TVA TENNESSEE VALLEY AUTHORITY

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10 CFR 50.59(d)(2)

U. S. Nuclear Regulatory Commission
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Watts Bar Nuclear Plant, Units 1 and 2
Facility Operating License Nos. NPF-90 and NPF-96
NRC Docket Nos. 50-390 and 50-391

Subject: Watts Bar Nuclear Plant Units 1 and 2 – 10 CFR 50.59 Summary Report

Reference: TVA Letter to NRC, WBL-20-039 "Watts Bar Nuclear Plant Units 1 and 2 – 10 CFR 50.59 Summary Report," dated October 28, 2020 (ML 20302A097)

Pursuant to Title 10, Code of Federal Regulations (10 CFR) 50.59(d)(2), Tennessee Valley Authority (TVA) is submitting a summary report of the changes, tests, and experiments implemented at the Watts Bar Nuclear Plant (WBN), Units 1 and 2 since the last 10 CFR 50.59 report was submitted on October 28, 2020 (Reference). The evaluations summarized in the enclosure cover the period from June 6, 2020, to December 4, 2021, and demonstrate that the described changes do not meet the criteria for license amendments as defined by 10 CFR 50.59(c)(2).

There are no new regulatory commitments in this letter. Should you have questions regarding this submittal, please contact Jonathan Johnson, Manager of Watts Bar Site Licensing, at jtjohnson0@tva.gov.

Respectfully,

Anthony L. Williams IV
Site Vice President
Watts Bar Nuclear Plant

Enclosure

Watts Bar Nuclear Plant, Units 1 and 2 10 CFR 50.59 Summary Report

cc: (Enclosure)

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant

Enclosure

Watts Bar Nuclear Plant, Units 1 and 2
10 CFR 50.59 Summary Report

1. Evaluation: Design Change Package (DCP) 66650 Revision 0, Evaluation Revision 0
2. Evaluation: WBN-18-264 Revision 3, Evaluation Revision 1
3. Evaluation: WBN-20-1065 Revision 0, Evaluation Revision 0
4. Evaluation: WBN-18-253 Revision 2, Evaluation Revision 0
5. Evaluation: WBN-21-012 Revision 0, Evaluation Revision 0
6. Evaluation: 04-042 Safety Analysis Report (SAR) Change Revision 0, Evaluation Revision 0
7. Evaluation: WBN-2-2021-068-001 Revision 0, Evaluation Revision 0

1. Evaluation: Design Change Package (DCP) 66650 Revision 0, Evaluation Revision 0

Activity Description:

DCP 66650 is to replace pressure control valves (PCV) 2-PCV-003-0122 and -0132 with cavitating venturis. The description below describes detailed changes required to perform this design change.

Modifications in the Main and Auxiliary Control Room include:

- Pressure differential indicating controllers 2-PDIC-3-122A & -132A will be removed from 2-M-4 and a blanking plate will be installed to cover the opening (2-PDI-3-122A & -132A will remain in 2-M-4).
- Pressure differential indicating controller 2-PDIC-3-122C will be replaced with a pressure differential indicator 2-PDI-3-122C in 2-L-10.
- Pressure differential indicating controller 2-PDIC-3-132C will be replaced with a pressure differential indicator 2-PDI-3-132C in 2-L-10.
- Selector switch 2-XS-3-122 will be removed in 2-L-11A.
- Selector switch 2-XS-3-132 will be removed in 2-L-11B.

Modifications in the Auxiliary Control Room Include:

Train A cables will be disconnected and/or termination points will be moved to accommodate new instrument loop in 2-L-11A.

Train B cables will be disconnected and/or termination points will be moved to accommodate new instrument loop in 2-L-11B.

Modifications in the Auxiliary Building and Auxiliary Instrument Room Include:

A Train:

- Pressure control valve 2-PCV-3-122 and its associated air tubing and airset will be removed.
- Pressure modulator 2-PM-3-122 will be removed from local panel 2-L-214 along with associated air tubing, airset, and panel isolation valves.
- Associated cables will be disconnected as required in 2-L-214.
- Station air and nitrogen supply tubing for 2-PCV-3-122 will be reworked as required and supply valves will be isolated.
- Pump “recirculation line” will be rerouted to accommodate the installation of the cavitating venturi.
- Install cavitating venturi 2-CAVV-003-122.
- Cables will be disconnected and internal wiring reconfigured in 2-R-129.

B Train:

- Pressure control valve 2-PCV-3-132 and its associated air tubing and airset will be removed.
- Pressure modulator 2-PM-3-132 will be removed from local panel 2-L-222 along with associated air tubing, airset, and panel isolation valves.
- Associated cables will be disconnected as required in 2-L-222.
- Station Air and Nitrogen supply tubing for 2-PCV-3-132 will be reworked as required and supply valves will be isolated.
- Pump “recirculation line” will be rerouted to accommodate the installation of the cavitating venturi.
- Install cavitating venturi 2-CAVV-003-132.

- Cables will be disconnected and internal wiring reconfigured in 2-R-132.

AFW PCVs (2-PCV-003-0122 & -0132) have experienced numerous maintenance and reliability problems. A cavitating venturi will allow adequate AFW flow for the design function of the MDAFW pumps, but prevent pump runout should an AFW or MFW pipe break occur. At MDAFW minimum required flow conditions (approximately 410 gpm) the venturi is sized not to cavitate, so it operates just like any other orifice. The cavitation mode should only occur if the pump is approaching a “run out condition”. The venturi is sized to limit flow from the AFWMDPs to 650 gpm (plus 30 gpm for recirculation flow leaving 20 gpm margin, runout flow = 700 gpm). In the cavitation mode differential pressure generated from the inlet section to the throat reduces the liquid’s absolute pressure to its vapor pressure of the fluid (AFW) and it begins to vaporize or boil. These vapor bubbles begin to physically block the throat passageway, which prevents any additional increase in flowrate. The vapor condenses in the discharge part of the venturi. At this point the fluid has recovered and reenters the piping system at velocities slightly lower than the inlet velocity, reestablishing AFW flow.

