the current 18-month testing requirements to 24 months. TS 5.5.2, Primary Coolant Sources Outside Containment, includes integrated leak test requirements for systems within the scope of TS 5.5.2 at “refueling cycle intervals or less.” While there are no wording changes required for TS 5.5.2, the GL 91-04 technical justification is provided in this application for the change from 18 to 24 months.

3.1 Surveillance Interval Changes for a 24-Month Fuel Cycle

The following SR intervals are being revised to 24 months:

TS 3.1.7 Standby Liquid Control (SLC) System

SR 3.1.7.8 Verify flow through one SLC subsystem from pump into reactor pressure vessel.
SR 3.1.7.9 Verify all piping between storage tank and explosive valve is unblocked.

TS 3.1.8 Scram Discharge Volume (SDV) Vent and Drain Valves

SR 3.1.8.2 Verify each SDV vent and drain valve:

a. Closes in ≤ 30 seconds after receipt of an actual or simulated scram signal; and
b. Opens when the actual or simulated scram signal is reset.

TS 3.3.1.1 Reactor Protection System (RPS) Instrumentation

SR 3.3.1.1.13 Perform CHANNEL FUNCTIONAL TEST.
SR 3.3.1.1.14 Perform CHANNEL CALIBRATION.
SR 3.3.1.1.15 Perform LOGIC SYSTEM FUNCTIONAL TEST.
SR 3.3.1.1.16 Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP.
SR 3.3.1.1.17 Verify the RPS RESPONSE TIME is within limits.

TS 3.3.2.1 Control Rod Block Instrumentation

SR 3.3.2.1.4 Perform CHANNEL FUNCTIONAL TEST.

TS 3.3.2.2 Feedwater and Main Turbine High Water Level Trip Instrumentation

SR 3.3.2.2.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be ≤ 219 inches.
SR 3.3.2.2.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including valve actuation.

TS 3.3.3.1 Post Accident Monitoring (PAM) Instrumentation

SR 3.3.3.1.2 Perform CHANNEL CALIBRATION.

TS 3.3.3.2 Remote Shutdown System

SR 3.3.3.2.2 Verify each required control circuit and transfer switch is capable of performing the intended function.
SR 3.3.3.2.3 Perform CHANNEL CALIBRATION for each required instrumentation channel.

TS 3.3.4.1 Anticipated Transient Without Scram Recirculation Pump Trip (ATWS-RPT) Instrumentation

SR 3.3.4.1.3 Perform CHANNEL CALIBRATION. The Allowable Values shall be:
a. Reactor Vessel Water Level-Low Low, Level 2: ≥ 103.8 inches; and
b. Reactor Vessel Pressure-High: ≤ 1153 psig.

SR 3.3.4.1.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including breaker actuation.

TS 3.3.5.1 Emergency Core Cooling System (ECCS) Instrumentation

SR 3.3.5.1.4 Perform CHANNEL CALIBRATION.
SR 3.3.5.1.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.
SR 3.3.5.1.6 Perform CHANNEL FUNCTIONAL TEST.

TS 3.3.5.2 Reactor Core Isolation Cooling (RCIC) System Instrumentation

SR 3.3.5.2.4 Perform CHANNEL CALIBRATION.
SR 3.3.5.2.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.
SR 3.3.5.2.6 Perform CHANNEL FUNCTIONAL TEST.

TS 3.3.5.3 Reactor Pressure Vessel (RPV) Water Inventory Control Instrumentation

SR 3.3.5.3.3 Perform CHANNEL FUNCTIONAL TEST

TS 3.3.6.1 Primary Containment Isolation Instrumentation

SR 3.3.6.1.4 Perform CHANNEL CALIBRATION.
SR 3.3.6.1.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.
SR 3.3.6.1.6 Perform CHANNEL FUNCTIONAL TEST.
SR 3.3.6.1.7 Verify the Main Steam Line Isolation Instrumentation DC Output Relays response time allows the overall ISOLATION SYSTEM RESPONSE TIME to remain within limits.

TS 3.3.6.2 Secondary Containment Isolation Instrumentation

SR 3.3.6.2.4 Perform CHANNEL CALIBRATION.
SR 3.3.6.2.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.

TS 3.3.6.3 Low-Low Set (LLS) Instrumentation

SR 3.3.6.3.3 Perform CHANNEL CALIBRATION.
SR 3.3.6.3.4 Perform LOGIC SYSTEM FUNCTIONAL TEST.

TS 3.3.7.1 Control Room Emergency Filtration (CREF) System Instrumentation

SR 3.3.7.1.5 Perform CHANNEL CALIBRATION.
SR 3.3.7.1.6 Perform LOGIC SYSTEM FUNCTIONAL TEST.

TS 3.3.7.2 Mechanical Vacuum Pump (MVP) Trip Instrumentation

SR 3.3.7.2.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be $\leq$ 3.6 x full power background.
SR 3.3.7.2.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including MVP breaker actuation.

TS 3.3.7.3 Gland Seal Exhauster (GSE) Trip Instrumentation

SR 3.3.7.3.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be $\leq$ 3.6 x full power background.
SR 3.3.7.3.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including GSE breaker actuation.

TS 3.3.8.2 Reactor Protection System (RPS) Electric Power Monitoring

SR 3.3.8.2.2 Perform CHANNEL CALIBRATION. The Allowable Values shall be:
a. Overvoltage $\leq$ 132 V.
b. Undervoltage $\geq$ 108 V.
c. Underfrequency $\geq$ 57 Hz.
SR 3.3.8.2.3 Perform a system functional test.

TS 3.4.3 Safety Relief Valves (SRVs)

SR 3.4.3.2 Verify each required SRV is capable of being opened.

3.4.6 RCS Leakage Detection Instrumentation

SR 3.4.6.3 Perform a CHANNEL CALIBRATION of required leakage detection instrumentation.

TS 3.5.1 ECCS - Operating

SR 3.5.1.7 Verify each recirculation pump discharge valve cycles through one complete cycle of full travel or is de-energized in the closed position.
SR 3.5.1.10 Verify, with reactor pressure ≤ 215 psig, the HPCI pump can develop a flow rate ≥ 5000 gpm against a system head corresponding to reactor pressure.
SR 3.5.1.11 Verify each ECCS injection/spray subsystem actuates on an actual or simulated automatic initiation signal.
SR 3.5.1.12 Verify the ADS actuates on an actual or simulated automatic initiation signal.
SR 3.5.1.13 Verify each ADS valve is capable of being opened.
SR 3.5.1.14 Verify ECCS RESPONSE TIME is within limits.

TS 3.5.2 Reactor Pressure Vessel (RPV) Water Inventory Control

SR 3.5.2.8 Verify each valve credited for automatically isolating a penetration flow path actuates to the isolation position on an actual or simulated isolation signal.
SR 3.5.2.9 Verify the required ECCS injection/spray subsystem can be manually operated.

TS 3.5.3 RCIC System

SR 3.5.3.4 Verify, with reactor pressure ≤ 200 psig, the RCIC pump can develop a flow rate ≥ 600 gpm against a system head corresponding to reactor pressure.
SR 3.5.3.5 Verify the RCIC System actuates on an actual or simulated automatic initiation signal.

TS 3.6.1.1 Primary Containment

SR 3.6.1.1.2 Verify drywell to suppression chamber differential pressure does not decrease at a rate > 0.2 inch water gauge per minute tested over a 10 minute period at an initial differential pressure of 1 psid.

TS 3.6.1.3 Primary Containment Isolation Valves (PCIVs)

SR 3.6.1.3.8 Verify each automatic PCIV actuates to the isolation position on an actual or simulated isolation signal.
SR 3.6.1.3.9 Verify a representative sample of reactor instrumentation line EFCVs actuates on simulated instrument line break to restrict flow.
SR 3.6.1.3.10 Remove and test the explosive squib from each shear isolation valve of the TIP System.

TS 3.6.1.6 Low-Low Set (LLS) Valves

SR 3.6.1.6.1 Verify each LLS valve is capable of being opened.
SR 3.6.1.6.2 Verify the LLS System actuates on an actual or simulated automatic initiation signal.

TS 3.6.1.7 Reactor Building-to-Suppression Chamber Vacuum Breakers

SR 3.6.1.7.3 Verify the opening setpoint of each vacuum breaker is ≤ 0.5 psid.

TS 3.6.1.8 Suppression Chamber-to-Drywell Vacuum Breakers

SR 3.6.1.8.3 Verify the opening setpoint of each vacuum breaker is ≤ 0.5 psid.

TS 3.6.4.1 Secondary Containment

SR 3.6.4.1.5 Verify each standby gas treatment (SGT) subsystem will draw down the secondary containment to ≥ 0.25 inch of vacuum water gauge in ≤ 12 minutes.
SR 3.6.4.1.6 Verify each SGT subsystem can maintain ≥ 0.25 inch of vacuum water gauge in the secondary containment for 1 hour at a flow rate ≤ 3000 cfm.

TS 3.6.4.2 Secondary Containment Isolation Valves (SCIVs)

SR 3.6.4.2.3 Verify each automatic SCIV actuates to the isolation position on an actual or simulated actuation signal.

TS 3.6.4.3 Standby Gas Treatment (SGT) System

SR 3.6.4.3.3 Verify each SGT subsystem actuates on an actual or simulated initiation signal.
SR 3.6.4.3.4 Verify each SGT filter cooler bypass damper can be opened and the fan started.

TS 3.7.2 Emergency Equipment Cooling Water (EECW)/Emergency Equipment Service Water (EESW) System and Ultimate Heat Sink (UHS)

SR 3.7.2.5 Verify each EECW/EESW subsystem actuates on an actual or simulated initiation signal.

TS 3.7.3 Control Room Emergency Filtration (CREF) System

SR 3.7.3.3 Verify each CREF subsystem actuates on an actual or simulated initiation signal.

TS 3.7.6 The Main Turbine Bypass System and Moisture Separator Reheater

SR 3.7.6.3 Perform a system functional test.
SR 3.7.6.4 Verify the TURBINE BYPASS SYSTEM RESPONSE TIME is within limits.

TS 3.8.1 AC Sources – Operating

SR 3.8.1.13 Verify each EDG operates for ≥ 24 hours:

a. For all but the final ≥ 2 hours loaded ≥ 2500 kW and ≤ 2600 kW; and
b. For the final ≥ 2 hours of the test loaded ≥ 2800 kW and ≤ 2900 kW.

SR 3.8.1.14 Verify each EDG starts and achieves:

a. In ≤ 10 seconds, voltage ≥ 3950 V and frequency ≥ 58.8 Hz; and
b. Steady state voltage ≥ 3950 V and ≤ 4580 V and frequency ≥ 58.8 Hz and ≤ 61.2 Hz.

SR 3.8.1.16 Verify interval between each sequenced load block is within ± 10% of design interval for each load sequencer timer.

TS 3.8.4 DC Sources – Operating

SR 3.8.4.3 Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration that could degrade battery performance.
SR 3.8.4.4 Remove visible corrosion and verify battery cell to cell and terminal connections are coated with anti-corrosion material.
SR 3.8.4.5 Verify each battery:

a. Cell-to-cell and terminal connection resistance is ≤ 1.5E-4 ohm; and
b. Total cell-to-cell and terminal connection resistance is ≤ 2.7E-3 ohm.

SR 3.8.4.6 Verify each required battery charger supplies ≥ 100 amps at ≥ 124.7 V for ≥ 4 hours.

SR 3.8.4.7 Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the actual or simulated emergency loads for the design duty cycle when subjected to a battery service test.

TS 5.5 Programs and Manuals

The following TS programs have periodic requirements which are performed at 18 month intervals. The proposed change increases the intervals to 24 months.

TS 5.5.2 Primary Coolant Sources Outside Containment

The program shall include the following:

b. Integrated leak test requirements for each system at refueling cycle intervals or less.

TS 5.5.2 refers to "refueling cycle intervals or less." No changes are proposed to TS 5.5.2 the phrase "refueling cycle intervals or less." However, it is proposed that the phrase "refueling interval" will be understood to mean 24 months.

TS 5.5.7 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of Engineered Safety Feature (ESF) filter ventilation systems at the frequencies specified in Regulatory Guide 1.52, Revision 2, and in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980.

Regulatory Guide 1.52, Revision 2, specifies performance of required tests once every 18 months. The proposes change revises TS 5.5.7 as follows (changes are italicized):

"A program shall be established to implement the following required testing of Engineered Safety Feature (ESF) filter ventilation systems at the frequencies specified in Regulatory Guide 1.52, Revision 2, *except that the testing specified at a frequency of 18 months is required at a frequency of 24 months. The required testing shall be* in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980."

TS 5.5.14 Control Room Envelope Habitability Program

The program shall include the following elements:

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one subsystem of the CREF

System, operating at the flow rate required by the VFTP, at a Frequency of 18 months on a STAGGERED TEST BASIS. The results shall be trended and assessed every 18 months.

3.2 Need for Changes

DTE plans to transition Fermi 2 from the current 18-month fuel cycle to a 24 MFC. This transition necessitates corresponding changes to SR intervals from 18 to 24 months to accommodate SRs that typically or can only be performed while the plant is shutdown for a refueling outage.

The transition to a 24 MFC is expected to increase plant availability by eliminating one refueling outage every six years; reduce cumulative radiological occupational exposure due to fewer refueling outages; increase outage planning efficiency; and allow SRs that need to be performed while the plant is not operating to be completed.

3.3 Technical Specifications Bases Changes

There are no changes to the Technical Specifications Bases associated with this amendment request. With the implementation of the SFCP by License Amendment No. 201 (ML15155B416), the TS Bases were revised to replace specific SR intervals with references to the SFCP.

4.0 TECHNICAL EVALUATION

4.1 Generic Letter 91-04 Change Evaluation

NRC GL 91-04 provides generic guidance for evaluating SR interval changes from 18 to 24 months for two broad SR classifications; Non-Calibration SRs, and Calibration SRs. GL-91-04 defines three evaluation steps for Non-Calibration SR interval changes, and seven steps are defined for calibration SR interval changes. This section describes the approach used by DTE to address these steps for each proposed SR interval change from 18 to 24 months. The approach taken by DTE is consistent with that used to support previous 24 MFC license amendments including Grand Gulf (2013); Cooper (2012); and River Bend (2010).

Historical SR test data and associated maintenance records were reviewed for both Non-Calibration and Calibration changes to evaluate whether there is any adverse effect on safety. The licensing basis (UFSAR and commitments) was reviewed for functions associated with the subject SR intervals.

The impact of instrument drift was evaluated for the proposed calibration SR interval changes. As part of the drift evaluation, Fermi 2 instrumentation setpoint and uncertainty

calculations were revised, as necessary, to reflect the proposed calibration SR interval changes. Calibration information is affected for some instrumentation. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

There are no changes to TS Allowable Values (AV).

The results of Non-Calibration and Calibration change reviews support the conclusion that the effect on plant safety associated with the proposed SR interval increases from 18 to 24 months, if any, is small.

4.1.1 Non-Calibration Changes

GL 91-04 identifies three steps to evaluate Non-Calibration changes:

STEP 1: Licensees should evaluate the effect on safety of an increase in 18-month surveillance intervals to accommodate a 24-month fuel cycle. This evaluation should support a conclusion that the effect on safety is small.

EVALUATION

Each proposed Non-Calibration SR interval change has been evaluated with respect to the effect on plant safety. The methodology utilized to justify the conclusion that changing the SR interval to 24 months has a minimal effect on safety, is based on whether the associated function/feature is:

1. Tested on a more frequent basis during the operating cycle by other plant programs;
2. Designed to have redundant counterparts or be single failure proof; or
3. Highly reliable.

A summary of the evaluation of the effect on safety for each proposed Non-Calibration SR interval change is presented in Enclosure 5.

STEP 2: Licensees should confirm that historical plant maintenance and surveillance data support this conclusion.

EVALUATION

The SR test history of the affected SRs has been evaluated. This evaluation consisted of a review of available SR test results and associated maintenance records for at least five cycles of operation. With the extension of the SR interval to 24 months, there will be a longer period between each SR performance. If a failure that results in the loss of the associated safety function should occur during the operating cycle, and would only be

detected by the performance of the 18-month TS SR, then the increase in the SR testing interval could reduce the associated function availability. In addition to evaluating these SR failures, potential common failures of similar components tested by different SRs were also evaluated. This additional evaluation determined whether there is evidence of repetitive failures among similar plant components. These common component failures have been further evaluated to determine if there was an impact on plant reliability.

The evaluation documented in Enclosure 5 determined that current plant programs are adequate to ensure system reliability. SR failures that are discussed in Enclosure 5 exclude failures that:

1. Did not impact a TS safety function or TS operability;
2. Are detectable by required testing performed more frequently than the 18-month SR being extended; or
3. The cause can be attributed to an associated event such as a preventative maintenance task, human error, previous modification, or previously existing design deficiency; or that were subsequently re-performed successfully with no intervening corrective maintenance (e.g., plant conditions or malfunctioning measurement and test equipment may have caused aborting the test performance).

These categories of failures are not related to potential unavailability due to SR interval extension and are therefore not listed or further evaluated in this submittal. This review of SR test history validates the conclusion that the impact, if any, on system availability will be minimal as a result of the change to a 24-month SR interval. Specific SR test failures and justification for this conclusion are discussed in Enclosure 5.

STEP 3: Licensees should confirm that assumptions in the plant licensing basis would not be invalidated on the basis of performing any surveillance at the bounding SR interval limit provided to accommodate a 24 MFC.

EVALUATION

The impact of the proposed SR changes were reviewed to confirm that assumptions in the plant licensing basis would not be invalidated. In general, SR intervals are not discussed in the descriptions of functions in the plant licensing basis. A review of the Fermi 2 Updated Final Safety Analysis (UFSAR) and Fermi 2 commitment tracking database identified that no assumptions in the plant licensing basis that would be invalidated by the proposed SR interval changes. Any necessary conforming changes will be made during implementation of the license amendment as required by 10 CFR 50.71(e), or permitted by 10 CFR 50.59.

The Maintenance Rule Program monitors and trends performance of structures, systems, and components (SSC) included in the program scope. Degraded performance of SSCs are evaluated so that appropriate corrective measures can be taken. The evaluation of

degrading performance that may result from the proposed SR interval changes would be considered routinely as part of this evaluation.

4.1.2 Calibration Changes

GL 91-04 identifies seven steps for the evaluation of instrumentation Calibration changes.

STEP 1: Confirm that instrument drift as determined by as-found and as-left calibration data from surveillance and maintenance records has not, except on rare occasions, exceeded acceptable limits for a calibration interval.

EVALUATION

The effect of the proposed calibration SR interval changes on the associated TS instrumentation was evaluated by performing a review of the SR test history for the affected instrumentation including where appropriate, an instrument drift study. In performing the historical evaluation, the recorded channel calibration data for associated instruments for at least five operating cycles were retrieved. By obtaining this past recorded calibration data, an acceptable basis for drawing conclusions about the expectation of satisfactory performance can be made.

The Surveillance Failure Analysis identified no SR failures that would call into question the acceptability of the proposed extension of surveillance intervals. Furthermore, the drift evaluations for the Calibration SRs do not result in any changes to TS Allowable Values (AV).

STEP 2: Confirm that the values of drift for each instrument type (make, model, and range) and application have been determined with a high probability and a high degree of confidence. Provide a summary of the methodology and assumptions used to determine the rate of instrument drift with time based upon historical plant calibration data.

EVALUATION

A listing of the instrument make, model, and range affected by this submittal is provided in Enclosure 6. The effect of longer calibration intervals on the TS instrumentation was evaluated by performing an instrument drift study. In performing the drift study, the recorded channel calibration data for associated instruments was obtained for at least five operating cycles. This historical calibration data was analyzed to determine a statistically valid representation of instrument drift.

The methodology used to perform the drift analysis is consistent with the methodology utilized by other utilities requesting transition to a 24 MFC. The Fermi 2 methodology is

based on Electric Power Research Institute (EPRI) 3002002556 (TR-103335R2), Guidelines for Instrument Calibration Extension/Reduction – Revision 2; Statistical Analysis of Instrument Calibration Data, and is provided in Enclosure 7.

STEP 3: Confirm that the magnitude of instrument drift has been determined with a high probability and a high degree of confidence for a bounding calibration interval of 30 months for each instrument type (make, model number, and range) and application that performs a safety function. Provide a list of the channels by TS section that identifies these instrument applications.

EVALUATION

In accordance with the methodology described in Enclosure 7, the magnitude of instrument drift has been determined with a high degree of confidence and a high degree of probability (at least 95/95) for a bounding calibration interval of 30 months for each instrument make, model, and range. For instruments not in service long enough to establish a projected drift value, or where an insufficient number of calibrations have been performed to utilize the statistical methods (i.e., fewer than 30 calibrations for any given group of instruments), the SR interval is proposed to be extended to a 24-month interval based on justification obtained from analysis as presented in Enclosure 7. The list of affected channels by TS section, including instrument make, model, and range, is provided in Enclosure 6.

STEP 4: Confirm that a comparison of the projected instrument drift errors has been made with the values of drift used in the setpoint analysis. If this results in revised setpoints to accommodate larger drift errors, provide proposed TS changes to update trip setpoints. If the drift errors result in revised safety analysis to support existing setpoints, provide a summary of the updated analysis conclusions to confirm that safety limits and safety analysis assumptions are not exceeded.

EVALUATION

The projected 30-month drift values were compared to the design allowances as calculated in the associated instrument setpoint analyses. The projected drift values were incorporated into the setpoint calculations, and the analysis of the setpoint, allowable value, and/or analytical limit was reviewed. Setpoint calculations were revised, as necessary, to reflect appropriate drift values. The setpoint calculation revisions were performed in accordance with NEDC-31336P-A, dated September 1996, “General Electric Instrument Setpoint Methodology.” The revised calculations determined that sufficient margins are maintained relative to the applicable safety analyses and confirmed that the associated instruments are capable of performing their intended design function.

There are no changes required to TS Allowable Values. Calibration information is affected for some instrumentation as noted in Enclosure 5. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

STEP 5: Confirm that the projected instrument errors caused by drift are acceptable for control of plant parameters to effect a safe shutdown with the associated instrumentation.

EVALUATION

Enclosure 5 discusses the evaluation of impact of drift on instrument setpoint and uncertainty calculations associated with increasing the calibration interval from 18 to 24 months. This evaluation includes instrumentation used for safe shutdown. The revised setpoint and uncertainty calculations change calibration information if needed to accommodate 24-month calibration intervals. The changes in calibration information provide assurance that the instrumentation will perform with the required accuracy to effect a safe shutdown. The calibration information is implemented through plant calibration procedures. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

STEP 6: Confirm that all conditions and assumptions of the setpoint and safety analyses have been checked and are appropriately reflected in the acceptance criteria of plant SR procedures for channel checks, channel functional tests, and channel calibrations.

EVALUATION

As discussed above, the revised setpoint and uncertainty calculations result in changes to calibration information which are implemented through plant calibration procedures. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation. Existing plant processes ensure that the conditions and assumptions of the setpoint and safety analyses have been checked and are appropriately reflected in the acceptance criteria of plant surveillance procedures for channel checks, channel functional tests and channel calibrations.

STEP 7: Provide a summary description of the program for monitoring and assessing the effects of increased calibration surveillance intervals on instrument drift and its effect on safety.

EVALUATION

Instruments with TS calibration SR intervals extended to 24 months will be monitored and trended in accordance with station procedures including recording of as-found and as-left calibration data.

As required by plant procedures, out of tolerance conditions are entered into the corrective action program and are evaluated and trended. This approach will identify occurrences of instruments found outside of their allowable value and instruments whose performance is not as assumed in the drift or setpoint analysis. When the as found conditions are outside the allowable value, an evaluation will be performed in accordance with the station corrective action program to evaluate the effect, if any, on plant safety.

5.0 REGULATORY ANALYSIS

The proposed changes involve increasing SR intervals from 18 to 24 months to support the Fermi 2 transition to a 24 MFC. The proposed changes are based on the guidance provided by NRC GL 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle, dated April 2, 1991 (ML013100215). The guidance provided by GL 91-04 has been used as the basis for all 24 MFC SR interval license amendments requested and approved since April 2, 1991. Recent BWRs using GL 91-04 as the basis for SR interval changes to support 24 MFCs include: Grand Gulf Nuclear Station, Unit 1 (2013, ML13343A109); Cooper Nuclear Station (2012, ML11264A165); and River Bend Station, Unit 1 (2010, ML102350266).

DTE has evaluated the proposed changes and supporting information provided by this submittal relative to the GL 91-04 guidance. DTE has concluded the proposed changes and supporting information are consistent with and satisfy the guidance provided by GL 91-04.

In addition, DTE has evaluated the proposed changes with respect to the applicable regulatory requirements discussed below. DTE has concluded that the proposed changes do not impact conformance with regulatory requirements.

5.1 Applicable Regulatory Requirements/Criteria

5.1.1 10 CFR 50.36

10 CFR 50.36, Technical Specifications, defines the content required in licensee TS. Specifically, 10 CFR 50.36(c)(3) requires that the TS include SR requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met. The proposed changes increase SR intervals from 18 to 24 months. No SRs are eliminated by the proposed changes. The proposed SR

interval changes have been evaluated using the guidance provided by GL 91-04. Based on this evaluation, the proposed SR interval changes continue to support compliance 10 CFR 50.36(c)(3).

5.1.2 Applicable 10 CFR 50 Appendix A - General Design Criteria

Criterion 18

Inspection and testing of electric power systems. Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

The proposed changes to SR intervals have no impact on the physical configuration, design, function, or capability to test electric power systems. Therefore, Fermi 2 conformance to Criterion 18 is unaffected by the proposed changes.

Criterion 37

Testing of emergency core cooling system. The emergency core cooling system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system.

The proposed changes to SR intervals have no impact on the physical configuration, design, function, or capability to test emergency core cooling systems. Therefore, Fermi 2 conformance to Criterion 37 is unaffected by the proposed changes.

Criterion 40

Testing of containment heat removal system. The containment heat removal system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of

the active components of the system, and (3) the operability of the system as a whole, and under conditions as close to the design as practical the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system.

The proposed changes to SR intervals have no impact on the physical configuration, design, function, or capability to test containment heat removal systems. Therefore, Fermi 2 conformance to Criterion 40 is unaffected by the proposed changes.

Criterion 43

Testing of containment atmosphere cleanup systems. The containment atmosphere cleanup systems shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the systems such as fans, filters, dampers, pumps, and valves and (3) the operability of the systems as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of associated systems.

The proposed changes to intervals have no impact on the physical configuration, design, function, or capability to test containment atmosphere cleanup systems. Therefore, Fermi 2 conformance to Criterion 43 is unaffected by the proposed changes.

Criterion 46

Testing of cooling water system. The cooling water system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and the performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation for reactor shutdown and for loss-of-coolant accidents, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources.

The proposed changes to SR intervals have no impact on the physical configuration, design, function, or capability to test cooling water systems. Therefore, Fermi 2 conformance to Criterion 46 is unaffected by the proposed changes.

5.1.3 Applicable Regulatory Guidance

Regulatory Guide 1.52, Revision 2

Regulatory Guide 1.52, provides NRC Staff guidance regarding acceptable approaches to satisfy NRC regulations related to the design, testing, and maintenance of post-accident Engineered Safety Feature atmosphere cleanup systems. Regulatory Guide 1.52 identifies required testing that is to be performed at 18-month intervals. Fermi 2 TS 5.5.7, Ventilation Filter Testing Program references Regulatory Guide 1.52 for testing intervals, some of which are specified at 18 months. The proposed change increases the 18-month intervals to 24-months. All other elements of Regulatory Guide 1.52, Revision 2, conformance are unaffected by the proposed change. Enclosure 5, Section 2.A, Non-Calibration Changes, discusses the justification for the proposed frequency change.

5.2 Precedent

NRC GL 91-04 provides generic guidance for evaluating SR interval changes from 18 to 24 months. GL 91-04 identifies specific considerations to be addressed in applications to change SR intervals in support of a 24 MFC. The methodology and approach taken by DTE in addressing the GL 91-04 considerations is consistent with that used to support previous 24 MFC license amendments. Recent Boiling Water Reactor precedents include:

1. Grand Gulf Nuclear Station, Unit 1-Amendment No. 197, dated December 26, 2013 (ML13343A109)
2. Cooper Nuclear Station-Amendment No. 242, dated September 28, 2012 (ML12251A098)
3. River Bend Station, Unit 1-Amendment No. 168, dated August 31, 2010 (ML102350266)

5.3 No Significant Hazards Consideration

DTE has concluded that the proposed changes to the Fermi 2 TS described above do not involve a Significant Hazards Consideration. In support of this determination, an evaluation of each of the three standards, set forth in 10 CFR 50.92, Issuance of amendment, is provided below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed TS changes involve increasing SR intervals from 18 to 24 months to support a 24 MFC. The proposed TS changes do not physically alter the plant or its operation. The changes in calibration tolerances assure that the

instrumentation continues to function as assumed in the accident analyses. The proposed TS changes do not degrade the performance of, or increase the challenges to, any safety systems assumed to function in the accident analysis. The proposed TS changes do not impact the usefulness of the SR and testing requirements in evaluating the operability of required systems and components, or the way in which the SRs are performed. In addition, the SR intervals are not considered to be an initiator of any analyzed accident, nor do the SR interval changes introduce any new accident initiators. Therefore, the proposed change does not involve a significant increase in the probability of an accident previously evaluated.

The proposed changes to SR intervals do not affect the performance of any equipment credited to mitigate the radiological consequences of an accident. Evaluation of the proposed TS changes demonstrated that the availability of credited equipment is not significantly affected because of other more frequent testing that is performed, the availability of redundant systems and equipment, and the high reliability of the equipment. Historical review of SR test results and associated maintenance records did not find evidence of failures that would invalidate the above conclusions.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Do the proposed changes create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed TS changes involve increasing SR intervals from 18 to 24 months to support a 24 MFC. The proposed TS changes do not physically alter the plant or its operation or result in installed equipment being operated in a different manner. The changes in calibration tolerances assure that the instrumentation continues to function as assumed in the accident analyses. The proposed TS changes do not degrade the performance of, or increase the challenges to, any safety systems assumed to function in the accident analysis. Therefore, the proposed TS changes do not introduce any failure mechanisms of a different type than those previously evaluated.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Do the proposed changes involve a significant reduction in a margin of safety?