Maximum SG Pressure for AFW:

This design change updates the U2 Technical Specification Bases to resolve an inconsistency in the maximum steam generator pressure that the Auxiliary Feedwater System is required to pump against. Section B 3.7.5 states that the AFW system is designed supply sufficient water to the steam generator(s) to remove decay heat with steam generator pressure at the lowest setpoint (plus 3% tolerance plus 3% accumulation) of the MSSVs. This formula leads to a maximum SG pressure of 1,257 psig that AFW is required to pump against.

This maximum SG pressure was previously reduced to 1,228 psig based on Westinghouse evaluation SECL-94-066 (see reference 19 for details), which documented test data for the Main Steam Safety Valves (MSSVs). This proved that the safety valves immediately “pop” open to full capacity with essentially no accumulation. Westinghouse currently models a 5 psi accumulation in the MSSV safety analyses. Therefore, the maximum steam generator pressure that the Auxiliary Feedwater System is currently designed to pump against is the lowest MSSV setpoint (1,185 psig) + 3% setpoint tolerance + 5 psi accumulation + 2 psi pressure drop to the MSSVs, or 1,228 psig.

This change has already been incorporated into FSAR Section 10.4.9.2 (Ref 2) by DCN 59007B (Ref 24). This DCN also updated assorted calculation and system descriptions, including WBN calculation EPMOED070391 (Ref. 20) which calculates the effect of this change on the MDAFW pumps. This to the U2 Technical Specification Bases is administrative in nature, since the other required documentation has been previously updated by other modifications.

<u>Summary of Evaluation:</u>

DCP 66650 is to replace pressure control valves 2-PCV-003-0122 and -0132 with cavitating venturis. The MSSV set pressure is being revised down from 1,257 psig to 1,228 psig based on test data and evaluation by Westinghouse. Effects on the FSAR and Accident analysis were reviewed and it was determined that a license amendment will not be required to implement this change.

2. Evaluation: WBN-18-264 Revision 3, Evaluation Revision 1

Activity Description:

The existing Main Feedpump Turbine (MFPT) control system at Watts Bar Nuclear Plant Unit 2 is obsolete and is replaced by a new control system by DC WBN-18-264. The replacement system adds equipment to the plant's Distributed Control System (DCS) for MFPT control and uses electric actuators for positioning of the High Pressure (HP) and Low Pressure (LP) MFPT steam control valves.

The system incorporates the control, protective, and monitoring functions of the existing MFPT controls with enhancements designed to improve fault tolerance. The system provides automatic and manual speed control.

The system is designed to minimize the potential for the failure or malfunction of any single component adversely impacting MFPT and plant operation. Failures and malfunctions will be alarmed. The system is configured to support on-line maintenance such as hot swappable modules and power supplies.

The following provides a summary of the scope of DC WBN-18-264. See the screening review for a more detailed description of the change.

1. MFPT Control System Digital Upgrade

The DCS regulates and monitors the flow of Feedwater (FW) to the steam generators to control the SG level. This includes Main Feedwater regulating valve control, Main Feedwater bypass valve control, and Main Feedpump and Standby Pump recirculation control.

At WBN there have been numerous performance problems with the hydraulic control valve actuators resulting in flow oscillations which required plant reductions in power to remove the MFPT from service.

Each MFPT has its own lube oil and hydraulic control system. The hydraulic control system is maintained to open the High Pressure (HP) and the Low Pressure (LP) Stop Valves. The MFPT HP and LP hydraulic control valve servos are being replaced with Exlar electric actuators to control the position of the HP control valves and the LP control valves. The new Exlar electric actuators are controlled by a Siemens SINAMICS S120 drive control system. There are two separate SINAMICS S120 drive control systems for each MFPT, one for the HP control valve and one for the LP control valve.

The existing feedwater control functions in W205CP are maintained, but the speed changer logic is deleted. Speed demand analog output signals are provided by redundant FBMs in W205CP to new control groups W220CP (MFPT-A) and W221CP (MFPT-B). A redundant speed control signal is also provided over the DCS network to W220CP and W221 CP in the event that the analog signal is lost from the redundant FBMs. If the analog and network signals are all failed, the system reverts to Manual control and generates an alarm.

Interface with the Main Control Room (MGR) MFPT Speed Manual Auto Hand Stations, and the manual auto control logic are moved from W205CP to W220CP and W221CP, but will perform the same functions. New HMI displays have been developed for the MFPT control groups for feedwater pump operation and testing.

The minimum flow bypass valve control positioners for each Main Feedpump and the Standby Feed pump are being replaced with digital positioners similar to that installed on the Main Feedwater Regulating Valves. Valve controls are from the existing DCS control group W205CP

4-20mA signals to the positioners. HART communications are added to DCS W205CP from the new valve positioners for position feedback from the valve positioner for monitoring and alarm functions. If valve demand and feedback position deviate from each other by more than 5% for more than 10 seconds, a process alarm is generated. HART communications are not used for valve control.

MFPT control is performed by the new Foxboro DCS control groups W220CP (MFPT-A) and W221CP (MFPT-8), which provides two 4-20mA valve demand signals from redundant FBMs to the SINAMICS S120 system, one for the HP control valve and one for the LP control valve. The SINAMICS S120 system positions the valve actuator to the position based on the valve demand signal.

All of the control system interface to the SINAMICS S120 MFPT Actuator Control system is to and from the Foxboro DCS control groups W220CP and W221CP. Control system and switches and manual controls from the control room are inputs to DCS, which process the signals and provide the outputs to the SINAMICS S120 system.

Two new fault-tolerant FCP280 CPs pairs will be added to the system for the new Feed pump Turbine control groups - two in W220CP and two in W221CP. The new CPs will be connected via the existing Foxboro I/A fiber-optic mesh network design. Foxboro I/A Series Software version 9.2 as well as FoxView software version 10.4 will be used to develop the WBN2 expansion. The existing W205CP feedwater controls retain the existing fault-tolerant FCP270 Control Processors (CPs).

During initial startup there is not sufficient low pressure steam to operate the MFPT. The LP Control Valve Actuator is positioned full open by the DCS and the LP SINAMICS S120 control system. The HP Control Valve Actuator is then positioned by the DCS and the HP SINAMICS S120 control system to control MFPT speed based on the speed control signal from control group W205CP.