   Response: No.

   The proposed TS changes involve increasing in the SR intervals from 18 to 24 months to support a 24 MFC. The evaluation of the historical SR test data concludes the proposed SR interval changes will have little, if any, impact on system availability. Performance of other more frequent testing, the existence of redundant systems and equipment, and overall system reliability supports this conclusion. The proposed TS changes do not physically alter the plant or the performance of functions assumed in accident analyses. There are no changes to setpoints. Existing margin between plant operating conditions and setpoints is not affected by the proposed changes.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

5.4 Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with Nuclear Regulatory Commission regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

The proposed TS change was reviewed against the three criteria provided in 10 CFR 51.22 for environmental considerations. The review has resulted in the determination that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

Enclosure 2 to
NRC-19-0054

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

Proposed Technical Specifications Changes (Markup)

5.5 Programs and Manuals (continued)

5.5.7 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of Engineered Safety Feature (ESF) filter ventilation systems ~~at the frequencies specified in Regulatory Guide 1.52, Revision 2, and~~ in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980.

Testing will be performed at the frequencies specified by Regulatory Guide 1.52, Revision 2, except testing specified as having an 18-month frequency will be performed at a 24-month frequency.

a. Demonstrate for each of the ESF systems that an inplace test of the HEPA filters shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%.

ESF Ventilation System	Flowrate (cfm)	Penetration and System Bypass
Standby Gas Treatment	3800	0.05%
Control Room Emergency Filtration	1800 (makeup filter) 3000 (recirculation filter)	1.0%

b. Demonstrate for each of the ESF systems that an inplace test of the charcoal adsorber shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%.

ESF Ventilation System	Flowrate (cfm)	Penetration and System Bypass
Standby Gas Treatment	3800	0.05%
Control Room Emergency Filtration	1800 (makeup filter) 3000 (recirculation filter)	1.0%

(continued)

5.5 Programs and Manuals

5.5.14 Control Room Envelope Habitability Program (continued)

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one subsystem of the CREF System, operating at the flow rate required by the VFTP, at a Frequency of ~~18~~ months on a STAGGERED TEST BASIS. The results shall be trended and assessed every ~~18~~ months. 24 24

e. The quantitative limits on unfiltered air inleakage into the CRE. These limits shall be stated in a manner to allow direct comparison to the unfiltered air inleakage measured by the testing described in paragraph c. The unfiltered air inleakage limit for radiological challenges is the inleakage flow rate assumed in the licensing basis analyses of DBA consequences. Unfiltered air inleakage limits for hazardous chemicals must ensure that exposure of CRE occupants to these hazards will be within the assumptions in the licensing basis.

f. The provisions of SR 3.0.2 are applicable to the Frequencies for assessing CRE habitability, determining CRE unfiltered inleakage, and measuring CRE pressure and assessing the CRE boundary as required by paragraphs c and d, respectively.

5.5.15 Surveillance Frequency Control Program

This program provides controls for the Surveillance Frequencies. The program shall ensure that Surveillance Requirements specified in the Technical Specifications are performed at intervals sufficient to assure the associated Limiting Conditions for Operation are met.

a. The Surveillance Frequency Control Program shall contain a list of Frequencies of those Surveillance Requirements for which the Frequency is controlled by the program.

b. Changes to the Frequencies listed in the Surveillance Frequency Control Program shall be made in accordance with the NEI 04-10, "Risk-Informed Method for Control of Surveillance Frequencies," Revision 1.

INSERT A →

c. The provisions of Surveillance Requirements 3.0.2 and 3.0.3 are applicable to the Frequencies established in the Surveillance Frequency Control Program.

INSERT A

The one-time 24 Month Fuel Cycle related Surveillance Requirement Frequency changes approved by the NRC in License Amendment XXX are not subject to this provision. Subsequent changes are subject to the Surveillance Frequency Control Program.

Enclosure 3 to
NRC-19-0054

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

Technical Specifications Revised

5.5 Programs and Manuals (continued)

5.5.7 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of Engineered Safety Feature (ESF) filter ventilation systems in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980. Testing will be performed at the frequencies specified by Regulatory Guide 1.52, Revision 2, except testing specified as having an 18-month frequency will be performed at a 24-month frequency.

a. Demonstrate for each of the ESF systems that an inplace test of the HEPA filters shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%.

ESF Ventilation System	Flowrate (cfm)	Penetration and System Bypass
Standby Gas Treatment	3800	0.05%
Control Room Emergency Filtration	1800 (makeup filter) 3000 (recirculation filter)	1.0%

b. Demonstrate for each of the ESF systems that an inplace test of the charcoal adsorber shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%.

ESF Ventilation System	Flowrate (cfm)	Penetration and System Bypass
Standby Gas Treatment	3800	0.05%
Control Room Emergency Filtration	1800 (makeup filter) 3000 (recirculation filter)	1.0%

(continued)

5.5 Programs and Manuals

5.5.14 Control Room Envelope Habitability Program (continued)

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one subsystem of the CREF System, operating at the flow rate required by the VFTP, at a Frequency of 24 months on a STAGGERED TEST BASIS. The results shall be trended and assessed every 24 months.

e. The quantitative limits on unfiltered air inleakage into the CRE. These limits shall be stated in a manner to allow direct comparison to the unfiltered air inleakage measured by the testing described in paragraph c. The unfiltered air inleakage limit for radiological challenges is the inleakage flow rate assumed in the licensing basis analyses of DBA consequences. Unfiltered air inleakage limits for hazardous chemicals must ensure that exposure of CRE occupants to these hazards will be within the assumptions in the licensing basis.

f. The provisions of SR 3.0.2 are applicable to the Frequencies for assessing CRE habitability, determining CRE unfiltered inleakage, and measuring CRE pressure and assessing the CRE boundary as required by paragraphs c and d, respectively.

5.5.15 Surveillance Frequency Control Program

This program provides controls for the Surveillance Frequencies. The program shall ensure that Surveillance Requirements specified in the Technical Specifications are performed at intervals sufficient to assure the associated Limiting Conditions for Operation are met.

a. The Surveillance Frequency Control Program shall contain a list of Frequencies of those Surveillance Requirements for which the Frequency is controlled by the program.

b. Changes to the Frequencies listed in the Surveillance Frequency Control Program shall be made in accordance with the NEI 04-10, “Risk-Informed Method for Control of Surveillance Frequencies,” Revision 1.

The one-time 24 Month Fuel Cycle related Surveillance Requirement Frequency changes approved by the NRC in License Amendment XXX are not subject to this provision. Subsequent changes are subject to the Surveillance Frequency Control Program.

(continued)

5.5 Programs and Manuals

5.5.15 Surveillance Frequency Control Program (continued)

c. The provisions of Surveillance Requirements 3.0.2 and 3.0.3 are applicable to the Frequencies established in the Surveillance Frequency Control Program.

Enclosure 4 to
NRC-19-0054

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

Proposed Technical Specifications Bases (Markup)
(For Information Only)

There are no changes to the Technical Specifications Bases associated with this license amendment request.

Enclosure 5 to
NRC-19-0054

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

GL 91-04 Evaluation

1. BACKGROUND

DTE Energy Company (DTE), plans to transition Fermi 2 from the current 18-month operating cycle to a 24 Month Fuel Cycle (24 MFC). Technical Specification (TS) Surveillance Requirement (SR) interval changes are required to accommodate a 24 MFC for Fermi 2. The proposed TS SR interval changes were evaluated in accordance with the guidance provided in Nuclear Regulatory Commission (NRC) Generic Letter (GL) 91-04, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle," dated April 2, 1991. GL 91-04 provides the NRC Staff guidance that identifies the types of information that must be addressed when proposing extension of a SR interval from 18 to 24 months.

Enclosure 1 to this letter identifies the 18-month TS SRs where frequency changes are necessary to accommodate a proposed 24 MFC. Performance data and failure history associated with the affected TS SRs has been evaluated. The evaluations support the conclusion that the effect of the proposed changes on plant safety, reliability and availability of the systems, components, and functions, if any, is small.

The SRs were broadly categorized as non-calibration SRs and calibration SRs.

Fermi 2 historical SR performance data and associated maintenance records were reviewed to evaluate the effect of these changes on safety. This Surveillance Failure Analysis (SFA) included both non-calibration and calibration SRs. In addition, the potential impact of instrument drift associated with the proposed increases in calibration intervals was evaluated for the calibration SRs. These evaluations and results are described below.

The SFA identified no SR failures that would call into question the acceptability of the proposed extension of SR intervals. Furthermore, the drift evaluations for the calibration SRs did not result in any changes to TS Allowable Values (AV).

In addition, UFSAR reviews confirm that plant-licensing basis assumptions are not affected by the proposed SR interval changes.

In summary, these reviews support the conclusion that the effect on plant safety associated with the proposed SR interval increases from 18 to 24 months, if any, is small.

GL 91-04 identifies two subjects of special consideration that are not applicable to Fermi 2 and are not addressed in this submittal. First, steam generator inspections are not applicable to Fermi 2. Second, DTE has adopted 10 CFR 50, Appendix J, Option B, test intervals are performance based and are compatible with a 24 MFC. Therefore, no changes are required to containment leakage SR intervals specified by 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors."

Additionally, Fermi 2 has adopted TSTF-545, Revision 3, "TS Inservice Testing Program Removal & Clarify SR Usage Rule Application to Section 5.5 Testing." (Fermi 2 License

Amendment 207, dated November 29, 2017 ML17128A316). Any necessary changes to Inservice Testing (IST) SR intervals to support 24 MFC are being addressed under the IST program and are not discussed in this submittal.

2. EVALUATION

Enclosure 1 of this submittal discusses each step outlined by the NRC in GL 91-04 and provides a description of the methodology used by DTE to complete the evaluation for each applicable TS SR. The Fermi 2 drift analysis methodology is based on Electric Power Research Institute (EPRI) 3002002556 (TR-103335R2), Guidelines for Instrument Calibration Extension/Reduction-Revision 2; Statistical Analysis of Instrument Calibration Data. This is the current revision of EPRI TR-103335 which was used for previous plant submittals including: Grand Gulf Nuclear Station, Unit 1 (2013, ML13343A109); Cooper Nuclear Station (2012, ML11264A165); and River Bend Station, Unit 1 (2010, ML102350266). The Fermi 2 specific Drift Analysis methodology is provided as Enclosure 7.

Ideally, five operating cycles (approximately seven years at the 18-month SR interval) of performance data was obtained for each SR proposed for extension to 24 months. This provides sufficient data to identify repetitive issues. Exceptions to the availability of historical data, e.g., for recently added SRs, are discussed with the individual evaluations for the affected SRs.

Surveillance Failure Analysis

Surveillance Failure Analysis includes non-calibration and calibration SR interval changes. LOGIC SYSTEM FUNCTIONAL TESTS, CHANNEL FUNCTIONAL TESTS, and RESPONSE TIME Tests are included in the non-calibration change classification. The failure history for each of the affected 18-month SRs was evaluated.

The SFA is concerned with failures that could result in the loss of the associated safety function during the operating cycle that would only be detected by the performance of the 18-month SR, and whether the proposed increase in the SR interval might result in a decrease in availability of the associated function. Additionally, the SFA reviews potential common failures of similar components tested by different SRs. This additional evaluation determined whether there is evidence of repetitive failures among similar plant components.

The Fermi 2 SR program tracks and schedules "Events" which are credited with satisfying TS SRs. These Events involve performance of all or part of SR procedures which fulfill one or more SRs. The Events that satisfy SRs where SR interval changes are proposed were evaluated. The SR failures described in this enclosure exclude failures that:

a. Did not impact a TS safety function or TS operability;
b. Are detectable by required testing performed more frequently than the 18-month SR being extended; or

c. The cause can be attributed to an associated event such as a preventative maintenance task, human error, previous modification, or previously existing design deficiency; or that were subsequently re-performed successfully with no intervening corrective maintenance (e.g., plant conditions or malfunctioning measurement and test equipment may have caused aborting the test performance).

These types of failures are not related to potential unavailability due to testing interval extension, and are therefore not listed or further evaluated in this submittal.

The following sections summarize the results of the SR failure history evaluation. The evaluation confirmed that the impact on system availability of increasing the SR intervals to 24-months, if any, is small.

A. Non-Calibration Changes

For the non-calibration 18-month surveillances, GL 91-04 requires the following information to support conversion to a 24-month surveillance interval:

1) Licensees should evaluate the effect on safety of an increase in 18-month surveillance intervals to accommodate a 24-month fuel cycle. This evaluation should support a conclusion that the effect on safety is small.

2) Licensees should confirm that historical plant maintenance and surveillance support this conclusion.

3) Licensees should confirm that the assumptions in the plant licensing basis would not be invalidated as a result of performing any surveillance at the bounding surveillance interval limit provided to accommodate a 24-month fuel cycle.

GL 91-04 states that licensees need not quantify the effect of the change in surveillance intervals on the availability of individual systems or components.

The proposed changes increase the SR interval from 18 to 24 months (a maximum of 30 months including the 25% extension afforded by TS SR 3.0.2 where applicable) for the non-calibration SRs discussed below. The evaluations provided for each of these changes, support the conclusion that: the effect of these changes on plant safety, if any is small; that the changes do not invalidate any assumption in the plant licensing basis; and that the impact, if any, on system availability is minimal. The SFA review of the Fermi 2 SR performance history that supports this conclusion is summarized for each SR discussed below.

TS 3.1.7 Standby Liquid Control (SLC) System

SR 3.1.7.8 Verify flow through one SLC subsystem from pump into reactor pressure vessel.

SR 3.1.7.9 Verify all piping between storage tank and explosive valve is unblocked.

The SR interval months for these SRs is being increased from 18 to 24, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

SR 3.1.7.8 verifies flow through one SLC subsystem from the pump into the reactor vessel during every refueling outage on a STAGGERED TEST BASIS. SR 3.1.7.9 verifies all piping between the storage tank and the explosive valve is unblocked and is performed every refueling outage. These tests could inadvertently cause a reactor transient if performed with the unit operating. Therefore, to decrease the potential impact of the tests, they are performed during outage conditions.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

The SLC pumps and valves are powered and controlled from separate buses and circuits so that a single electrical failure will not prevent system operation. The SLC pumps are tested quarterly in accordance with the Inservice Testing (IST) Program per SR 3.1.7.7 to verify operability. SR 3.1.7.1 verifies the available volume of the sodium pentaborate solution every 24 hours. To preclude precipitation of the boron solution, the temperature of the sodium pentaborate solution in the storage tank and the temperature of the pump suction piping are verified to be within limits every 24 hours per SR 3.1.7.2 and SR 3.1.7.3 respectively. Additionally, an installed backup heater (automatically controlled) is used to maintain solution temperature above the saturation point (51°F to 63°F). In addition, SR 3.1.7.4 verifies the continuity of the charge in the explosive valves every 31 days. These more frequent tests ensure that the SLC system remains operable during the operating cycle.

Accordingly, the impact, if any, on system availability from the proposed SR interval increase is small. Based on the inherent system and component reliability as shown by the failure history, and the more frequent testing performed during the operating cycle, the impact of this change on safety, if any, is small.

TS 3.1.8 Scram Discharge Volume (SDV) Vent and Drain Valves

SR 3.1.8.2 Verify each SDV vent and drain valve:
a. Closes in ≤ 30 seconds after receipt of an actual or simulated scram signal; and
b. Opens when the actual or simulated scram signal is reset.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

This SR ensures SDV vent and drain valves close in ≤ 30 seconds after receipt of an actual or simulated scram signal and open when the actual or simulated scram signal is reset.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.2.1 Control Rod Block Instrumentation

SR 3.3.2.1.4 Perform CHANNEL FUNCTIONAL TEST.

Function 3 Reactor Mode Switch – Shutdown Position

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

With the reactor mode switch in the shutdown position, a control rod withdrawal block is applied to all control rods to ensure that the shutdown condition is maintained. This Function prevents inadvertent criticality as the result of a control rod withdrawal during MODE 3 or 4, or during MODE 5 when the reactor mode switch is required to be in the shutdown position.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.4.3 Safety Relief Valves (SRVs)

SR 3.4.3.2 Verify each required SRV is capable of being opened.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

SRVs are required to actuate in the safety mode or automatically upon receipt of specific initiation signals (ADS or LLS). A manual actuation of each required SRV per SR 3.4.3.2 is performed to verify that the valve is functioning properly, and no blockage exists in the valve discharge line.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.5.1 ECCS - Operating

SR 3.5.1.7	Verify each recirculation pump discharge valve cycles through one complete cycle of full travel or is de-energized in the closed position.
SR 3.5.1.10	Verify, with reactor pressure ≤ 215 psig, the HPCI pump can develop a flow rate ≥ 5000 gpm against a system head corresponding to reactor pressure.
SR 3.5.1.11	Verify each ECCS injection/spray subsystem actuates on an actual or simulated automatic initiation signal.
SR 3.5.1.12	Verify the ADS actuates on an actual or simulated automatic initiation signal.
SR 3.5.1.13	Verify each ADS valve is capable of being opened.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

Cycling the recirculation pump discharge valves through one complete cycle of full travel demonstrates that the valves are mechanically operable and will close when required. Upon initiation of an automatic LPCI subsystem injection signal, these valves are required to be closed to ensure full LPCI subsystem flow injection in the reactor via the recirculation jet pumps.

The flow tests for the High Pressure Coolant Injection (HPCI) System are performed at two different pressure ranges such that system capability to provide rated flow against a system head corresponding to reactor pressure is tested at both the higher (SR 3.5.1.9, in accordance with the IST Program) and lower (SR 3.5.1.10) operating ranges of the system. The required system head should overcome the Reactor Pressure Vessel (RPV) pressure and associated discharge line losses. Adequate reactor pressure must be available to perform these tests. Additionally, adequate steam flow must be passing through the main turbine or turbine bypass valves to continue to control reactor pressure when the HPCI System diverts steam flow. Therefore, sufficient time is allowed after adequate pressure and flow are achieved to perform these tests. Adequate reactor steam pressure must be ≥165 psig to perform SR 3.5.1.10. Adequate steam flow is represented by main turbine generator online or turbine bypass valves at least 15% open in auto-pressure control. Reactor startup is allowed prior to performing the low pressure SR test

because the reactor pressure is low and the time allowed to satisfactorily perform the SR test is short.

The Emergency Core Cooling System (ECCS) and Automatic Depressurization System (ADS) functional tests ensure that a system initiation signal (actual or simulated) to the automatic initiation logic will cause the systems or subsystems to operate as designed. The ECCS logic has built-in redundancy so that no single active failure prevents accomplishing the safety function of the ECCS.

The pumps associated with ECCS are tested quarterly in accordance with the IST Program and SR 3.5.1.8 (some valves may have approval under 10 CFR 50.55a for less frequent IST testing). This testing ensures that the major components of the systems are capable of performing their design function. The SRs proposed to be extended need to be performed during outage conditions since they have the potential to initiate an unplanned transient if performed during operating conditions.

Valve operability and the setpoints for overpressure protection are verified, per ASME Code requirements, prior to valve installation. Actuation of each required ADS valve is performed to verify that mechanically the valve is functioning properly.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed SR interval change from 18 to 24 months. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.5.2 Reactor Pressure Vessel (RPV) Water Inventory Control

SR 3.5.2.8 Verify each valve credited for automatically isolating a penetration flow path actuates to the isolation position on an actual or simulated isolation signal.

SR 3.5.2.9 Verify the required ECCS injection/spray subsystem can be manually operated.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The RPV has penetrations below the top of the active fuel (TAF) that have the potential to drain the reactor coolant inventory to below the TAF. If the water level should drop below the TAF, the ability to remove decay heat is reduced, which could lead to elevated cladding temperatures and clad perforation. Safety Limit 2.1.1.3 requires the RPV water level to be above the top of the active irradiated fuel at all times to prevent such elevated cladding temperatures. SR 3.5.2.7 verifies, every 92 days, that the required ECCS injection/spray subsystem can be manually started and operated for at least 10 minutes.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.5.3 RCIC System

SR 3.5.3.4 Verify, with reactor pressure ≤ 200 psig, the RCIC pump can develop a flow rate ≥ 600 gpm against a system head corresponding to reactor pressure.

SR 3.5.3.5 Verify the RCIC System actuates on an actual or simulated automatic initiation signal.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The flow tests for the RCIC System are performed at two different pressure ranges such that system capability to provide rated flow is tested both at the higher (SR 3.5.3.3) and lower (SR 3.5.3.4) operating ranges of the system. Additionally, adequate steam flow must be passing through the main turbine or turbine bypass valves to continue to control reactor pressure when the RCIC System diverts steam flow. Reactor steam pressure must be ≥ 945 psig to perform SR 3.5.3.3 (each 92 days) and ≥ 150 psig to perform SR 3.5.3.4. The functional test ensures that a system initiation signal (actual or simulated) to the automatic initiation logic will cause the system to operate as designed.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.6.1.1 Primary Containment

SR 3.6.1.1.2 Verify drywell to suppression chamber differential pressure does not decrease at a rate > 0.2 inch water gauge per minute tested over a 10 minute period at an initial differential pressure of 1 psid.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months including the 25% extension afforded by TS SR 3.0.2.

This SR ensures the drywell to suppression chamber bypass leakage is limited to an amount equivalent to a hole < 1.0 inch in diameter. The SR interval was developed considering it is

prudent that this SR be performed during a unit outage and in view of the fact that component failures that might have affected this test are identified by other primary containment SRs.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval and the history of system performance. Therefore, the impact of this change on safety, if any, is small.

TS 3.6.1.3 Primary Containment Isolation Valves

SR 3.6.1.3.8 Verify each automatic PCIV actuates to the isolation position on an actual or simulated isolation signal.

SR 3.6.1.3.9 Verify a representative sample of reactor instrumentation line EFCVs actuates to the isolation position on an actual or simulated instrument line break to restrict flow.

SR 3.6.1.3.10 Remove and test the explosive squib from each shear isolation valve of the TIP System.

The SR interval for these SRs is being increased from 18 to 24 months, (SR 3.6.1.3.10 on a STAGGERED TEST BASIS), for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The function of the PCIVs, in combination with other accident mitigation systems, is to limit fission product release during and following postulated Design Basis Accidents (DBAs) to within limits. Primary containment isolation within the time limits specified for those isolation valves designed to close automatically ensures that the release of radioactive material to the environment will be consistent with the assumptions used in the analyses for a DBA.

During the operating cycle, SR 3.6.1.3.5 requires automatic PCIV isolation times to be verified in accordance with the IST Program. Stroke testing of PCIVs tests a significant portion of the PCIV circuitry as well as the mechanical function of the valve. The ASME OM Code specifies valve stroke testing at 92-day intervals; however, includes exceptions for valves that cannot be stroked during normal operation.

The SR 3.6.1.3.9 excess flow check valves (EFCV) SR interval is based on the need to perform the SR during a plant outage when there is not the potential for a plant transient if the surveillance was performed during power operation. A representative sample is tested each refueling interval such that the total population is tested every 10 years.

In addition to the SR 3.6.1.10 Traversing Incore Probe (TIP) System explosive squib testing, SR 3.6.1.3.4 verifies continuity of the TIP shear isolation valve explosive charge on a 31-day SR interval providing confidence that the TIP explosive squibs would perform their safety function.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.6.1.6 Low-Low Set (LLS) Valves

SR 3.6.1.6.1 Verify each LLS valve is capable of being opened.

SR 3.6.1.6.2 Verify the LLS System actuates on an actual or simulated automatic initiation signal.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The SR interval for SR 3.6.1.6.1 is based on the SRV tests required by the ASME OM Code. SR 3.3.6.3.1 requires a more frequent CHANNEL FUNCTIONAL TEST at a 31-day interval. This CHANNEL FUNCTIONAL TEST ensures that a major portion of the LLS instrumentation is operating properly and will detect significant failures within the instrument loop. Additionally, the LLS valves (i.e., SRVs assigned to the LLS logic) are designed to meet applicable reliability, redundancy, single failure, and qualification standards and regulations as described in the Fermi 2 UFSAR. As such, these functions are designed to be highly reliable.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.6.1.7 Reactor Building-to-Suppression Chamber Vacuum Breakers

SR 3.6.1.7.3 Verify the opening setpoint of each vacuum breaker is ≤ 0.5 psid.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

This SR ensures that the vacuum breaker opening setpoint safety analysis assumption regarding vacuum breaker full open differential pressure of ≤ 0.5 psid is valid. SR 3.6.1.7.1 (14 days) and SR 3.6.1.7.2 (31 days) performed at shorter intervals convey the proper functioning status of each vacuum breaker.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

<u>TS 3.6.1.8 Suppression Chamber-to-Drywell Vacuum Breakers</u>

SR 3.6.1.8.3 Verify the opening setpoint of each vacuum breaker is ≤ 0.5 psid.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

This SR ensures that the vacuum breaker opening setpoint safety analysis assumption regarding vacuum breaker opening differential pressure of ≤ 0.5 psid is valid. SR 3.6.1.8.1 (7 days) which is performed at shorter intervals, establishes the requisite initial conditions for the proper functioning of each vacuum breaker.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

<u>TS 3.6.4.1 Secondary Containment</u>

SR 3.6.4.1.5 Verify each standby gas treatment (SGT) subsystem will draw down the secondary containment to ≥ 0.25 inch of vacuum water gauge in ≤ 12 minutes.

SR 3.6.4.1.6 Verify each SGT subsystem can maintain ≥ 0.25 inch of vacuum water gauge in the secondary containment for 1 hour at a flow rate ≤ 3000 cfm.

The SR interval for these SRs is being increased from 18 to 24 months, on a STAGGERED TEST BASIS, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

To ensure that all fission products are treated, the test required per SR 3.6.4.1.5 is performed utilizing one SGT subsystem (on a STAGGERED TEST BASIS) to ensure secondary containment boundary integrity. SR 3.6.4.1.1 (every 24 hours), 3.6.4.1.2 (every 31 days), and 3.6.4.1.3 (every 31 days) provide more frequent assurance that no significant boundary degradation has occurred.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.6.4.2 Secondary Containment Isolation Valves (SCIVs)

SR 3.6.4.2.3 Verify each automatic SCIV actuates to the isolation position on an actual or simulated actuation signal.

The SR interval for this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

Verifying that each automatic SCIV closes on a secondary containment isolation signal is required to prevent leakage of radioactive material from secondary containment following a DBA or other accidents. This SR ensures that each automatic SCIV will actuate to the isolation position on a secondary containment isolation signal. The LOGIC SYSTEM FUNCTIONAL TEST in SR 3.3.6.2.5 overlaps this SR to provide complete testing of the safety function.

During the operating cycle, SR 3.6.4.2.2 requires the isolation time of each power operated automatic SCIV to be tested (i.e., stroke timed to the closed position) every 92 days, in accordance with the IST Program. The stroke testing of these SCIVs tests a portion of the circuitry and the mechanical function and provides more frequent testing to detect failures.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.6.4.3 Standby Gas Treatment (SGT) System

SR 3.6.4.3.3 Verify each SGT subsystem actuates on an actual or simulated initiation signal.

SR 3.6.4.3.4 Verify each SGT filter cooler bypass damper can be opened and the fan started.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

These SGT functional tests ensure that subsystems operate as designed. The SGT subsystems are redundant so that following initial draw-down of post-Loss-of-Coolant Accident (LOCA) Reactor Building pressure, no single-failure prevents accomplishing the safety functions of filtering the discharge from secondary containment and directing the discharge to the Elevated

Release Point. This SGT subsystem redundancy assures overall reliability of the SGT system function. More frequent verification of portions of the SGT function are accomplished by operating each SGT subsystem and heaters every 31 days per SR 3.6.4.3.1.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24 month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.7.2 Emergency Equipment Cooling Water (EECW)/Emergency Equipment Service Water (EESW) System and Ultimate Heat Sink (UHS)

SR 3.7.2.5 Verify each EECW/EESW subsystem actuates on an actual or simulated initiation signal.

The SR interval for these SRs is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

This SR verifies that the automatic isolation valves of each EECW/EESW subsystem will automatically switch to the safety or emergency position to provide cooling water exclusively to the safety-related equipment during an accident. This SR also verifies the automatic start capability of the EECW and EESW pumps in each subsystem. The EECW and EESW subsystems are designed with sufficient redundancy so that no single-failure can prevent accomplishing the safety function of providing the required cooling.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance and inherent redundancy in the system design, the impact of this change on safety, if any, is small.

TS 3.7.3 Control Room Emergency Filtration (CREF) System

SR 3.7.3.3 Verify each CREF subsystem actuates on an actual or simulated initiation signal.

The SR interval of this SR is being increased from 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The CREF System maintains the habitability of the Control Room Envelope from which occupants can control the unit following an uncontrolled release of radioactivity during certain design basis accidents. More frequent verification of portions of the CREF System function is accomplished by operating the CREF System every 31 days per SR 3.7.3.1. The LOGIC

SYSTEM FUNCTIONAL TEST in SR 3.3.7.1.6 overlaps this SR to provide complete testing of the safety function.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, system design, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.7.6 The Main Turbine Bypass System and Moisture Separator Reheater

SR 3.7.6.3 Perform a system functional test.

The SR interval of this SR is being increased from once every 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

SR 3.7.6.3 ensures that on increasing main steam line pressure events, the main turbine bypass system will operate as designed.

SR 3.7.6.1 verifies that each main bypass valve opens at least 5% every 120 days. This provides assurance of proper operation of each bypass valve and tests the valve, operator and portions of the actuation circuitry on a more frequent basis than SR 3.7.6.3.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR. Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, and the history of system performance, the impact of this change on safety, if any, is small.

TS 3.8.1 AC Sources – Operating

SR 3.8.1.13 Verify each EDG operates for ≥ 24 hours:
a. For all but the final ≥ 2 hours loaded ≥ 2500 kW and ≤ 2600 kW; and
b. For the final ≥ 2 hours of the test loaded ≥ 2800 kW and ≤ 2900 kW.

SR 3.8.1.14 Verify each EDG starts and achieves:
a. In ≤ 10 seconds, voltage ≥ 3950 V and frequency ≥ 58.8 Hz; and,
b. Steady state voltage ≥ 3950 V and ≤ 4580 V and frequency ≥ 58.8 Hz and ≤ 61.2 Hz.