During power ascension low pressure steam will increase and become available to operate the MFPT. The HP Actuator Control valve is slowly closed and the LP Actuator will begin to move toward the closed direction by the DCS and the SINAMICS S120 control systems.

The Unit 2 MFPT equipment will be housed in new panels. One of these panels is in the Auxiliary Instrument Room (AIR). The remaining equipment is in new panels in the Turbine Building.

2. <u>Woodward QuickTrip and Deletion of the SSPS Trip Solenoids</u>

The existing MFPT trip solenoid and the SSPS trip solenoid valves are removed and replaced with a 2-out-3 Woodward QuickTrip device. The Woodward QuickTrip provides a 2-out-of-3 trip solenoid valve arrangement for fault tolerance. 2 out of 3 of the solenoids must be deenergized to open to initiate a trip. This ensures that a single failure will not cause a spurious trip or prevent a trip when required. Opening 2-out-of-3 trip solenoid valves dumps the hydraulic fluid to the High and Low Pressure Stop Valves, closing the Stop Valves. The solenoid valves can be tested online. The Woodward QuickTrip solenoids can be de-energized to initiate a trip by the following:

- SSPS A (via interposing control relays)
- SSPS B (via interposing control relays)
- MCR Trip Handswitch (via interposing control relays)
- Local Trip Pushbutton
- DCS MFPT Trips (The trip solenoids respond to trip signals from redundant FBMs in the DCS to trip the MFPT.)

- ProTech Overspeed Trip Device (Trips independent of the DCS overspeed trip)

The SSPS MFPT signal initiates interposing control relays that open contacts to de-energize the Woodward QuickTrip device. The 125V DC circuit to the existing trip solenoid valves is protected by fuses and provides 1 E/non-1 E isolation to the 125V DC vital boards. 1 E/non-1 E isolation to SSPS is provided by coil to contact separation of the SSPS trip relays.

Three 24VDC trip "strings" are provided to energize/de-energize the QuickTrip 2-out-of-3 device. Redundant 24VDC is provided for each trip string. A trip signal is de-energize to trip. Each of the trip strings operates one of the solenoid valves in the QuickTrip device. The QuickTrip device solenoids can be tested independently using HMI screens. Upon any detected trip signal, the Low and High Pressure Control Valve demands are set to minimum to drive the valves full closed.

The MFPT Trip SSPS Solenoid Valves are currently classified in MEL as Safety- Related, class 1E, Q31 Main Feedwater System (Regulating valves) TGCPS- RPS Interface; Safety Function.

However, the MFPT Trip function is not credited in the safety analysis, but is a defense in depth anticipatory trip. DC WBN-18-264 deletes the SSPS trip solenoid valves and replaces them with the Woodward QuickTrip that is classified as non-1 E Quality Related, Q31 (Main Feedwater System (Regulating valves)/ TGCPS- RPS Interface). SDD-N3-3A-4002 is revised by DC WBN-18-264 to document the safety classification of the Woodward QuickTrip.

The 125V DC circuit to the existing trip solenoid valves is protected by fuses and is retained to provide 1 E/non-1 E isolation from the new SSPS trip relays to the 125V DC vital boards as shown on drawing 2-45W600-46-7. 1 E/non-1 E isolation to SSPS is also provided by coil to contact separation of the SSPS trip relays.

3. <u>Woodward ProTech Overspeed Trip Device</u>

The MFPT mechanical over speed trip device is removed and replaced with a Woodward ProTech overspeed trip device in the drive control panel similar to that used on the Main Turbine control system. This device accurately monitors turbine rotor speed and acceleration via passive MPUs (magnetic pickups) and issues a trip command to the Woodard QuickTrip Assembly. The Protech has three channels (A, B, and C). Speed information is provided to each channel through connection to a dedicated passive speed probe (one speed probe for each channel). The speed probes that input to DCS for speed control are installed on the existing toothed wheel. The Protech speed probes are installed on the turning gear to provide physical separation between the DCS and Protech speed probes. The three Protech channels are connected via a backplane and motherboard which provides two out of three voting on the speed. If overspeed is detected the Protech will de-energize trip relays, whose contacts will be hardwired into the trip string to the Woodard QuickTrip Assembly.

4. <u>MFPT Oil Pumps Guardistor Circuit</u>

The MFPT oil pumps Guardistor circuit is modified to remove the oil pump trip on high winding temperatures. The Guardistor circuit will initiate a Main Control Room alarm on high temperatures. The motor thermal overloads at the motor control center breakers are used to trip a running oil pump on a high current condition and start the standby pump.

5. <u>System Power Feeds from Plant Sources</u>

Control power to the DCS control groups W220CP and W221CP, and the SINAMICS S120 system is supplied from two separate 480V AC boards in the turbine building via 480V / 120V transformers in the Siemens Power Cabinet. These 480V AC board are supplied from diverse 6.9kV Unit Boards.

- 6.9kV Unit Board supplies the 480V TMOV Boards
  - MFPT-A 480V TMOV Board 2A, Breaker 5F1
  - MFPT-8 480V TMOV Board 28, Breaker 3F1
- 6.9kV Common Board supplies the 480V Common Board
  - MFPT-A 480V Common Board MCC A, Breaker 5F2
  - MFPT-8 480V Common Board MCC B, Breaker 6E2

This arrangement ensures the that a single failure of an input power source will not cause an MFPT trip due to a complete loss of control power to the DCS or SINAMICS S120 MFPT control system.

The following elements of the modification are considered adverse and are screened in for further evaluation under 10 CFR 50.59:

1. <u>MFPT Control System Digital Upgrade</u>

The new MFPT control system installed by DC WBN-180264 is a digital control system. The MFPT mechanical over speed trip device is removed and replaced with a Woodward ProTech GII digital overspeed trip device in the drive control panel similar to that used on the Main Turbine control system. This is considered adverse and is screened in for further evaluation under 10 CFR 50.59 due to the following:

a) This modification combines the functions of several previously separate analog components within the digital devices in the new control system and must be considered and evaluated in accordance with NEI 01-01.
b) The new digital controller increases the complexity of the system and creates the potential for different component failures that must be considered and evaluated for impact on the failure modes of the MFPT control system as evaluated in the UFSAR.
c) Software development, configuration settings of the new system is evaluated to TVA digital system requirements and UFSAR described functions in accordance with SSE 18.15.01.