SR 3.8.1.16 Verify interval between each sequenced load block is within ± 10% of design interval for each load sequencer timer.

The SR interval of these SRs is being increased from once every 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The Fermi 2 Class 1E AC Electrical Power Distribution System AC sources consist of the offsite power sources, and the onsite standby power sources provided by four emergency diesel generators (EDGs). As required by 10 CFR 50, Appendix A, GDC 17, the design of the AC electrical power system provides independence and redundancy to ensure an available source of power to the Engineered Safety Feature (ESF) systems. The Class 1E AC distribution system is divided into redundant load groups (Division I and Division II), so loss of any one group does not prevent the minimum safety functions from being performed. Each load group is connected to an offsite power supply and two EDGs. Additional capability exists for each load group to be connected to the alternate division's offsite power supply (referred to as the maintenance cross-tie). Offsite power is supplied to the 120 kV and 345 kV switchyards from the transmission network by a total of five transmission lines. The ESF systems of one of the two divisions provide for the minimum safety functions necessary to shut down the unit and maintain it in a safe shutdown condition. This design provides substantial redundancy in AC power sources. The EDGs are infrequently operated; therefore, the risk of wear-related degradation is minimal. Additional SR testing during operation proves the ability of the diesel engines to start and operate under various load conditions.

More frequent testing of the AC sources is also required as follows:

SR 3.8.1.1 Verifying correct breaker alignment and indicated power availability for each required offsite circuit every 7 days;

SR 3.8.1.2 and SR 3.8.1.3
Verifying the EDG starting and load carrying capability is demonstrated every 31 days;

SR 3.8.1.4 Verify each day tank contains ≥ one hour supply of fuel oil every 31 days;

SR 3.8.1.5 Check for and remove accumulated water from each day tank every 31 days;

SR 3.8.1.6 Verify each fuel oil transfer system operates to automatically transfer fuel oil from storage tanks to the day tanks, every 31 days;

SR 3.8.1.7 Verifying the ability of each EDG to reach rated voltage and frequency within required time limits every 184 days will provide prompt identification of any substantial EDG degradation or failure;

SR 3.8.3.1 Verify each required EDG fuel oil storage tank contains ≥ a 7 day supply of fuel;

SR 3.8.3.3 Verify each required EDG air start receiver pressure is ≥ 215 psig every 31 days; and

SR 3.8.3.4 Check for and remove accumulated water from each required EDG fuel oil storage tank every 31 days.

Properties of new and stored fuel oil are tested and maintained within specified limits in accordance with the Emergency Diesel Generator Fuel Oil Testing Program (TS 5.5.9).

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, and the history of system performance, the impact of this change on safety, if any, is small.

<u>TS 3.8.4 DC Sources – Operating</u>

SR 3.8.4.3 Verify battery cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration that could degrade battery performance.

SR 3.8.4.4 Remove visible corrosion and verify battery cell to cell and terminal connections are coated with anti-corrosion material.

SR 3.8.4.5 Verify each battery:

a. Cell-to-cell and terminal connection resistance is ≤ 1.5E-4 ohm; and
b. Total cell-to-cell and terminal connection resistance is ≤ 2.7E-3 ohm.

SR 3.8.4.6 Verify each required battery charger supplies ≥ 100 amps at ≥ 124.7 V for ≥ 4 hours.

SR 3.8.4.7 Verify battery capacity is adequate to supply, and maintain in OPERABLE status, the actual or simulated emergency loads for the design duty cycle when subjected to a battery service test.

The SR interval of these SRs is being increased from once every 18 to 24-months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The DC electrical power system provides the AC emergency power system with control power. It also provides both motive and control power to selected safety-related equipment. As required by 10 CFR 50, Appendix A, GDC 17, the DC electrical power system is designed to have sufficient independence, redundancy, and testability to perform its safety functions, assuming a single failure. The DC power sources provide both motive and control power to selected safety related equipment. Two center-tapped 260 VDC batteries are provided for Class 1E loads, one for each division. Each 260 VDC battery is divided into two 130 VDC batteries connected in series. Each 130 VDC battery section has a battery charger connected in parallel with their respective battery. Each 260 VDC battery has a spare battery charger that can replace either of the normal 130 VDC connected chargers. Each division's two 130 VDC batteries and their chargers are the source of DC control power for that respective division, including the respective EDG. Each 260 VDC source furnishes power to DC motors necessary for shutdown conditions. During normal operation, the DC loads are powered from the battery chargers with the batteries floating on the system. In case of loss of normal power to the battery charger, the DC loads are automatically powered from the batteries.

Additionally, SR 3.8.4.1 and SR 3.8.4.2 are performed at 7-day and 92-day intervals respectively. These more frequent tests verify battery terminal voltage and condition of battery

terminals and connectors. These more frequent tests provides additional confidence that the batteries are capable of performing their safety functions.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of the system, and the history of system performance, the impact of this change on safety, if any, is small.

<u>TS 5.5.2 Primary Coolant Sources Outside Containment</u>

The program shall include the following:

b. Integrated leak test requirements for each system at refueling cycle intervals or less.

No changes are proposed for TS 5.5.2. The phrase "refueling cycle intervals or less" is not being changed; however, "refueling interval" will be understood to mean 24 months.

This program provides controls to minimize leakage from those portions of systems outside containment that could contain highly radioactive fluids during a serious transient or accident to levels as low as practicable. The systems include Core Spray, High Pressure Coolant Injection, Residual Heat Removal, Reactor Core Isolation Cooling, Reactor Water Sampling, Post Accident Sampling, Reactor Water Cleanup, Hydrogen Recombiners, Primary Containment Monitoring, Control Rod Drive discharge headers, and Standby Gas Treatment.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of testing associated with this TS.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

<u>TS 5.5.7 Ventilation Filter Testing Program (VFTP)</u>

The VFTP requires the following testing of Engineered Safety Feature (ESF) filter ventilation systems at the frequencies specified in Regulatory Guide 1.52, Revision 2, and in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980.

a. Demonstrate for each of the ESF systems that an inplace test of the HEPA filters shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%. *(See TS for performance criteria).*

b. Demonstrate for each of the ESF systems that an inplace test of the charcoal adsorber shows a penetration and system bypass < specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%. *(See TS for performance criteria).*

c. Demonstrate for each of the ESF systems that a laboratory test of a sample of the charcoal adsorber, when obtained as described in Regulatory Guide 1.52, Revision 2, shows the methyl iodide penetration less than the value specified below when tested in accordance with ASTM D3803-1989 at a temperature of 30°C (86°F) and the relative humidity specified below. *(See TS for performance criteria).*

d. Demonstrate for each of the ESF systems that the pressure drop across the combined HEPA filters, the prefilters, and the charcoal adsorbers is less than the value specified below when tested in accordance with Regulatory Guide 1.52, Revision 2, and ASME N510-1980 at the system flowrate specified below ± 10%. *(See TS for performance criteria).*

e. Demonstrate that the heaters for each of the ESF systems dissipate the value specified below when tested in accordance with ASME N510-1980. *(See TS for performance criteria).*

Regulatory Guide 1.52, Revision 2, specifies performance of these tests once every 18 months. Additionally, Regulatory Guide 1.52, Revision 2, requires testing of High Efficiency Particulate Air Filters (HEPA) and charcoal adsorbers after 720 hours of operation, and following painting, fire, or chemical release in any ventilation zone communicating with the system.

The proposed increase in the testing interval specified by Regulatory Guide 1.52, Revision 2, from 18 months to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The proposed change does not affect the requirements to perform HEPA and charcoal adsorber testing after 720 hours of operation, and following painting, fire, or chemical release in any ventilation zone communicating with the system.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of testing required by the TS 5.5.7 VFTP.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 5.5.14 Control Room Envelope Habitability Program (CREHP)

The CREHP requires testing and trending of the control room envelope as follows:

d. Measurement, at designated locations, of the CRE pressure relative to all external areas adjacent to the CRE boundary during the pressurization mode of operation by one subsystem of the CREF System, operating at the flow rate required by the VFTP, at a Frequency of 18 months on a STAGGERED TEST BASIS. The results shall be trended and assessed every 18 months.

The proposed change increases the testing interval from once every 18 to 24 months, on a STAGGERED TEST BASIS, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2. The proposed change increases the trending and assessment interval from every 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance tests required by TS 5.5.14.d.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

B. Other Non-Calibration Changes

B.1 LOGIC SYSTEM FUNCTIONAL TESTS (LSFT) and Selected CHANNEL FUNCTIONAL TESTS (CFT)

The proposed SR interval changes from 18 to 24 months (30 months including a 25% extension provided by SR 3.0.2) for the LSFTs and selected CFTs are discussed in the following section. The selected 18-month interval CFTs discussed in this section apply only to manual initiation logic.

Logic systems subject to the 18-month interval LSFT and associated instrument channels are subject to more frequently performed CHANNEL CHECKs and CHANNEL FUNCTIONAL TESTs. Other activities such as analog trip module calibrations, and confirmation of satisfactory operation such as during the performance of IST of actuated pumps and valves, provide assurance of proper operation. These more frequent activities test and exercise major portions of the logic system circuitry and will detect significant failures of the associated instrumentation. The actuation instrumentation and logic, controls, monitoring capabilities, and protection systems, are designed to meet applicable reliability, redundancy, single failure, qualification standards and regulations as described in the Fermi 2 Updated Safety Analysis Report (UFSAR). Accordingly, these functions are designed to be highly reliable. Furthermore, as stated in the July 15, 1993 NRC Safety Evaluation Report relating to extension of the Peach Bottom Atomic

Power Station, Units 2 and 3, ML011440159, surveillance intervals from 18 months to 24 months:

> Industry reliability studies for boiling water reactors (BWRs), prepared by the BWR Owners Group (NEDC-30936P) show that the overall safety systems' reliabilities are not dominated by the reliabilities of the logic systems, but by that of the mechanical components, (e.g., pumps and valves), which are consequently tested on a more frequent basis.
>
> Since the probability of a relay or contact failure is small relative to the probability of mechanical component failure, increasing the LOGIC SYSTEM FUNCTIONAL TEST interval represents no significant change in the overall safety system unavailability.

The above justification for increasing the SR interval from 18 to 24 months is applicable to the LSFT and CFT SRs identified below.

<u>TS 3.3.1.1 Reactor Protection System (RPS) Instrumentation</u>

SR 3.3.1.1.13 Perform CHANNEL FUNCTIONAL TEST.

Function 11 Reactor Mode Switch – Shutdown Position

This test is essentially an LSFT for the Reactor Mode Switch scram circuit. The justification for extending LSFTs is applicable to extension of this SR.

SR 3.3.1.1.15 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1.a Intermediate Range Monitors: Neutron Flux - High
Function 1.b Intermediate Range Monitors: Inop
Function 3 Reactor Vessel Steam Dome Pressure - High
Function 4 Reactor Vessel Water Level - Low, Level 3
Function 5 Main Steam Isolation Valve - Closure
Function 7 Drywell Pressure - High
Function 8.a Scram Discharge Volume Water Level - High: Level Transmitter
Function 8.b Scram Discharge Volume Water Level - High: Float Switch
Function 9 Turbine Stop Valve - Closure
Function 10 Turbine Control Valve Fast Closure
Function 11 Reactor Mode Switch - Shutdown Position
Function 12 Manual Scram

<u>TS 3.3.2.2 Feedwater and Main Turbine High Water Level Trip Instrumentation</u>

SR 3.3.2.2.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including valve actuation.

TS 3.3.3.2 Remote Shutdown System

SR 3.3.3.2.2 Verify each required control circuit and transfer switch is capable of performing the intended functions.

This test is essentially an LSFT for the transfer circuits associated with shifting indication and control from the control room to the remote shutdown panel. The justification for extending LSFTs is also valid for the extension of this SR.

TS 3.3.4.1 Anticipated Transient Without Scram Recirculation Pump Trip (ATWS-RPT) Instrumentation

SR 3.3.4.1.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including breaker actuation.

Function a Reactor Vessel Water Level - Low Low, Level 2
Function b Reactor Vessel Pressure - High

TS 3.3.5.1 Emergency Core Cooling System (ECCS) Instrumentation

SR 3.3.5.1.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 – Core Spray System
Function 1.a Reactor Vessel Water Level – Low Low Low, Level 1
Function 1.b Drywell Pressure – High
Function 1.c Reactor Steam Dome Pressure – Low (Injection Permissive)

Function 2 – Low Pressure Coolant Injection (LPCI) System
Function 2.a Reactor Vessel Water Level – Low Low Low, Level 1
Function 2.b Drywell Pressure – High
Function 2.c Reactor Steam Dome Pressure – Low (Injection Permissive)
Function 2.d Reactor Vessel Water Level – Low Low, Level 2 (Loop Select Logic)
Function 2.e Reactor Steam Dome Pressure – Low (Break Detection Logic)
Function 2.f Riser Differential Pressure – High (Break Detection)
Function 2.g Recirculation Pump Differential Pressure – High (Break Detection)

Function 3 - High Pressure Coolant Injection (HPCI) System
Function 3.a Reactor Vessel Water Level – Low Low, Level 2
Function 3.b Drywell Pressure – High
Function 3.c Reactor Vessel Water Level – High, Level 8
Function 3.d Condensate Storage Tank Level – Low
Function 3.e Suppression Pool Water Level - High

Function 4 – Automatic Depressurization System (ADS) Trip System A; and
Function 5 – ADS Trip System B

Function a Reactor Vessel Water Level – Low Low Low, Level 1
Function b Drywell Pressure – High
Function c Automatic Depressurization System Initiation Timer
Function d Reactor Vessel Water Level – Low, Level 3 (Confirmatory)
Function e Core Spray Pump Discharge Pressure – High
Function f Low Pressure Coolant Injection Pump Discharge Pressure - High
Function g Drywell Pressure – High Bypass
Function h Manual Inhibit

SR 3.3.5.1.6 Perform CHANNEL FUNCTIONAL TEST.

Function 1.d Core Spray System: Manual Initiation
Function 2.h Low Pressure Coolant Injection (LPCI) System: Manual Initiation
Function 3.f High Pressure Coolant Injection (HPCI) System: Manual Initiation
Function 4.i Automatic Depressurization System (ADS) Trip System A: Manual Initiation
Function 5.i ADS Trip System B: Manual Initiation

<u>TS 3.3.5.2 Reactor Core Isolation Cooling (RCIC) System Instrumentation</u>

SR 3.3.5.2.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 Reactor Vessel Water Level – Low Low, Level 2
Function 2 Reactor Vessel Water Level – High, Level 8
Function 3 Condensate Storage Tank Level – Low

SR 3.3.5.2.6 Perform CHANNEL FUNCTIONAL TEST.

Function 4 Manual Initiation

<u>TS 3.3.5.3 RPV Water Inventory Control Instrumentation</u>

SR 3.3.5.3.3 Perform CHANNEL FUNCTIONAL TEST.

Function 1.b Core Spray System: Manual Initiation
Function 2.b Low Pressure Coolant Injection (LPCI) System: Manual Initiation

TS 3.3.6.1 Primary Containment Isolation Instrumentation

SR 3.3.6.1.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 Main Steam Line Isolation
- Function 1.a Reactor Vessel Water Level – Low Low Low, Level 1
- Function 1.b Main Steam Line Pressure – Low
- Function 1.d Condenser Pressure – High
- Function 1.e Main Steam Tunnel Temperature – High
- Function 1.g Turbine Building Area Temperature – High

Function 2 Primary Containment Isolation
- Function 2.a Reactor Vessel Water Level – Low, Level 3
- Function 2.b Reactor Vessel Water Level – Low, Level 2
- Function 2.c Drywell Pressure - High
- Function 2.d Main Steam Line Radiation – High

Function 3 High Pressure Coolant Injection (HPCI) System Isolation
- Function 3.a HPCI Steam Line Flow – High
- Function 3.b HPCI Steam Supply Line Pressure – Low
- Function 3.c HPCI Turbine Exhaust Diaphragm Pressure – High
- Function 3.d HPCI Equipment Room Temperature – High
- Function 3.e Drywell Pressure - High

Function 4 Reactor Core Isolation Cooling (RCIC) System Isolation
- Function 4.a RCIC Steam Line Flow – High
- Function 4.b RCIC Steam Supply Line Pressure – Low
- Function 4.c RCIC Turbine Exhaust Diaphragm Pressure – High
- Function 4.d RCIC Equipment Room Temperature – High
- Function 4.e Drywell Pressure - High

Function 5 Reactor Water Cleanup (RWCU) System Isolation
- Function 5.a Differential Flow – High
- Function 5.b Area Temperature - High
- Function 5.c Area Ventilation Differential Temperature – High
- Function 5.d SLC System Initiation
- Function 5.e Reactor Vessel Water Level – Low Low, Level 2

Function 6 Shutdown Cooling System Isolation
- Function 6.a Reactor Steam Dome Pressure - High
- Function 6.b Reactor Vessel Water Level – Low, Level 3

Function 7 Traversing In-core Probe Isolation
- Function 7.a Reactor Vessel Water Level – Low, Level 3
- Function 7.b Drywell Pressure - High

SR 3.3.6.1.6 Perform CHANNEL FUNCTIONAL TEST.

Function 1.h Main Steam Line Isolation: Manual Initiation
Function 2.e Primary Containment Isolation: Manual Initiation
Function 3.f High Pressure Coolant Injection (HPCI) System Isolation: Manual Initiation
Function 4.f Reactor Core Isolation Cooling (RCIC) System Isolation: Manual Initiation
Function 5.f Reactor Water Cleanup (RWCU) System Isolation: Manual Initiation
Function 6.c Shutdown Cooling System Isolation: Manual Initiation

TS 3.3.6.2 Secondary Containment Isolation Instrumentation

SR 3.3.6.2.5 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 Reactor Vessel Water Level – Low Low, Level 2
Function 2 Drywell Pressure – High
Function 3 Fuel Pool Ventilation Exhaust Radiation – High
Function 4 Manual Initiation

TS 3.3.6.3 Low-Low Set (LLS) Instrumentation

SR 3.3.6.3.4 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 Reactor Steam Dome Pressure - High
Function 2 Low - Low Set Pressure Setpoints
Function 3 Tailpipe Pressure Switch

TS 3.3.7.1 Control Room Emergency Filtration (CREF) System Instrumentation

SR 3.3.7.1.6 Perform LOGIC SYSTEM FUNCTIONAL TEST.

Function 1 Reactor Vessel Water Level – Low Low, Level 2
Function 2 Drywell Pressure – High
Function 3 Fuel Pool Ventilation Exhaust Radiation – High

TS 3.3.7.2 Mechanical Vacuum Pump (MVP) Trip Instrumentation

SR 3.3.7.2.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including MVP breaker actuation.

Function Main Steam Line Radiation - High

TS 3.3.7.3 Gland Seal Exhauster (GSE) Trip Instrumentation

SR 3.3.7.3.4 Perform LOGIC SYSTEM FUNCTIONAL TEST including GSE breaker actuation.

Function Main Steam Line Radiation – High

On September 20, 2018, NRC issued Amendment 212 to the Fermi 2 TS. Amendment 212 eliminated the main steam line radiation monitor (MSLRM) functions that formerly initiated a reactor protection system (RPS) automatic reactor trip and primary containment isolation system (PCIS) automatic closure of the main steam isolation valves (MSIVs) and main steam line (MSL) drain valves. These changes were made to eliminate potential spurious trips and unnecessary plant transients. As part of Amendment 212 new MSLRM trips were added for the GSE and MVP. Amendment 212 added new TS 3.3.7.2, Mechanical Vacuum Pump (MVP) Trip Instrumentation, and TS 3.3.7.3, Gland Seal Exhauster (GSE) Trip Instrumentation to address these new MSLRM trip functions. Plant modifications were implemented during the fall 2018 refueling outage to add the MVP and GSE MSLRM trips. The associated new MSLRM MVP and GSE trip logic is safety related up to the point of interface with the non-safety related MVP and GSE control circuits. The use of the safety-related MSLRM trips increases the redundancy and improves the reliability of the initiating trip logic.

As the new MVP and GSE MSLRM trip instrumentation have been recently added, there has only been one performance of SR 3.3.7.2.4 and 3.3.7.3.4 (post modification testing). However, only the new interfacing logic between the MSLRM trip logic and the MVP and GSE control circuits was not subjected to previous SR 3.3.1.1.15 and SR 3.3.6.1.5 logic functional tests. A review of SR history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs. Considering the successful post modification testing (SRs 3.3.7.2.4 and 3.3.7.3.4), and that the MVP and GSE trip functions are subject to more frequent CHANNEL FUNCTIONAL TESTs (SR 3.3.7.2.2 and 3.3.7.3.2), the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval.

TS 3.3.8.2 Reactor Protection System (RPS) Electric Power Monitoring

SR 3.3.8.2.3 Perform a system functional test.

This test overlaps the CHANNEL CALIBRATION (SR 3.3.8.2.2) to include Class 1E breaker actuation and is essentially an LSFT for the RPS Electric Power Monitor circuits. The justification for extending LSFTs is also valid for this SR.

A review of SR history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

Based on the above discussions, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on other more frequent testing of portions of the circuits, and the history of logic system performance, and the corrective action for the failures, the impact of this change on safety, if any, is small.

LSFT and Selected CFT Summary

Based on the foregoing the impact on safety, if any, for the proposed changes in SR intervals from 18 to 24 months for the LOGIC SYSTEM FUNCTIONAL TESTs and CHANNEL FUNCTIONAL TESTs discussed above, would be small.

B.2 RESPONSE TIME TESTS

The SR interval for these SRs is being increased from once every 18 to 24 months, for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2.

The TS functions associated with the RESPONSE TIME tests are verified to be operating properly throughout the operating cycle by the performance of other more frequently performed SRs (e.g., CHANNEL CHECKs and CHANNEL FUNCTIONAL TESTs). This testing ensures that a significant portion of the circuitry is operating properly and will detect significant failures of this circuitry. These functions, including the actuating logic, are designed to be highly reliable with suitable redundancy to address single failures in accordance with 10 CFR 50 Appendix A, General Design Criteria for Nuclear Power Plants. Moreover, the Fermi 2 TS Bases (as well as NUREG-1433, "Standard Technical Specifications BWR/4,") states that the SR interval of response time testing is based in part "upon plant operating experience, which shows that random failures of instrumentation components causing serious time degradation, but not channel failure, are infrequent occurrences."

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of these SRs.

Accordingly, the impact of increasing the SR testing interval to 24 months, if any, on system availability is minimal. Based on other more frequent testing of the systems, the ability to readily detect system performance deficiencies, and the history of system performance, the impact of these changes on safety, if any, is small.

TS 3.3.1.1 Reactor Protection System (RPS) Instrumentation

SR 3.3.1.1.17 Verify the RPS RESPONSE TIME is within limits.

The SR interval for SR 3.3.1.1.17 is being increased from the current 18 to 24 months on a STAGGERED TEST BASIS.

SR 3.3.1.1.17 applies to the following Table 3.3.1.1-1 RPS Functions:

Function 2.e	Average Power Range Monitors 2-out-of-4 Voter
Function 5	Main Steam Isolation Valve-Closure
Function 9	Turbine Stop Valve - Closure
Function 10	Turbine Control Valve Fast Closure

SR 3.3.1.1.17 applies to Functions that are subject to more frequent CHANNEL CHECKs and CHANNEL FUNCTIONAL TESTs which verify proper operation.

TS 3.3.6.1 Primary Containment Isolation Instrumentation

SR 3.3.6.1.7 Verify the Main Steam Line Isolation Instrumentation DC Output Relays response time allows the overall ISOLATION SYSTEM RESPONSE TIME to remain within limits.

This SR applies to the following Table 3.3.6.1-1 Main Steam Line Isolation Functions:

Function 1.a	Reactor Vessel Water Level-Low Low Low, Level 1; and,
Function 1.c	Main Steam Line Flow-High

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. The response time must be added to the PCIV closure times to obtain the ISOLATION SYSTEM RESPONSE TIME.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance SR 3.3.6.1.7.

TS 3.5.1 ECCS – Operating

SR 3.5.1.14 Verify ECCS RESPONSE TIME is within limits.

The SR 3.5.1.14 NOTE states “ECCS instrumentation response times are not required to be measured.” This is justified because the contribution of the instrument response times to the overall ECCS response time are assumed based on the guidance of NEDO-32291, "System Analyses for Elimination of Selected Response Time Testing Requirements," January 1994; and Fermi-2 SER for Amendment 111, dated April 18, 1997. The SR applies to response time of actuated Functions listed in TS Table 3.3.5.1-1.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance SR 3.5.1.14.

TS 3.7.6 The Main Turbine Bypass System and Moisture Separator Reheater

SR 3.7.6.4 Verify the TURBINE BYPASS SYSTEM RESPONSE TIME is within limits.

SR 3.7.6.1 verifies that each main bypass valve opens at least 5% every 120 days. This provides assurance of proper operation of each bypass valve and tests the valve, operator and portions of the actuation circuitry.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance SR 3.7.6.4.

B.3 Other Non-Calibration Changes Summary

Based on the above discussion, the impact on safety, if any, for the proposed changes in SR intervals from 18 to 24 months for the LOGIC SYSTEM FUNCTIONAL TESTs, CHANNEL FUNCTIONAL TESTs, and RESPONSE TIME tests, discussed above, would be small.

C. Calibration Changes

NRC GL 91-04 requires that licensees address instrument drift when proposing an increase in the SR interval for calibrating instruments that perform safety functions including providing the capability for safe shutdown. The effect of the increased calibration interval on instrument errors must be addressed because instrument errors caused by drift were considered when determining safety system setpoints and when performing safety analyses.

NRC GL 91-04 identifies seven steps for the evaluation of instrumentation calibration changes. These seven steps are discussed in Enclosure 1 to this submittal. Enclosure 1 describes the DTE approach addressing each step.

In summary, the Fermi 2 drift evaluation for proposed calibration interval extensions resulted in no changes to TS Allowable Values. The evaluation identified changes to calibration tolerances included in plant calibration surveillance procedures. The discussion for each calibration SR that follows identifies whether calibration tolerances are affected. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

Drift Evaluation Overview

1. The Surveillance Failure Analysis (SFA) included calibration SRs where extension of the SR Applicable Instrumentation. The instrumentation identified in Enclosure 6 includes: transmitters/sensors (e.g., pressure, level, temperature); certain trip units; and time delay relays, generally associated with actuation functions (e.g., Reactor Protection System trip functions, Engineered Safety Features Actuation System functions).

Rigorous drift analysis includes evaluation of historical as-found and as-left Fermi 2 calibration data. Enclosure 7, DTE-18001, Instrument Drift Analysis Design Guide in Support of 24-Month Fuel Cycle Extension Project, describes methods used for this evaluation.

The methods are based on the Electric Power Research Institute (EPRI) EPRI 3002002556 (TR-103335R2), "Guidelines for Instrument calibration Extension/Reduction - Revision 2; Statistical Analysis of Instrument Calibration Data," dated January 2014.

NRC reviewed and commented on TR 103335 Rev. 0 in 1997. (US Nuclear Regulatory Commission Letter from Mr. Thomas H. Essig to Mr. R. W. James of Electric Power Research Institute, dated December 1, 1997, "Status Report on the Staff Review of EPRI Technical Report TR-103335, “Guidelines for Instrument Calibration Extension/Reduction Programs,” dated March 1994”). The comments are addressed in TR-103335R2, Appendix E. The methodology is consistent with that used by other utilities identified in Enclosure 1 (Section 5.2, Precedent) requesting transition to a 24 MFC which have referenced the EPRI Guidelines.

2. Rigorous drift analyses as described above, was applied to the instrumentation identified in Enclosure 6. Conventional methods were used to evaluate drift for other instrumentation devices (e.g., recorders, resistors, isolators, indicators, modulators/demodulators, and transmitters/sensors other than those included in Enclosure 6). These same methods were employed for the current calibration interval. In cases where Vendor Drift (VD) is specified, the VD is extrapolated to reflect the calibration interval. Where VD is not specified, the drift contribution is assumed to be negligible, or included in the vendor accuracy specified for the device. The overall absence of calibration failures identified by the Surveillance Failure Analysis (SFA) supports a conclusion that these approaches are sound.

The 30-month (i.e., 24 months +25%) drift terms developed as described above were applied to the associated Fermi 2 setpoint calculations and calibration procedure validation calculations. These calculations determined instrument loop uncertainties and validated setpoints and Allowable Values, as appropriate, for the associated functions. The revised setpoint calculations were developed in accordance with NEDC-31336, GE Instrument Setpoint Methodology.

As noted previously, there are no changes required to TS Allowable Values. Some calibration information (e.g., tolerances) that are implemented through plant calibration surveillance procedures are affected. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

The proposed calibration-related SR interval increases from 18 to 24 months,for a maximum interval of 30 months, including the 25% extension afforded by TS SR 3.0.2 are discussed below.

TS 3.3.1.1 Reactor Protection System (RPS) Instrumentation

The RPS initiates a reactor scram when one or more monitored parameters exceed their specified limit, to preserve the integrity of the fuel cladding and the Reactor Coolant System and minimize the energy that must be absorbed following a loss of coolant accident.

SR 3.3.1.1.14, CHANNEL CALIBRATION, applies to the RPS functions listed below. The proposed change extends the SR 3.3.1.1.14 interval from 18 to 24 months.

SR 3.3.1.1.14 Perform CHANNEL CALIBRATION.

Function 3 Reactor Vessel Steam Dome Pressure-High
Function 4 Reactor Vessel Water Level – Low, Level 3
Function 5 Main Steam Isolation Valve – Closure
Function 7 Drywell Pressure – High
Function 8 Scram Discharge Volume Water Level-High
Function 8.a Level Transmitter
Function 8.b Float Switch
Function 9 Turbine Stop Valve - Closure

Functions 5, 8.b, and 9, were not subject to rigorous drift analysis. The basis for not performing a rigorous drift analysis for each of these functions is discussed below.

Function 5, Main Steam Isolation Valve – Closure

Main Steam Isolation Valve (MSIV) closure signals are initiated from position switches located on each of the eight MSIVs. The limit switches that perform this function are considered mechanical components which do not experience instrument drift as addressed by GL 91-04. Therefore, rigorous drift analysis is not necessary for this instrumentation. Plant calibration surveillance procedures are unaffected.