2. <u>Woodward QuickTrip and Deletion of the SSPS Trip Solenoids</u>

The existing MFPT trip solenoid and the SSPS trip solenoid valves are removed and replaced with a 2-out-3 Woodward QuickTrip device. The Woodward QuickTrip provides a 2-out-of-3 trip solenoid valve arrangement for fault tolerance. The Woodward QuickTrip solenoids can be de-energized to initiate a trip by the following:

- SSPS A (via interposing control relays)
- SSPS B (via interposing control relays)
- MCR Trip Handswitch (via interposing control relays)
- Local Trip Pushbutton
- DCS MFPT Trips (The trip solenoids respond to trip signals from redundant FBMs in the DCS to trip the MFPT.)
- Pro Tech Overspeed Trip Device (Trips independent of the DCS overspeed trip)

The MFPT Trip SSPS Solenoid Valves are currently classified in MEL as Safety- Related, class 1 E, Q31 Main Feedwater System (Regulating valves) TGCPS- RPS Interface; Safety Function. The Woodward QuickTrip is classified as non-1 E Quality Related, Q31 (Main Feedwater System (Regulating valves)/ TGCPS- RPS Interface).

Combining the MFPT trip functions into one device (the Woodward QuickTrip) and classifying Woodward QuickTrip and the SSPS trip interposing control relays as non-1 E Quality Related Q31 is considered adverse and is screened in for further evaluation under 10 CFR 50.59.

Summary of Evaluation:

This evaluation has determined that the MFPT Control System and DCS will continue to meet its design requirements following the implementation of the proposed modification that converts to a digital control system. The use of the new Feedwater Pump Control DCS HMI displays (DCS Control Groups W205CP, W220CP and W221CP) will not adversely impact any MFPT control functions or create additional operator burden. The design functions of the existing DCS NSSS/BOP and Auxiliary Control applications are not changed or modified.

Since the new MFPT Control System components are more reliable that the existing components and no new system level failure mode effects are introduced, the proposed modification does not result in more than a minimal increase in the frequency of occurrence of an accident or transient previously evaluated in the WBN UFSAR.

The new equipment being installed will not result in any component malfunctions that could increase the potential for a trip or transient nor will any malfunction result in an increase in the potential for a required protective function to be performed (tripping the MFPT). Therefore, the modification does not result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC important to safety previously evaluated in the UFSAR.

Performance requirements associated with core cooling are unaltered such that fuel integrity will be maintained and the UFSAR analysis of radiological consequences remains bounding. The new equipment will not initiate any new accidents. The modification will not impair or prevent the ECCS from mitigating the consequences of any design basis accidents. Therefore, this activity does not result in more than a minimal increase the consequence of an accident previously evaluated in the UFSAR.

Failure or malfunction of the new equipment will not prevent or affect the ability of safety related systems or systems important to safety to respond to the accidents described in the UFSAR. Therefore, implementation of the proposed modification does not result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the UFSAR. The potential malfunctions of the modified equipment are bounded at a system level in the UFSAR. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety or an accident of a different type than any previously evaluated in the UFSAR is not created.

As described in the UFSAR accident analysis, no malfunction of the MFPT Control System or DCS can cause a transient sufficient to damage the fuel barrier or exceed the nuclear limits as required by the safety design basis. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety that can challenge a fuel barrier or an accident of a different type than any previously evaluated in the UFSAR is not created.

The new digital equipment does not necessitate a revision or replacement of any currently used evaluation methodology. The modification does not result in a departure from the method of evaluation described in the UFSAR in establishing the design bases or in the safety analyses.

Guidance for evaluation of digital upgrades is contained in NEI 01-01, Guideline on Licensing Digital Upgrades, March 2002. NRC Information Notice (IN) 2010-10 stated the NRC expectation that all the questions in Appendix A of NEI 01-01 should be considered in a 50.59 Evaluation for systems that could cause a plant trip or reactivity transient. In the Evaluation that follows, the questions in Appendix A of NEI 01-01 are provided in italics and answered for the proposed digital upgrade.

The 50.59 screening review concludes that implementation of the modification does not require a Technical Specification change. This evaluation concludes that implementation of the modification does not require a License Amendment, and therefore may proceed without NRC approval.

3. Evaluation: WBN-20-1065 Revision 0, Evaluation Revision 0

Activity Description:

This activity replaces the Spent Fuel Handling Bridge (SFHB) to eliminate age-related degradation and obsolescence issues and to improve efficiency. The SFHB replacement consists of replacing the existing SFHB steel structure in its entirety and all associated components and equipment with a new SFHB structure and modern electrical systems and control systems (including a programmable logic controller (PLC), AC induction motors, variable frequency drives (VFDs), control panels, pendant control consoles (PCCs), and monitoring stations).

The existing SFHB analog control system is being replaced with a new control system. The new control system is a digital system with touch screen operator interfaces. The existing control system is relay based and utilizes pushbuttons, switches and indicator lights in the operator interfaces. The upgrades address obsolescence and reliability issues.

The following control system functions have a potentially adverse effect on the method of performing the SFHB function to safely transport fuel assemblies:

- the replacement of the relay based SFHB control system with a digital SFHB control system may potentially result in a marginal increase in the likelihood of failure due to the introduction of software/firmware (NEI 01-01, Section 4.3.2),
- combining previously separate functions into one SFHB digital device (i.e., the PLC) may potentially create new malfunctions (NEI 01-01, Section 4.3.3),
- converting the manual operation of the bridge and trolley to automatic operation when using the semi-automatic and automatic modes of operation may potentially increase the likelihood of a malfunction (NEI 96-07 Section 4.2.1, NEI 01-01, Section 4.3.1),
- the new control system utilizes enhanced HMIs that employ "touch screen" technology, video displays, and joy sticks for improved information presentation and ergonomics. This is conservatively considered a fundamental change in data presentation and operator interaction (NEI 01-01, Section 4.3.4) and is screened in as being potentially adverse.

Therefore, these control system functions may have a potentially adverse effect on the SFHB function to safely handle fuel assemblies.

Other changes accomplished by EC WBN-20-1065 are the subject of the associated 10CFR50.59 screening review.

Summary of Evaluation:

The activity being addressed by this evaluation is the replacement of the existing SFHB control system with a digital control system. The existing control system consists of a relay based control system. The replacement control system consists of a PLC based platform with touch screen displays and VFDs. The PLC based system employs the use of boundary zones to enhance system safety as well as enabling automatic and semi-automatic bridge and hoist trolley operation. The lifting hoists continue to be manually operated. The HMI design is similar to the design used on fuel handling equipment used at other nuclear utilities as well as at Brown Ferry Nuclear Plant and has been reviewed and accepted by SFHB operating personnel. The remaining basic design functions of the SFHB are retained and are not adversely impacted by the proposed activity as discussed in the associated screening review.

Digital device quality assurance measures include: 1) development of a project specific software quality assurance plan, 2) performance of critical digital reviews, 3) performance of a failure modes and effects analysis (FMEA), 4) extensive acceptance testing and 5) a qualitative assessment to support a conclusion that the digital control system upgrade has a sufficiently low likelihood of failure. The use of these quality assurance measures provides reasonable assurance that the use of digital controls in the SFHB does not increase the probability or the consequences of any Fuel Handling Accident described in the UFSAR, nor will it introduce the possibility of a new type of accident not previously considered. The assumptions and conclusions of the existing Fuel Handling Accident analyses remain valid. No reductions in the existing margins of safety are created by implementing this modification. The existing shutdown margins during refueling operations are maintained. The existing submergence limits and radiation shielding margins are retained. No changes to the Technical Specifications or their Bases are required. In order to ensure that this 50.59 evaluation sufficiently addresses issues related to digital upgrades, the questions in Appendix A of NEI 01-01 (Reference I) were listed and answered with the corresponding 50.59 evaluation question.

4. Evaluation: WBN-18-253 Revision 2, Evaluation Revision 0

Activity Description:

The existing Main Feedpump Turbine (MFPT) control system at Watts Bar Nuclear Plant Unit 1 is obsolete and is replaced by a new control system by DC WBN-18-253. The replacement system adds equipment to the plant's Distributed Control System (DCS) for MFPT control and uses electric actuators for positioning of the High Pressure (HP) and Low Pressure (LP) MFPT steam control valves.

The system incorporates the control, protective, and monitoring functions of the existing MFPT controls with enhancements designed to improve fault tolerance. The system provides automatic and manual speed control.

The system is designed to minimize the potential for the failure or malfunction of any single component adversely impacting MFPT and plant operation. Failures and malfunctions will be alarmed. The system is configured to support on-line maintenance such as hot swappable modules and power supplies.

The following provides a summary of the scope of DC WBN-18-253. See the screening review for a more detailed description of the change.

Enclosure

1. MFPT Control System Digital Upgrade

The DCS regulates and monitors the flow of Feedwater (FW) to the steam generators to control the SG level. This includes Main Feedwater regulating valve control, Main Feedwater bypass valve control, and Main Feedpump and Standby Pump recirculation control.

At WBN there have been numerous performance problems with the hydraulic control valve actuators resulting in flow oscillations which required plant reductions in power to remove the MFPT from service.

Each MFPT has its own lube oil and hydraulic control system. The hydraulic control system is maintained to open the High Pressure (HP) and the Low Pressure (LP) Stop Valves. The MFPT HP and LP hydraulic control valve servos are being replaced with Exlar electric actuators to control the position of the HP control valves and the LP control valves. The new Exlar electric actuators are controlled by a Siemens SINAMICS S120 drive control system. There are two separate SINAMICS S120 drive control systems for each MFPT, one for the HP control valve and one for the LP control valve.

The existing feedwater control functions in DCS control group W105CP are maintained, but the speed changer logic is deleted. Speed demand analog output signals are provided by redundant FBMs in W105CP to new control groups W120CP (MFPT-A) and W121CP (MFPT- 8). A redundant speed control signal is also provided over the DCS network to W120CP and W121CP in the event that the analog signal is lost from the redundant FBMs. If the analog and network signals are all failed, the system reverts to Manual control and generates an alarm.

Interface with the Main Control Room (MCR) MFPT Speed Manual Auto Hand Stations, and the manual auto control logic are moved from W105CP to W120CP and W121 CP, but will perform the same functions. New HMI displays have been developed for the MFPT control groups for feedwater pump operation and testing.

The minimum flow bypass valve control positioners for each Main Feedpump and the Standby Feedpump are being replaced with digital positioners similar to that installed on the Main Feedwater Regulating Valves. Valve controls are from the existing DCS control group W105CP 4-20mA signals to the positioners. HART communications are added to DCS W105CP from the new valve positioners for position feedback from the valve positioner for monitoring and alarm functions. If valve demand and feedback position deviate from each other by more than 5% for more than 10 seconds, a process alarm is generated. HART communications are not used for valve control.

MFPT control is performed by the new Foxboro DCS control groups W120CP (MFPT-A) and W121CP (MFPT-8), which provides two 4-20mA valve demand signals from redundant FBMs to the SINAMICS S120 system, one for the HP control valve and one for the LP control valve. The SINAMICS S120 system positions the valve actuator to the position based on the valve demand signal.

All of the control system interface to the SINAMICS S120 MFPT Actuator Control system is to and from the Foxboro DCS control groups W120CP and W121CP. Control system handswitches and manual controls from the control room are inputs to DCS, which process the signals and provide the outputs to the SINAMICS S120 system.

Two new fault-tolerant FCP280 CPs pairs will be added to the system for the new Feedpump Turbine control groups - two in W120CP and two in W121CP. The new CPs will be connected via the existing Foxboro I/A fiber-optic mesh network design. Foxboro I/A Series Software version 9.2 as well as FoxView software version 10.4 will be used to develop the WBN2 expansion. The existing W105CP feedwater controls retain the existing fault-tolerant FCP270 Control Processors (CPs).