Function 8.b, Scram Discharge Volume Water Level – High, Float Switch

The components that perform this function are float type level switches. These instruments are considered mechanical components which do not experience instrument drift as addressed by GL 91-04. Therefore, rigorous drift analysis is not necessary for this instrumentation. Plant calibration surveillance procedures are unaffected.

Function 9, Turbine Stop Valve – Closure

Turbine Stop Valve (TSV) closure signals are initiated from position switches located on each of the four TSVs. The limit switches that perform this function are considered mechanical components which do not experience instrument drift as addressed by GL 91-04. Therefore, rigorous drift analysis is not necessary for this instrumentation. Plant calibration surveillance procedures are unaffected.

The GL 91-04 evaluations for the functions subject to SR 3.3.1.1.14 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation requires changes to calibration tolerances for Function 8.a. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

SR 3.3.1.1.16 Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP.

SR 3.3.1.1.16 involves calibration of the bypass channels, Table 3.3.1.1-1 RPS Instrumentation, Functions:

Function 9 Turbine Stop Valve-Closure
Function 10 Turbine Control Valve Fast Closure

SR 3.3.1.1.16 ensures that scrams initiated from the Turbine Stop Valve Closure and Turbine Control Valve Fast Closure will not be inadvertently bypassed when THERMAL POWER is ≥ 29.5% RTP.

The GL 91-04 evaluations for these functions result in no changes to TS Allowable Values. Plant calibration surveillance procedures are unaffected.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.2.2 Feedwater and Main Turbine High Water Level Trip Instrumentation

The Feedwater and Main Turbine High Water Level Trip Instrumentation is designed to detect a potential failure of the Feedwater Level Control System that causes excessive feedwater flow.

SR 3.3.2.2.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be ≤ 219 inches.

The GL 91-04 evaluations for this functions result in no changes to TS Allowable Values. Plant calibration surveillance procedures are unaffected.

A review of the applicable Fermi 2 SR history for this Function identified only one occurrence where the as-found calibration data for the Division 2 Reactor Level Narrow Range Transmitter (B21N095B) exceeded the specified As-Found tolerance for the transmitter. This failure would have been discovered solely through the performance of this SR. This SR failure was further evaluated:

> On April 2, 2009, while performing a CHANNEL CALIBRATION, all As-Found data obtained for the reactor level narrow range transmitter exceeded the specified As-Found tolerance. Evaluation of the SR failure identified that it resulted from the inability to adjust the transmitter zero potentiometer. The work order indicated that the device was probably an original installation and had failed due to age. However, a review of failures of like devices indicated no similar failures. The transmitter was replaced with a like-for-like device, successfully calibrated within As Left Tolerance, and was returned to service. (The Event that performs this calibration fulfills all, or part of SRs 3.3.2.2.3, SR 3.3.2.2.4, SR 3.3.5.1.4 for Table 3.3.5.1-1, Functions 4.d and 5.d, and SR 3.5.1.12).

The identified failure is unique and did not occur on a repetitive basis, no similar failures of like devices were identified, and no time-based failure mechanism was apparent since there were no similar failures identified. Therefore, this failure will have no impact on an extension to a 24-month SR interval.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.3.1 Post Accident Monitoring (PAM) Instrumentation

The function of the PAM instrumentation is to provide the operator information to track and assess plant conditions following an accident and take manual actions as necessary based on plant conditions.

SR 3.3.3.1.2, CHANNEL CALIBRATION, applies to the PAM instrumentation functions listed below. The proposed change extends the SR 3.3.3.1.2 interval from 18 to 24 months.

SR 3.3.3.1.2 Perform CHANNEL CALIBRATION.

Function 1	Reactor Vessel Pressure
Function 2	Reactor Vessel Water Level-Fuel Zone
Function 3	Reactor Vessel Water Level-Wide Range
Function 4	Suppression Pool Water Level
Function 5	Suppression Pool Water Temperature
Function 6	Drywell Pressure-Wide Range

Function 7 Primary Containment High Range Radiation Monitor
Function 8 PCIV Position

As discussed in the previous Drift Analysis Overview, conventional methods (e.g., extrapolation of vendor drift) were used to account for PAM instrumentation drift in design calculations that develop calibration information for plant calibration surveillance procedures. The GL 91-04 evaluations for the functions subject to SR 3.3.3.1.2 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation requires changes to calibration tolerances for Function 4. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

PAM instrumentation is designed with a high degree of reliability and redundancy. A CHANNEL CHECK (SR 3.3.3.1.1) is required every 31 days which provides assurance that the PAM instrumentation is operating within expected parameters. These tests provide assurance that the indication and recording instruments are acceptable and operating within established tolerances.

A review of SR test history for each of the above Post Accident Monitoring functions identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.3.2 Remote Shutdown System

The Remote Shutdown System provides the control room operator with sufficient instrumentation and controls to place and maintain the plant in a safe shutdown condition from a location other than the control room.

SR 3.3.3.2.3, CHANNEL CALIBRATION, applies to the Remote Shutdown System instrumentation functions listed below. The proposed change extends the SR 3.3.3.2.3 interval from 18 to 24 months.

SR 3.3.3.2.3 Perform CHANNEL CALIBRATION for each required instrumentation channel.

Function 1 Reactor Vessel Pressure
Function 2 Reactor Vessel Water Level
Function 3 Suppression Chamber Water Temperature
Function 4 Drywell Pressure
Function 5 RHR Heat Exchanger Discharge Flow
Function 6 RCIC Flow

As discussed in the previous Drift Analysis Overview, conventional methods (e.g., extrapolation of vendor drift) were used to account for Remote Shutdown System instrumentation drift used in design calculations that develop calibration information used for plant calibration surveillance procedures. The GL 91-04 evaluations for the functions subject to SR 3.3.3.2.3 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation requires changes to calibration tolerances for Functions 5. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

The Remote Shutdown instrumentation is not required to function during environmentally harsh conditions. The Remote Shutdown System instrumentation is designed with a high degree of accuracy and reliability.

TS requires a CHANNEL CHECK (SR 3.3.3.2.1) of the Remote Shutdown System instruments every 31 days that compares the reading of the Remote Shutdown System instruments to corresponding Control Room indications. This CHANNEL CHECK provides an effective means to demonstrate the operability of the monitoring instrumentation used at the Remote Shutdown panel during the operating cycle. Any gross failure or excessive drift of these instruments will be detected by the monthly CHANNEL CHECK.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.4.1 Anticipated Transient Without Scram Recirculation Pump Trip (ATWS-RPT) Instrumentation

The ATWS-RPT System initiates a recirculation pump trip, adding negative reactivity, following events in which a scram does not (but should) occur, to lessen the effects of an ATWS event. Tripping the recirculation pumps adds negative reactivity from the increase in steam voiding in the core area as core flow decreases. When Reactor Vessel Water Level-Low Low (Level 2) or Reactor Vessel Pressure-High setpoint is reached, the Reactor Recirculation Pump Motor Generator field and drive motor breakers trip.

SR 3.3.4.1.3 Perform CHANNEL CALIBRATION. The Allowable Values shall be:

a. Reactor Vessel Water Level – Low Low, Level 2: ≥ 103.8 inches; and
b. Reactor Pressure Vessel-High: ≤ 1153 psig.

The GL 91-04 evaluations for the functions subject to SR 3.3.4.1.3 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluations resulted in no changes to calibration tolerances or plant calibration surveillance procedures.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.5.1 Emergency Core Cooling System (ECCS) Instrumentation

The purpose of the ECCS instrumentation is to initiate appropriate responses from the systems to ensure that the fuel is adequately cooled in the event of a design basis accident or transient. For most anticipated operational occurrences and Design Basis Accidents (DBAs), a wide range of dependent and independent parameters are monitored. The ECCS instrumentation actuates core spray (CS), low pressure coolant injection (LPCI), high pressure coolant injection (HPCI), automatic depressurization system (ADS), and the emergency diesel generators (EDGs).

SR 3.3.5.1.4, CHANNEL CALIBRATION, applies to the ECCS functions listed below. The proposed change extends the SR 3.3.5.1.4 SR interval from 18 to 24 months.

SR 3.3.5.1.4 Perform CHANNEL CALIBRATION.

Function 1 – Core Spray System

Function 1.a Reactor Vessel Water Level – Low Low Low, Level 1
Function 1.b Drywell Pressure – High
Function 1.c Reactor Steam Dome Pressure – Low (Injection Permissive)

Function 2 – Low Pressure Coolant Injection (LPCI) System

Function 2.a Reactor Vessel Water Level – Low Low Low, Level 1
Function 2.b Drywell Pressure – High
Function 2.c Reactor Steam Dome Pressure – Low (Injection Permissive)
Function 2.d Reactor Vessel Water Level – Low Low, Level 2 (Loop Select Logic)
Function 2.e Reactor Steam Dome Pressure – Low (Break Detection Logic)
Function 2.f Riser Differential Pressure – High (Break Detection)
Function 2.g Recirculation Pump Differential Pressure – High (Break Detection)

Function 3 - High Pressure Coolant Injection (HPCI) System

Function 3.a	Reactor Vessel Water Level - Low Low, Level 2
Function 3.b	Drywell Pressure – High
Function 3.c	Reactor Vessel Water Level - High, Level 8
Function 3.d	Condensate Storage Tank Level - Low
Function 3.e	Suppression Pool Water Level - High

Function 4 – Automatic Depressurization System (ADS) -Trip System A; and
Function 5 – ADS - Trip System B

Function a	Reactor Vessel Water Level - Low Low Low, Level 1
Function b	Drywell Pressure - High
Function c	Automatic Depressurization System Initiation Timer*
Function d	Reactor Vessel Water Level - Low, Level 3 (Confirmatory)
Function e	Core Spray Pump Discharge Pressure - High
Function f	Low Pressure Coolant Injection Pump Discharge Pressure - High
Function g	Drywell Pressure - High Bypass**

* For Functions 4.c and 5.c, CHANNEL FUNCTIONAL TEST SR 3.3.5.1.2 requires verification of the trip setpoint associated with the ADS Initiation Timer on a more frequent basis. Therefore, the drift interval associated with this function is unaffected by this increase in SR interval, and drift is not assessed for this instrumentation.

** For Functions 4.g and 5.g, the time delay associated with the Drywell Pressure - High Bypass is calibration checked as a part of the CHANNEL FUNCTIONAL TEST of SR 3.3.5.1.2 and setpoint verified by SR 3.3.5.1.3 on a more frequent basis. Therefore, the drift interval associated with this function is unaffected by this increase in SR interval, and drift is not assessed for this instrumentation.

In summary, the GL 91-04 evaluations for the functions subject to SR 3.3.5.1.4 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation requires changes to calibration tolerances for Function 3.e. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

A review of the applicable Fermi 2 SR history for SR 3.3.5.1.4 identified only one occurrence where the As-Found calibration data for the Division 2 Reactor Level Narrow Range Transmitter (B21N095B) exceeded the specified As-Found tolerance for the transmitter. This failure would have been discovered solely through the performance of this SR. This SR failure was further evaluated:

> On April 2, 2009, while performing a CHANNEL CALIBRATION, all As-Found data obtained for the reactor level narrow range transmitter, exceeded the specified As-Found tolerance. Evaluation of the SR failure identified that it resulted from the inability to adjust

the transmitter zero potentiometer. The work order indicated that the device was probably an original installation and had failed due to age. However, a review of failures of like devices indicated no similar failures. The transmitter was replaced with a like-for-like device, successfully calibrated within As Left Tolerance, and was returned to service. (The Event that performs this calibration fulfills all, or part of SRs 3.3.2.2.3, SR 3.3.2.2.4, SR 3.3.5.1.4 for Table 3.3.5.1-1, Functions 4.d and 5.d, and SR 3.5.1.12).

The identified failure is unique and did not occur on a repetitive basis, no similar failures of like devices were identified, and no time based failure mechanism was apparent since there were no similar failures identified. Therefore, this failure will have no impact on an extension to a 24-month SR interval.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.5.2 Reactor Core Isolation Cooling (RCIC) System Instrumentation

The purpose of the RCIC System instrumentation is to initiate actions to ensure adequate core cooling when the reactor vessel is isolated from its primary heat sink (the main condenser) and normal coolant makeup flow from the Reactor Feedwater System is unavailable, such that initiation of the low pressure Emergency Core Cooling Systems (ECCS) pumps does not occur.

SR 3.3.5.2.4, CHANNEL CALIBRATION, applies to the RCIC functions listed below. The proposed change extends the SR 3.3.5.2.4 interval from 18 to 24-months.

SR 3.3.5.2.4 Perform CHANNEL CALIBRATION.

Function 1 Reactor Vessel Water Level - Low Low, Level 2
Function 2 Reactor Vessel Water Level-High, Level 8
Function 3 Condensate Storage Tank Level - Low

The GL 91-04 evaluations for the functions subject to SR 3.3.5.2.4 requirements do not impact any TS Allowable Values. The GL 91-04 evaluations resulted in no calibration tolerance changes. Plant calibration surveillance procedures are not affected.
A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.6.1 Primary Containment Isolation Instrumentation

The primary containment isolation instrumentation automatically initiates closure of appropriate primary containment isolation valves (PCIVs). The function of the PCIVs, in combination with other accident mitigation systems, is to limit fission product release during and following postulated Design Basis Accidents (DBAs). Primary containment isolation within the time limits specified for those isolation valves designed to close automatically ensures that the release of radioactive material to the environment will be consistent with the assumptions used in the analyses for a DBA.

SR 3.3.6.1.4, CHANNEL CALIBRATION, applies to the Primary Containment Isolation functions listed below. The proposed change extends the SR 3.3.6.1.4 interval from 18 to 24 months.

SR 3.3.6.1.4 Perform CHANNEL CALIBRATION.

Function 1 Main Steam Line Isolation
- Function 1.a Reactor Vessel Water Level – Low Low Low, Level 1
- Function 1.b Main Steam Line Pressure - Low
- Function 1.d Condenser Pressure – High
- Function 1.e Main Steam Tunnel Temperature – High
- Function 1.g Turbine Building Area Temperature – High

Function 2 Primary Containment isolation
- Function 2.a Reactor Vessel Water Level – Low, Level 3
- Function 2.b Reactor Vessel Water Level – Low, Level 2
- Function 2.c Drywell Pressure – High
- Function 2.d Main Steam Line Radiation – High

Function 3 High Pressure Coolant Injection (HPCI) System Isolation
- Function 3.a HPCI Steam Line Flow – High
- Function 3.b HPCI Steam Supply Line Pressure – Low
- Function 3.c HPCI Turbine Exhaust Diaphragm Pressure – High
- Function 3.d HPCI Equipment Room Temperature – High
- Function 3.e Drywell Pressure – High

Function 4 Reactor Core Isolation Cooling (RCIC) System Isolation
- Function 4.a RCIC Steam Line Flow – High
- Function 4.b RCIC Steam Supply Line Pressure – Low
- Function 4.c RCIC Turbine Exhaust Diaphragm Pressure – High
- Function 4.d RCIC Equipment Room Temperature – High
- Function 4.e Drywell Pressure – High

Function 5 Reactor Water Cleanup (RWCU) System Isolation
Function 5.a Differential Flow – High
Function 5.b Area Temperature – High
Function 5.c Area Ventilation Differential Temperature – High
Function 5.e Reactor Vessel Water Level – Low Low, Level 2

Function 6 Shutdown Cooling System Isolation
Function 6.a Reactor Steam Dome Pressure – High
Function 6.b Reactor Vessel Water Level – Low, Level 3

Function 7 Traversing In-core Probe Isolation
Function 7.a Reactor Vessel Water Level – Low, Level 3
Function 7.b Drywell Pressure – High

The following Primary Containment Isolation functions subject to SR 3.3.6.1.4 were not rigorously analyzed for instrument drift for the reasons discussed below.

Function 1.e Main Steam Tunnel Temperature – High
Function 1.g Turbine Building Area Temperature – High

The Resistance Temperature Detectors (RTDs) used for these functions are not calibrated, and as such, rigorous drift analysis is not possible. Response of the RTDs to temperature variations during normal plant operation verifies proper operation of the input signal. The trip unit RTD bridges are calibrated and are used for the Technical Specification function. Therefore, the trip unit RTD bridges are included within the drift analysis scope

Function 2.d, Primary Containment isolation, Main Steam Line Radiation – High

Radiation monitor uncertainties are dominated by factors other than electronic drift. The uncertainties associated with calibration source strength and geometry dominate. Radiation detectors are calibrated using a radioactive source as an input signal to the detector. The source check is performed by exposing the detector to a known source in a constant geometry. Source checks of radiation monitors are subject to greater uncertainties than electronic calibration checks due to source decay geometry, signal strength, and the sensor response curves of that particular monitoring system. Because of the uncertainties associated with the calibration methods for these devices, a rigorous drift evaluation would not provide a meaningful indication of the instrument performance over time. 12 hour CHANNEL CHECKs (SR 3.3.6.1.1) and 92 day CHANNEL FUNCTIONAL TESTs (SR 3.3.6.1.2) verify that the instruments are performing within expected parameters. Therefore, rigorous drift analyses are not performed for radiation monitors.

Function 3.d, HPCI Equipment Room Temperature – High

The thermocouples used for this function are not calibrated, and as such, rigorous drift analysis is not possible. Response of the thermocouples to temperature variations during

normal plant operation verifies proper operation of the input signal. Therefore, rigorous drift analysis is not necessary for this instrumentation.

Function 4.d, RCIC Equipment Room Temperature – High

The thermocouples used for this function are not calibrated, and as such, rigorous drift analysis is not possible. Response of the thermocouples to temperature variations during normal plant operation verifies proper operation of the input signal. Therefore, rigorous drift analysis is not necessary for this instrumentation.

Function 5.a, Reactor Water Cleanup (RWCU) System Isolation, Differential Flow – High

This function includes a time delay to prevent spurious trips during most RWCU operational transients. The time delay setpoint does not have an Allowable Value in the TS and is not included in any uncertainty calculation. Therefore, there are no specific accuracy requirements for the time delay function, and rigorous drift analysis is not necessary for the time delay relay. The remaining components are included within the drift analysis scope.

Function 5.b, Reactor Water Cleanup (RWCU) System Isolation, Area Temperature – High

The thermocouples used for this function are not calibrated, and as such, rigorous drift analysis is not possible. Response of the thermocouples to temperature variations during normal plant operation verifies proper operation of the input signal. Therefore, rigorous drift analysis is not necessary for this instrumentation.

Function 5.c, Reactor Water Cleanup (RWCU) System Isolation, Area Ventilation Differential Temperature – High

The thermocouples used for this function are not calibrated, and as such, rigorous drift analysis is not possible. Response of the thermocouples to temperature variations during normal plant operation verifies proper operation of the input signal. Therefore, rigorous drift analysis is not necessary for this instrumentation.

In summary, the GL 91-04 evaluations for the functions subject to SR 3.3.6.1.4 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation requires changes to calibration tolerances for Functions 1.d and 5.a. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.6.2 Secondary Containment Isolation Instrumentation

The secondary containment isolation instrumentation automatically initiates closure of appropriate secondary containment isolation valves (SCIVs), trips the reactor building HVAC, and starts the Standby Gas Treatment (SGT) System.

SR 3.3.6.2.4, CHANNEL CALIBRATION, applies to the Secondary Containment Isolation functions listed below. The proposed change extends the SR 3.3.6.2.4 interval from 18 to 24 months.

SR 3.3.6.2.4 Perform CHANNEL CALIBRATION.

Function 1	Reactor Vessel Water Level – Low Low, Level 2
Function 2	Drywell Pressure – High
Function 3	Fuel Pool Ventilation Exhaust Radiation-High

Instrument drift for Function 3, Fuel Pool Ventilation Exhaust Radiation – High was not rigorously analyzed for instrument drift for the reasons discussed below.

Radiation monitor uncertainties are dominated by factors other than electronic drift. The uncertainties associated with calibration source strength and geometry dominate. Radiation detectors are calibrated using a radioactive source as an input signal to the detector. The source check is performed by exposing the detector to a known source in a constant geometry. Source checks of radiation monitors are subject to greater uncertainties than electronic calibration checks due to source decay geometry, signal strength, and the sensor response curves of that particular monitoring system. Because of the uncertainties associated with the calibration methods for these devices, a rigorous drift evaluation would not provide a meaningful indication of the instrument performance over time. 12 hour CHANNEL CHECKs (SR 3.3.6.2.1) and 92 day CHANNEL FUNCTIONAL TESTs (SR 3.3.6.2.2) verify that the instruments are performing within expected parameters. Therefore, rigorous drift analyses are not performed for radiation monitors.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.6.3 Low-Low Set (LLS) Instrumentation

The LLS logic and instrumentation is designed to mitigate the effects of postulated thrust loads on the safety/relief valve (SRV) discharge lines by preventing subsequent actuations with an elevated water leg in the SRV discharge line. It also mitigates the effects of postulated pressure

loads on suppression chamber structural components by preventing multiple actuations in rapid succession of the SRVs subsequent to their initial actuation.

SR 3.3.6.3.3, CHANNEL CALIBRATION, applies to the Low-Low Set Instrument functions listed below. The proposed change extends the SR 3.3.6.3.3 interval from 18 to 24 months.

SR 3.3.6.3.3 Perform CHANNEL CALIBRATION.

Function 1 Reactor Steam Dome Pressure – High
Function 2 Low-Low Set Pressure Setpoints
Function 3 Tailpipe Pressure Switch

The GL 91-04 evaluations for the functions subject to SR 3.3.6.3.3 CHANNEL CALIBRATION requirements do not affect any TS Allowable Values. The evaluation does not affect calibration tolerances and no changes to plant calibration surveillance procedures are required.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.7.1 Control Room Emergency Filtration (CREF) System Instrumentation

The CREF System is designed to provide a radiologically controlled environment to ensure the habitability of the control room for the safety of control room operators under all plant conditions. Two CREF subsystems are each capable of fulfilling the stated safety function. The instrumentation and controls for the CREF System automatically initiate action to pressurize, recirculate and filter the main control room (MCR) air to minimize the consequences of radioactive material in the control room environment.

SR 3.3.7.1.5, CHANNEL CALIBRATION, applies to the CREF instrumentation functions listed below. The proposed change extends the SR 3.3.7.1.5 interval from 18 to 24 months.

SR 3.3.7.1.5 Perform CHANNEL CALIBRATION.

Function 1 Reactor Vessel Water Level – Low Low, Level 2
Function 2 Drywell Pressure – High
Function 3 Fuel Pool Ventilation Exhaust Radiation – High
Function 4 Control Center Normal Makeup Air Radiation-High

Instrument drift for Function 3, Fuel Pool Ventilation Exhaust Radiation – High and Function 4, Control Center Normal Makeup Air Radiation-High was not rigorously analyzed for instrument drift for the reasons discussed below.

Radiation monitor uncertainties are dominated by factors other than electronic drift. The uncertainties associated with calibration source strength and geometry dominate. Radiation detectors are calibrated using a radioactive source as an input signal to the detector. The source check is performed by exposing the detector to a known source in a constant geometry. Source checks of radiation monitors are subject to greater uncertainties than electronic calibration checks due to source decay geometry, signal strength, and the sensor response curves of that particular monitoring system. Because of the uncertainties associated with the calibration methods for these devices, a rigorous drift evaluation would not provide a meaningful indication of the instrument performance over time. 12 hour CHANNEL CHECKs (SR 3.3.7.1.1) and CHANNEL FUNCTIONAL TESTs (SR 3.3.7.1.2, 31 days (Function 4), and 3.3.7.1.3, 92 days (Function 3)) verify that the instruments are performing within expected parameters. Therefore, rigorous drift analyses are not performed for radiation monitors.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.3.7.2 Mechanical Vacuum Pump (MVP) Trip Instrumentation

SR 3.3.7.2.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be ≤ 3.6 x full power background.

TS 3.3.7.3 Gland Seal Exhauster (GSE) Trip Instrumentation

SR 3.3.7.3.3 Perform CHANNEL CALIBRATION. The Allowable Value shall be ≤ 3.6 x full power background.

The proposed change extends the interval for SR 3.3.7.2.3 and SR 3.3.7.3.3 from 18 to 24 months.

TS 3.3.7.2 and TS 3.3.7.3 were added to the TS as part of Amendment 212 which NRC issued on September 20, 2018. Amendment 212 eliminated the main steam line radiation monitor (MSLRM) functions that formerly initiated a reactor protection system (RPS) automatic reactor trip and primary containment isolation system (PCIS) automatic closure of the main steam isolation valves (MSIVs) and main steam line (MSL) drain valves. These changes were made to eliminate potential spurious trips and unnecessary plant transients. As part of Amendment 212 new MSLRM trips were added for the GSE and MVP.

The main condenser MVP trip instrumentation initiates a trip of the MVP breakers and isolates the MVP lines. The main turbine GSE trip instrumentation initiates a trip of the GSE breakers. Following events in which radiation in the main steam lines exceeds a predetermined value, the MVP and GSE trips limit offsite and control room doses in the event of a control rod drop accident (CRDA).

Plant modifications were implemented during the fall 2018 refueling outage to add the MVP and GSE MSLRM trips. The associated new MSLRM MVP and GSE trip logic is safety related up to the point of interface with the non-safety related MVP and GSE control circuits. The use of the safety-related MSLRM trips increases the redundancy and improves the reliability of the initiating trip logic.

As the new MVP and GSE MSLRM trip instrumentation have been recently added, there has only been one performance of SR 3.3.7.2.3 and 3.3.7.3.3 (post modification testing). However, only the new interfacing logic between the MSLRM trip logic and the MVP and GSE control circuits was not subjected to the previous RPS SR 3.3.1.1.14 and PCIS SR 3.3.6.1.4 CHANNEL CALIBRATIONs.

The MSLRM radiation monitor uncertainties are dominated by factors other than electronic drift. The uncertainties associated with calibration source strength and geometry dominate. Radiation detectors are calibrated using a radioactive source as an input signal to the detector. The source check is performed by exposing the detector to a known source in a constant geometry. Source checks of radiation monitors are subject to greater uncertainties than electronic calibration checks due to source decay, geometry, signal strength, and the sensor response curves of the particular monitoring system. Because of the uncertainties associated with the calibration methods for these devices, a rigorous drift evaluation would not provide a meaningful indication of the instrument performance over time and was not performed.

CHANNEL CHECKs (SR 3.3.7.2.1 and SR 3.3.7.3.1) are performed once every 12 hours and CHANNEL FUNCTIONAL TESTs (SR 3.3.7.2.2 and SR 3.3.7.3.2) are performed at 92 day intervals. These more frequently performed SRs provide assurance that the instruments are operating within expected parameters.

A review of SR history of previous MSLRM RPS and PCIS trip functions identified no failures that would have been detected solely by the periodic performance of the previous RPS SR 3.3.1.1.14 and PCIS SR 3.3.6.1.4 CHANNEL CALIBRATIONs. Considering the increased reliability associated with the new safety-related trips, successful post modification testing (SRs 3.3.7.2.3 and 3.3.7.3.3), and that the MVP and GSE trip functions are subject to more frequent performed SRs, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval.

TS 3.3.8.2 Reactor Protection System (RPS) Electric Power Monitoring

The RPS Electric Power Monitoring System is provided to isolate the RPS bus from the motor generator (MG) set or alternate power supply in the event of overvoltage, undervoltage, or

underfrequency. This system protects the loads connected to the RPS bus against unacceptable voltage and frequency conditions.

The proposed change extends the interval for SR 3.3.8.2.2 from 18 to 24 months.

SR 3.3.8.2.2 Perform CHANNEL CALIBRATION. The Allowable Values shall be:

a.	Overvoltage	≤ 132 V.
b.	Undervoltage	≥ 108 V.
c.	Underfrequency	≥ 57 Hz.

The allowable values established based on the methodology outlined in the GE RPS Design Specification are not associated with an analytical limit. The field settings surveillance procedure acceptance criteria are based on engineering judgement to provide sufficient margin to the TS Allowable Values.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

TS 3.4.6 RCS Leakage Detection Instrumentation

Limits on leakage from the reactor coolant pressure boundary (RCPB) are required so that appropriate action can be taken before the integrity of the RCPB is impaired. Leakage detection systems for the RCS are provided to alert the operators when leakage rates above normal background levels are detected and also to supply quantitative measurement of leakage rates. In addition to meeting the OPERABILITY requirements, the monitors are typically set to provide the most sensitive response without causing an excessive number of spurious alarms.

Systems for separating the leakage of an identified source from an unidentified source are necessary to provide prompt and quantitative information to the operators to permit them to take immediate corrective action.

SR 3.4.6.3, CHANNEL CALIBRATION, applies to the RCS leakage detection instrumentation functions listed below. The proposed change extends the SR 3.4.6.3 interval from 18 to 24 months.

SR 3.4.6.3 Perform a CHANNEL CALIBRATION of required leakage detection instrumentation.

a. Drywell floor drain sump flow monitoring system;
b. The primary containment atmosphere gaseous radioactivity monitoring system; and
c. Drywell floor drain sump level monitoring system.

The Reactor Coolant Leakage Detection instrumentation provides a monitoring function only to alert the operator to a potential unit problem. The alarm setpoints of these devices are not an assumption in any safety analyses or accident analysis. SR 3.4.6.1 requires that a CHANNEL CHECK be performed on a 12-hour basis on the required containment atmosphere radioactivity monitor. SR 3.4.6.2 requires that a CHANNEL FUNCTIONAL TEST be performed every 31 days on the required leakage detection instrumentation.

The instrument drift associated with these functions was not rigorously analyzed for instrument drift for the reasons discussed below.

TS 3.4.6 Function a Drywell floor drain sump flow monitoring system; and,
TS 3.4.6 Function c Drywell floor drain sump level monitoring system

The drywell floor drain sump flow and level monitoring instrumentation is used to detect a relative change in leakage over short time intervals (i.e., hours, not refueling intervals). Instrument drift is considered a long-term effect, and the drift that occurs during the short duration between readings on the leakage instruments is insignificant and will not affect the conclusions drawn relative to a change in RCS leakage over a short period. Therefore, the short-term leakage change measurement is unaffected by long term drift of the instrumentation. Normal operation of all leakage detection instrumentation is also confirmed by verifying that RCS operational leakage is within limits every 8 hours is accordance with SR 3.4.4.1. This verification would identify any significant changes in the leakage detection instruments and therefore confirms proper operation.