During initial startup there is not sufficient low pressure steam to operate the MFPT. The LP Control Valve Actuator is positioned full open by the DCS and the LP SINAMICS S120 control system. The HP Control Valve Actuator is then positioned by the DCS and the HP SINAMICS S120 control system to control MFPT speed based on the speed control signal from control group W105CP.

During power ascension low pressure steam will increase and become available to operate the MFPT. The HP Actuator Control valve is slowly closed and the LP Actuator will begin to move toward the closed direction by the DCS and the SINAMICS S120 control systems.

The Unit 1 MFPT equipment will be housed in new panels. One of these panels is in the Auxiliary Instrument Room (AIR). The remaining equipment is in new panels in the Turbine Building.

2. Woodward QuickTrip and Deletion of the SSPS Trip Solenoids

The existing MFPT trip solenoid and the SSPS trip solenoid valves are removed and replaced with a 2-out-3 Woodward QuickTrip device. The Woodward QuickTrip provides a 2-out-of-3 trip solenoid valve arrangement for fault tolerance. 2 out of 3 of the solenoids must be deenergized to open to initiate a trip. This ensures that a single failure will not cause a spurious trip or prevent a trip when required. Opening 2-out-of-3 trip solenoid valves dumps the hydraulic fluid to the High and Low Pressure Stop Valves, closing the Stop Valves. The solenoid valves can be tested online. The Woodward QuickTrip solenoids can be de-energized to initiate a trip by the following:

- SSPS A (via interposing control relays)
- SSPS B (via interposing control relays)
- MCR Trip Handswitch (via interposing control relays)
- Local Trip Pushbutton
- DCS MFPT Trips (The trip solenoids respond to trip signals from redundant FBMs in the DCS to trip the MFPT.)
- Pro Tech Overspeed Trip Device (Trips independent of the DCS overspeed trip)

The SSPS MFPT signal initiates interposing control relays that open contacts to de-energize the Woodward QuickTrip device. The 125V DC circuit to the existing trip solenoid valves is protected by fuses and provides 1 E/non-1 E isolation to the 125V DC vital boards. 1E/non-1E isolation to SSPS is provided by coil to contact separation of the SSPS trip relays.

Three 24VDC trip "strings" are provided to energize/de-energize the QuickTrip 2-out-of-3 device. Redundant 24VDC is provided for each trip string. A trip signal is de-energize to trip. Each of the trip strings operates one of the solenoid valves in the QuickTrip device. The QuickTrip device solenoids can be tested independently using HMI screens. Upon any detected trip signal, the Low and High Pressure Control Valve demands are set to minimum to drive the valves full closed.

The MFPT Trip SSPS Solenoid Valves are currently classified in MEL as Safety- Related, class 1E, Q31 Main Feedwater System (Regulating valves) TGCPS- RPS Interface; Safety Function.

However, the MFPT Trip function is not credited in the safety analysis, but is a defense in depth anticipatory trip. DC WBN-18-253 deletes the SSPS trip solenoid valves and replaces them with the Woodward QuickTrip that is classified as non-1 E Quality Related, Q31 (Main Feedwater System (Regulating valves) / TGCPS- RPS Interface). SDD-N3-3A-4002 is revised by DC WBN-18-253 to document the safety classification of the Woodward QuickTrip for WBN Unit 1.

The 125V DC circuit to the existing trip solenoid valves is protected by fuses and is retained to provide 1 E/non-1 E isolation from the new SSPS trip relays to the 125V DC vital boards as shown on drawing 1-45W600-46-7. 1 E/non-1 E isolation to SSPS is also provided by coil to contact separation of the SSPS trip relays.

3. Woodward ProTech Overspeed Trip Device

The MFPT mechanical over speed trip device is removed and replaced with a Woodward Pro Tech overspeed trip device in the drive control panel similar to that used on the Main Turbine control system. This device accurately monitors turbine rotor speed and acceleration via passive MPUs (magnetic pickups) and issues a trip command to the Woodard QuickTrip Assembly. The Protech has three channels (A, B, and C). Speed information is provided to each channel through connection to a dedicated passive speed probe (one speed probe for each channel). The speed probes that input to DCS for speed control are installed on the existing toothed wheel. The Protech speed probes are installed on the turning gear to provide physical separation between the DCS and Protech speed probes. The three Protech channels are connected via a backplane and motherboard which provides two out of three voting on the speed. If overspeed is detected the Protech will de-energize trip relays, whose contacts will be hardwired into the trip string to the Woodard QuickTrip Assembly.

4. MFPT Oil Pumps Guardistor Circuit

The MFPT oil pumps Guardistor circuit is modified to remove the oil pump trip on high winding temperatures. The Guardistor circuit will initiate a Main Control Room alarm on high temperatures. The motor thermal overloads at the motor control center breakers are used to trip a running oil pump on a high current condition and start the standby pump.

5. System Power Feeds from Plant Sources

Control power to the DCS control groups W120CP and W121CP, and the SINAMICS S120 system is supplied from two separate 480V AC boards in the turbine building via 480V / 120V transformers in the Siemens Power Cabinet. These 480V AC board are supplied from diverse 6.9kV Unit Boards.

- 6.9kV Unit Board supplies the 480V TMOV Boards
    - ➢ MFPT-A 480V TMOV Board 1A
    - ➢ MFPT-B 480V TMOV Board 1 B
- 6.9kV Common Board supplies the 480V Common Board
    - ➢ MFPT-A 480V Common Board MCC A
    - ➢ MFPT-B 480V Common Board MCC B

This arrangement ensures the that a single failure of an input power source will not cause an MFPT trip due to a complete loss of control power to the DCS or SINAMICS S120 MFPT control system.

The following elements of the modification are considered adverse and are screened in for further evaluation under 10 CFR 50.59:

1. MFPT Control System Digital Upgrade

The new MFPT control system installed by DC WBN-18-253 is a digital control system. The MFPT mechanical over speed trip device is removed and replaced with a Woodward Pro Tech GIi digital overspeed trip device in the drive control panel similar to that used on the Main Turbine control system. This is considered adverse and is screened in for further evaluation under 10 CFR 50.59 due to the following:

a) This modification combines the functions of several previously separate analog components within the digital devices in the new control system and must be considered and evaluated in accordance with NEI 01-01.
b) The new digital controller increases the complexity of the system and creates the potential for different component failures that must be considered and evaluated for impact on the failure modes of the MFPT control system as evaluated in the UFSAR.
c) Software development, configuration settings of the new system is evaluated to TVA digital system requirements and UFSAR described functions in accordance with SSE18.15.01.

2. Woodward QuickTrip and Deletion of the SSPS Trip Solenoids

The existing MFPT trip solenoid and the SSPS trip solenoid valves are removed and replaced with a 2-out-3 Woodward QuickTrip device. The Woodward QuickTrip provides a 2-out-of-3 trip solenoid valve arrangement for fault tolerance. The Woodward QuickTrip solenoids can be de-energized to initiate a trip by the following:

- SSPS A (via interposing control relays)
- SSPS B (via interposing control relays)
- MCR Trip Handswitch (via interposing control relays)
- Local Trip Pushbutton
- DCS MFPT Trips (The trip solenoids respond to trip signals from redundant FBMs in the DCS to trip the MFPT.)
- Pro Tech Overspeed Trip Device (Trips independent of the DCS overspeed trip)

The MFPT Trip SSPS Solenoid Valves are currently classified in MEL as Safety- Related, class 1 E, Q31 Main Feedwater System (Regulating valves) TGCPS- RPS Interface; Safety Function. The Woodward QuickTrip is classified as non-1 E Quality Related, Q31 (Main Feedwater System (Regulating valves)/ TGCPS- RPS Interface).

Combining the MFPT trip functions into one device (the Woodward QuickTrip) and classifying Woodward QuickTrip and the SSPS trip interposing control relays as non-1 E Quality Related Q31 is considered adverse and is screened in for further evaluation under 10 CFR 50.59.

Summary of Evaluation:

This evaluation has determined that the MFPT Control System and DCS will continue to meet its design requirements following the implementation of the proposed modification that converts to a digital control system. The use of the new Feedwater Pump Control DCS HMI displays (DCS Control Groups W105CP, W120CP and W121CP) will not adversely impact any MFPT control functions or create additional operator burden. The design functions of the existing DCS NSSS/BOP and Auxiliary Control applications are not changed or modified.

Since the new MFPT Control System components are more reliable that the existing components and no new system level failure mode effects are introduced, the proposed modification does not result in more than a minimal increase in the frequency of occurrence of an accident or transient previously evaluated in the WBN UFSAR.

The new equipment being installed will not result in any component malfunctions that could increase the potential for a trip or transient, nor will anv malfunction result in an increase in the potential for a required protective function to be performed (tripping the MFPT). Therefore, the modification does not result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC important to safety previously evaluated in the UFSAR.

Performance requirements associated with core cooling are unaltered such that fuel integrity will be maintained and the UFSAR analysis of radiological consequences remains bounding. The new equipment will not initiate any new accidents. The modification will not impair or prevent the ECCS from mitigating the consequences of any design basis accidents. Therefore, this activity does not result in more than a minimal increase the consequence of an accident previously evaluated in the UFSAR.

Failure or malfunction of the new equipment will not prevent or affect the ability of safety related systems or systems important to safety to respond to the accidents described in the UFSAR. Therefore, implementation of the proposed modification does not result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the UFSAR. The potential malfunctions of the modified equipment are bounded at a system level in the UFSAR. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety or an accident of a different type than any previously evaluated in the UFSAR is not created.

As described in the UFSAR accident analysis, no malfunction of the MFPT Control System or DCS can cause a transient sufficient to damage the fuel barrier or exceed the nuclear limits as required by the safety design basis. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety that can challenge a fuel barrier or an accident of a different type than any previously evaluated in the UFSAR is not created.

The new digital equipment does not necessitate a revision or replacement of any currently used evaluation methodology. The modification does not result in a departure from the method of evaluation described in the UFSAR in establishing the design bases or in the safety analyses.

Guidance for evaluation of digital upgrades is contained in NEI 01-01, Guideline on Licensing Digital Upgrades, March 2002. NRC Information Notice (IN) 2010-10 stated the NRC expectation that all the questions in Appendix A of NEI 01-01 should be considered in a 50.59 Evaluation for systems that could cause a plant trip or reactivity transient. In the Evaluation that follows, the questions in Appendix A of NEI 01-01 are provided in italics and answered for the proposed digital upgrade.

The 50.59 screening review concludes that implementation of the modification does not require a Technical Specification change. This evaluation concludes that implementation of the modification does not require a License Amendment, and therefore may proceed without NRC approval.

5. Evaluation: WBN-21-012 Revision 0, Evaluation Revision 0

Activity Description:

The Woodward MicroNet operating system, firmware and WBN application software for the Main Turbine Digital Electrohydraulic (DEH) control system and Moisture Separator Reheater (MSR) controls at Watts Bar Units 1 and 2 Nuclear Plant are being upgraded by DC WBN-21-012. This change is made to correct a software error that could cause a corruption of Governor Valve or Throttle valve calibration data stored on the MicroNet CPU card (Reference WBN CR 1636916).

DC WBN-21-012, Stage 1 implements the changes in WBN Unit 1.

DC WBN-21-012, Stage 2 implements the changes in WBN Unit 2.

Woodward has developed a revision to the operating system software to correct this possible calibration data transfer error. The software revision also requires updating the CPU card firmware, and the WBN specific application GAP Software.

The DEH MicroNet TMR DEH system software includes the Woodward operating system software which consists of the following:

1. Firmware on the Micronet components (the CPU firmware is referred to as the Footprint by Woodward). As Woodward controls firmware versions by component part number, the CPU part number is changed from 5466-1250 to 5466-1350. The hardware of the CPU is the same, only the firmware is changed. The existing CPUs 5466-1250 are being replaced with new CPUs 5466-1350. The old CPUs are returned to Woodward to have the new firmware installed, tested at the Woodward factory, then returned to Siemens Energy and TVA as spares.
2. The MicroNet TMR Graphical Application Programmer (GAP) Editor allows for the editing and revision of the WBN Units 1 and 2 application specific GAP software. After graphically entering the control logic in GAP editor, GAP checks the application for correctness and generates a meta-data file for use with Woodward Coder. Monitor is a mode in the GAP program which allows personnel to view and tune GAP values in context while the application is running. Monitor GAP is available on the Engineering Work Station in the DEH panels 1/2-R-56.
3. The WBN Units 1 and 2 application specific Graphical Application Programmer (GAP) software which consists of software blocks configured for the WBN DEH specific system logic and functionality (developed by Siemens Energy).
4. A generic embedded operating system referred to as the Coder (developed by Woodward). The Coder is the program that converts the WBN specific GAP application into code and combines it with the embedded operating system. The compiled file is loaded onto the CPUs using the AppManager software tool application on the EWS.

The new version of the Coder and application GAP are loaded from the Engineering Work Station (EWS) in panels 1/2-R-56. Software tools on the EWS are also updated to support the new software versions.

Improvements are made to the EWS displays and diagnostics log initiation to provide better information in the event of a Governor Valve or Throttle Valve actuator shutdown. This was a lesson learned from the recent WBN Unit 2 GV2A and GV2B position indication deviation and actuator shutdowns (Reference WBN CR 1653934).

Summary of Screening Review
The new Woodward software changes the MicroNet CPU firmware, embedded operating system and the applications used to develop and compile the WBN Units 1 and 2 application specific GAP software. This potentially affects every GAP software block used in the WBN application specific GAP. This is considered adverse and is screened in for further evaluation under 10 CFR 50.59.

Summary of Evaluation:

This evaluation has determined that the EHC Turbine Control and Turbine Protection Systems (TGCPS) will continue to meet its design requirements following the implementation of revised Woodward Software.

DEH System hardware components are not changed by this software upgrade (the CPU part number is changed to note the new firmware version). The design functions described in the UFSAR are maintained with the new Woodward software. There are no changes to the DEH or MSR system operation and control functions, and no new system level failure mode effects are introduced. The proposed modification does not result in more than a minimal increase in the frequency of occurrence of an accident or transient previously evaluated in the WBN UFSAR.

The new software will not result in any component malfunctions that could increase the potential for a turbine trip or transient nor will any malfunction result in an increase in the potential for a required protective function to be performed (tripping the turbine). Therefore, the modification does not result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC important to safety previously evaluated in the UFSAR.

Performance requirements associated with core cooling are unaltered such that fuel integrity will be maintained and the UFSAR analysis of radiological consequences remains bounding. The new equipment will not initiate any new accidents. The modification will not impair or prevent the ECCS from mitigating the consequences of any design basis accidents. Therefore, this activity does not result in more than a minimal increase the consequence of an accident previously evaluated in the UFSAR.

Failure or malfunction of the new equipment will not prevent or affect the ability of safety related systems or systems important to safety to respond to the accidents describe in the UFSAR. Therefore, implementation of the proposed modification does not result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the UFSAR. The potential malfunctions of the modified equipment are bounded at a system level in the UFSAR. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety or an accident of a different type than any previously evaluated in the UFSAR is not created.

As described in the UFSAR accident analysis, no malfunction of the Turbine Control and Turbine Protection Systems (TGCPS) can cause a transient sufficient to damage the fuel barrier or exceed the nuclear limits as required by the safety design basis. Therefore, the possibility for an unanalyzed malfunction of an SSC important to safety that can challenge a fuel barrier or an accident of a different type than any previously evaluated in the UFSAR is not created.

The new software does not necessitate a revision or replacement of any currently used evaluation methodology. The modification does not result in a departure from the method of evaluation described in the UFSAR in establishing the design bases or in the safety analyses.

Guidance for evaluation of digital upgrades is contained in NEI 01-01, Guideline on Licensing Digital Upgrades, March 2002. NRC Information Notice (IN) 2010-10 stated the NRC expectation that all the questions in Appendix A of NEI 01-01 should be considered in a 50.59 Evaluation for systems that could cause a plant trip or reactivity transient. In the Evaluation below, the questions in Appendix A of NEI 01-01 are provided in italics and answered for the proposed digital upgrade. NEI 01-01 discusses the use of an FMEA, Failure Modes Effect Analysis. In line with the graded approach referenced in NEI 01-01, the DEH failure modes and effect analysis 20583-FMEAL583001-05215 has been updated for the new software and documents that failure modes are not affected by the new DEH system software.

The 50.59 screening review concludes that implementation of the modification does not require a Technical Specification change. This evaluation concludes that implementation of the modification does not require a License Amendment, and therefore may proceed without NRC approval.

6. Evaluation: 04-042 Safety Analysis Report (SAR) Change Revision 0, Evaluation Revision 0

Activity Description:

The methods used to analyze and monitor reload core designs for Watts Bar Unit 1 are updated beginning with Cycle 18. Two methods are updated: (1) the PHOENIX-P/ANC Nuclear Design System (Reference 6) embodied in ALPHA/PARAGON/ANC (APA) system is replaced with the NEXUS Nuclear Data Methodology (Reference 3) and (2) BEACON (Reference 7 and 8) is updated to replace the neutronic engine (SPNOVA) with ANC.

Summary of Evaluation:

It is shown that use of the updated methods do not constitute a departure from a method of evaluation, and therefore, that a license amendment is not required prior to implementation of these changes. Use of these methods does not constitute a departure from a method of evaluation because (1) the methods are approved by the NRC specifically for this application and (2) the application of these methods to Watts Bar Unit 1 is consistent with the terms, conditions, and limitations of the NRC approval of the methods.

7. <u>Evaluation</u>: WBN-2-2021-068-001 Revision 0, Evaluation Revision 0

Activity Description:

Modify control logic for Unit 2 Pressurizer backup heater banks to allow heater banks B and C to be continuously energized from the MCR. This will energize relay PB455GXB by installation of a jumper and lift a wire in the 2-HS-68-341H start circuit to remove the standing start signal for the C heater bank and allow for manual energizing/de-energizing of the bank.

Summary of Evaluation:

Evaluations performed by Westinghouse determined that even with the additional heat input from the backup heater groups, the change did not represent a "substantial safety hazard" and that all acceptance criteria for each accident would be met which entailed ensuring that the transients are arrested prior to Pressurizer overfilling and none of the affected events are expected to escalate to a more severe event.