TS 3.4.6 Function b, Primary containment atmosphere gaseous radioactivity monitoring system

The primary containment atmosphere radioactivity instruments monitor for a sudden increase of radioactivity, which could be due to steam or water leakage. The primary containment atmosphere radioactivity monitoring instruments are not capable of quantifying leakage rates but are sensitive enough to indicate increased leakage rates. Additionally, radiation monitor uncertainties are dominated by factors other than electronic drift. The uncertainties associated with calibration source strength and geometry dominate. Radiation detectors are calibrated using a radioactive source as an input signal to the detector. The source check is performed by exposing the detector to a known source in a constant geometry. Source checks of radiation monitors are subject to greater uncertainties than electronic calibration checks due to source decay, geometry, source strength, and the sensor response characteristics of that particular monitoring system. Because of the uncertainties associated with the calibration methods for

these devices, a rigorous drift evaluation would not provide a meaningful indication of the instrument performance over time. 12 hour CHANNEL CHECKs (SR 3.4.6.1) and CHANNEL FUNCTIONAL TESTs (SR 3.4.6.2) every 31 days verify that the instruments are performing within expected parameters. Therefore, rigorous drift analyses are not performed for radiation monitors.

There are no Allowable Values associated with these functions. The GL 91-04 evaluations for SR 3.4.6.3, CHANNEL CALIBRATION, results in changes to calibration tolerances for Functions a. and c. The affected calibration surveillance procedures will be revised as part of implementation, prior to the first 24-month cycle of operation.

A review of SR test history identified no failures of the TS functions that would have been detected solely by the periodic performance of this SR.

Accordingly, the impact, if any, on system availability is minimal from the proposed change to a 24-month SR interval. Based on the history of system performance, the impact of this change on safety, if any, is small.

Overall Calibration Changes Summary

Based on the foregoing the impact on safety, if any, for the proposed changes in SR intervals from 18 to 24 months for the CHANNEL CALIBRATION SRs discussed above, would be small.

D. GL 91-04 Evaluation Conclusion

NRC GL 91-04 provides generic guidance for evaluating SR interval changes from 18 to 24 months. This enclosure provides DTE's evaluation of the proposed surveillance interval changes for Non-Calibration and Calibration changes. The evaluation addresses the supporting information requested by GL91-04 to support the proposed Non-Calibration and Calibration changes.

The review of historical surveillance test data and associated maintenance records for both Non-Calibration and Calibration changes support a conclusion that the impact on safety, if any, for the proposed changes in surveillance intervals from 18 to 24 months, would be small.

Additionally, the impact of instrument drift was evaluated for the proposed calibration surveillance interval changes. The proposed increase in calibration SR intervals from 18 to 24 months does not impact any TS Allowable Values.

In conclusion, the GL 91-04 evaluation supports the determination that the effect on plant safety associated with the proposed SR interval changes from 18 to 24 months, if any, is small.

Enclosure 6 to
NRC-19-0054

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

Applicable Instrumentation

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.1.1.14	3.3.1.1-1-3	CHANNEL CALIBRATION Reactor Protection System Instrumentation Reactor Vessel Steam Dome Pressure - High	ROSEMOUNT INC.	1153GB9RCN0037	0 to 1500 psig
SR 3.3.1.1.14	3.3.1.1-1-4	CHANNEL CALIBRATION Reactor Protection System Instrumentation Reactor Vessel Water Level - Low, Level 3	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches
SR 3.3.1.1.14	3.3.1.1-1-7	CHANNEL CALIBRATION Reactor Protection System Instrumentation Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.1.1.14	3.3.1.1-1-8.a	CHANNEL CALIBRATION Reactor Protection System Instrumentation Scram Discharge Volume Water Level - High a. Level Transmitter	GOULD-ELECTRONICS	PD3218-100-38-12-10-	10.17 to 102.79 in WC
SR 3.3.1.1.16	3.3.1.1-1-9	Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP. Turbine Stop Valve - Closure	ROSEMOUNT INC.	1151GP9E22T0003PB	10 to 1010 psig
SR 3.3.1.1.16	3.3.1.1-1-9	Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP. Turbine Stop Valve - Closure	ROSEMOUNT INC.	710DUOTT16026	4 to 20 mA
SR 3.3.1.1.16	3.3.1.1-1-10	Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP. Turbine Control Valve Fast Closure	ROSEMOUNT INC.	1151GP9E22T0003PB	10 to 1010 psig
SR 3.3.1.1.16	3.3.1.1-1-10	Verify Turbine Stop Valve-Closure and Turbine Control Valve Fast Closure Functions are not bypassed when THERMAL POWER is ≥ 29.5% RTP. Turbine Control Valve Fast Closure	ROSEMOUNT INC.	710DUOTT16026	4 to 20 mA
SR 3.3.2.2.3	N/A	CHANNEL CALIBRATION The Allowable Value shall be ≤219 inches. Feedwater and Main Turbine High Water Level Trip Instrumentation	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.4.1.3.a	N/A	CHANNEL CALIBRATION The Allowable Values shall be: a. Reactor Vessel Water Level-Low Low, Level 2: ≥ 103.8 inches	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.4.1.3.b	N/A	CHANNEL CALIBRATION The Allowable Values shall be: b. Reactor Vessel Pressure-High: ≤ 1153 psig.	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.5.1.4	3.3.5.1-1-1.a	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Core Spray System a. Reactor Vessel Water Level - Low Low Low, Level 1	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-1.b	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Core Spray System b. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.5.1.4	3.3.5.1-1-1.c	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Core Spray System c. Reactor Steam Dome Pressure - Low (Injection Permissive)	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.5.1.4	3.3.5.1-1-2.a	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System a. Reactor Vessel Water Level - Low Low Low, Level 1	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-2.b	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System b. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.5.1.4	3.3.5.1-1-2.c	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System c. Reactor Steam Dome Pressure - Low (Injection Permissive)	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.5.1.4	3.3.5.1-1-2.d	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System d. Reactor Vessel Water Level - Low Low, Level 2 (Loop Select Logic)	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.5.1.4	3.3.5.1-1-2.e	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System e. Reactor Steam Dome Pressure - Low (Break Detection Logic)	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.5.1.4	3.3.5.1-1-2.f	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System f. Riser Differential Pressure - High (Break Detection)	ROSEMOUNT INC.	1153DB4RCN0037	0 to 55.06 in WC
SR 3.3.5.1.4	3.3.5.1-1-2.g	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Low Pressure Coolant Injection (LPCI) System g. Recirculation Pump Differential Pressure - High (Break Detection)	ROSEMOUNT INC.	1153DB4RCN0037	0 to 137.61 in WC
SR 3.3.5.1.4	3.3.5.1-1-3.a	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System a. Reactor Vessel Water Level — Low Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-3.b	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System b. Drywell Pressure — High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.5.1.4	3.3.5.1-1-3.c	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System c. Reactor Vessel Water Level — High, Level 8	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-3.d	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System d. Condensate Storage Tank Level — Low	ROSEMOUNT INC.	1152DP3N22T0280PB	-9.92 to 9.95 in WC
SR 3.3.5.1.4	3.3.5.1-1-3.d	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System d. Condensate Storage Tank Level — Low	ROSEMOUNT INC.	1153DB3RCN0037	-9.92 to 9.95 in WC

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.5.1.4	3.3.5.1-1-3.e	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System e. Suppression Pool Water Level — High	GOULDS PUMPS INC.	PD3018 W/40 FT CAP.	61.84 to 82.29 in WC
SR 3.3.5.1.4	3.3.5.1-1-3.e	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation High Pressure Coolant Injection (HPCI) System e. Suppression Pool Water Level — High	GULTON INDUSTRIES INC.	PD3218-100-38-21-36-N3-40-0	61.84 to 82.29 in WC
SR 3.3.5.1.4	3.3.5.1-1-4.a	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System A a. Reactor Vessel Water Level - Low Low Low, Level 1	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-4.b	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System A b. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.5.1.4	3.3.5.1-1-4.d	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System A d. Reactor Vessel Water Level - Low, Level 3 (Confirmatory)	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-4.e	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System A e. Core Spray Pump Discharge Pressure - High	ROSEMOUNT INC.	1153GB8RC	0 to 500 psig
SR 3.3.5.1.4	3.3.5.1-1-4.f	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System A f. Low Pressure Coolant Injection Pump Discharge Pressure - High	ROSEMOUNT INC.	1153GB8RC	0 to 500 psig
SR 3.3.5.1.4	3.3.5.1-1-5.a	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System B a. Reactor Vessel Water Level - Low Low Low, Level 1	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.5.1.4	3.3.5.1-1-5.b	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System B b. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.5.1.4	3.3.5.1-1-5.d	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System B d. Reactor Vessel Water Level - Low, Level 3 (Confirmatory)	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches
SR 3.3.5.1.4	3.3.5.1-1-5.e	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System B e. Core Spray Pump Discharge Pressure - High	ROSEMOUNT INC.	1153GB8RC	0 to 500 psig
SR 3.3.5.1.4	3.3.5.1-1-5.f	CHANNEL CALIBRATION Emergency Core Cooling System Instrumentation Automatic Depressurization System (ADS) Trip System B f. Low Pressure Coolant Injection Pump Discharge Pressure - High	ROSEMOUNT INC.	1153GB8RC	0 to 500 psig
SR 3.3.5.2.4	3.3.5.2-1-1	CHANNEL CALIBRATION Reactor Core Isolation Cooling System Instrumentation 1. Reactor Vessel Water Level — Low Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.2.4	3.3.5.2-1-2	CHANNEL CALIBRATION Reactor Core Isolation Cooling System Instrumentation 2. Reactor Vessel Water Level — High, Level 8	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.5.2.4	3.3.5.2-1-3	CHANNEL CALIBRATION Reactor Core Isolation Cooling System Instrumentation 3. Condensate Storage Tank Level — Low	ROSEMOUNT INC.	1152DP3N22T0280PB	-9.92 to 9.95 in WC
SR 3.3.5.2.4	3.3.5.2-1-3	CHANNEL CALIBRATION Reactor Core Isolation Cooling System Instrumentation 3. Condensate Storage Tank Level — Low	ROSEMOUNT INC.	1153DB3RCN0037	-9.92 to 9.95 in WC
SR 3.3.6.1.4	3.3.6.1-1-1.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation a. Reactor Vessel Water Level - Low Low Low, Level 1	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.6.1.4	3.3.6.1-1-1.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation b. Main Steam Line Pressure - Low	ROSEMOUNT INC.	1151GP9E22T0003PB	7 to 1207 psig
SR 3.3.6.1.4	3.3.6.1-1-1.c	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation c. Main Steam Line Flow - High	ROSEMOUNT INC.	1151DP7E22T0003PB	0 to 148.39 psid
SR 3.3.6.1.4	3.3.6.1-1-1.c	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation c. Main Steam Line Flow - High	ROSEMOUNT INC.	1152DP7N22T0280PB	0 to 148.39 psid
SR 3.3.6.1.4	3.3.6.1-1-1.d	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation d. Condenser Pressure - High	ROSEMOUNT INC.	1151AP6E22T0003PB	3 to 18 psia
SR 3.3.6.1.4	3.3.6.1-1-1.d	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation d. Condenser Pressure - High	ROSEMOUNT INC.	1153AB6PA	3 to 18 psia
SR 3.3.6.1.4	3.3.6.1-1-1.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation e. Main Steam Tunnel Temperature - High	ROSEMOUNT INC.	510DU434163	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-1.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation e. Main Steam Tunnel Temperature - High	ROSEMOUNT INC.	710DU0TR	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-1.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation e. Main Steam Tunnel Temperature - High	ROSEMOUNT INC.	710DU0TR27000	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-1.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation e. Main Steam Tunnel Temperature - High	ROSEMOUNT INC.	710DUOTR34163	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-1.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation e. Main Steam Tunnel Temperature - High	ROSEMOUNT INC.	510DU434163	103.9 to 167.23 Ohms

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.6.1.4	3.3.6.1-1-1.g	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation g. Turbine Building Area Temperature - High	ROSEMOUNT INC.	510DU434163	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-1.g	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Main Steam Line Isolation g. Turbine Building Area Temperature - High	ROSEMOUNT INC.	710DU0TR27000	103.9 to 167.23 Ohms
SR 3.3.6.1.4	3.3.6.1-1-2.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Primary Containment Isolation a. Reactor Vessel Water Level - Low, Level 3	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 Inches
SR 3.3.6.1.4	3.3.6.1-1-2.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Primary Containment Isolation b. Reactor Vessel Water Level - Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.6.1.4	3.3.6.1-1-2.c	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Primary Containment Isolation c. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.6.1.4	3.3.6.1-1-3.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation a. HPCI Steam Line Flow - High	AGASTAT	ETR14D3B004	0.55 to 15 seconds
SR 3.3.6.1.4	3.3.6.1-1-3.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation a. HPCI Steam Line Flow - High	AGASTAT	ETR14D3BC2004002	0.55 to 15 seconds
SR 3.3.6.1.4	3.3.6.1-1-3.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation a. HPCI Steam Line Flow - High	ROSEMOUNT INC.	1153DB6RC	-450.6 to 535 in WC
SR 3.3.6.1.4	3.3.6.1-1-3.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation b. HPCI Steam Supply Line Pressure - Low	ROSEMOUNT INC.	1153GB7RC	0 to 200 psig

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.6.1.4	3.3.6.1-1-3.c	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation c. HPCI Turbine Exhaust Diaphragm Pressure - High	ROSEMOUNT INC.	1153GB6RC	0 to 50 psig
SR 3.3.6.1.4	3.3.6.1-1-3.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation High Pressure Coolant Injection (HPCI) System Isolation e. Drywell Pressure-High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.6.1.4	3.3.6.1-1-4.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation a. RCIC Steam line Flow - High	AGASTAT	ETR14D3BC2004	0.55 to 15 seconds
SR 3.3.6.1.4	3.3.6.1-1-4.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation a. RCIC Steam line Flow - High	AGASTAT	ETR14D3BC2004002	0.55 to 15 seconds
SR 3.3.6.1.4	3.3.6.1-1-4.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation a. RCIC Steam line Flow - High	ROSEMOUNT INC.	1151DP5E22T0003PB	-260.3 to 334 in WC
SR 3.3.6.1.4	3.3.6.1-1-4.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation b. RCIC Steam Supply Line Pressure - Low	ROSEMOUNT INC.	1151GP7E22T0003PB	0 to 200 psig
SR 3.3.6.1.4	3.3.6.1-1-4.c	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation c. RCIC Turbine Exhaust Diaphragm Pressure - High	ROSEMOUNT INC.	1151GP6E22T0003PB	0 to 30 psig
SR 3.3.6.1.4	3.3.6.1-1-4.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Core Isolation Cooling (RCIC) System Isolation e. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	GEMAC (DIV. OF GE)	50-560111AAAC1PAX	10 to 50 mA
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	GEMAC (DIV. OF GE)	50-563052AAAC1PLY	10 to 50 mA
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	GEMAC (DIV. OF GE)	565100AAAC1	4 to 20 mA
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	ROSEMOUNT INC.	1152DP5N22T0280PB	0 to 166.41 in WC
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	ROSEMOUNT INC.	1153DB5RCN0037	0 to 196.65 in WC
SR 3.3.6.1.4	3.3.6.1-1-5.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation a. Differential Flow - High	ROSEMOUNT INC.	3152ND2B2F1A1	0 to 148.11 in WC
SR 3.3.6.1.4	3.3.6.1-1-5.e	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Reactor Water Cleanup (RWCU) System Isolation e. Reactor Vessel Water Level - Low Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.6.1.4	3.3.6.1-1-6.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Shutdown Cooling System Isolation a. Reactor Steam Dome Pressure - High	ROSEMOUNT INC.	1153GB7RCN0037	0 to 200 psig
SR 3.3.6.1.4	3.3.6.1-1-6.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Shutdown Cooling System Isolation b. Reactor Vessel Water Level - Low, Level 3	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches
SR 3.3.6.1.4	3.3.6.1-1-7.a	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Traversing In-core Probe Isolation a. Reactor Vessel Water Level - Low, Level 3	ROSEMOUNT INC.	1153DB4RCN0037	160 to 220 inches

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

APPLICABLE INSTRUMENTATION

TS Surveillance	TS Function*	Description	Manufacturer	Model No.	Range
SR 3.3.6.1.4	3.3.6.1-1-7.b	CHANNEL CALIBRATION Primary Containment Isolation Instrumentation Traversing In-core Probe Isolation b. Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.6.2.4	3.3.6.2-1-1	CHANNEL CALIBRATION Secondary Containment Isolation Instrumentation Reactor Vessel Water Level - Low Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.6.2.4	3.3.6.2-1-2	CHANNEL CALIBRATION Secondary Containment Isolation Instrumentation Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig
SR 3.3.6.3.3	3.3.6.3-1-1	CHANNEL CALIBRATION Low-Low Set Instrumentation Reactor Steam Dome Pressure - High	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.6.3.3	3.3.6.3-1-2	CHANNEL CALIBRATION Low-Low Set Instrumentation Low-Low Set Pressure Setpoints	ROSEMOUNT INC.	1153GD9RCN0037	0 to 1200 psig
SR 3.3.6.3.3	3.3.6.3-1-3	CHANNEL CALIBRATION Low-Low Set Instrumentation Tailpipe Pressure Switch	PRESSURE CONTROLS, INC.	A17-1P	25 to 200 psig
SR 3.3.7.1.5	3.3.7.1.1-1-1	CHANNEL CALIBRATION Control Room Emergency Filtration System Instrumentation Reactor Vessel Water Level - Low Low, Level 2	ROSEMOUNT INC.	1153DB5RCN0037	10 to 220 inches
SR 3.3.7.1.5	3.3.7.1.1-1-2	CHANNEL CALIBRATION Control Room Emergency Filtration System Instrumentation Drywell Pressure - High	ROSEMOUNT INC.	1153GB4RCN0037	0 to 5 psig

Table Notes:
*TS Function is identified by TS Table-Function. For example "3.3.1.1-1-3" refers to TS Table 3.3.1.1-1, Function 3.

Enclosure 7 to
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Instrument Drift Analysis Design Guide, DTE-18001, Revision 0

DTE ENERGY
FERMI 2 POWER PLANT

INSTRUMENT DRIFT ANALYSIS DESIGN GUIDE

IN SUPPORT OF

24-MONTH FUEL CYCLE EXTENSION PROJECT

DTE-18001

Revision 0

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0	Original issue.

1. OBJECTIVE/PURPOSE

The objective of this Design Guide is to provide the necessary detail and guidance to perform drift analyses using past calibration history data for the purposes of:

- Quantifying component/loop drift characteristics within defined probability limits to gain an understanding of the expected behavior for the component/loop by evaluating past performance
- Estimating component/loop drift for integration into setpoint calculations
- Analysis aid for reliability centered maintenance practices (e.g., optimizing calibration frequency)
- Establishing a technical basis for extending calibration and surveillance intervals using historical calibration data
- Trending device performance based on extended surveillance intervals

2. DRIFT ANALYSIS SCOPE

The scope of this design guide is limited to the calculation of the expected performance for a component, group of components or loop, utilizing past calibration data. Drift Calculations are the final product of the data analysis. The output from the Drift Calculations may be used directly as input to setpoint or loop accuracy calculations. However, if desired, the output may be compared to the design values used within setpoint and loop accuracy calculations to show that the existing design approach is conservative.

The approaches described within this design guide can be applied to all devices that are surveilled or calibrated where As-Found and As-Left data is recorded. The scope of this design guide includes, but is not limited to, the following list of devices:

- Transmitters (Differential Pressure, Flow, Level, Pressure, Temperature, etc.)
- Bistables (Master & Slave Trip Units, Alarm Units, etc.)
- Indicators (Analog, Digital)
- Switches (Differential Pressure, Flow, Level, Position, Pressure, Temperature, etc.)
- Signal Conditioners/Converters (Summers, E/P Converters, Square Root Converters, etc.)
- Recorders (Temperature, Pressure, Flow, Level, etc.)
- Monitors & Modules (Radiation, Neutron, H_2O_2, Pre-Amplifiers, etc.)
- Relays (Time Delay, Undervoltage, Overvoltage, etc.)

Note that a given device or device type may be justified not to require drift analysis in accordance with this design guide, if appropriate.

3. DISCUSSION/METHODOLOGY

3.1. Methodology Options

This design guide is written to provide the methodology necessary for the analysis of As-Found versus As-Left calibration data, as a means of characterizing the performance of a component or group of components via the following methods:

3.1.1. Electric Power Research Institute (EPRI) has developed a guideline to provide nuclear plants with practical methods for analyzing historic component calibration data to predict component performance via a simple spreadsheet program (e.g., Excel, Lotus 1-2-3). This design guide is written in close adherence to the EPRI guideline, Reference 7.1.1. The Nuclear Regulatory Commission reviewed Revision 0 of Reference 7.1.1 and had a list of concerns documented in Reference 7.1.7. These concerns prompted the issuance of Revision 1 to Reference 7.1.1. Revision 2 of Reference 7.1.1 was issued to address an error in outlier detection, to provide clarity on certain approaches, and to address the NRC concerns from Revision 0. Appendix E of Reference 7.1.1 addresses each NRC concern individually and provides the resolution.

3.1.2. Commercial Grade Software programs other than Microsoft Excel (e.g. Quattro Pro, Lotus 1-2-3, Mathcad, etc.), that perform the functions necessary to evaluate drift, may be utilized providing:

- the intent of this design guide is met as outlined in Reference 7.1.1, and
- software is used only as a tool to produce hard copy outputs which are to be independently verified.

3.1.3. The final products of the data analyses are hard copy Drift Calculations. The electronic files of the Drift Calculations are an intermediate step from raw data to final product and are not controlled as QA files. The Drift Calculation is independently verified using different software than that used to create the Drift Calculation. The documentation of the review of the Drift Calculation will include a summary tabulation of results from each program used in the review process to provide visual evidence of the acceptability of the results of the review.

3.2. Data Analysis Discussion

The following data analysis methods were evaluated for use: 1) As-Found Versus Setpoint, 2) Worst Case As-Found Versus As-Left, 3) Combined Calibration Data Points Analysis, and 4) As-Found Versus As-Left. The evaluation concluded that the As-Found versus As-Left methodology provided results that were more representative of the data and has been chosen for use by this Design Guide. Statistical tests not covered by this design guide may be utilized, provided the Engineer performing the analysis adequately justifies the use of the tests.

3.2.1. As-Found Versus As-Left Calibration Data Analysis

The As-Found versus As-Left calibration data analysis is based on calculating drift by subtracting the previous As-Left component setting from the current As-Found setting. Each calibration point is treated as an independent set of data for purposes of characterizing drift across the full, calibrated span of the component/loop. By evaluating As-Found versus As-Left data for a component/loop or a similar group of components/loops, the following information may be obtained:

- The typical component/loop drift between calibrations (Random in nature)
- Any tendency for the component/loop to drift in a particular direction (Bias)
- Any tendency for the component/loop drift to increase in magnitude over time (Time Dependency)

- Confirmation that the selected setting or calibration tolerance is appropriate or achievable for the component/loop

3.2.1.1. General Features of As-Found Versus As-Left Analysis

- The methodology evaluates historical calibration data only. The method does not monitor on-line component output; data is obtained from component calibration records.
- Present and future performance is predicted based on statistical analysis of past performance.
- Data is readily available from component calibration records. Data can be analyzed from plant startup to the present or only more recent data can be evaluated.
- Since only historical data is evaluated, the method is not intended as a tool to identify individual faulty components, although it can be used to demonstrate that a particular component model or application historically performs poorly.
- A similar class of components, i.e., same make, model, or application, is evaluated. For example, the method can determine the drift of all analog indicators of a certain type installed in the control room.
- The methodology is less suitable for evaluating the drift of a single component over time, due to statistical analysis penalties that occur with smaller sample sizes.
- The methodology obtains a value of drift for a particular model, loop, or function that can be used in component or loop uncertainty and setpoint calculations.
- The methodology is designed to support the analysis of longer calibration intervals and is consistent with the NRC expectations described in Reference 7.3.3. Values for instrument drift developed in accordance with this Design Guide are to be applied in accordance with References 7.2.2 and 7.2.3, as appropriate.

3.2.1.2. Error and Uncertainty Content in As-Found Versus As-Left Calibration Data

The As-Found versus the As-Left data includes several sources of uncertainty over and above component drift. The difference between As-Found and previous As-Left data encompasses a number of instrument uncertainty terms in addition to drift, as defined by the plant instrument uncertainty / setpoint methodologies. The drift is <u>not</u> assumed to encompass the errors associated with temperature effect, since the temperature difference between the two calibrations is not quantified, and is not anticipated to be significant. Additional instruction for the use of As-Found and As-Left data may be found in Reference 7.1.2. The following possible contributors could be included within the measured variation, but are not necessarily considered as such.

- Accuracy errors present between any two consecutive calibrations
- Measurement and test equipment error between any two consecutive calibrations
- Personnel-induced or human-related variation or error between any two consecutive calibrations

- Normal temperature effects due to a difference in ambient temperature between any two consecutive calibrations
- Power Supply variations between any two consecutive calibrations
- Environmental effects on component performance, e.g., radiation, humidity, vibration, etc., between any two consecutive calibrations that cause a shift in component output
- Misapplication, improper installation, or other operating effects that affect component calibration between any two consecutive calibrations
- True drift representing a change, time-dependent or otherwise, in component/loop output over the time period between any two consecutive calibrations

3.2.1.3. Potential Impacts of As-Found Versus As-Left Data Analysis

Many of the bulleted items listed in step 3.2.1.2 are not expected to have a significant effect on the measured As-Found and As-Left settings. Because there are so many independent parameters contributing to the possible variance in calibration data, they are all considered together and termed the component's Analyzed Drift (DA) uncertainty. This approach has the following potential impacts on an analysis of the component's calibration data:

- The magnitude of the calculated variation may exceed any assumptions or manufacturer predictions regarding drift. Attempts to validate manufacturer's performance claims should consider the possible contributors listed in step 3.2.1.2 to the calculated drift.

- The magnitude of the calculated variation that includes all of the above sources of uncertainty may mask any "true" time-dependent drift. In other words, the analysis of As-Found versus As-Left data may not demonstrate any time dependency. This does not mean that time-dependent drift does not exist, only that it could be so small that it is negligible in the cumulative effects of component uncertainty, when all of the above sources of uncertainty are combined.

3.3. Tolerance Interval

This Design Guide recommends a single confidence interval level to be used for performing data analyses and the associated calculations.

NOTE: The default Tolerance Interval Factor (TIF) for all Drift Calculations, performed using this Design Guide, is chosen for a 95%/95% probability and confidence, although this is not specifically required in every situation. This term means that the results have a 95% confidence (γ) that at least 95% of the population lies between the stated interval (P) for a sample size (n). Extrapolating the drift value for the extended time between surveillance is based on the assumption that future drift values will also be within the calculated drift interval 95% of the time. Components that perform functions that support a specific Technical Specification (or other licensing basis requirements document) value, or are associated with the safety analysis assumptions or inputs, are always analyzed at a 95%/95% tolerance interval. Components/loops that fall into this level must:

- be included in the data group (or be justified to apply the results per the guidance of Reference 7.1.1) if the analyzed drift value is to be applied to the component/loop in a Setpoint/Uncertainty Calculation,
- use the 95/95% TIF for determination of the Analyzed Drift term (see step 3.4.2 and Table 1 – 95%/95%Tolerance Interval Factors), and
- be evaluated in the Setpoint/Uncertainty Calculation for application of the Analyzed

Drift term. (For example, the DA term may include the normal temperature effects for a given device, but due to the impossibility of separating out that specific term, an additional temperature uncertainty may be included in the Setpoint/Uncertainty Calculation.)

3.4. Calibration Data Collection

3.4.1. Sources of Data

The sources of data to perform a drift analysis are Surveillance Tests, Calibration Procedures and other calibration processes (calibration files, calibration sheets for Balance of Plant devices, Preventative Maintenance, etc.).

3.4.2. How Much Data to Collect

3.4.2.1. The goal is to collect enough data for the instrument or group of instruments to make a statistically valid pool. There is no hard fast number that must be attained for any given pool, but a minimum of 30 drift values must be attained before the drift analysis can be performed without additional justification. As a general rule, drift analyses should not be performed for sample sizes of less than 20 drift values. Table 1 provides the 95%/95% TIF for various sample pool sizes; it should be noted that the smaller the pool the larger the penalty. A tolerance interval is a statement of confidence that a certain proportion of the total population is contained within a defined set of bounds. For example, a 95%/95% TIF indicates a 95% level of confidence that 95% of the population is contained within the stated interval.

Table 1 – 95%/95%Tolerance Interval Factors (Per Table VII(a) of Ref 7.3.2)

Sample Size	95%/95%	Sample Size	95%/95%	Sample Size	95%/95%
≥ 2	37.674	≥ 23	2.673	≥ 120	2.205
≥ 3	9.916	≥ 24	2.651	≥ 130	2.194
≥ 4	6.370	≥ 25	2.631	≥ 140	2.184
≥ 5	5.079	≥ 26	2.612	≥ 150	2.175
≥ 6	4.414	≥ 27	2.595	≥ 160	2.167
≥ 7	4.007	≥ 30	2.549	≥ 170	2.160
≥ 8	3.732	≥ 35	2.490	≥ 180	2.154
≥ 9	3.532	≥ 40	2.445	≥ 190	2.148
≥ 10	3.379	≥ 45	2.408	≥ 200	2.143
≥ 11	3.259	≥ 50	2.379	≥ 250	2.121
≥ 12	3.162	≥ 55	2.354	≥ 300	2.106
≥ 13	3.081	≥ 60	2.333	≥ 400	2.084
≥ 14	3.012	≥ 65	2.315	≥ 500	2.070
≥ 15	2.954	≥ 70	2.299	≥ 600	2.060
≥ 16	2.903	≥ 75	2.285	≥ 700	2.052
≥ 17	2.858	≥ 80	2.272	≥ 800	2.046
≥ 18	2.819	≥ 85	2.261	≥ 900	2.040
≥ 19	2.784	≥ 90	2.251	1000	2.036
≥ 20	2.752	≥ 95	2.241	∞	1.960
≥ 21	2.723	≥ 100	2.233		
≥ 22	2.697	≥ 110	2.218		

3.4.2.2. Different information may be needed, depending on the analysis purpose, therefore, the total population of components - all makes, models, and applications that are to be analyzed must be known (e.g., all Rosemount transmitters).

3.4.2.3. Once the total population of components is known, the components should be separated into functionally equivalent groups. Each grouping is treated as a separate population for analysis purposes. For example, start with all Rosemount Differential Pressure Transmitters as the initial group and break them down into various sub-groups - Different Range Codes, Large vs. Small Turn Down Factors (TDF), Level vs. Flow Applications, etc. Note that TDF is significant, since drift is specified as a percent of Upper Range Limit for Rosemount transmitters.

3.4.2.4. Where the number of data points is so enormous that the data acquisition task would be prohibitive, not all components or available calibration data points need to be analyzed within each group in order to establish statistical performance limits for the group. Acquisition of data should be considered from different perspectives.

- For each grouping, a large enough sample of components should be randomly selected from the population, so there is assurance that the evaluated components are representative of the entire population. By randomly selecting the components and confirming that the behavior of the randomly selected components is similar, a basis for not evaluating the entire population can be established.
- For each selected component in the sample, enough historic calibration data should be provided to ensure that the component's performance over time is understood.
- If the data from the entire population of instruments are not being analyzed, a randomized selection process, not dependent upon engineering judgment, should be used. This selection process should have three steps. 1) All data for the chosen instrument grouping is selected, regardless of the age of the data. 2) A proportion of the applicable data is chosen by automated random selection, ensuring that the data records for single instruments are complete, and enough individual instruments are included to constitute a statistically diverse sample. 3) The amount of data analyzed, and the method used to select the data, are documented.
- Due to the difficulty of determining the total sample set, developing specific sampling criteria is difficult. A sampling method must be used which ensures that various instruments calibrated at different frequencies are included. The sampling method must also ensure that the different component types, operating conditions and other influences on drift are included. Because of the difficulty in developing a valid sampling program, it is often simpler to evaluate all available data for the required instrumentation within the chosen time period. This eliminates changing sample methods, should groups be combined or split, based on plant conditions or performance. For the purposes of this guide, specific justification in the Drift Calculation is required to document any sampling plan.

3.5. Categorizing Calibration Data

3.5.1. Grouping Calibration Data

One analysis goal should be to combine functionally equivalent components (components with similar design and performance characteristics) into a single group. In some cases, all components of a particular manufacturer make and model can be combined into a single sample. In other cases, virtually no grouping of data beyond a particular component make, model, and specific span or application may be possible. Some examples of possible groupings include, but are not limited to, the following:

3.5.1.1. Small Groupings

- All devices of same manufacturer, model and range, covered by the same Surveillance Test
- All trip units used to monitor a specific parameter (assuming that all trip units are the same manufacturer, model and range)

3.5.1.2. Larger Groupings

- All transmitters of a specific manufacturer, model that have similar spans and performance requirements
- All control room isolators with functionally equivalent model numbers
- All control room analog indicators of a specific manufacturer and model

3.5.2. Rationale for Grouping Components into a Larger Sample

- A single component analysis may result in too few data points to make statistically meaningful performance predictions.
- Smaller sample sizes associated with a single component may unduly penalize performance predictions by applying a larger TIF to account for the smaller data set. Larger sample sizes reflect a greater understanding and assurance of representative data that in turn, reduces the uncertainty factor.
- Large groupings of components into a sample set for a single population ultimately allows the user to state the plant-specific performance for a particular make and model of component. For example, the user may state, "Main Steam Flow Transmitters have historically drifted by less than 1%", or "All control room indicators of a particular make and model have historically drifted by less than 1.5%".
- An analysis of smaller sample sizes is more likely to be influenced by non-representative variations of a single component (outliers).
- Grouping similar components together, rather than analyzing them separately, is more efficient and minimizes the number of separate calculations that must be maintained.

3.5.3. Considerations When Combining Components into a Single Group

Grouping components together into a sample set for a single population does not have to become a complicated effort. Most components can be categorized readily into the appropriate population. Consider the following guidelines when grouping functionally equivalent components together.

- If performed on a type-of-component basis, component groupings should usually be established down to the manufacturer make and model, as a minimum. For example, data from Rosemount and Foxboro transmitters should not be combined in the same drift analysis. The principles of operation are different for the various manufacturers, and combining the data could mask some trend for one type of component. However, it might be desirable to combine groups of components for certain calculations. If dissimilar component types are combined, a separate analysis of each component type should still be completed to ensure analysis results of the mixed population are not misinterpreted or misapplied.
- Sensors of the same manufacturer make and model, but with different calibrated spans or elevated zero points, can possibly still be combined into a single group. For example, a single analysis that determines the drift for all Rosemount pressure transmitters installed onsite might simplify the application of the results. Note that some manufacturers provide a predicted accuracy and drift value for a given component model, regardless of its span. However, the validity of combining components with a variation of span, ranging from tens of pounds to several thousand pounds, should be confirmed. As part of the analysis, the performance of components within each span should be compared to the performance of the other devices to determine if any differences are evident between components with different spans.
- Components combined into a single group should be exposed to similar calibration or surveillance conditions, as applicable. Note that the term operating condition was not used in this case. Although it is desirable that the grouped components perform similar functions, the method by which the data is obtained for this analysis is also significant. If half the components are calibrated in the summer at 90°F and the other half in the winter at 40°F, a difference in observed drift between the data for the two sets of components might exist. In many cases, ambient temperature variations are not expected to have a large effect, since the components are located in environmentally controlled areas.

3.5.4. Verification That Data Grouping Is Appropriate

- Combining functionally equivalent components into a single group for analysis purposes may simplify the scope of work; however, some level of verification should be performed to confirm that the selected component grouping is appropriate. As an example, the manufacturer may claim the same accuracy and drift specifications for two components of the same model, but with different ranges, e.g., 0-5 PSIG and 0-3000 PSIG. However, in actual application, components of one range may perform differently than components of another range.
- Standard statistics texts provide methods that can be used to determine if data from similar types of components can be pooled into a single group. If different groups of components have essentially equal variances and means at the desired statistical level, the data for the groups can be pooled into a single group.
- When evaluating groupings, care must be taken not to split instrument groups only because they are calibrated on a different time frequency. Differences in variances may be indicative of a time dependent component to the device drift.

The separation of these groups may mask a time-dependency for the component drift.

- A t-Test (two samples assuming unequal variances) should be performed on the proposed components to be grouped. The t-Test returns the probability associated with a Student's t-Test to determine whether the means from two samples are significantly different. The t-Test is performed using the "t-Test: Two-Sample Assuming Unequal Variances" within an Excel spreadsheet with the Hypothesized Mean Difference set to 0, and the level of significance (Alpha) set to 0.05. If the returned t Stat value is less than the returned t Critical two-tail value, the two means are essentially equal. If the proposed group contains 5 sub-groups, the t-Tests should be performed on all possible combinations for the groupings. However, if there is no plausible engineering explanation for the two sets of data being incompatible, the groups should be combined, despite the results of the t-Test. The following formula is used to determine the test statistic value t.

$$t = \frac{\overline{x}_1 - \overline{x}_2 - \Delta_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad \text{(Ref.7.1.1)}$$

Where;

t - Calculated value of the t-statistic

n_1 - Total number of data points in sample 1

n_2 - Total number of data points in sample 1

$\bar{x}_1$ - Mean of sample 1

$\bar{x}_2$ - Mean of sample 2

s_1^2 - Variance of sample 1

s_2^2 - Variance of sample 2

Δ_0 - Hypothesized mean difference

The following formula is used to estimate the degrees of freedom (df) for the test statistic.

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}} \qquad \text{(Ref. 7.1.1)}$$

Where;

Values are as previously defined.

The t-Test may be performed using the t-Test: Two-Sample Assuming Unequal Variances analysis tool within Microsoft Excel. The Microsoft Excel output will look similar to the following:

t-Test: Two-Sample Assuming Unequal Variances

	Variable 1	*Variable 2*
Mean	-0.017045	0.08413462
Variance	0.1008523	0.31185697
Observations	11	26
Hypothesized Mean Difference	0	
df	32	
t Stat	-0.695517	
P(T<=t) one-tail	0.245876	
t Critical one-tail	1.6938887	
P(T<=t) two-tail	0.4917521	
t Critical two-tail	2.0369333	

A comparison is made to determine whether the proposed groups of data can be combined for analysis. The t distribution is two-sided in this case, and therefore the t Critical two-tail is used as the criterion. If the absolute value of the t statistic (t Stat) is less than the t Critical two-tail value, then the data can be considered to have very similar means, and can be considered acceptable for combination on that basis.

- The F-distribution test should be used to test the equality of two sample variances. The F statistic is the ratio of the larger to smaller variances of the two samples. The critical value of F can be determined using the Excel FINV function with the probability equal to 0.025, degrees of freedom 1 equal to the number of the samples minus 1 in the group with the larger variance, and the degrees of freedom 2 equal to the number of samples minus 1 in the group with the smaller variance. If the calculated F statistic is less than or equal to the critical value of F, the two variances are essentially equal. The following formula is used to determine the F statistic value.

$$F_{calc} = \frac{s^2_{max}}{s^2_{min}} \quad \text{(Ref. 7.1.1)}$$

Where;

s^2_{max} - Largest variance of the sample groups

s^2_{min} - Smallest variance of the sample groups

The Excel FINV function is used to determine the critical value of F:

$F_{crit} = FINV(0.025, v_1, v_2)$

Where;

v_1 - Number of the samples minus 1 in the group with the larger variance

v_2 - Number of the samples minus 1 in the group with the smaller variance

3.5.5. Examples of Proven Groupings:

- All control room indicators receiving a 4-20mAdc (or 1-5Vdc) signal. Notice that a combined grouping may be possible even though the indicators have different indication spans. For example, a 12 mAdc signal should move the indicator pointer to the 50% of span position on each indicator scale, regardless of the span indicated on the face plate (exceptions are non-linear meter scales).

- All control room bistables of similar make or model tested quarterly for Technical Specification surveillance. Note that this assumes that all bistables are tested in a similar manner and have the same input range, e.g., a 1-5Vdc or 4-20mAdc spans.
- A specific type of pressure transmitter used for similar applications in the plant in which the operating and calibration environment does not vary significantly between applications or location.
- A group of transmitters of the same make and model, but with different spans, given that a review confirms that the transmitters of different spans have similar performance characteristics.

3.5.6. Using Data from Other Nuclear Power Plants:

- It is acceptable, although not recommended, to pool data from one nuclear power plant with data obtained from other nuclear power plants, providing the data can be verified to be of high quality. In these cases, justification must be provided for applicability of the data and in the conservatism of the approaches to be used. The data must also be verified to be acceptable for grouping. Acceptability may be defined by verification of grouping, and an evaluation of calibration procedure methods, Measurement and Test Equipment used, and defined setting tolerances. Where there is agreement in calibration method (for instance, starting at zero increasing to 100 percent and decreasing to zero, taking data every 25%), calibration equipment, and area environment (if performance is affected by the temperature), there is a good possibility that the groups may be combined. Previously collected industry data may not have sufficient information about the manner of collection to allow combination with plant specific data.

3.6. Outlier Analysis

An outlier is a data point significantly different in value from the rest of the sample. The presence of an outlier or multiple outliers in the sample of component or group data may result in the calculation of a larger than expected sample standard deviation and tolerance interval. Calibration data can contain outliers for several reasons. Outlier analyses can be used in the initial analysis process to help to identify problems with data that require correction. Examples include:

- *Data Transcription Errors* - Calibration data can be recorded incorrectly either on the original calibration data sheet or in the spreadsheet program used to analyze the data.
- *Calibration Errors* - Improper setting of a device at the time of calibration would indicate larger than normal drift during the subsequent calibration.
- *Measurement and Test Equipment Errors* - Improperly selected or mis-calibrated test equipment could indicate drift, when little or no drift was actually present.
- *Scaling or Setpoint Changes* - Changes in scaling or setpoints can appear in the data as larger than actual drift points unless the change is detected during the data entry or screening process.
- *Failed Instruments* - Calibrations are occasionally performed to verify proper operation due to erratic indications, spurious alarms, etc. These calibrations may be indicative of component failure (not drift), which would introduce errors that are not representative of the device performance during routine conditions.
- *Design or Application Deficiencies* - An analysis of calibration data may indicate a particular component that always tends to drift significantly more than all other similar components installed in the plant. In this case, the component may need an evaluation for the possibility of a design, application, or installation problem. Including this particular

component in the same population as the other similar components may skew the drift analysis results.

3.6.1. Detection of Outliers

There are several methods for determining the presence of outliers. This design guide utilizes the Critical Values for t-Test (Extreme Studentized Deviate). This test is also described by Section 26.5 of NUREG-1475 (Reference 7.1.8) as a Grubbs test. The t-Test utilizes the values listed in Table 2 with an upper significance level of 5% to compare a given data point against. Note that the critical value of t increases as the sample size increases. This signifies that as the sample size grows, it is more likely that the sample is truly representative of the population. The t-Test assumes that the data is normally distributed.

Because it is desired to detect outliers in two directions (positive and negative), this is considered a two-sided test. The two-sided test values within Table 2 are generally derived from Table T-20 of NUREG-1475 (Reference 7.1.8), under the column with a significance (α) of 0.025. Table T-20 gives critical values for a one-sided test. Thus, per Section 26.5 of NUREG-1475 (Reference 7.1.8), the desired significance (0.05) must be divided by two when applying the Table T-20 values for a two-sided test. The value used for populations of 141 through 150 is based on the lookup value of 3.51 for a population of 150 and a 2.5% significance from Table 7-1 of Reference 7.1.1. A conservative value of 4 is used for any data population greater than 150.

Table 2 - Critical Values for t-Test (Two-Sided)

Sample Size	5% Significance Level	Sample Size	5% Significance Level
3	1.155	76	3.287
4	1.481	77	3.291
5	1.715	78	3.297
6	1.887	79	3.301
7	2.020	80	3.305
8	2.126	81	3.309
9	2.215	82	3.315
10	2.290	83	3.319
11	2.355	84	3.323
12	2.412	85	3.327
13	2.462	86	3.331
14	2.507	87	3.335
15	2.549	88	3.339
16	2.585	89	3.343
17	2.620	90	3.347
18	2.651	91	3.350
19	2.681	92	3.355
20	2.709	93	3.358
21	2.733	94	3.362
22	2.758	95	3.365
23	2.781	96	3.369
24	2.802	97	3.372
25	2.822	98	3.377
26	2.841	99	3.380
27	2.859	100	3.383
28	2.876	101	3.386
29	2.893	102	3.390
30	2.908	103	3.393

Sample Size	5% Significance Level	Sample Size	5% Significance Level
31	2.924	104	3.397
32	2.938	105	3.400
33	2.952	106	3.403
34	2.965	107	3.406
35	2.979	108	3.409
36	2.991	109	3.412
37	3.003	110	3.415
38	3.014	111	3.418
39	3.025	112	3.422
40	3.036	113	3.424
41	3.046	114	3.427
42	3.057	115	3.430
43	3.067	116	3.433
44	3.075	117	3.435
45	3.085	118	3.438
46	3.094	119	3.441
47	3.103	120	3.444
48	3.111	121	3.447
49	3.120	122	3.450
50	3.128	123	3.452
51	3.136	124	3.455
52	3.143	125	3.457
53	3.151	126	3.460
54	3.158	127	3.462
55	3.166	128	3.465
56	3.172	129	3.467
57	3.180	130	3.470
58	3.186	131	3.473
59	3.193	132	3.475
60	3.199	133	3.478
61	3.205	134	3.480
62	3.212	135	3.482
63	3.218	136	3.484
64	3.224	137	3.487
65	3.230	138	3.489
66	3.235	139	2.491
67	3.241	140	3.493
68	3.246	141-150	3.510
69	3.252	>150	4.000
70	3.257		
71	3.262		
72	3.267		
73	3.272		
74	3.278		
75	3.282		

3.6.2. t-Test Outlier Detection Equation

$$t = \frac{|x_i - \bar{x}|}{s}$$ (Ref. 7.1.1)

Where;

x_i - An individual sample data point

$\bar{x}$ - Mean of all sample data points

s - Standard deviation of all sample data points

t - Calculated value of extreme studentized deviate that is compared to the critical value of t for the sample size.

3.6.3. Outlier Expulsion

This design guide does not permit multiple outlier tests or passes. The removal of poor quality data as listed in Section 3.6 is not considered removal of outliers, since it is merely assisting in identifying data errors. However, after removal of poor quality data as listed in Section 3.6, certain data points can still appear as outliers when the outlier analysis is performed. These "unique outliers" are not consistent with the other data collected; and could be judged as erroneous points, which tend to skew the representation of the distribution of the data. However, for the general case, since these outliers may accurately represent instrument performance, only one (1) additional unique outlier (as indicated by the t-Test), may be removed from the drift data. After removal of poor quality data and the removal of the unique outlier (if necessary), the remaining drift data is known as the Final Data Set.

For transmitters or other devices with multiple calibration points, the general process is to use the calibration point with the worst-case drift values. This is determined by comparing the different calibration points and using the one with the largest error, determined by adding the absolute value of the drift mean to 2 times the drift standard deviation. The data set with the largest of those terms is used throughout the rest of the analysis, after outlier removal, as the Final Data Set. (Note that it is possible to use a specific calibration point and neglect the others, only if that is the single point of concern for application of the results of the Drift Calculation. If so, this fact should be stated boldly in the results / conclusions of the calculation.)

The data set basic statistics (i.e., the Mean, Median, Standard Deviation, Variance, Minimum, Maximum, Kurtosis, Skewness, Count and Average Time Interval between Calibrations) should be computed and displayed for the data set prior to removal of the unique outlier and for the Final Data Set, if different.

3.7. Methods for Verifying Normality

A test for normality can be important because many frequently used statistical methods are based upon an assumption that the data is normally distributed. This assumption applies to the analysis of component calibration data also. For example, the following analyses may rely on an assumption that the data is normally distributed:

- Determination of a tolerance interval that bounds a stated proportion of the population based on calculation of mean and standard deviation
- Identification of outliers
- Pooling of data from different samples into a single population

The normal distribution occurs frequently and is an excellent approximation to describe many processes. Testing the assumption of normality is important to confirm that the data appears to

fit the model of a normal distribution, but the tests do not prove that the normal distribution is a correct model for the data. At best, it can only be found that the data is reasonably consistent with the characteristics of a normal distribution, and that the treatment of a distribution as normal is conservative. For example, some tests for normality only allow the rejection of the hypothesis that the data is normally distributed. A group of data passing the test does not mean the data is normally distributed; it only means that there is no evidence to say that it is not normally distributed. However, because of the wealth of industry evidence that drift can be conservatively represented by a normal distribution, a group of data passing these tests is considered as normally distributed without adjustments to the standard deviation of the data set.

Distribution-free techniques are available when the data is not normally distributed; however, these techniques are not as well known and often result in penalizing the results by calculating tolerance intervals that are substantially larger than the normal distribution equivalent. Because of this fact, there is a good reason to demonstrate that the data is normally distributed or can be bounded by the assumption of normality.

Analytically verifying that a sample appears to be normally distributed usually invokes a form of statistics known as hypothesis testing. In general, a hypothesis test includes the following steps:

1) Statement of the hypothesis to be tested and any assumptions
2) Statement of a level of significance to use as the basis for acceptance or rejection of the hypothesis
3) Determination of a test statistic and a critical region
4) Calculation of the appropriate statistics to compare against the test statistic
5) Statement of conclusions

The following sections discuss various ways in which the assumption of normality can be verified to be consistent with the data or can be claimed to be a conservative representation of the actual data. Analytical hypothesis testing and subjective graphical analyses are discussed. If the analytical hypothesis test (either D Prime or W Test) is passed, the coverage analysis and additional graphical analyses are not required. Generally, only a single hypothesis test should be performed on a given data set. Because of the consistent approach given for the D Prime and W tests from Reference 7.1.4, these tests are recommended. The following are descriptions of the methods for assessing normality.

3.7.1. W Test

Reference 7.1.4 recommends this test for sample sizes less than or equal to 50. The W Test calculates a test statistic value for the sample population and compares the calculated value to the critical values for W, which are tabulated in Reference 7.1.4. The W Test is a lower-tailed test. Thus if the calculated value of W is less than the critical value of W, the assumption of normality would be rejected at the stated significance level. If the calculated value of W is larger than the critical value of W, there is no evidence to reject the assumption of normality.

3.7.1.1. Equations to Perform the W Test

1) Order the sample data (x_n) in ascending order from smallest to largest value. Where x_1 = the smallest value and x_n = largest value.

2) Compute the total sum of squares about the mean, S^2, for the sample data.

$$S^2 = \sum_{i=1}^{n} x_i^2 - \frac{1}{n} \times \left(\sum_{i=1}^{n} x_i \right)^2 \qquad \text{(Ref. 7.1.1)}$$

Note that S^2 equals (n-1) times the variance of the sample data, or

$$S^2 = (n-1) \times s^2 \qquad \text{(Ref. 7.1.1)}$$

Thus, it is usually straightforward to calculate the variance and multiply by (n-1). The term can be calculated from either the ordered or unordered sample data.

3) Calculate the quantity, b, for the sample data.

$$b = \sum_{i=1}^{k} \left[a_{n-i+1} \times \left(x_{n-i+1} - x_i \right) \right] \qquad \text{(Ref. 7.1.1)}$$

Where $i = 1$ to k, and $k = n/2$ if n is even or $k = (n - 1)/2$ if n is odd. The values for coefficient a_{n-i+1} are tabulated in Table 1 of Reference 7.1.4.

4) Calculate the test statistic, W, for the sample data.

$$W = \frac{b^2}{S^2} \qquad \text{(Ref. 7.1.1)}$$

5) The test statistic (W) is compared to the corresponding critical value at the desired level of confidence, which in this case is 5%. If the calculated value of W is less than the critical value of W, the assumption of normality would be rejected at the stated significance level. If the calculated value of W is larger than the critical value of W, there is no evidence to reject the assumption of normality. The critical value of W is obtained from Table 2 of Reference 7.1.4.

3.7.2. D-Prime Test

Reference 7.1.4 recommends this test for moderate to large sample sizes, greater than 50. The D′ Test calculates a test statistic value for the sample population and compares the calculated value to the values for the D′ percentage points of the distribution, which are tabulated in Reference 7.1.4. The D′ Test is two-sided, which means that the two-sided percentage limits at the stated level of significance must envelop the calculated D′ value. For the given sample size, the calculated value of D′ must lie within the two values provided in the Reference 7.1.4 table in order to accept the hypothesis of normality.

3.7.2.1. Equations to Perform the D′ Test

1) First, calculate the linear combination of the sample group. (Note: Data must be placed in ascending order of magnitude, prior to the application of this formula.)

$$T = \sum\left[\left(i - \frac{n+1}{2}\right) \times x_i\right]$$ (Ref. 7.1.1)

Where;
T - Linear combination
x_i - An individual sample data point
i - The number of the sample point
n - Total number of data points

2) Second, calculate the S^2 for the sample group.

$$S^2 = (n-1)s^2$$ (Ref. 7.1.1)

Where;
S^2 - Sum of the Squares about the mean
s^2 - Unbiased estimate of the sample population variance
n - Total number of data points

3) Third, calculate the D′ value for the sample group.

$$D' = \frac{T}{S}$$ (Ref. 7.1.1)

4) Finally, evaluate the results. If the D' value lies within the acceptable range of results (for the given data count) per Table 5 of Reference 7.1.4, for columns showing Probability (P) = 0.025 and 0.975, then the assumption of normality is not rejected. (These values of P were chosen to obtain a 5% significance, α, for the test.) (If the exact data count is not contained within the tables, the critical value limits for the D' value should be linearly interpolated to the correct data count.) If however, the value lies outside that range, the assumption of normality is rejected.

3.7.3. Probability Plots

For most Drift Calculations performed per this methodology, probability plots will not be included, since numerical methods or coverage analyses are recommended. However, probability plots are discussed, since a graphical presentation of the data can sometimes reveal possible reasons for why the data is or is not normal. A probability plot is a graph of the sample data with the axes scaled for a normal distribution. If the data is normal, the data tends to follow a straight line. If the data is non-normal, a nonlinear shape should be evident from the graph. This method of normality determination is subjective, and is not required if the numerical method shows the data to be normal, or if a coverage analysis is used. The types of probability plots used by this design guide are as follows:

- *Cumulative Probability Plot* - an XY scatter plot of the Final Data Set plotted against the percent probability (P_i) for a normal distribution. P_i is calculated using the following equation:

$$P_i = \frac{100 \times \left(i - \frac{1}{2}\right)}{n} \qquad \text{(Ref. 7.1.1)}$$

where; i = sample number i.e. 1,2,...
n = sample size

NOTE: Refer, as necessary, to Appendix C Section C.4 of Reference 7.1.1.

- *Normalized Probability Plot* - an XY scatter plot of the Final Data Set plotted against the probability for a normal distribution, expressed in multiples of the standard deviation.

3.7.4. Coverage Analysis

A coverage analysis is recommended for cases in which the hypothesis tests reject the assumption of normality, but the assumption of normality is still a conservative representation of the data. The coverage analysis involves the use of a histogram of the Final Data Set, overlaid with the equivalent probability distribution curve for the normal distribution, based on the data sample's mean and standard deviation.

3.7.4.1. Steps to Create the Histogram

1) First calculate the Mean for the sample group

$$\bar{x} = \frac{\sum x_i}{n} \qquad \text{(Ref. 7.1.1)}$$

Where;

x_i - An individual sample data point

$\bar{x}$ - Mean of all sample data points

n - Total number of data points

2) Second calculate the Standard Deviation for the sample group

$$s = \sqrt{\frac{n\sum x^2 - \left(\sum x\right)^2}{n(n-1)}} \qquad \text{(Ref. 7.1.1)}$$

Where;

x - Sample data values (x1, x2, x3 ...)

s - Standard Deviation of all sample data points

n - Total number of data points

3) Third the data is divided into bins to aid in determination of a normal distribution. The number of bins selected is up to the individual performing the analysis. Refer to Reference 7.1.1 for further guidance. Generally, a 12-bin analysis is used (see Section 4.4). The bin limits are determined in ½ Standard Deviation increments, starting with the bin defined by the limits of [-∞ to ($\bar{x}$-2.5s)], proceeding to the bin defined by the limits of [($\bar{x}$+2.5s) to +∞].

4) The fractions of the data expected in each bin for a normal distribution are determined from standard statistical texts, multiplied by the total population of the analyzed data set, and plotted with a curve fit as an overlay to the histogram.

5) The data being analyzed is split into the appropriate bins defined above and plotted as a bar chart.
6) The total count of data within the limits of ± 2 Standard Deviations from the Mean is computed.

Visual examination of the plot is used to determine if the distribution of the data is near normal, or if a normal distribution model for the data would adequately cover the data within the 2 sigma limits. Another measure of the conservatism in the use of a normal distribution as a model is the kurtosis of the data. Reference 7.1.1 states that samples that have a large value of kurtosis are the most likely candidates for a coverage analysis. Kurtosis characterizes the relative peakedness or flatness of the distribution compared to the normal distribution, and is readily calculated within statistical and spreadsheet programs. As shown in Reference 7.1.1, a positive kurtosis indicates a relatively high peaked distribution, and a negative kurtosis indicates a relatively flat distribution, with respect to the normal distribution.

If the data is near normal or is more peaked than a normal distribution (positive kurtosis), then a normal distribution model is derived that adequately covers the set of drift data, as observed. This normal distribution is used as the model for the drift of the device. Sample counting is used to determine an acceptable normal distribution model. The Standard Deviation of the group is computed. The number of samples that are within ± two Standard Deviations of the mean is computed. The count is divided by the total number of samples in the group to determine a percentage. The following table provides the percentage that should fall within the two Standard Deviation values for a normal distribution.

Table 3 – Population Percentage for a Normal Distribution

	Percentage for a Normal Distribution
2 Standard Deviations	95.45%

If the percentage of data within the two standard deviations tolerance is greater than the value in Table 3 for a given data set, the existing standard deviation is acceptable to be used for the encompassing normal distribution model. However, if the percentage is less than required, the standard deviation of the model is enlarged, such that greater than or equal to the required percentage falls within the adjusted ± two Standard Deviations bounds. The required multiplier for the standard deviation in order to provide this coverage is termed the Normality Adjustment Factor (NAF). If no adjustment is required, the NAF is equal to one (1).

3.8. Binomial Pass/Fail Analysis For Distributions Considered Not To Be Normal

A pass/fail criteria for component performance simply compares the As-Found versus As-Left surveillance drift data against a pre-defined acceptable value of drift. If the drift value is less than the pass/fail criteria, that data point passes; if it is larger than the pass/fail criteria, it fails. By comparing the total number of passes to the number of failures, a probability can be computed for the expected number of component passes in the population. Note that the term failure in this instance does not mean that the component actually failed, only that it exceeded the selected pass/fail criteria for the analysis. Often the pass/fail criteria will be established at a point that clearly demonstrates acceptable component performance. The equations used to determine the Failure Proportion, Normal, Minimum and Maximum Probabilities are as follows:

Failure Proportion

P_f = x/n where;

x = Number of values exceeding the pass/fail criteria (Failures) (Ref. 7.1.1)

n = Total number of drift values in the sample

Normal Probability that a value will pass

$P = 1 - P_f$ (Ref. 7.1.1)

Minimum Probability that a value will pass

$$P_l = 1 - \frac{x}{n} - z \times \sqrt{\left(\frac{1}{n}\right) \times \left(\frac{x}{n}\right) \times \left(1 - \frac{x}{n}\right)}$$ (Ref. 7.1.1)

Maximum Probability that a value will pass

$$P_u = 1 - \frac{x}{n} + z \times \sqrt{\left(\frac{1}{n}\right) \times \left(\frac{x}{n}\right) \times \left(1 - \frac{x}{n}\right)}$$ (Ref. 7.1.1)

where;

P_l = the minimum probability that a value will pass

P_u = the maximum probability that a value will pass

z = the standardized normal distribution value corresponding to the desired confidence level, e.g., z = 1.96 for a 95% confidence level.

The Binomial Pass/Fail Analysis is a good tool for verifying that drift values calculated for calibration extensions are appropriate for the interval. See Reference 7.1.1 for the necessary detail to perform a pass/fail analysis.

3.9. Time-Dependent Drift Analysis

The component/loop drift calculated in the previous sections represented a predicted performance limit, without any consideration of whether the drift may vary with time between calibrations or component age. This section discusses the importance of understanding the time-related performance and the impact of any time-dependency on an analysis. Understanding the time dependency can be either important or unimportant, depending on the application. A time dependency analysis is important whenever the drift analysis results are intended to support an extension of calibration intervals.

3.9.1. Limitations of Time Dependency Analyses

Reference 7.1.1 performed drift analysis for numerous components at several nuclear plants as part of the project. The data evaluated did not demonstrate any significant time-dependent or age-dependent trends. Time dependency may have existed in all of the cases analyzed, but was insignificant in comparison to other uncertainty contributors. Because time dependency cannot be completely ruled out, there should be an ongoing evaluation to verify that component drift continues to meet expectations whenever calibration intervals are extended.

3.9.2. Scatter (Drift Interval) Plot

A drift interval plot is an XY scatter plot that shows the Final Data Set plotted against the time interval between tests for the data points. This plot method relies upon the human eye to discriminate the plot for any trend in the data to exhibit time dependency. A prediction line can be added to this plot which shows a "least squares" fit of the data over time. This can provide visual evidence of an increasing or decreasing mean over time, considering all drift data. An increasing standard deviation is indicated by a trend towards increasing "scatter" over the increased calibration intervals.

3.9.3. Standard Deviations and Means at Different Calibration Intervals (Binning Analysis)

This analysis technique is the most recommended method of determining time dependent tendencies in a given sample pool. (See Reference 7.1.1.) The test consists simply of segregating the drift data into different groups (Bins) corresponding to different ranges of calibration or surveillance intervals and comparing the standard deviations and means for the data in the various groups. The purpose of this type of analysis is to determine if the standard deviation or mean tends to become larger as the time interval between calibrations increases.

3.9.3.1. The available data is placed in interval bins. The intervals normally used at nuclear power plants typically coincide with Technical Specification calibration intervals plus the allowed tolerance as follows:

a. 0 to 45 days (covers most weekly and monthly calibrations)

b. 46 to 135 days (covers most quarterly calibrations)

c. 136 to 230 days (covers most semi-annual calibrations)

d. 231 to 460 days (covers most annual calibrations)

e. 461 to 690 days (covers most 18 month refuel cycle calibrations)

f. 691 to 915 days (covers most extended refuel cycle calibrations)

g. > 915 days covers missed and forced outage refueling cycle calibrations.

Data will naturally fall into these time interval bins based on the calibration requirements for the subject instrument loops. Only on occasion will a device be calibrated on a much longer or shorter interval than that of the rest of the population within its calibration requirement group. Therefore, the data will naturally separate into groups for analysis.

3.9.3.2. Although not generally recommended, different bin splits could be used, but must be evaluated for data coverage, significant diversity in calibration intervals, and acceptable data groupings.

3.9.3.3. For each bin where there is data, the mean (average), standard deviation, average time interval and data count will be computed.

3.9.3.4. To determine if time dependency does or does not exist, the data must be distributed across multiple bins, with a sufficient population of data in each of two or more bins, to consider the statistical results for those bins to be valid. Normally the minimum expected distribution that would allow evaluation is defined below.

a. A bin is considered valid in the final analysis if it holds more than five data points and more than ten percent of the total data count.
b. At least two bins, including the bin with the most data, must be left for evaluation to occur.

The distribution percentages listed in these criteria are somewhat arbitrary, and thus engineering evaluation can modify them for a given situation.

The mean and standard deviations of the valid bins are plotted versus average time interval on a diagram. This diagram can give a good visual indication of whether or not the mean or standard deviation of a data set is increasing significantly over time interval between calibrations.

If the binning analysis plot shows an increase in standard deviation over time, the critical value of the F-distribution is compared to the ratio of the smallest

and largest variances for the evaluated bins. If the ratio of variances exceeds the critical value, this result is indicative of time dependency for the random portion of drift. Likewise, a ratio of variances not exceeding the critical value is not indicative of significant time dependency.

NOTE: If multiple valid bins do NOT exist for a given data set, then the plot is not to be shown, and the regression analyses are not to be performed. The reasoning is that there is not enough diversity in the calibration intervals analyzed to make meaningful conclusions about time dependency from the existing data. In this case, unless overwhelming evidence to the contrary exists in the scatter plot, the final data set is treated as moderately time dependent for the purposes of extrapolation of the drift value.

3.9.4. Regression Analyses and Plots

Regression Analyses can often provide very valuable data for the determination of time dependency. A standard regression analysis within an EXCEL spreadsheet can plot the drift data versus time, with a prediction line showing the trend. It can also provide Analysis of Variance (ANOVA) table printouts, which contain information required for various numerical tests to determine level of dependency between two parameters (time and drift value). Note that regression analyses are only to be performed if multiple valid bins are determined from the binning analysis.

Regression Analyses are to be performed on the Final Data Set drift values and on the Absolute Value of the Final Data Set drift values. The Final Data Set drift values show trends for the mean of drift, and the Absolute Values show trends for the standard deviation over time.

Regression Plots

The following are descriptions of the two plots generated by these regressions.

- *Drift Regression* - an XY scatter plot that fits a line through the final drift data, plotted against the time interval between tests for the data points, using the "least squares" method to predict values for the given data set. The predicted line is plotted through the actual data for use in predicting drift over time. It is important to note that statistical outliers can have a dramatic effect upon the regression line.
- *Absolute Value Drift Regression* - an XY scatter plot that fits a line through the Absolute Value of the final drift data, plotted against the time interval between tests for the data points, using the "least squares" method to predict values for the given data set. The predicted line is plotted through the actual data for use in predicting drift, in either direction, over time. It is important to note that statistical outliers can have a dramatic effect upon the regression line.

Regression Time Dependency Analytical Tests

Typical spreadsheet software includes capabilities to include ANOVA tables with regression analyses. ANOVA tables give various statistical data, which can allow certain numerical tests to be employed, to search for time dependency. For each of the two regressions (drift regression and absolute value drift regression), the following ANOVA parameters are used to determine if time dependency of the drift data is evident. All tests listed should be evaluated, and if time dependency is indicated by any of the tests, the data should be considered as time dependent.

- *R Squared Test* - The R Squared value, printed out in the ANOVA table, is a relatively good indicator of time dependency. If the value is greater than 0.09 (thereby indicating the R value greater than 0.3), then it appears that the data closely conforms to a linear function, and therefore, should be considered time dependent.

- *P Value Test* - A P Value for X Variable 1 (as indicated by the ANOVA table for an EXCEL spreadsheet) less than 0.05 is indicative of time dependency.
- *Significance of F Test* - An ANOVA table F value greater than the critical F-table value would indicate a time dependency. In an EXCEL spreadsheet, the FINV function can be used to return critical values from the F distribution. To return the critical value of F, use the significance level (in this case 0.05 or 5.0%) as the probability argument to FINV, 1 as the numerator degrees of freedom, and the data count minus two as the denominator. If the F value in the ANOVA table exceeds the critical value of F, then the drift is considered time dependent.

NOTE: For each of these tests, if time dependency is indicated, the plots should be observed to determine the reasonableness of the result. The tests above generally assess the possibility that the function of drift is linear over time, not necessarily that the function is significantly increasing over time. Time dependency can be indicated even when the plot shows the drift to remain approximately the same or decrease over time. Generally, a decreasing drift over time is not expected for instrumentation, nor is a case where the drift function crosses zero. Under these conditions, the extrapolation of the drift term would normally be established assuming that the test indicates no time dependency, if extrapolation of the results is required beyond the analyzed time intervals between calibrations.

3.9.5. Additional Time Dependency Analyses

- *Instrument Resetting Evaluation* - For data sets that consist of a single calibration interval the time dependency determination may be accomplished simply by evaluating the frequency at which instruments require resetting. This type of analysis is particularly useful when applied to extend quarterly Technical Specification surveillances to semi-annual. However, this type of analysis is less useful for instruments such as sensors or relays that may be reset at each calibration interval, regardless of whether the instrument was already in calibration.

  The Instrument Resetting Evaluation may be performed only if the devices in the sample pool are shown to be stable, not requiring adjustment (i.e. less than 5% of the data shows that adjustments were made). Care also must be taken when mechanical connections or flex points may be exercised by the act of checking calibration (actuation of a bellows or switch movement), where the act of checking the actuation point may have an effect on the next reading. Methodology for calculating the drift is as follows:

  Quarterly As-Found/As-Left

  (As-Found Current Calibration - As-Left Previous Calibration) or $AF_1 - AL_2$ (Ref. 7.1.1)

  Semi-Annual As-Found/As-Left using Monthly Data

  $(AF_1 - AL_2) + (AF_2 - AL_3)$ (Ref. 7.1.1)

3.9.6. Age-Dependent Drift Considerations

Age-dependency is the tendency for a component's drift to increase in magnitude as the component ages. This can be assessed by plotting the As-Found value for each calibration minus the previous calibration As-Left value of each component over the period of time for which data is available. Random fluctuations around zero may obscure any age-dependent drift trends. By plotting the absolute values of the As-Found versus As-Left calibration data, the tendency for the magnitude of drift to increase with time can be assessed. This analysis is generally not performed as a part of a standard Drift Calculation, but can be used, if desired, when establishing maintenance practices.

3.10. Calibration Point Drift

For devices with multiple calibration points (e.g., transmitters, indicators, etc.) the Drift-Calibration Point Plot is a useful tool for comparing the amount of drift exhibited by the group of devices at the different calibration points. The plot consists of a line graph of tolerance interval as a function of calibration point. This is useful to understand the operation of an instrument, but is not normally included as a part of a standard Drift Calculation.

3.11. Drift Bias Determination

If an instrument or group of instruments consistently drifts predominately in one direction, the drift is assumed to have a bias. The application of a significant bias must be considered separately, so that the overall treatment of the analyzed drift remains conservative. Based on Sections 3.5 and 3.5.2 of Reference 7.3.2, a method is used to assess whether or not a significant bias exists for the drift data, based on the relative magnitudes of the mean and standard deviation and the sample size. Specifically, when the absolute value of the calculated average for the sample pool exceeds a critical value (x_{crit}), the average is treated as a bias to the drift term. Otherwise, the drift bias term is considered insignificant and is not considered further in the drift analysis.

The critical value (x_{crit}) for a given standard deviation (s) and sample size (n) is calculated using the following formula:

$$x_{crit} = t_{0.025,df} \times \frac{s}{\sqrt{n}}$$ (Ref. 7.3.2)

Where;

X_{crit} = Maximum value of non-biased mean for a given s & n

$t_{.025,df}$ = Normal Deviate for a single-sided t-distribution @ 0.025 for 95% Confidence (See Table 4)

s = Standard Deviation of sample pool

n = Sample pool size

df = Degrees of Freedom = n – 1

The normal deviate (t) can be looked up for a given value of degrees of freedom, or it can be generated automatically, utilizing the TINV function within Microsoft Excel, as follows.

$t_{.025,df}$ = TINV (0.05, df)

Note that the probability listed within the parentheses is 0.05 instead of 0.025 because the function returns the normal deviate for a double-sided distribution. In order to attain the value for a single-sided distribution, the probability is doubled, per the description of the function within Microsoft Excel.

The following are excerpts from the Microsoft Excel "Help" function:

TINV(probability,degrees_freedom)

Probability is the probability associated with the two-tailed Student's t-distribution.

Degrees_freedom is the number of degrees of freedom with which to characterize the distribution.

A one-tailed t-value can be returned by replacing probability with 2*probability. For a probability of 0.025 and degrees of freedom of 10,

the two-tailed value is calculated with TINV(0.025,10), which returns 2.633767. The one-tailed value for the same probability and degrees of freedom can be calculated with TINV(2*0.025,10), which returns 2.228139.

The values within Table 4 were generated from the TINV function within Microsoft Excel and have been verified to be consistent with the values from Table V of Reference 7.3.2. Therefore, they are acceptable for use in drift analyses.

Table 4 – Percentiles of the t Distribution ($t_{0.025,df}$)

Degrees of Freedom (df)	Normal Deviate (t) @ 0.025 for 95% Confidence	Degrees of Freedom (df)	Normal Deviate (t) @ 0.025 for 95% Confidence	Degrees of Freedom (df)	Normal Deviate (t) @ 0.025 for 95% Confidence
1	12.706	42	2.018	83	1.989
2	4.303	43	2.017	84	1.989
3	3.182	44	2.015	85	1.988
4	2.776	45	2.014	86	1.988
5	2.571	46	2.013	87	1.988
6	2.447	47	2.012	88	1.987
7	2.365	48	2.011	89	1.987
8	2.306	49	2.010	90	1.987
9	2.262	50	2.009	91	1.986
10	2.228	51	2.008	92	1.986
11	2.201	52	2.007	93	1.986
12	2.179	53	2.006	94	1.986
13	2.160	54	2.005	95	1.985
14	2.145	55	2.004	96	1.985
15	2.131	56	2.003	97	1.985
16	2.120	57	2.002	98	1.984
17	2.110	58	2.002	99	1.984
18	2.101	59	2.001	100	1.984
19	2.093	60	2.000	101	1.984
20	2.086	61	2.000	102	1.983
21	2.080	62	1.999	103	1.983
22	2.074	63	1.998	104	1.983
23	2.069	64	1.998	105	1.983
24	2.064	65	1.997	106	1.983
25	2.060	66	1.997	107	1.982
26	2.056	67	1.996	108	1.982
27	2.052	68	1.995	109	1.982
28	2.048	69	1.995	110	1.982
29	2.045	70	1.994	111	1.982
30	2.042	71	1.994	112	1.981
31	2.040	72	1.993	113	1.981
32	2.037	73	1.993	114	1.981
33	2.035	74	1.993	115	1.981
34	2.032	75	1.992	116	1.981
35	2.030	76	1.992	117	1.980
36	2.028	77	1.991	118	1.980
37	2.026	78	1.991	119	1.980
38	2.024	79	1.990	120	1.980
39	2.023	80	1.990	>120	1.960
40	2.021	81	1.990		
41	2.020	82	1.989		

Examples of determining and applying bias to the analyzed drift term:

1) Transmitter Group With a Biased Mean - A group of transmitters are calculated to have a standard deviation of 1.150%, mean of - 0.355% with a count of 47. The degrees of freedom are 46. From Table 4, the t value is 2.013. Therefore, x_{crit} is computed as:

$$x_{crit} = t \times \frac{s}{\sqrt{n}} = 2.013 \times \frac{1.150\%}{\sqrt{47}} = 0.338\%$$

Therefore, the mean value is significant because the absolute value of it is larger than x_{crit}, and the bias must be considered. The analyzed drift term for a 95%/95% tolerance interval level is shown as follows.

DA = - 0.355% ± 1.150% x 2.396 (TIF interpolated from Table 1 for 47 samples)
DA = - 0.355% ± 2.755%

For conservatism, the DA term for the positive direction is not reduced by the bias value where as the negative direction is summed with the bias value.

DA = + 2.769%, - 3.124%.

2) Transmitter Group With a Non-Biased Mean - A group of transmitters are calculated to have a standard deviation of 1.150%, mean of 0.100% with a count of 47. The degrees of freedom are 46. From Table 4, the t value is 2.013. Therefore, x_{crit} is computed as:

$$x_{crit} = t \times \frac{s}{\sqrt{n}} = 2.013 \times \frac{1.150\%}{\sqrt{47}} = 0.338\%$$

Therefore, the absolute value of the mean value is less than x_{crit}. Therefore, the bias is insignificant, and can be neglected. The analyzed drift term for a 95%/95% tolerance interval level is shown as follows.

DA = ± 1.150% x 2.396 (TIF interpolated from Table 1 for 47 samples)
DA = ± 2.755%

3.12. Time Dependent Drift Uncertainty

When calibration intervals are extended beyond the range for which historical data is available, the statistical confidence in the ability to predict drift is reduced. The bias and the random portions of the drift are extrapolated separately, but in the same manner. Where the analysis shows slight to moderate time dependency or time dependency is indeterminate, drift is extrapolated using the Square Root of the Sum of the Squares (SRSS) method per Section 6.2.7 of Reference 7.1.2. This method assumes that the drift to time relationship is not linear. The formula below is used.

$$DA_{Extended} = DA \times \sqrt{\frac{Rqd\_Calibration\_Interval}{Avg\_Bin\_Time\_Interval}}$$

Where: $DA_{Extended}$ = the newly determined, extrapolated Drift Bias or Random Term

DA = the bias or random drift term from the Final Data Set or of the longest-interval, valid time bin from the binning analysis (see note)

Avg_ Bin_Time_Interval = the average observed time interval within the longest-interval, valid time bin from the binning analysis (see note)

Rqd_Calibration_Interval = the worst case calibration interval, once the calibration interval requirement is changed

Note: For conservatism, the largest drift value (DA) of either the Final Data Set or the longest-interval, valid time bin from the binning analysis is used as a starting point for the drift extrapolation. For those cases where no time dependency is apparent from the drift analysis, it is also acceptable to use the maximum observed time interval from the longest-interval, valid time bin from the binning analysis, as a starting point in the extrapolation, as opposed to the average observed time interval. This can be used to reduce over-conservatisms in determining an extrapolated analyzed drift value.

Where there is indication of a strong relationship between drift and time, drift is extrapolated using the linear method per Section 6.2.7 of Reference 7.1.2. The following formula may be used.

$$DA_{Extended} = DA \times \left[\frac{Rqd\_Calibration\_Interval}{Avg\_Bin\_Time\_Interval} \right]$$

Where the terms are the same as defined above.

Where it can be shown that there is no relationship between surveillance interval and drift, the drift value determined may be used for other time intervals, without change. However, for conservatism, due to the uncertainty involved in extrapolation to time intervals outside of the analysis period, drift values that show minimal or no particular time dependency are generally treated as moderately time dependent, for the purposes of the extrapolation.

3.13. Methods of Drift Assessment for Very Low Sample Sizes

Per Section 3.4.2.1, "There is no hard fast number that must be attained for any given pool, but a minimum of 30 drift values must be attained before the drift analysis can be performed without additional justification." When it has been determined that the sample size is small for an instrument group, the first thing which should be considered is increasing the sample size. In order to increase the sample size, more historical data should be collected on the subject devices if possible. Also, other similar devices can be added to the analysis, if they can be shown to be maintained with similar QA control of the calibration processes, and if they meet the requirements to properly pool the drift data, per Section 3.5. It is possible that after obtaining all data possible on certain device types, less than 30 samples will be available for analysis. The following paragraphs provide guidance for assessment of the drift in those circumstances.

Rigorous drift analysis as described in the sections above may be performed for sample sizes as low as 20 data values, with additional justification. The justification is generally based on engineering judgment, which would conclude that the drift analysis would provide a reasonably accurate, but conservative estimate for future performance for the subject devices. The following types of arguments can be made for this engineering judgment; but not all of these are required, and other similar arguments could be made in support of this position.

- All data possible is analyzed from the device type with the level of Quality Assurance treatment.
- The small number of devices in the study limits the AF/AL data available.
- Preliminary analysis of the drift values shows the data to be relatively consistent.
- The data distribution is similar to a normal distribution, per a Histogram plot, as would be expected.
- The method of determining the Analyzed Drift for 20 data values uses a high Tolerance Interval Factor (TIF) for 95/95 confidence, providing the required conservatism for use in setpoint calculations.

The rigorous drift analysis would be comprised of the same components as the others with data counts ≥ 30, but would have the additional justification stated in the assumptions / engineering judgments section of the calculation.

For cases where there is no drift data, manufacturer drift specifications may be extrapolated to a maximum calibration interval of 30 months for use in the setpoint calculations, in accordance with the plant instrument uncertainty / setpoint methodologies. This encompasses the cases where the devices will be replaced prior to, or concurrent with, project implementation; or where the devices have been recently replaced, such that two calibrations have not yet been performed for any of the subject devices.

For those cases where there is a very small sample size (i.e., ≤ 20 drift data values or 20-29 where the data does not appear to be reasonably uniform), a drift assessment should be prepared, based on engineering judgment. The assessment would not include any normality or time dependency evaluations. Within the assessment, all possible drift values from the available AF/AL data are computed. The magnitude of the largest computed drift value is compared to the Square Root of the Sum of the Squares (SRSS) combination of the following terms:

1. Manufacturer Specification for drift,
2. Manufacturer Specification for Reference Accuracy, and
3. Calibration Term, comprised of Measurement and Test Equipment (M&TE), M&TE Standard, and Setting Tolerance

If all of the computed drift values are encompassed by the combined total, the conclusion should be made that the manufacturer specifications are conservative with respect to the observed drift values. For this case, the manufacturer specification for drift should be extrapolated to a maximum calibration interval of 30 months for use in the setpoint calculations, in accordance with the plant instrument uncertainty / setpoint methodologies.

If the comparison within the assessment shows any of the computed drift values to exceed the combined total, an Analyzed Drift value should be derived for use in setpoint calculations, based on engineering judgment. If the device has multiple calibration points, such as a transmitter, the data from the worst case calibration point should be used in the assessment, unless that calibration point has significantly less data values than the other calibration points. (See Section 4.3.4 for the determination of the worst case calibration point.)

Because of the low data count, unless significant evidence to the contrary exists; the drift should be considered random in nature. The drift value chosen for the current calibration interval should be equal to or larger than the following:

1. The magnitude of the worst case drift value observed, and
2. The magnitude of the mean + 2 standard deviations.

The random portion of the drift value chosen for the current calibration interval should be extrapolated to the maximum proposed interval via the equation below.

$$DA_{Extended.random} = DA_{Current.random} \times \sqrt{\frac{Max\_Rqd\_Time\_Interval}{Avg\_Observed\_Time\_Interval}}$$

If the mean value is very large in comparison to the standard deviation, with a significant enough data count (per engineering judgment), then a bias should be used as a portion of the Analyzed Drift. The bias should be set equal to the mean for the current calibration interval. The bias portion of the drift value chosen for the current calibration interval should be extrapolated to the maximum proposed interval via the equation below.

$$DA_{Extended.bias} = DA_{Current.bias} \times \frac{Max\_Rqd\_Time\_Interval}{Avg\_Observed\_Time\_Interval}$$

3.14. Shelf Life of Analysis Results

Any analysis result based on performance of existing components has a shelf life. In this case, the term "shelf life" is used to describe a period of time extending from the present into the future during which the analysis results are considered valid. Predictions for future component/loop performance are based upon our knowledge of past calibration performance. This approach assumes that changes in component/loop performance occur slowly or not at all over time. For example, if evaluation of the last ten years of data shows the component/loop drift is stable with no observable trend, there is little reason to expect a dramatic change in performance during the next year. However, it is also difficult to claim that an analysis completed today is still a valid indicator of component/loop performance ten years from now. For this reason, the analysis results should be re-verified periodically through an instrument trending program in accordance with Reference 7.1.1. The Analyzed Drift values from the Drift Calculations are to be used by the trending program as thresholds, which will require further investigation if exceeded.

Depending on the type of component/loop, the analysis results are also dependent on the method of calibration, the component/loop span, and the M&TE accuracy. Any of the following program or component/loop changes should be evaluated to determine if they affect the analysis results.

- Changes to M&TE accuracy
- Changes to the component or loop (e.g. span, environment, manufacturer, model, etc.)
- Calibration procedure changes that alter the calibration method

4. PERFORMING AN ANALYSIS

As Found and As Left calibration data for the subject instrumentation is collected from historical calibration records. The collected data is entered into Microsoft Excel spreadsheets, grouped by manufacturer and model number. All data is also entered into an independent software program (such as Quattro Pro, Lotus 1-2-3, or Mathcad), for independent review of certain of the drift analysis functions. The drift analysis is generally performed using EXCEL spreadsheets, but can be performed using other software packages. The discussion provided in this section is to assist in setting up an EXCEL spreadsheet for producing a Drift Calculation.

Microsoft Excel spreadsheets generally compute values to an approximate 15 decimal resolution, which is well beyond any required rounding for engineering analyses. However, for printing and display purposes, most values are displayed to lesser resolution. It is possible that hand computations would produce slightly different results, because of using rounded numbers in initial and intermediate steps, but the Excel computed values are considered highly accurate in comparison. Values with significant differences between the original computations and the computations of the independent verifier are to be investigated to ensure that the Excel spreadsheet is properly computing the required values.

4.1. Populating the Spreadsheet

4.1.1. For a New Analysis

4.1.1.1. The Responsible Engineer determines the component group to be analyzed (e.g., all Rosemount pressure transmitters). The Responsible Engineer should determine the possible sub-groups within the large groupings, which from an engineering perspective, might show different drift characteristics; and therefore, may warrant separation into smaller groups. This determination would involve the manufacturer, model, calibration span, setpoints, time intervals, specifications, locations, environment, etc., as necessary.

4.1.1.2. The Responsible Engineer develops a list of component numbers, manufacturers, models, component types, brief descriptions, surveillance tests, calibration procedures and calibration information (spans, setpoints, etc.).

4.1.1.3. The Responsible Engineer determines the data to be collected, following the guidance of Sections 3.4 through 3.6 of this Design Guide.

4.1.1.4. The Data Entry Person identifies, locates and collects data for the component group to be analyzed (e.g., all Surveillance Tests for the Rosemount pressure transmitters completed to present).

4.1.1.5. The Data Entry Person sorts the data by surveillance test or calibration procedure if more than one test/procedure is involved.

4.1.1.6. The Data Entry Person sequentially sorts the surveillance or calibration sheets descending, by date, starting with the most recent date.

4.1.1.7. The Data Entry Person enters the Surveillance or Calibration Procedure Number, Tag Numbers, Ideal Calibration Input values, Ideal Calibration Output values (Trips, Indications or Output signal levels), Date, As-Found values and As-Left values on the appropriate data entry sheet.

4.1.1.8. The Responsible Engineer verifies the data entered.

4.1.1.9. The Responsible Engineer reviews the notes on each calibration data sheet to determine possible contributors for excluding data. The notes should be condensed and entered onto the EXCEL spreadsheet for the applicable calibration points. Where appropriate and obvious, the Responsible Engineer should remove the data that is invalid for calculating drift for the device.

4.1.1.10.The Responsible Engineer (via the spreadsheet) calculates the time interval for each drift point by subtracting the date from the previous calibration from the date of the subject calibration. (If the measured value is not valid for the As-Left or As-Found calibration information, then the time interval is not required to be computed for this data point.)

4.1.1.11.The Responsible Engineer (via the spreadsheet) calculates the Drift value for each calibration by subtracting the As-Left value from the previous calibration from the As-Found value of the subject calibration. (If the measured value is not valid for the As-Left or As-Found calibration information, then the Drift value is not computed for this data point.)

4.2. Spreadsheet Performance of Basic Statistics

Separate data columns are created for each calibration point within the calibrated span of the device. The % Span of each calibration point should closely match from device to device within a given analysis. Basic statistics include, at a minimum, determining the number of data points in the sample, the average drift, the average time interval between calibrations, standard deviation of the drift, variance of the drift, minimum drift value, maximum drift value, kurtosis, and skewness contained in each data column. This section provides the specific details for using Microsoft Excel. Other spreadsheet, statistical or Math programs that are similar in function, are acceptable for use to perform the data analysis, provided all analysis requirements are met.

4.2.1. Determine the number of data points contained in each column for each initial group by using the "COUNT" function. Example cell format = **COUNT(C2:C133)**. The Count function returns the number of all populated cells within the range of cells C2 through C133.

4.2.2. Determine the average for the data points contained in each column for each initial group by using the "AVERAGE" function. Example cell format = **AVERAGE(C2:C133)**. The Average function returns the average of the data contained within the range of cells C2 through C133. This average is also known as the mean of the data. This same method should be used to determine the average time interval between calibrations.

4.2.3. Determine the standard deviation for the data points contained in each column for each initial group by using the "STDEV" function. Example cell format **=STDEV(C2:C133)**. The Standard Deviation function returns the measure of how widely values are dispersed from the mean of the data contained within the range of cells C2 through C133. Formula used by Microsoft Excel to determine the standard deviation:

STD (Standard Deviation of the sample population): (Ref. 7.3.1)

$$s = \sqrt{\frac{n\sum x^2 - (\sum x)^2}{n(n-1)}}$$

Where;

x - Sample data values (x_1, x_2, x_3, ...)

s - Standard deviation of all sample data points

n - Total number of data points

4.2.4. Determine the variance for the data points contained in each column for each initial group by using the "VAR" function. Example cell format **=VAR(C2:C133)**. The Variance function returns the measure of how widely values are dispersed from the mean of the data contained within the range of cells C2 through C133. Formula used by Microsoft Excel to determine the variance:

VAR (Variance of the sample population): (Ref. 7.3.1)

$$s^2 = \frac{n\sum x^2 - (\sum x)^2}{n(n-1)}$$

Where;

x - Sample data values (x_1, x_2, x_3, ...)

s^2 - Variance of the sample population

n - Total number of data points

4.2.5. Determine the kurtosis for the data points contained in each column for each initial group by using the "KURT" function. Example cell format **=KURT(C2:C133)**. The Kurtosis function returns the relative peakedness or flatness of the distribution within the range of cells C2 through C133. Formula used by Microsoft Excel to determine the kurtosis:

$$KURT = \left\{ \frac{n(n+1)}{(n-1)(n-2)(n-3)} \Sigma \left(\frac{x_i - \bar{x}}{s} \right)^4 \right\} - \frac{3(n-1)^2}{(n-2)(n-3)} \quad \text{(Ref. 7.3.1)}$$

Where ;

x - Sample data values (x_1, x_2, x_3, ...)

n - Total number of data points

s - Sample Standard Deviation

4.2.6. Determine the skewness for the data points contained in each column for each initial group by using the "SKEW" function. Example cell format **=SKEW(C2:C133)**. The Skewness function returns the degree of symmetry around the mean of the cells contained within the range of cells C2 through C133. Formula used by Microsoft Excel to determine the skewness:

$$SKEW = \frac{n}{(n-1)(n-2)} \Sigma \left(\frac{x_i - \bar{x}}{s} \right)^3 \quad \text{(Ref. 7.3.1)}$$

Where;

x - Sample data values (x_1, x_2, x_3, ...)

n - Total number of data points

s - Sample Standard Deviation

4.2.7. Determine the maximum value for the data points contained in each column for each initial group by using the "MAX" function. Example cell format **=MAX(C2:C133)**. The Maximum function returns the largest value of the cells contained within the range of cells C2 through C133.

4.2.8. Determine the minimum value for the data points contained in each column for each initial group by using the "MIN" function. Example cell format **=MIN(C2:C133)**. The Minimum function returns the smallest value of the cells contained within the range of cells C2 through C133.

4.2.9. Determine the median value for the data points contained in each column for each initial group by using the "MEDIAN" function. Example cell format **=MEDIAN(C2:C133)**. The median is the number in the middle of a set of numbers; that is, half the numbers have values that are greater than the median, and half have values that are less. If there is an even number of data points in the set, then MEDIAN calculates the average of the two numbers in the middle.

4.2.10. Where sub-groups have been combined in a data set, and where engineering reasons exist for the possibility that the data should be separated, analyze the statistics and component data of the sub-groups to determine the acceptability for combination.

4.2.11. Perform the t-Test and the F-distribution tests in accordance with step 3.5.4 on each possible sub-group combination to test for the acceptability of combining the data.

For the t-Test, acceptability for combining the data is indicated when the absolute value of the Test Statistic [t Stat] is less than the t Critical two-tail. Example: t Stat for combining sub-group A & B may be 0.485, which is smaller than the t Critical two-tail of 0.703, thus allowing combination of the sub-groups.

For the F-distribution test, acceptability for combining the data is indicated when the calculated F statistic is less than or equal to the critical value of F.

However, as a part of this process, the Responsible Engineer should ensure that the apparent unacceptability for combination does not mask time dependency. In other words, if the only difference in the groupings is that of the calibration interval, the differences in the data characteristics could exist because of time dependent drift. If this is the only difference, the data should be combined, even though the tests show that it may not be appropriate.

4.3. Outlier Detection and Expulsion

Refer to Section 3.6 for a detailed explanation of Outliers.

4.3.1. Obtain the Critical Values for the t-Test from Table 2, which is based on the sample size of the data contained within the specified range of cells. Use the COUNT value to determine the sample size.

4.3.2. Perform the outlier test for all the samples. For any values that show up as outliers, analyze the initial input data to determine if the data is erroneous. If so, remove the data in the earlier pages of the spreadsheet, and re-run all of the analysis up to this point. Continue this process until all erroneous data has been removed.

4.3.3. If appropriate, if any outliers are still displayed, remove the worst-case outlier as a statistical outlier, per step 3.6.3. Once this outlier has been removed (if applicable), the remaining data set is the Final Data Set.

4.3.4. For transmitters, or other devices with multiple calibration points, the general process is to use the calibration point with the worst case drift values. This is determined by comparing the different calibration points and using the one with the largest error, determined by adding the absolute value of the mean to 2 times the standard deviation. The data set with the largest of those terms is used throughout the rest of the analysis, after outlier removal, as the Final Data Set. (Note that it is possible to use a specific calibration point and neglect the others, only if that is the single point of concern for application of the results of the Drift Calculation. If so, this fact should be stated boldly in the results / conclusions of the calculation.)

4.3.5. Recalculate the Average, Median, Standard Deviation, Variance, Minimum, Maximum, Kurtosis, Skewness, Count and Average Time Interval Between Calibrations for the Final Data Set.

4.4. Normality Tests

To test for normality of the Final Data Set, the first step is to perform the required hypothesis testing. For Final Data Sets with more than 50 data points, the hypothesis testing is performed with the D-Prime Test (Section 3.7.2). If the Final Data Set has less than or equal to 50 data points, the W Test (Section 3.7.1) is used.

If the assumption of normality is rejected by the numerical test, then a coverage analysis should generally be performed as described in Section 3.7.4. Otherwise, a histogram is provided for information only. The coverage analysis or histogram are established with a 12 bin approach unless inappropriate for the application.

If an adjustment is required to the standard deviation to provide a normal distribution that adequately covers the data set, then the required multiplier to the standard deviation (Normality Adjustment Factor (NAF)) is determined iteratively in the coverage analysis. This multiplier produces a normal distribution model for the drift, which shows adequate data population from the Final Data Set within the adjusted $\pm 2\sigma$ bounds of the model.

4.5. Time Dependency Testing

Time dependency testing is only required for instruments for which the calibration intervals are being extended; however, the scatter plot is recommended for information in all Drift Calculations. Time dependency is evaluated through the use of a scatter (drift interval) plot, binning analysis, and regression analyses. The methods for each of these are detailed below.

4.5.1. Scatter Plot

The scatter plot is performed under a new page to the spreadsheet entitled "Scatter Plot" or "Drift Interval Plot". The chart function of EXCEL is used to merely chart the data with the x axis being the calibration interval and the y axis being the drift value for the Final Data Set. The prediction line should be added to the chart, along with the equation of the prediction line. This plot provides visual indication of the trend of the mean, and somewhat obscurely, of any increases in the scatter of the data over time. Note: The trend line should NOT be forced to have a y-intercept value of 0, but should be plotted for the actual drift data only.

4.5.2. Binning Analysis

The binning analysis is performed under a separate page of the EXCEL spreadsheet. The Final Data Set is split by bins 1 through 8 into the time intervals as defined in Section 3.9.3.1. A table is set up to compute the standard deviation, mean, average time interval, and count of the data in each time bin. Similar equation methods are used here as described in Section 4.2, when characterizing the drift data set. Another table is used to evaluate the validity of the bins, based on population per the criteria of Section 3.9.3.4. If multiple valid bins are not established, the time dependency analysis stops here, and no regression analyses are performed.

If multiple valid bins are established, the standard deviations, means and average time intervals are tabulated, and a plot is generated to show the variation of the bin averages and standard deviations versus average time interval. This plot can be used to determine whether standard deviations and means are significantly increasing over time between calibrations.

If the plot shows no increase in the standard deviation over time, then the test does not indicate significant time dependency of the random portion of the drift. If the plot shows an increase in standard deviation over time, compare the critical value of the F-distribution to the ratio of the smallest and largest variances for the required bins.

$$F_{calc} = \frac{s_1^{\,2}}{s_2^{\,2}}$$

where:

S_1 = largest drift standard deviation value

S_2 = smallest drift standard deviation value

The critical value of F-distribution can be found, using the FINV function in Microsoft Excel:

F_{crit} = FINV (0.05, V_1, V_2)

V_1 = number of samples minus 1 in bin with largest standard deviation

V_2 = number of samples minus 1 in bin with smallest standard deviation

If the ratio of variances exceeds the critical value, this result is indicative of time dependency for the random portion of drift. Likewise, a ratio of variances not exceeding the critical value is not indicative of significant time dependency.

4.5.3. Regression Analyses

The regression analyses are performed in accordance with the requirements of Section 3.9.4, given that multiple valid time bins were established in the binning analysis. New pages should be created for the Drift Regression and the Absolute Value Drift Regression, using the Final Data Set as the input values.

For each of the two Regression Analyses, use the following steps to produce the regression analysis output. Using the "Data Analysis" package under "Tools" in Microsoft EXCEL, the Regression option should be chosen. The Y range is established as the Drift (or Absolute Value of Drift) data range, and the X range should be the calibration time intervals. The output range should be established on the Regression Analysis page of the spreadsheet. The option for the residuals should be established as "Line Fit Plots". The regression computation should then be performed. The output of the regression routine is a list of residuals, an ANOVA table listing, and a plot of the Drift (or Absolute Value of Drift) versus the Time Interval between Calibrations. A prediction line is included on the plot.

Add a cell close to the ANOVA table listing which establishes the Critical Value of F, using the guidance of Section 3.9.4 for the Significance of F Test. This utilizes the FINV function of Microsoft EXCEL.

Analyze the results in the Drift Regression ANOVA table for R Square, P Value, and F Value, using the guidance of Section 3.9.4. If any of these analytical methods shows time dependency in the Drift Regression, the mean of the data set should be established as strongly time dependent if the slope of the prediction line significantly increases over time from an initially positive value (or decreases over time from an initially negative value), without crossing zero within the time interval of the regression analysis. This increase can also be validated by observing the results of the binning analysis plot for the mean of the bins and by observing the scatter plot and regression analysis prediction lines.

Analyze the results in the Absolute Value of Drift Regression ANOVA table for R Square, P Value, and F Value, using the guidance of Section 3.9.4. If any of these analytical means shows time dependency, the standard deviation of the data set should be established as strongly time dependent if the slope of the prediction line significantly increases over time. This increase can also be validated by observing the results of the binning analysis plot for the standard deviation of the bins, by observation of the results from the F distribution comparison within the binning plot, and by observing any discernible increases in data scatter, as time increases, on the scatter plot.

Regardless of the results of the analytical regression tests, if the plots tend to indicate significant increases in either the mean or standard deviation over time, those parameters should be judged to be strongly time dependent. Otherwise, for conservatism, the data is always considered to be moderately time dependent if extrapolation of the data is necessary, to accommodate the uncertainty involved in the extrapolation process, since no data has generally been observed at time intervals as large as those proposed.

4.6. Calculate the Analyzed Drift (DA) Value

The first step in determining the Analyzed Drift Value is to determine the required time interval for which the value must be computed. For the majority of the cases for instruments calibrated on a refueling basis, the required nominal calibration time interval is 24 months, or a maximum of 30 months. Since the average time intervals are generally computed in days, the most conservative value for a 30-Month calibration interval is established as 915 days.

The Analyzed Drift Value generally consists of two separate components - a random term and a bias term. If the mean of the Final Data Set is significant per the criteria in Section 3.11, a bias term is considered. If no extrapolation is necessary, the bias term is set equal to the mean of the Final Data Set. If extrapolation is necessary, it is performed in one of two methods, as determined by the degree of time dependency established in the time dependency analysis. If the mean is determined to be strongly time dependent, the following equation is used, which extrapolates the value in a linear fashion.

$$DA_{Extended.bias} = \bar{x} \times \frac{Max\_Rqd\_Time\_Interval}{Avg\_Bin\_Time\_Interval}$$

If the mean is determined to be moderately time dependent, the following equation is used to extrapolate the mean. (Note that this equation is also generally used for cases where no time dependency is evident, because of the uncertainty in defining a drift value beyond analysis limits.)

$$DA_{Extended.bias} = \bar{x} \times \sqrt{\frac{Max\_Rqd\_Time\_Interval}{Avg\_Bin\_Time\_Interval}}$$

Where: $\bar{x}$ = Mean of the Final Data Set or of the longest-interval, valid time bin from the binning analysis (see note)

Avg_Bin_Time_Interval = the average observed time interval within the longest-interval, valid time bin from the binning analysis (see note)

Max_Rqd_Time_Interval = the maximum time interval for desired calibration interval. For instance, 915 days for a desired 24 month nominal calibration interval.

Note: For conservatism, the largest drift value (DA) of either the Final Data Set or the longest-interval, valid time bin from the binning analysis is used as a starting point for the drift extrapolation. For those cases where no time dependency is apparent from the drift analysis, it is also acceptable to use the maximum observed time interval from the longest-interval, valid time bin from the binning analysis, as a starting point in the extrapolation, as opposed to the average observed time interval. This can be used to reduce over-conservatisms in determining an extrapolated analyzed drift value.

The random portion of the Analyzed Drift is calculated by multiplying the standard deviation of the Final Data Set by the Tolerance Interval Factor for the sample size and by the Normality Adjustment Factor (if required from the Coverage Analysis). If extrapolation is necessary, it is performed in one of two methods, similar to the methods shown above for the bias term, depending on the degree of time dependency observed. Use the following procedure to perform the operation.

4.6.1. Use the COUNT value of the Final Data Set to determine the sample size.

4.6.2. Obtain the appropriate Tolerance Interval Factor (TIF) for the size of the sample set. If the exact data count is not contained within the table, the TIF value should be linearly interpolated to the correct data count. Table 1 lists the 95%/95% TIFs; refer to Standard

statistical texts for other TIF multipliers. Note: TIFs other than 95%/95% must be specifically justified.

4.6.3. For a generic data analysis, multiple Tolerance Interval Factors may be used, providing a clear tabulation of results is included in the analysis, showing each value for the multiple levels of TIF.

4.6.4. Multiply the Tolerance Interval Factor by the standard deviation for the data points contained in the Final Data Set and by the Normality Adjustment Factor determined in the Coverage Analysis (if applicable).

4.6.5. If the analyzed drift term calculated above is applied to the existing calibration interval, application of additional drift uncertainty is not necessary.

4.6.6. When calculating drift for calibration intervals that exceed the historical calibration intervals, use the following equations, depending on whether the data is shown to be strongly time dependent or moderately time dependent.

For a Strongly Time Dependent random term, use the following equation.

$$DA_{Extended.random} = \sigma \times TIF \times NAF \times \frac{Max\_Rqd\_Time\_Interval}{Avg\_Bin\_Time\_Interval}$$

For a Moderately Time Dependent random term, use the following equation. (Note that this equation is also generally used for cases where no time dependency is evident, because of the uncertainty in defining a drift value beyond analysis limits.)

$$DA_{Extended.random} = \sigma \times TIF \times NAF \times \sqrt{\frac{Max\_Rqd\_Time\_Interval}{Avg\_Bin\_Time\_Interval}}$$

Where: σ = Standard Deviation of the Final Data Set or of the longest-interval, valid time bin from the binning analysis (see note)

TIF = Tolerance Interval Factor from Table 1

NAF = Normality Adjustment Factor from the Coverage Analysis (If Applicable)

Avg_Bin_Time_Interval = the average observed time interval within the longest-interval, valid time bin from the binning analysis (see note)

Max_Rqd_Time_Interval = the maximum time interval for desired calibration interval. For instance, 915 days for a desired 24 month nominal calibration interval.

Note: For conservatism, the largest drift value (DA) of either the Final Data Set or the longest-interval, valid time bin from the binning analysis is used as a starting point for the drift extrapolation. For those cases where no time dependency is apparent from the drift analysis, it is also acceptable to use the maximum observed time interval from the longest-interval, valid time bin from the binning analysis, as a starting point in the extrapolation, as opposed to the average observed time interval. This can be used to reduce over-conservatisms in determining an extrapolated analyzed drift value.

4.6.7. Since random errors are always expressed as ± errors, specific consideration of directionality is not generally a concern. However, for bistables and switches, the directionality of any bias error must be carefully considered. Because of the fact that the As-Found and As-Left setpoints are recorded during calibration for these devices, the drift values determined up to this point in the Drift Calculation are representative of a drift in the setpoint, not in the indicated value.

Per Reference 7.1.2, error is defined as the algebraic difference between the indication and the ideal value of the measured signal. In other words,

Error = indicated value - ideal value (actual value)

For devices with analog outputs, a positive error means that the indicated value exceeds the actual value, which would mean that if a bistable or switching mechanism used that signal to produce an actuation on an increasing trend, the actuation would take place **prior to** the actual variable reaching the value of the intended setpoint. As analyzed so far in the Drift Calculation for bistables and switches, the drift causes the opposite effect. A positive Analyzed Drift would mean that the **setpoint** is higher than intended; thereby causing actuation to occur **after** the actual variable has exceeded the intended setpoint.

A bistable or switch can be considered to be a black box, which contains a sensing element or circuit and an ideal switching mechanism. At the time of actuation, the switch or bistable can be considered an indication of the process variable. Therefore, a positive shift of the setpoint can be considered to be a negative error. In other words, if the switch setting was intended to be 500 psig, but actually switched at 510 psig, at the time of the actuation, the switch "indicated" that the process value was 500 psig when the process value was actually 510 psig. Thus,

error = indicated value (500 psig) - actual value (510 psig) = -10 psig

Therefore, a positive shift of the setpoint on a switch or bistable is equivalent to a negative error, as defined by Reference 7.1.2. **Therefore, for clarity and consistency with the treatment of other bias error terms, the sign of the bias errors of a bistable or switch should be reversed, in order to comply with the convention established by Reference 7.1.2. In either case, the conclusions of the Drift Calculation should be clear enough for proper application to setpoint computations.**

5. CALCULATIONS

5.1. Drift Calculations

The Drift Calculations should be performed in accordance with the methodology described above, with the following documentation requirements.

5.1.1. The title includes the Manufacturer/Model number of the component group analyzed.

5.1.2. The calculation objective must:

5.1.2.1. describe, at a minimum, that the objective of the calculation is to document the drift analysis results for the component group, and extrapolate the drift value to the required calibration period (if applicable),

5.1.2.2. provide a list for the group of all pertinent information in tabular form (e.g. Tag Numbers, Manufacturer, Model Numbers, ranges and calibration spans), and

5.1.2.3. describe any limitations on the application of the results. For instance, if the analysis only applies to a certain range code, the objective should state this fact.

5.1.3. The method of solution should describe, at a minimum, a summary of the methodology used to perform the drift analysis outlined by this Design Guide. Exceptions taken to this Design Guide are to be included in this section including basis and references for any exceptions.

5.1.4. The actual calculation/analysis should provide:

5.1.4.1. A listing of data which was removed and the justification for removal

5.1.4.2. List of references

5.1.4.3. A narrative discussion of the specific activities performed for this calculation

5.1.4.4. Results and conclusions, including

- Manufacturer and model number analyzed
- Bias and random Analyzed Drift values, as applicable
- The applicable Tolerance Interval Factors (provide detailed discussion and justification if other than 95%/95%)
- Applicable drift time interval for application
- Normality conclusion
- Statement of time dependency observed, as applicable
- Limitations on the use of this value in application to uncertainty calculations, as applicable
- Limitations on the application if the results to similar instruments, as applicable

5.1.5. Attachment(s) should be provided, including the following information:

5.1.5.1. Input data with notes on removal and validity

5.1.5.2. Computation of drift data and calibration time intervals

5.1.5.3. Outlier summary, including Final Data Set and basic statistical summaries

5.1.5.4. W Test or D' Test Results (As Applicable)

5.1.5.5. Coverage Analysis, Including Histogram, Percentages in the Required Sigma Band, and Normality Adjustment Factor (As Applicable)

5.1.5.6. Scatter Plot with Prediction Line and Equation

5.1.5.7. Binning Analysis Summaries for Bins and Plots (As Applicable)

5.1.5.8. Regression Plots, ANOVA Tables, and Critical F Values (As Applicable)

5.1.5.9. Derivation of the Analyzed Drift Values, With Summary of Conclusions

5.2. Setpoint/Uncertainty Calculations

To apply the results of the drift analyses to a specific device or loop, a setpoint or loop accuracy calculation must be performed, revised or evaluated in accordance with the plant instrument uncertainty / setpoint methodologies. Per Section 3.2.1.2, the Analyzed Drift term characterizes various instrument uncertainty terms for the analyzed device, loop, or function. In order to save time, a comparison between these terms in an existing setpoint calculation to the Analyzed Drift can be made. If the terms within the existing calculation bound the Analyzed Drift term, then the existing calculation is conservative as is, and does not specifically require revision. If revision to the calculation is necessary, or if it is desired to use the drift analysis results, the Analyzed Drift term may be incorporated into the calculation, by replacing the appropriate terms for the analyzed devices with the Analyzed Drift term.

When comparing the results to setpoint calculations that have more than one device in the instrument loop that was analyzed for drift, comparisons can be made between the DA terms and the original terms on a device-by-device basis, or on a total loop basis. Care should be

taken to properly combine terms for comparison in accordance with the plant instrument uncertainty / setpoint methodologies.

When applying the Drift Calculation results of bistables or switches to a setpoint calculation, the preparer should fully understand the directionality of any bias terms within DA and apply the bias terms accordingly. (See Section 4.6.7.)

6. DEFINITIONS

95%/95%	Standard statistics term meaning that the results have a 95 percent probability with a 95 percent confidence.	Ref. 7.1.1
Analyzed Drift (DA)	A term representing the errors determined by a completed drift analysis for a group. Uncertainties that ***may*** be represented by the analyzed drift term are component reference accuracy, input and output M&TE errors, personnel-induced or human related errors, ambient temperature and other environmental effects, power supply effects, misapplication errors and true component drift.	Sections 4.6, 3.2.1.2
As-Found (AF)	The condition in which a channel, or portion of a channel, is found after a period of operation and before recalibration (if necessary).	Ref. 7.1.3
As-Left (AL)	The condition in which a channel, or portion of a channel, is left after calibration or final setpoint device setpoint verification.	Ref. 7.1.3
Bias (B)	A shift in the signal zero point by some amount.	Ref. 7.1.1
Calibrated Span (CS)	The maximum calibrated upper range value less the minimum calibrated lower range value.	Ref. 7.1.1
Calibration Interval	The elapsed time between the initiation or successful completion of calibrations or calibration checks on the same instrument, channel, instrument loop, or other specified system or device.	Ref. 7.1.1
Confidence Interval	An interval that contains the population parameter (e.g., mean) to a given probability.	Ref. 7.1.1
Coverage Analysis	An analysis to determine whether the assumption of a normal distribution effectively bounds the data. A histogram is used to graphically portray the coverage analysis.	Ref. 7.1.1
D-Prime Test	A test to verify the assumption of normality for moderate to large sample sizes (greater than 50 samples).	Ref. 7.1.1, 7.1.4
Dependent	In statistics, dependent events are those for which the probability of all occurring at once is different than the product of the probabilities of each occurring separately. In setpoint determination, dependent uncertainties are those uncertainties for which the sign or magnitude of one uncertainty affects the sign or magnitude of another uncertainty.	Ref. 7.1.1
Drift	An undesired change in output over a period of time, which is unrelated to the input, environment, or load. A variation in sensor or instrument channel output that may occur between calibrations that cannot be related to changes in the process variable or environmental conditions.	Ref. 7.1.1, 7.1.3
Error	The algebraic difference between the indication and the ideal value of the measured signal.	Ref. 7.1.3
Final Data Set (FDS)	The set of data that is analyzed for normality, time dependence, and used to determine the drift value. This data has all outliers and erroneous data removed, as allowed.	Section 3.6.3
Functionally Equivalent	Instruments with similar design and performance characteristics that can be combined to form a single population for analysis purposes.	Ref. 7.1.1
Histogram	A graph of a frequency distribution.	Ref. 7.1.1
Independent	In statistics, independent events are those in which the probability of all occurring at once is the same as the product of the probabilities of each occurring separately. In setpoint determination, independent uncertainties are those for which the sign or magnitude of one uncertainty does not affect the sign or magnitude of any other uncertainty.	Ref. 7.1.1

Instrument Channel	An arrangement of components and modules as required to generate a single protective action signal when required by a plant condition. A channel loses its identity where single protective action signals are combined.	Ref. 7.1.3
Instrument Range	The region between the limits within which a quantity is measured, received or transmitted, expressed by stating the lower and upper range values.	Ref. 7.1.1
Kurtosis	A characterization of the relative peakedness or flatness of a distribution compared to a normal distribution. A large kurtosis indicates a relatively peaked distribution and a small kurtosis indicates a relatively flat distribution.	Ref. 7.1.1
M&TE	Measurement and Test Equipment.	Ref. 7.1.1
Maximum Span	The instrument's maximum upper range limit less the maximum lower range limit.	Ref. 7.1.1
Mean	The average value of a random sample or population.	Ref. 7.1.1
Median	The value of the middle number in an ordered set of numbers. Half the numbers have values that are greater than the median and half have values that are less than the median. If the data set has an even number, the median is the average of the two middle numbers.	Ref. 7.1.1
Module	Any assembly of interconnected components that constitutes an identifiable device, instrument or piece of equipment. A module can be removed as a unit and replaced with a spare. It has definable performance characteristics that permit it to be tested as a unit.	Ref. 7.1.2
Normality Adjustment Factor	A multiplier to be used for the standard deviation of the Final Data Set to provide a drift model that adequately covers the population of drift points in the Final Data Set.	Section 3.7.4
Normality Test	A statistics test to determine if a sample is normally distributed.	Ref. 7.1.1
Outlier	A data point significantly different in value from the rest of the sample.	Ref. 7.1.1
Population	The totality of the observations with which we are concerned. A true population consists of all values, past, present and future.	Ref. 7.1.1
Probability	The branch of mathematics which deals with the assignment of relative frequencies of occurrence of the possible outcomes of a process or experiment according to some mathematical function. The probability of an event is the relative frequency of occurrences of that event with respect to all occurrences.	Ref. 7.3.2
Prob. Density Function	An expression of the distribution of probability for a continuous function.	Ref. 7.1.1
Probability Plot (Graph)	A graph scaled for a particular distribution in which the sample data will plot as approximately a straight line if the data follows that distribution. For example, normally distributed data will plot as a straight line on a probability plot scaled for a normal distribution; the data may not appear as a straight line on a graph scaled for a different type of distribution.	Ref. 7.1.1
Proportion	A segment of a population that is contained by an upper and lower limit. Tolerance intervals determine the bounds or limits of a proportion of the population, not just the sampled data. The proportion (P) is the second term in the tolerance interval value (e.g. 95%/99%).	Ref. 7.3.2
Random	Describing a variable whose value at a particular future instant cannot be predicted exactly, but can only be estimated by a probability distribution function.	Ref. 7.1.1
Raw Data	As-Found minus As-Left calibration data used to characterize the performance of a functionally equivalent group of components.	Ref. 7.1.1
Reference Accuracy	A number or quantity that defines a limit that errors will not exceed when a device is used under specified operating conditions.	Ref. 7.1.3

Sample	A subset of a population.	Ref. 7.1.1
Sensor	The portion of an instrument channel that responds to changes in a process variable and converts the measured process variable into an instrument signal.	Ref. 7.1.3
Signal Conditioning	One or more modules that perform signal conversion, buffering, isolation or mathematical operations on the signal as needed.	Ref. 7.1.2
Skewness	A measure of the degree of symmetry around the mean.	Ref. 7.1.1
Span	The region between the limits within which a quantity is measured, received, or transmitted, expressed by stating the lower- and upper-range values. The region for which a device is calibrated and verified to be operable. If a device is calibrated over its entire range, the span equals its range. The algebraic difference between the upper and lower values of a calibrated range is also known as the span.	Ref. 7.1.2, 7.1.1
Standard Deviation	A measure of how widely values are dispersed from the population mean.	Ref. 7.1.1
Surveillance Interval	The elapsed time between the initiation or successful completion of a surveillance or surveillance check on the same instrument, channel, instrument loop, or other specified system or device.	Ref. 7.1.1
Time-Dependent Drift	The tendency for the magnitude of instrument drift to vary with time.	Ref. 7.1.1
Time-Dependent Drift Uncertainty	The uncertainty associated with extending calibration intervals beyond the range of available historical data for a given instrument or group of instruments.	Section 3.12
Time-Independent Drift	The tendency for the magnitude of instrument drift to show no specific trend with time.	Ref. 7.1.1
Tolerance	The allowable variation from a specified or true value.	Ref. 7.1.2
Tolerance Interval	An interval that contains a defined proportion of the population to a given probability.	Ref. 7.1.1
Trip Setpoint	A predetermined value for actuation of a final setpoint device to initiate a protective action.	Ref. 7.1.3
Turndown Factor (TDF)	The upper range limit divided by the calibrated span of the device.	Year 2000 version of Ref. 7.1.2
t-Test	For this Design Guide the t-Test is used to determine: 1) if a sample is an outlier of a sample pool, and 2) if two groups of data originate from the same pool.	Ref. 7.1.1
Uncertainty	The amount to which an instrument channel's output is in doubt (or the allowance made therefore) due to possible errors either random or systematic which have not been corrected for. The uncertainty is generally identified within a probability and confidence level.	Ref. 7.1.1
Variance	A measure of how widely values are dispersed from the population mean.	Ref. 7.1.1
W Test	A test to verify the assumption of normality for sample sizes less than or equal to 50.	Ref. 7.1.1, 7.1.4

7. REFERENCES

7.1. Industry Standards and Correspondence

7.1.1. EPRI 3002002556 (TR-103335R2), "Guidelines for Instrument Calibration Extension/Reduction – Revision 2; Statistical Analysis of Instrument Calibration Data," January, 2014

7.1.2. ISA-RP67.04.02-2010, "Recommended Practice, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation"

7.1.3. ANSI/ISA-S67.04.01-2006, "American National Standard, Setpoints for Nuclear Safety-Related Instrumentation"

7.1.4. ANSI N15.15-1974, "Assessment of the Assumption of Normality (Employing Individual Observed Values)"

7.1.5. NRC to EPRI Letter, "Status Report on the Staff Review of EPRI Technical Report TR-103335, 'Guidelines for Instrument Calibration Extension/Reduction Program'," Dated March 1994

7.1.6. Regulatory Guide 1.105, Rev. 2, "Instrument Setpoints"

7.1.7. US Nuclear Regulatory Commission Letter from Mr. Thomas H. Essig to Mr. R. W. James of Electric Power Research Institute, Dated December 1, 1997, "Status Report on the Staff Review of EPRI Technical Report TR-103335, 'Guidelines for Instrument Calibration Extension / Reduction Programs,' Dated March 1994"

7.1.8. NUREG-1475, Rev. 1, "Applying Statistics"

7.2. Calculations and Programs

7.2.1. NEDC-31336P-A, "General Electric Instrument Setpoint Methodology," September, 1996 (incorporated into References 7.2.2 and 7.2.3)

7.2.2. Plant Engineering Practice Standard, PEPS-0046, "Setpoint Control Program"

7.2.3. DECo File C1-4180, "Setpoint Validation Guidelines"

7.3. Miscellaneous

7.3.1. Microsoft Excel for Microsoft Office 2003 (or Later Versions), Spreadsheet Program

7.3.2. Statistics for Nuclear Engineers and Scientists Part 1: Basic Statistical Inference, William J. Beggs; February, 1981

7.3.3. NRC Generic Letter 91-04, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle"