



South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

June 15, 2009  
U7-C-STP-NRC-090056

U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
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Rockville MD 20852-2738

South Texas Project  
Units 3 and 4  
Docket Nos. 52-012 and 52-013  
Response to Requests for Additional Information

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter number 104 related to Combined License Application (COLA) Tier 2 Chapter 7.

Attachments 1 through 6 provide responses to the RAI questions listed below.

07.01-1	07.01-4
07.01-2	07.02-1
07.01-3	07.07-1

When a change to the COLA is indicated, the change will be incorporated into the next routine revision of the COLA following NRC acceptance of the response.

There are no commitments in this letter.

If you have any questions, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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

Executed on 6/15/09



Scott Head  
Manager, Regulatory Affairs  
South Texas Project Units 3 & 4

jwc

Attachments:

1. Question 07.01-1
2. Question 07.01-2
3. Question 07.01-3
4. Question 07.01-4
5. Question 07.02-1
6. Question 07.07-1

cc: w/o attachment except\*  
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**RAI 07.01-1**

**QUESTION:**

The STPNOC response (U7-C-STP-NRC-090009) to the NRC audit refers to the Toshiba and Westinghouse platform topical reports for conformance with the NRC regulations. The NRC Staff requests that STPNOC clarify the scope of I&C departures in relation to these topical reports and provide sufficient information within COLA depending on the clarification of the scope.

**RESPONSE:**

This response focuses on departure STD DEP T1 3.4-1 as the relevant I&C departure from Tier 1, as noted in STPNOC letter U7-C-STP-NRC-090009. The NRC has requested supplemental information to this RAI regarding STPNOC's digital I&C design and use of the topical reports for DAC/ITAAC closure. Response to this request is also provided.

Also, this STPNOC initial response is limited to the Non-rewritable (NRW) Field Programmable Gate Array (FPGA) platform for Reactor Trip and Isolation System (RTIS) and Neutron Monitoring System (NMS). A supplemental response for the Common Q platform for Engineered Safety Features Logic and Control System (ELCS) will be provided by June 30, 2009.

NRW-FPGA Platform

This response for NMS and RTIS has five major sections. The first section provides a system overview for the NMS and RTIS. The second section provides a description of the equipment that is utilized for the NMS and RTIS. The third section describes the COLA departures and the relationship of the COLA departures to the equipment description. The fourth section clarifies that the NRW-FPGA Topical Reports identified in Attachment 5 to U7-C-STP-NRC-090009 has been withdrawn from NRC and provides some details on the Design Acceptance Criteria audit process. The fifth section provides a COLA markup to include additional information on the NRW-FPGA based platforms.

System Overview

The Neutron Monitoring System (NMS) consists of the following safety-related subsystems:

- Startup Range Neutron Monitoring (SRNM),
- Local Power Range Neutron Monitoring (LPRM),
- Average Power Range Neutron Monitoring (APRM), and
- Oscillation Power Range Neutron Monitoring (OPRM).

The SRNM monitors neutron flux from the source range to 15% of the rated power. The SRNM includes the following major elements:

1. The SRNM Subsystem has 10 SRNM channels, each having one fixed in-core regenerative fission chamber sensor.
2. SRNM detector signals are divided and assigned to four divisions.
3. SRNM monitors neutrons over a 10-decade flux range. The counting method is used in the lower range, and the Campbell technique (mean square voltage, or MSV measurement) are used in the higher range.
4. The calculation algorithm of the period-based trip circuitry generates the trip margin setpoint for the period trip protection function.
5. The SRNM digital measurement and control (DMC) provides various outputs for local and control console displays and to the Plant Computer Functions (PCF).
6. The SRNM provides alarm and trip outputs to the RTIS and RCIS separately for both high flux and short period conditions, and instrument inoperative trip.
7. The SRNM sends an interlock signal indicating whether the SRNM power level is above or below a specific setpoint level for use in Anticipated Transient Without SCRAM (ATWS) logic.

The Power Range Neutron Monitor (PRNM) system monitors reactor power by measuring neutron flux level and issues a trip signal to RTIS when specified setpoints are exceeded. The NMS also provides power information of operation and control of the reactor to the PCF and the rod block monitor (RBM). The PRNM includes the following major elements:

1. There are 208 Local Power Range Monitor (LPRM) detectors in the core. LPRM detector signals are divided and assigned to four Average Power Range Monitor (APRM) channels corresponding to four divisions.
2. LPRM monitors local neutron flux at each LPRM detector signal in the power range up to 125% of rated power.
3. APRM monitors average neutron flux of LPRM signals and generates a high neutron flux trip, a simulated thermal power (STP) trip signal, and a Core Flow Rapid Coastdown trip to the RTIS.
4. Oscillation Power Range Monitor (OPRM) monitors the LPRM signals for core instability and generates trips for RTIS.
5. On operator demand, LPRM units receive gain adjustment calibration information from PICS through the APRM unit and accepted on each PRNM.

6. The APRM sends an interlock signal to permit ATWS protection action.
7. Alarms to the operator warning of the impending and actual occurrence of trips.
8. Indications of PRNM System failures or operational problems.

The NMS also includes the following non safety-related subsystems:

- Multi-Channel Rod Block Monitor (MRBM) and
- Automated Automatic Traversing In-core Probe (ATIP).

These subsystems are described in FSAR Section 7.7.

The Reactor Trip and Isolation System (RTIS) initiates an automatic reactor trip (scram) when certain conditions are present (e.g., Reactor Water Level L-3, D/W Pressure Low, Reactor Pressure Low, etc.). The RTIS also initiates MSIV closure when certain conditions are present (e.g., Reactor Water Level L-1.5, Main Steam Line Flow Low, etc.). The RTIS consists of the following:

- Digital Trip Function (DTF),
- Trip Logic Function (TLF), and
- Output Logic Unit (OLU).

RTIS includes the following major elements:

1. Use four redundant instrument channels and the replication of the entire two-out-of-four combinational logic in all four divisions of the trip logic.
2. Full implementation of the single failure criterion and the physical separation and electrical independence between the RTIS divisions to ensure no credible failure will affect or defeat more than one division.
3. The RTIS initiates an automatic reactor trip (scram) by 11 different conditions (e.g., Reactor Water Level L-3, D/W Pressure Low, Reactor Pressure Low, etc.)
4. MSIV Closure Logic initiates an automatic MSIV closure from 10 different conditions (e.g., Reactor Water Level L-1.5, Main Steam Line Flow Low, etc.)

#### FPGA-based System Description

The Digital I&C System design for NMS and RTIS use NRW-FPGA-based safety-related I&C systems.

The FPGA-based system is a modular, chassis-based, rack-mounted system. FPGA-based systems are built as units, which provide the chassis and backplanes. The units perform specific functions, based on the modules placed in the backplane. Therefore, each module has unique architectural features, based on the differences in interfaces and requirements. The module design is implemented using only FPGAs. The design uses relatively simple medium-scale integrated (MSI) discrete logic chips for all simple logic functions, such as a monostable multivibrator to implement a watchdog timer. Data is transferred between units over fiber optic links.

Each module consists of one or more printed circuit boards and a front panel. The purpose of the front panel is to fix boards to the unit and to provide mounting for a Human-Machine Interface (HMI) and setpoints adjustment. The printed circuit board runs through channels, guiding the assembly into a position where the connector will mate with the backplane.

The design of HMI and modifiable setpoints of each module are based on the design of conventional analog-based or CPU-based Systems. Specifically, an aluminum front panel, which provides a flat, front surface for the discrete LEDs for status, numeric LEDs for values, and dedicated function pushbutton switches. The front panel also provides captive screws, to ensure that the printed circuit board remains in the unit and operable through seismic events. Status indicators are provided on the front panels (e.g., single-channel trip signal).

The FPGA-based system also includes power supplies, analog and digital input/output modules, status modules, and all cabling and wiring necessary for operation. As an example, the Local Power Range Neutron Monitor (LPRM) module consists of a front panel with an HMI, a printed circuit board, the analog circuitry necessary to interface to the in-core detector, power supply for the in-core detector, four FPGAs, and a limited amount of additional logic. An FPGA can only implement digital logic.

The system design uses multiple FPGAs on each module. The FPGA incorporates thousands of logic cells linked by one-time configurable connections that logically interconnect cells to meet different function requirements. In addition to logic cells, other configurable elements of an FPGA are (1) Input/Output (I/O) blocks, which serve as the interface between internal signal lines and the chip's external pins; and (2) interconnects, which route I/O signals to appropriate destinations. An FPGA can only implement digital logic. For the FPGA-based system, a single FPGA will be used for a single function, which makes testing the FPGA much easier, as well as diagnosis and root cause evaluation during design and development.

The FPGA-based systems are composed of logic designed specifically to be physically embedded on FPGA chips using special tools. The logic is built from simple functional elements (FEs) that are designed to perform simple logic functions that can be combined and arranged in specific patterns to perform signal processing and logic operations, and thus construct the logic necessary to perform a defined function. Once the logic is embedded, the logic is hard coded and cannot be changed. After the logic is defined and embedded, the FPGA components are treated as hardware.

The functions on a given module execute in sequence, and data is transferred between FPGAs over serial and parallel communication links. That is, the first FPGA completes its function, and then provides data to the next FPGA. When that FPGA completes its function, it provides data to the third FPGA. Only when all FPGAs have finished, passing data to the next, do the two watchdog timers on the module reset and restart timing. Failure of any FPGA to complete and pass data to the next FPGA will result in all subsequent FPGAs on that module failing to start. If this occurs in the FPGAs that implement the safety functions, the module is marked as inoperable.

In addition, the FPGA-based system has self-diagnostic functions that continuously verify proper FPGA and communications performance and provide outputs used to alert the operator. For example, the NRW-FPGA-based PRM units generate an inoperable signal when power loss occurs, which is treated as an inoperable channel and, therefore, initiates a single-channel trip signal.

The advantage of the FPGA platform is that the logic execution is completely defined, simple (compared to computer-based systems). FPGAs provide stable technology to minimize the risk of technology obsolescence. Because the FPGA is implemented directly in digital logic, the FPGA executes application logic without operating systems or application software. Further, the FPGAs provide permanent, non-volatile, unchangeable storage of the system configuration. Using an FPGA that has embedded logic and a design that requires an external special tool to embed the logic into the FPGA has eliminated all issues associated with inadvertent changes to software, which can occur with programmable digital devices.

The qualification is primarily based on the EPRI Technical Report TR-107330 "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," December 1996. The software qualification approach described in EPRI TR-107330 has been modified to fit the NRW-FPGA technology.

Key features of this process include use of a modified software lifecycle approach for logic design and qualification, and use of small logic elements, called Function Elements, to implement the logic based on their simplicity and testability.



COLA Departure

The relevant I&C departure from Tier 1 information is STD DEP T1 3.4-1. As described in the COLA Part 7 markup provided in U7-C-STP-NRC-090009, STD DEP T1 3.4-1 consists of the following changes:

1. Elimination of obsolete data communication technology;
2. Elimination of unnecessary inadvertent actuation prevention logic and equipment;
3. Clarification of digital controls nomenclature and systems;
4. Final selection of platforms changed the implementation architecture; and
5. Testing and surveillance changes for SSLC.

Changes (1), (4) and (5) are related to the FPGA-based system.

*Elimination of Obsolete Data Communication Technology – Change (1)*

The STP 3 & 4 COLA replaces the previous communication technology with high speed serial links (HSLs) to communicate Class 1E information.

For the FPGA-based systems, the inputs from the instrumentation are hard wired to the modules. Data is transferred between FPGAs over serial communication links. Data is transferred between units over fiber optic links. The modules communicate using simple, dedicated communication links internal to the unit.

The communication data links provided in the RTIS and NMS system have a one-way fiber optic communication link, providing fixed data sets from each safety-related division individually to the nonsafety-related systems, providing 1E to non-1E isolation, and offering no possibility of data transfer from the nonsafety to the safety equipment. This design eliminates any potential for data from one division being supplied to another division. In addition, for the fielded systems, the current FPGA-based system designs provide no means to attach personal computers or other software-based tools.

The LPRM and APRM calibration data is transmitted from the nonsafety-related core monitor function of PCIS to the safety related NMS. Plant personnel action to manually accept the data transfer to the operational safety side is required for such data to be accepted. NMS can receive calibration data from nonsafety-related maintenance support systems. On a divisional level, a division must be manually placed in inop and manually verified and accepted before such data is allowed in the portion of the device performing the safety function. Only limited data in a strict format will be accepted by the safety device. COLA Tier 1 Section 2.7.5 indicates that, "Data cannot be transferred from the non-safety side to safety related equipment." The acceptance criteria for ITAAC Item 4 in Tier 1 Table 2.7.5 further clarifies this statement by prohibiting only control and timing signals between safety related equipment and non-safety related

equipment. Thus, limited data transfer, such as the one for NMS calibration described above, is allowed from nonsafety-related systems to safety-related systems.

*Final selection of platforms changed the implementation architecture – Change (4)*

The FPGA-based systems are not microprocessor based. The FPGA-based systems use logic chips that can be configured. The systems are composed of logic that Toshiba designed specifically to be physically embedded in FPGA chips using special tools. The logic is built from simple functional elements (FEs) that are designed to perform simple logic functions that can be combined and arranged in specific patterns to perform signal processing and logic operations, and thus construct the logic necessary to perform a defined function. Once the logic is embedded, the logic is hard coded and cannot be changed.

*Testing and surveillance changes for SSLC – Change (5)*

The FPGA-based system has self-diagnostic functions that continuously verify proper FPGA and communications performance and provide outputs used to alert the operator. Failure of any FPGA to complete and pass data to the next FPGA will result in all subsequent FPGAs on that module failing to start. If this occurs in the FPGAs that implement the safety functions, the module is marked as inoperable.

The previous section described the communication links. No other capabilities exist for communication with external devices. There are no software based support tools for use at the nuclear plants, and no need for such tools. Repair of equipment is normally accomplished by simple module replacement in the field. Maintenance activities consist of maintenance of the FPGA logic to remove latent errors, to address revised requirements, or to accommodate modifications in the operating environment. Therefore, after a safety system is commissioned, no changes to the system can be performed without redesigning and re-commissioning the system.

In-service testability will meet the requirements described in FSAR Section 7.1.2.1.6.

In summary, there is no change in the ABWR DCD required safety and functional requirements of the RTIS or NMS resulting from STD DEP T1 3.4-1. The RTIS and NMS digital I&C platform departures associated with STD DEP T1 3.4-1 discussed in the certified ABWR DCD and evaluated and approved in the NRC Staff's FSER, NUREG-1503, are an improvement in both hardware and application.

Design Acceptance Criteria (DAC) Process

Topical Report UTLR 0001P, Revision 0 mentioned in Attachment 5 to U7-C-STP-NRC-090009 as being submitted for Generic Review, has been withdrawn. It will be replaced by a technical report or reports that discuss the details of the non-rewritable (NRW) Field Programmable Gate Array (FPGA)-based safety-related I&C system design. Specifically, Toshiba changed the processes described in the Generic Topical Report, and now applies 10 CFR 50 Appendix B processes to part of the Fuchu Complex design, development, and manufacturing facility. Fuchu

Complex is responsible for the design, development, manufacturing, and testing of NRW-FPGA-based systems.

As the final I&C platform design evolves, STPNOC will make technical report(s) covering NRW-FPGA based platforms available for NRC Staff audit through the DAC ITAAC closure process. The technical report(s) will address Tier 1 Table 3.4 Items 7 through 10, 12, and 14 related to software life cycle, electromagnetic compatibility (EMC) qualification, and equipment qualification (EQ).

Note that STPNOC intends to close DAC related items after COL issuance. More information on I&C related DAC items will be provided to the NRC in separate correspondence.

### COLA Markup

In this RAI, the staff requested STPNOC "to provide sufficient information within COLA," on the digital I&C platforms. For NRW-FPGA I&C Platforms, the following supplemental COLA section will be included in Part 2, Tier 2, for COLA Revision 3.

#### **7.1S Site Specific Instrumentation and Control Platforms**

This site specific supplemental section provides platform information for safety-related instrumentation and control (I&C) systems.

##### **7.1S.1 Field Programmable Gate Array Based Platforms**

The Reactor Trip and Isolation System (RTIS) and the Neutron Monitoring Systems (NMS), including the Local Power Range Monitoring (LPRM) system, the Average Power Range Monitoring (APRM) system, the Oscillation Power Range Monitor (OPRM) system, and the Startup Range Neutron Monitoring (SRNM) system are Non-Rewritable (NRW)-Field Programmable Gate Array (FPGA)-based systems.

Each FPGA-based system is a modular, chassis-based, rack-mounted system. FPGA-based systems are built as units, which provide the chassis and backplanes. The units perform specific functions, based on the modules placed in the backplane. Therefore, each module has unique architectural features, based on the differences in interfaces and requirements. The module design is implemented using only FPGAs. The design uses relatively simple medium-scale integrated (MSI) discrete logic chips for all simple logic functions, such as a monostable multivibrator to implement a watchdog timer. Data is transferred between units over fiber optic links.

Each module consists of one or more printed circuit boards and a front panel. The purpose of the front panel is to fix boards to the unit and to provide mounting for a Human-Machine Interface (HMI) and setpoints adjustment. The FPGA-based system also includes power supplies, analog and digital input/output modules, status modules, and all cabling and wiring necessary for operation. Each circuit board can contain one or more FPGAs.

The FPGA-based systems use logic chips that can be configured. The logic is physically embedded in FPGA chips using special tools. The logic is built from simple functional elements (FEs) that are designed to perform simple logic functions that can be combined and arranged in specific patterns to perform signal processing and logic operations, and thus construct the logic necessary to perform a defined function. Once the logic is embedded, the logic is hard coded and cannot be changed. After the logic is defined and embedded, the FPGA components are treated as hardware. Only an FPGA can implement digital logic.

The FPGA-based system has self-diagnostic functions that continuously verify proper FPGA and communications performance and provide outputs used to alert the operator.

**RAI 07.01-2**

**QUESTION:**

The STPNOC response (U7-C-STP-NRC-090009) to the NRC audit does not provide evaluation of I&C related departures for applicability of digital I&C Interim Staff Guidance (ISG) documents, D&IC-ISG-01, D&IC-ISG-02, D&IC-ISG-03, D&IC-ISG-04, and D&IC-ISG-05. The NRC Staff reviews acceptability of COLAs using the criteria as stated in the ISG documents. The NRC Staff requests that STPNOC provide evaluation of I&C departures against the ISG documents or justify an alternative.

**RESPONSE:**

STPNOC understands the request from the NRC I&C staff to address the staff's digital I&C Interim Staff Guidance (ISG) documents with respect to their applicability to I&C related departures. In addition, STPNOC understands that the finality of the approved DCD is retained wherever there is not a departure, and that addressing new and evolving internal staff interim guidance is not required. It is in this light that the following ISGs are addressed:

DI&C-ISG-01, *Cyber Security*, Revision 0 (12/31/07) – STPNOC is in the process of preparing a Cyber Security Plan that will address the new 10 CFR 73.54 Rule. While this new Rule applies to matters that are outside the scope of the approved DCD, STPNOC is preparing a plan to address the new rule. Even though no STPNOC departure affects cyber security, STPNOC intends to utilize the additional guidance contained in the ISG during the design phases for the I&C systems, software and hardware.

DI&C-ISG-02, *Diversity and Defense-in-Depth Issues*, Revision 1 (9/26/07) – The STP 3 & 4 COLA does not include any departures in the area of Diversity and Defense in Depth (D3). Therefore, STPNOC considers the approved ABWR DCD to have finality in the area of D3. Also, STPNOC considers this ISG as not applicable to the COLA and this ISG will not be addressed.

DI&C-ISG-03, *Review of New Reactor Digital Instrumentation and Control Probabilistic Risk Assessment*, Revision 0 (8/11/08) – The approved DCD does not employ risk based tools or insights relative to the digital I&C systems. In addition, STP 3 & 4 COLA does not have any departures that employ risk based tools or insights relative to the digital I&C systems; therefore, this ISG is not applicable to the COLA and will not be addressed.

DI&C-ISG-04, *Highly-Integrated Control Rooms – Communications Issues, (HICRc)* Revision 0 (9/28/07) – STPNOC DEP T1 3.4-1 specifically eliminates the obsolete data communication technology of “multiplexing” and replaces it with separate and independent system level data communication capabilities which are addressed in COLA Tier 2 Sections 7A.1 & 7A.2, where updated succinct responses are provided to address the NRC Staff's DCD RAIs on communications, previously focused on “multiplexing.” (Also, see at the end of this response that there is no departure relative to the Rod Control and Information System (RCIS).)

STPNOC DEP T1 3.4-1 defines separate dedicated data communication functions for each safety-related digital platform, including separate and independent data communication functions for each division within a system. The original concerns expressed by the NRC related to the common EMS are addressed as part of COLA Tier 2, Section 7A and have been updated to reflect the separate communication capabilities.

In addition, the reference ABWR DCD identified use of the data communication standard ANSI-X3 series, Fiber Distributed Data Interface (FDDI), as the communication protocol for the EMS. FDDI is an obsolete technology and no longer appropriate for use. The safety-related data communication will use a combination of proprietary network data communication protocols and dedicated point-to-point communication to fully meet the defined data communication functional requirements.

Therefore, this ISG is directly applicable to this departure. The design documents that are produced and provided to the NRC as part of the ITAAC Design Acceptance Criteria (DAC) closure process will address the review criteria of DI&C ISG-04. Note that the NRC will be able to perform their detailed validation of the data communication capabilities upon review of the digital platform technical reports, which will be available for review during ITAAC DAC closure process.

The RCIS will retain system level control and use of multiplexing as part of its system architecture for communication and operational control of the control rods. This multiplexing is retained from the approved DCD with the addition of details found at Tier 2, Section 7.7.1.2 (3) "The RCIS Multiplexing Network" and Figure 7.7-2 "Rod Control and Information System IED" Sheet 1, especially Note 4, "The RC&IS Multiplexing Network includes suitable configuration of the fiber optic communication links and associated hardwired communication links such that required communication to achieve the RC&IS functions and operation is established...." Therefore, there is no departure from the approved RCIS and this ISG will not be addressed relative to RCIS. However, as stated above, the NRC will be able to perform their detailed validation of the RCIS data communication capabilities, which will be available for review during ITAAC DAC validation review of the RCIS design and ITAAC closure.

DI&C-ISG-05, *Highly-Integrated Control Rooms – Human Factors Issues (HICR-HF)*, Revision 1 (11/3/08) - No STPNOC departure affects Human Factors and the approved DCD has finality. Although this ISG will not be specifically addressed, the STP 3&4 HFE Program Plan (Tier 1 ITAAC Table 3.1 Item 1.b.) will take into account the good practices identified in NUREG 0711 *Human Factors Engineering Program Review Model*.

No COLA revision is required as a result of this response.

**RAI 07.01-3**

**QUESTION:**

The NRC Staff finds that there are either discussions on or lists of some of the topical reports that were used to support the original ABWR Design Certification Application and subsequent Chapter 7 FSER. The NRC Staff requests that STPNOC provide a sufficient description of the STP COLA Part 7 (Departures) impact on the applicability of these topical reports.

**RESPONSE:**

STPNOC has reviewed the ABWR FSER (NUREG-1503) Chapter 7. The following topical reports are cited:

- NEDO-24708, "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors";
- NEDO-31439, "The Nuclear Measurement Analysis & Control Wide Range Neutron Monitoring System (NUMAC-WRNMS)";
- NEDC-31336, "General Electric Instrument Setpoint Methodology";
- NEDE-31096-P-A, "Anticipated Transients Without Scram Response to NRC ATWS Rule, 10 CFR 50.62"; and
- NEDO-31960, "BWR Owner's Group Long-Term Stability Solutions Licensing Methodology."

These topical reports and their disposition for the STP 3&4 project are addressed in STPNOC Letter U7-C-STP-NRC-080075 dated December 18, 2008. The dispositions of the topical reports described in this letter include the effects of the STP 3&4 departures documented in COLA R2. Per the summary in this document, the applicability of each of the FSER Chapter 7 topical reports noted above for STP 3&4 is as follows:

- NEDO-24708: this report provides the BWROG response to NUREG-0737 regarding emergency operating procedure development. The I&C departures have no impact on the responses provided in this topical report, and as such this report remains applicable for the STP 3&4 COLA.
- NEDO-31439: this report provides non ABWR-specific information on Start-up Range Nuclear Monitors (SRNM). The I&C departures have no impact on the information provided in this topical report, and as such this report remains applicable for the STP 3&4 COLA.
- NEDC-31336: this report summarizes the GE methods for developing setpoint calculations in accordance with RG 1.105. The STP 3&4 I&C departures do not

impact the methods described in this topical report. As such, it was intended that this topical report would remain applicable for STP 3&4 at the time of submittal of STP 3&4 COLA R2.

(NOTE: as noted in the December 18 letter cited above, a replacement setpoint methodology report is being prepared and will be submitted to NRC. This is not the result of any departure. Rather, this is the result of a revised NRC staff position, as explained in SECY-08-0142 and as described in DI&C ISG-08, which requires that the plant-specific technical specifications (PSTS) cannot be approved for COL with bracketed values. As described in STPNOC letter U7-C-STP-NRC-090003, this replacement setpoint methodology report will be submitted by November 30, 2009. Incorporation of the reference to this new topical report is planned for inclusion in STP 3&4 COLA R3.)

- NEDE-31096-P-A: this topical report describes the GE response to the NRC ATWS rule. The I&C departures do not change any of the ABWR functions, and therefore they have no impact on this topical report. As such, this report remains applicable for the STP 3&4 COLA. (Note that FSER Table 7-1 has a typographical error on this report number.)
- NEDO-31960: this report describes the BWR Owners Group options for long-term stability solutions. One of the I&C departures, STD DEP 7.6-1, changes specifics of the implementation of the stability option as described in the FSER, however this departure does not have any affect on the BWROG report itself. Therefore, this report remains applicable for the STP 3&4 COLA.

As discussed above, the topical reports referenced in Chapter 7 of the FSER all remain applicable for the STP 3&4 COLA as submitted in COLA R2. As such, the COLA Part 7 departure descriptions are adequate in this regard.

No COLA revision is required as a result of this RAI response.



**RAI 07.01-4**

**QUESTION:**

After initial review, the following editorial issues have been found. The NRC Staff requests that STPNOC conduct a comprehensive review of COL application documents to identify and correct any additional errors of these types. Either make the following conforming changes or describe why they are not necessary.

- Figure 2.2.6a used in 2nd paragraph on Tier 1 Page 2.2-8 of FSAR should be Figure 2.2.7b.
- On Tier 1 Page 2.2.-4, STD DEP 3.4-1 should be STD DEP T1 3.4-1.
- On Tier 2 Page 7.3-2, item (w) should be (a).
- On Tier 2 Page 7.9S-2, PCIS should be PICS
- Tier 2 Section 7.9S.2.1.2 is used on Page 7.9S-11, but there is no such section in the FSAR, Rev. 02.
- On FSAR IBD Figure 7.2-9 (Sheet 3), the main steam line (MSL) radiation trip signal is still included. It should be deleted according to STD DEP T1 2.3-1.
- FSAR Figure 7.9S-1 needs to be changed to show some missing components for the complete I&C system architecture, such as ATIP, core and zone switches, etc.
- FSAR Tier 1 Figure 3.4b, TLU still used on the diagram should be changed to TLF, and ELF used in note 4 should be SLF. Provide clarification on what type of equipment will be used for the non-microprocessor based final vote component for the ELCS system.
- On IBD Figure 7.3-2, old terminology such as DTU, SLU, etc. is still used on the diagrams. Use the revised terminology.
- MUX is still used on IED Figure 7.7.-2 (sheet 1).
- On IBD Figure 7.3-1, there are a few notes, reference documents, and Table 2 referred to on the diagrams, but those notes, references, and table are not provided.
- IBD Figures 7.2-9 (sheets 1 -3) and Figure 7.1-2, editorial changes need to be made by using the revised terminology for the COL application, such as DTU, DTM, and TLU which have been changed to DTF and TLF, respectively.

**RESPONSE:**

STPNOC will address editorial issues identified in the RAI. Of the twelve identified issues, bullet items 1, 2, 3, 4, 8, 9, and 12 will also be made and provided as an update in COLA Revision 3. Each of the changes is shown below. The text that is changed from Revision 2 is highlighted with grey shading. Explanations for the remaining items follow:

- Bullet Item 5; The reference to section 7.9S.2.1.2 for non-safety related functions is incorrect. The correct section is 7.9S.2.2.  
This will be corrected in COLA Revision 3.
- Bullet Item 6; The main steam line (MSL) radiation trip signal was removed from three of the four divisions on FSAR IED Figure 7.2-9 (Sheets 2 and 3). The remaining trip signal will be deleted from Sheet 3 according to STD DEP T1 2.3-1.
- Bullet Item 7; FSAR Figure 7.9S-1 is an upper level architecture diagram intended to show only the primary interfaces. Not all components are shown. Implementing details will be shown on the Design Drawings.  
No COLA change is required.
- Bullet Item 10; Multiplexers are used in the Rod Control and Information System (RC&IS). The use of MUX on IED Figure 7.7-2 (sheet 1) is not an error.  
No COLA change is required.
- Bullet Item 11; The Notes and Reference Documents are shown on ABWR DCD Tier 2, Chapter 21, Figure 7.3-1 Sheet 1 of 17. That sheet was not revised in the COLA but is incorporated by reference. Table 2 is shown on ABWR DCD Tier 2, Chapter 21, Figure 7.3-1 Sheet 16 of 17. It too is incorporated by reference.  
No COLA change is required.

STPNOC has identified additional inconsistencies in the use of nomenclature associated with changes made in STD DEP T1 3.4-1. Items identified to date will be corrected in COLA Revision 3. STPNOC will review the remaining I&C related departures to identify editorial issues similar to those in this RAI.

- Bullet Item 1; Figure 2.2.6a used in 2nd paragraph on Tier 1 Page 2.2-8 of FSAR should be Figure 2.2.7b.

The second sentence in COLA Part 2, Tier 1, Subsection 2.2.7 is changed as shown below:

*The RPS has four divisions. Figure ~~2.2.6a~~ 2.2.7b shows the RPS divisional aspects and the signal flow paths from sensors to scram pilot valve solenoids. ~~Functions~~ Equipment within an RPS division ~~consists of~~ include sensors (transducers or switches), I/O, ~~multiplexers~~, data communication, digital trip modules functions (DTM DTF), trip logic unit function (TLU TLF), output logic unit (OLU), and load drivers (LD). The LDs are only in Divisions II and III. The (DTF) and (TLF) are performed in digital control processors configurable logic devices. The data communication functions are described in Section 2.7.5.*

- Bullet Item 2; On Tier 1 Page 2.2-4, STD DEP 3.4-1 should be STD DEP T1 3.4-1.

The first departure listed in Section 2.2.5 is changed as shown below:

## 2.2.5 Neutron Monitoring System

STD DEP ~~T1~~ 3.4-1 (Figure 2.2.5)

### **Design Description**

*The automated in-core instrument calibration system provides local power information at various core locations that correspond to LPRM locations. The automated in-core instrument calibration system uses its own set of in-core detectors for local power measurement and provides local power information for three-dimension core power determination and for the calibration of the LPRMs. The measured data are sent to the Process Computer System Plant Computer Functions for such calculation and LPRM calibration.*

- Bullet Item 3; On Tier 2 Page 7.3-2, item (w) should be (a).

The first item in COLA Part 2, Tier 2, Subsection 7.3.1.1.1.1 is changed as shown below:

### (3) Equipment Design

#### (w) ~~(w)~~ (a) Initiating Circuits

*Reactor vessel low water level is monitored by four level transmitters (one in each of the four electrical divisions) that sense the difference between the pressure due to a constant reference leg of water and the*

- Bullet Item 4; On Tier 2 Page 7.9S-2, PCIS should be PICS

The first sentence in COLA Part 2, Tier 2, Subsection 7.9S.2.2 is changed as shown below:

Provide for the communication of the LPRM and APRM calibration data from the nonsafety-related core monitor function of ~~PCIS~~ PICS to the NMS. Plant personnel action to manually accept the data transfer to the operational safety side is required for such data to be accepted. ~~The nonsafety-related system can request certain LPRM performance data. NMS provides the data only when it has no impact on the performance of safety functions.~~

- Bullet Item 5; Tier 2 Section 7.9S.2.1.2 is used on Page 7.9S-11, but there is no such section in the FSAR, Rev. 02.

The third sentence in Section 7.9S.3.3.1 is changed as shown below:

#### **7.9S.3.3.1 General Requirements Conformance**

The PDN constitutes neither a power generation system nor a protection system, by itself. It is a support function utilized for the transmission of data for power generation (nonsafety-related) systems and their associated sensors, actuators and interconnections. The PDN equipment is classified as nonsafety-related and does not interface with any engineered safeguard or safety-related system except for the reception of isolated signals for alarm, display or nonsafety-related control purposes except those discussed in ~~7.9S.2.1.2~~ 7.9S.2.2. The PDN supports power generation systems. As such, it meets the same functional requirements imposed on those systems. Although not required to meet the single-failure criterion, the PDN equipment is redundant and receives its power from redundant, highly reliable power sources such that no single failure will cause its basic function to fail.

- Bullet Item 6; On FSAR IBD Figure 7.2-9 (Sheet 3), the main steam line (MSL) radiation trip signal is still included. It should be deleted according to STD DEP T1 2.3-1.

Chapter 21, Figure 7.2-9 Sheets 2 and 3 will be changed as shown below.

Note: Sheets 2 and 3 also require changes to Bullet Item 12. Therefore, all RAI changes are shown in Sheets 2 and 3 here and in Bullet Item 12.

Figure 7.2-9 (Sheet 2)

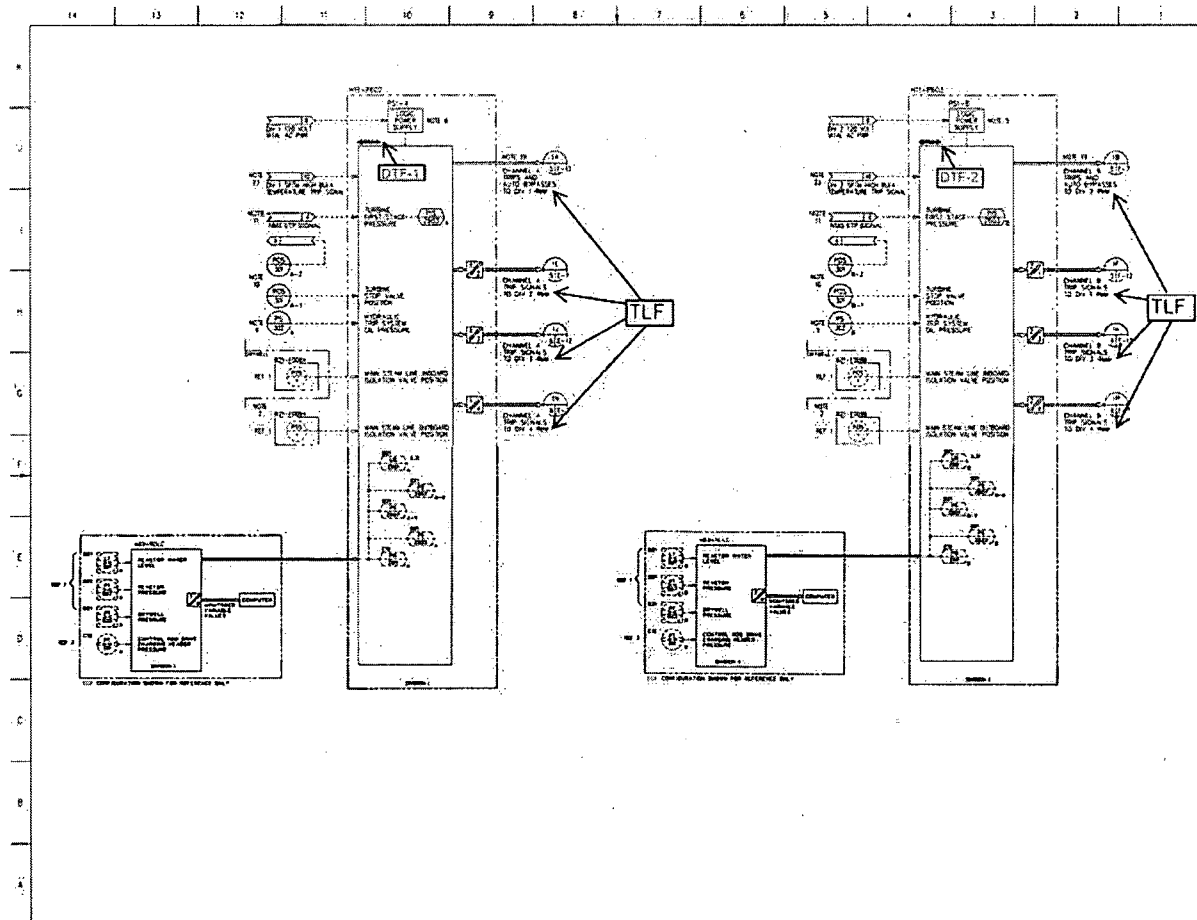


Figure 7.2-9 Reactor Protection System IED (Sheet 2 of 11)

Figure 7.2-9 (Sheet 3)

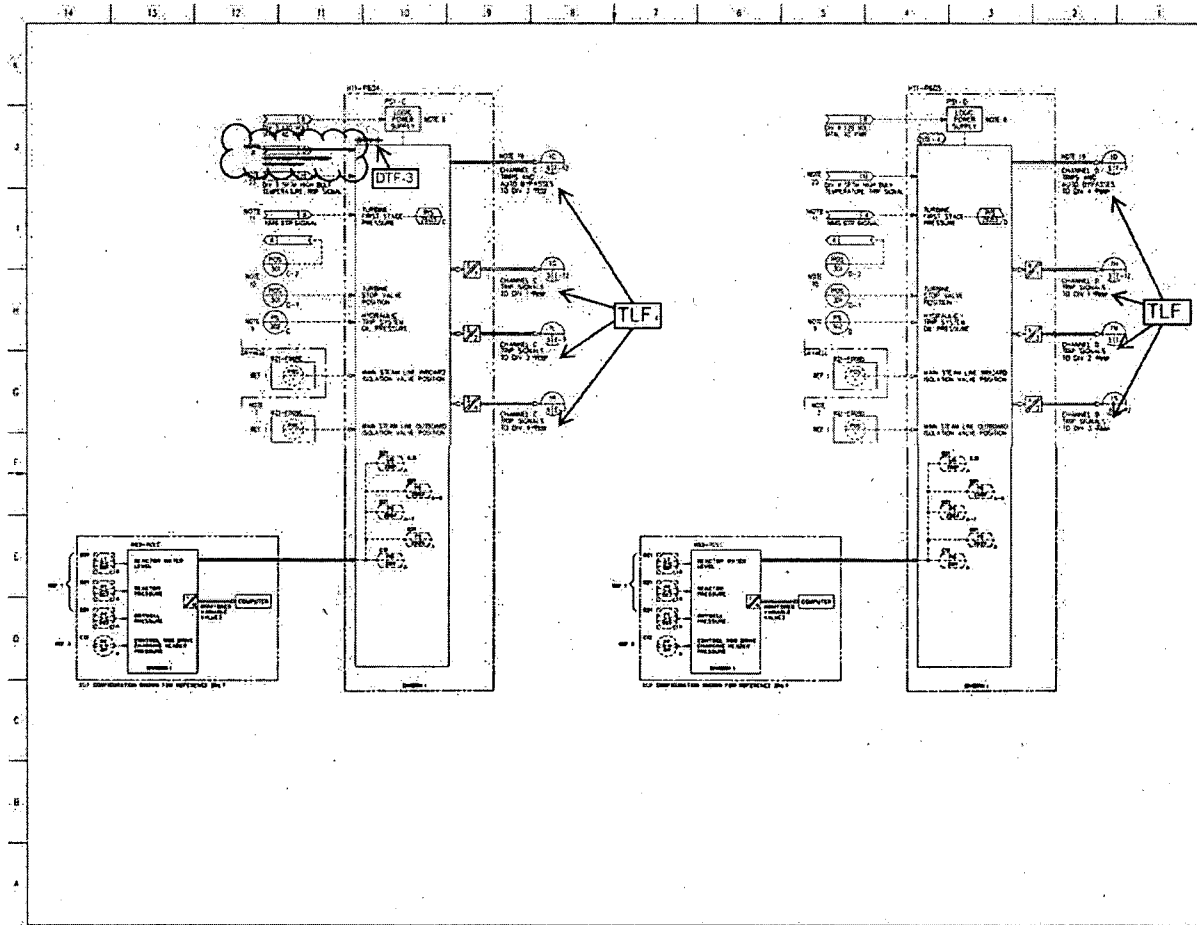


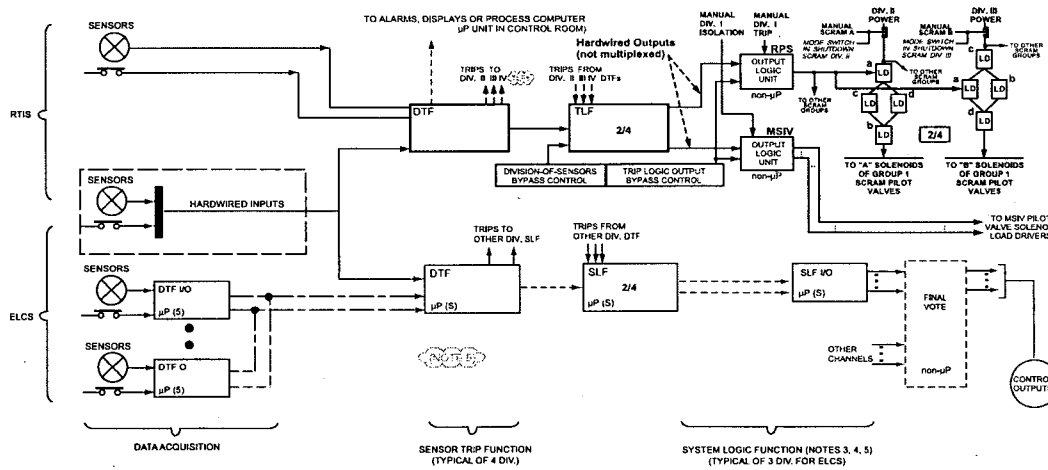
Figure 7.2-9 Reactor Protection System IED (Sheet 3 of 11)  
STP 3&4 Rev. 2

- Bullet Item 8; FSAR Tier 1 Figure 3.4b, TLU still used on the diagram should be changed to TLF, and ELF used in note 4 should be SLF. Provide clarification on what type of equipment will be used for the non-microprocessor based final vote component for the ELCS system.

The following revised figure will also be provided in COLA Revision 3. It corrects the errors stated in the above question.

Tier 1, Section 3.4 Figure 3.4b will be changed as shown below.

Tier 1, Figure 3.4b



**NOTES**

1. ARRANGMENT SHOWN IS A SIMPLIFIED EXAMPLE FOR ONE DIVISION
2. A. NOT ALL CONTROL SWITCH INPUTS SHOWN.  
B. INPUTS FROM NMS AND PRM NOT SHOWN.  
C. INTERDIVISIONAL COMMUNICATIONS USE FIBER OPTIC DATA LINKS.
3. SAFETY SYSTEM LOGIC FUNCTION (SLF) FOR ECSS FUNCTIONS IS IMPLEMENTED WITH REDUNDANT CHANNELS WITH A MINIMUM 2/2 VOTE OF THE OUTPUT SIGNALS TO PREVENT INADVERTENT COOLANT INJECTION OR DEPRESSURIZATION DUE TO SINGLE SLF ELECTRONICS FAILURE. THE OUTPUT VOTE MAY BE ACCOMPLISHED EITHER BY DIRECT VOTE OF SLF OUTPUT SIGNALS OR BY A SYSTEM VOTE WHERE BOTH VALVE AND PUMP ACTUATION IS REQUIRED TO INITIATE SYSTEM ACTION. BYPASS OF A FAILED SLF CHANNEL MAY BE PROVIDED AS LONG AS THE REMAINING OPERATIONAL CHANNELS PROVIDE A MINIMUM OF TWO SLF CHANNELS FOR ECSS FUNCTIONS.
4. SAFETY SYSTEM LOGIC FUNCTION (SLF) FOR SOME ISOLATION AND SUPPORTING ESF FUNCTIONS MAY BE IMPLEMENTED WITH REDUNDANT CHANNELS WITH A NORMAL MINIMUM 2/2 VOTE OF THE OUTPUT SIGNALS WHERE INADVERTENT ACTUATION OF THE FUNCTION MIGHT REQUIRE A REASONABLY SHORT REPAIR TIMES TO ELIMINATE OPERATIONAL IMPACT. FOR THESE FUNCTIONS, OPERATIONAL CONTROLLED BYPASS TO ALLOW OPERATION WITH A FINAL 1/1 VOTE IS PERMITTED.
5. EACH FUNCTION MAY BE ACCOMPLISHED BY MULTIPLE PROCESSORS TO MINIMIZE THE HARDWARE AND SOFTWARE COMPLEXITY OR OPERATIONAL IMPACT OF HARDWARE FAILURES, PROVIDED THE MINIMUM REDUNDANCY OF NOTES 3 AND 4 IS MAINTAINED.

- Bullet Item 9; On IBD Figure 7.3-2, old terminology such as DTU, SLU, etc. is still used on the diagrams. Use the revised terminology.

In Chapter 21 Figure 7.3-2 Nuclear Boiler System IBD Sheets 36 and 37 will be changed as shown below.

Figure 7.3-2 (Sheet 36)

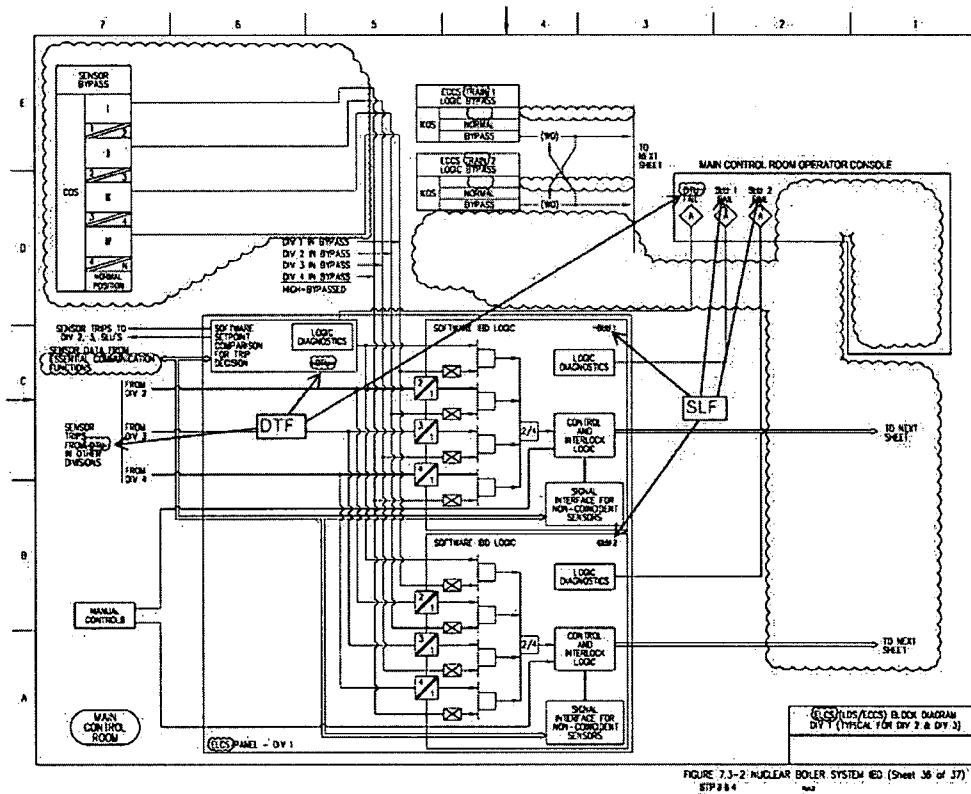




Figure 7.3-2 (Sheet 37)

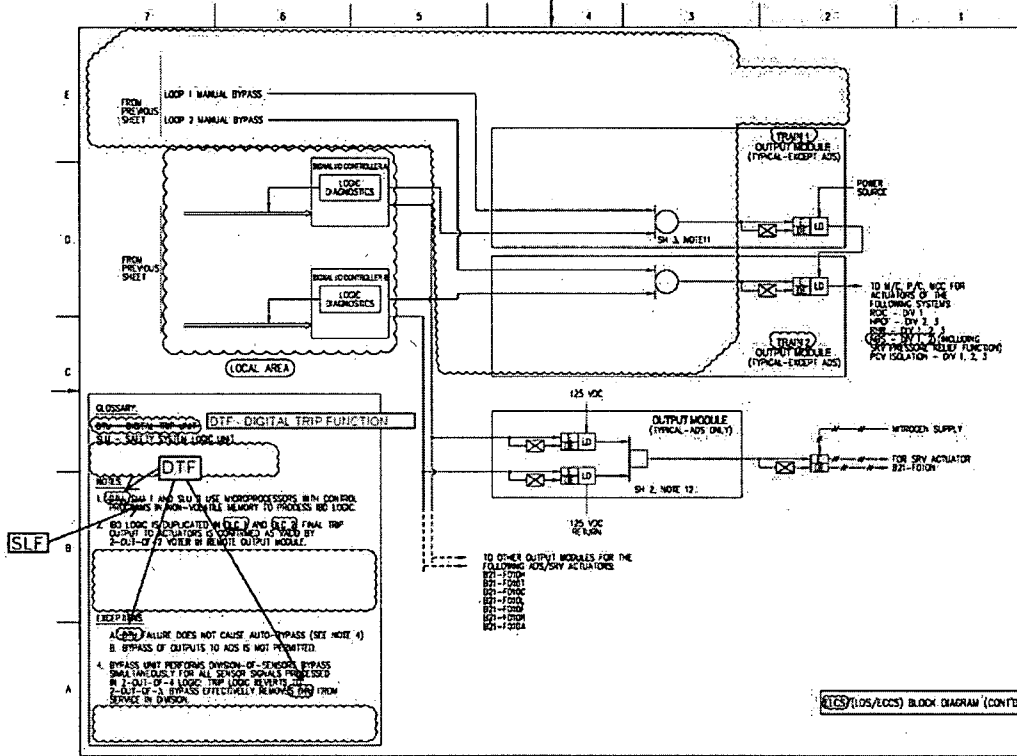


FIGURE 7.3-2 NUCLEAR BOILER SYSTEM (Sheet 37 of 37) STP 884

- Bullet Item 12; IBD Figures 7.2-9 (sheets 1 -3) and Figure 7.1-2, editorial changes need to be made by using the revised terminology for the COL application, such as DTU, DTM, and TLU which have been changed to DTF and TLF, respectively.

Chapter 21, Figure 7.2-9 Sheets 1, 2, and 3 will be changed as shown below.

Figure 7.2-9 (Sheet 1)

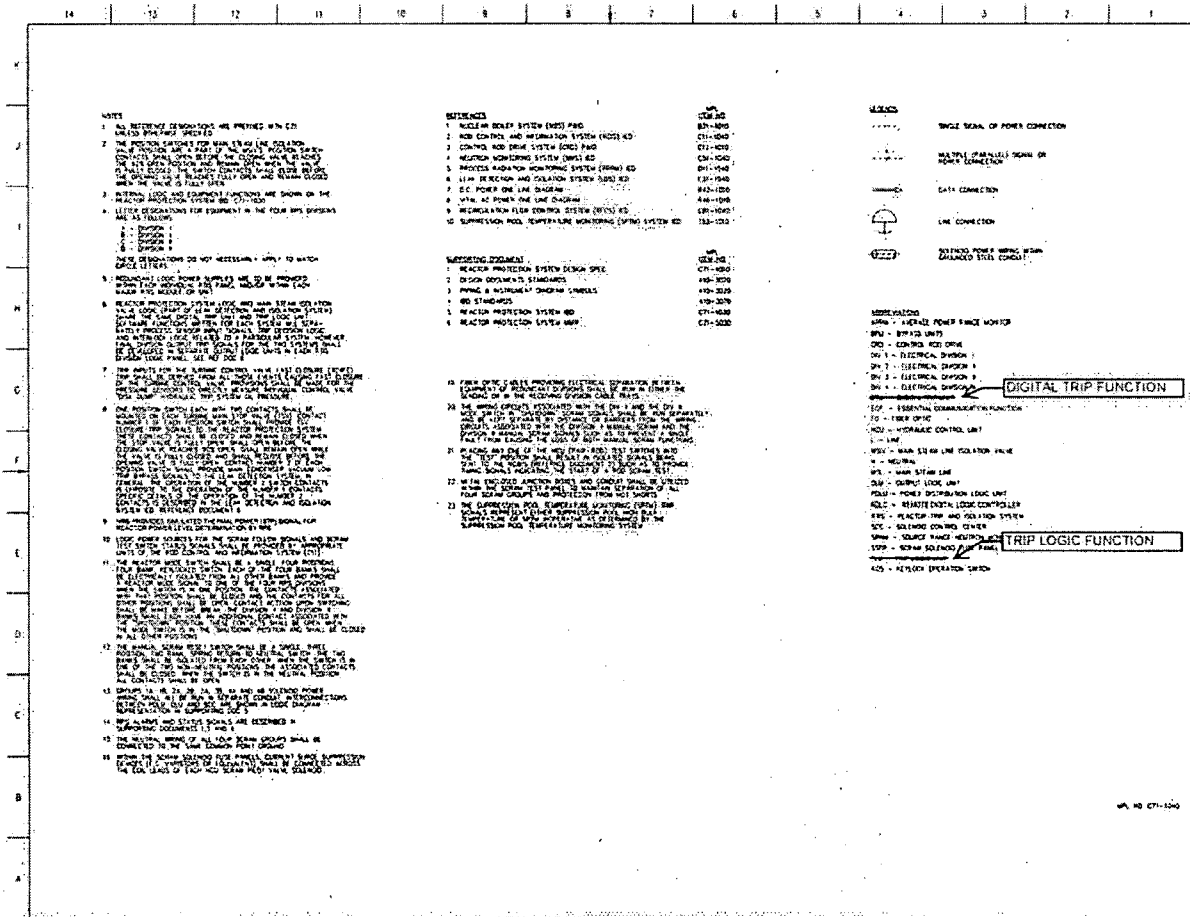


Figure 7.2-9: Reactor Protection System IED (Sheet 1 of 11)

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Figure 7.2-9 (Sheet 2)

Note: Sheets 2 and 3 also require changes identified in Bullet Item 6. Therefore, all RAI changes are shown in Sheets 2 and 3 here and in Bullet Item 6.

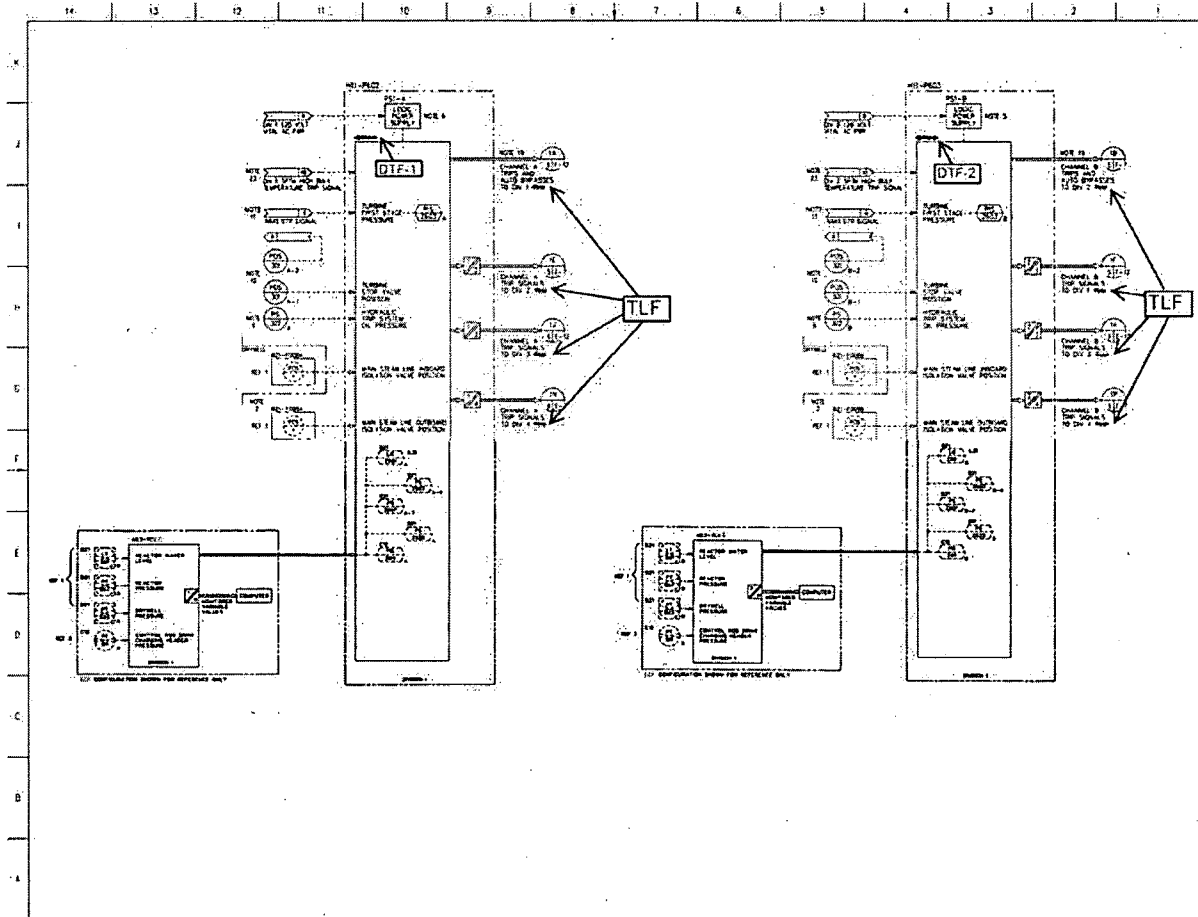


Figure 7.2-9 Reactor Protection System IED (Sheet 2 of 11)  
STP 3&4 Rev. 2

Figure 7.2-9 (Sheet 3)

Note: Sheets 2 and 3 also require changes identified in Bullet Item 6. Therefore, all RAI changes are shown in Sheets 2 and 3 here and in Bullet Item 6.

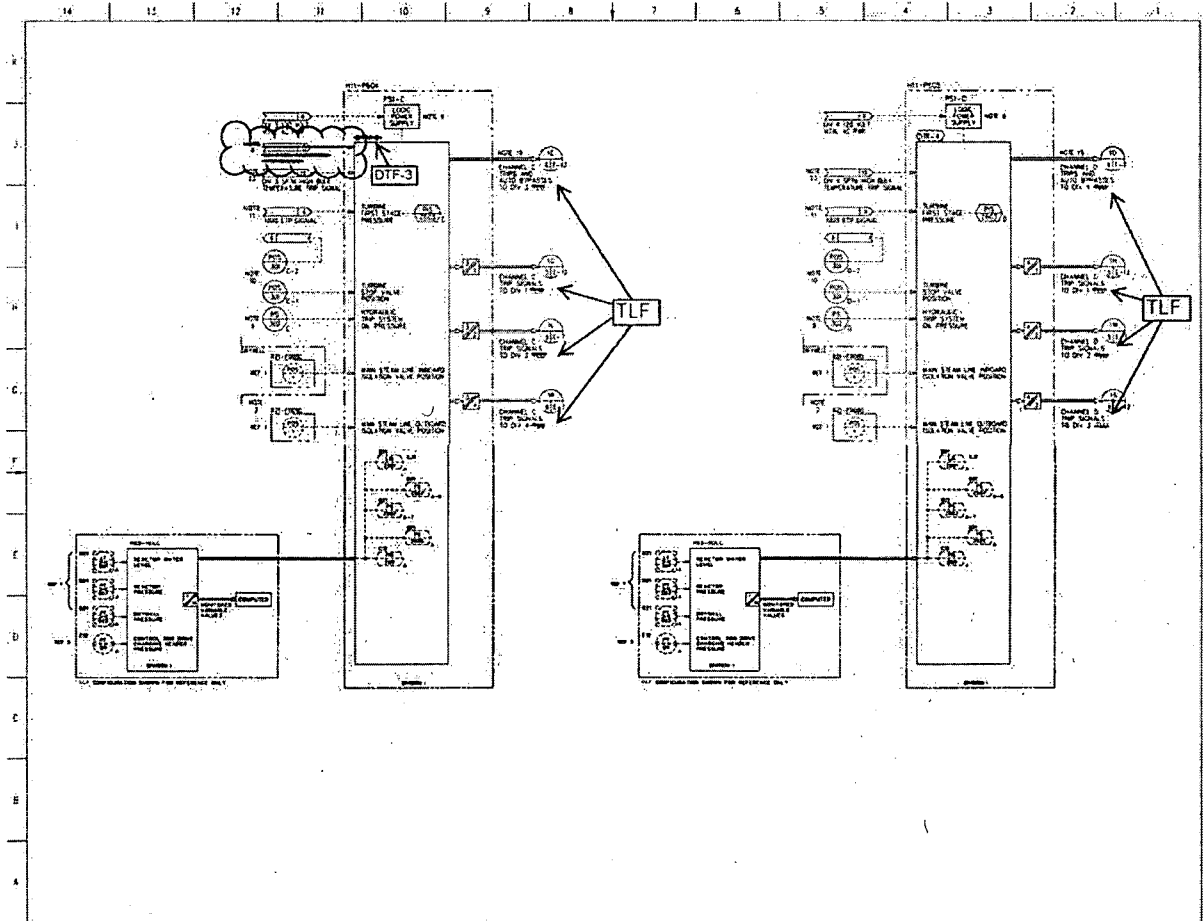
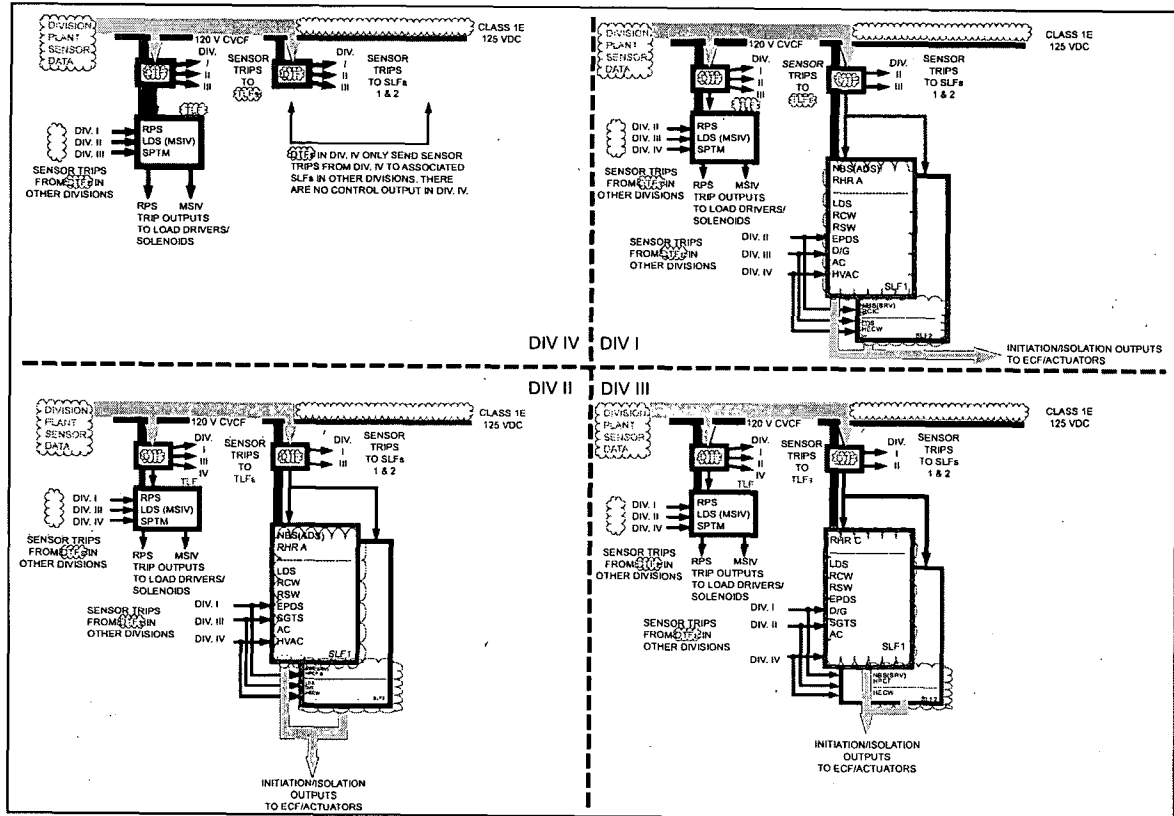


Figure 7.2-9 Reactor Protection System IED (Sheet 3 of 11)  
STP 3&4 Rev. 2

Figure 7.1-2 will be changed as shown below.



ABBREVIATIONS  
 ECF: ESSENTIAL COMMUNICATION FUNCTION  
 SLF: SAFETY SYSTEM LOGIC FUNCTION  
 SPTM: SUPPRESSION POOL TEMPERATURE MONITORING

AC = ATMOSPHERIC CONTROL  
 DIG = DIESEL GENERATOR  
 EPOS = ELECTRICAL POWER DISTRIBUTION SYSTEM  
 ESF = ENGINEERED SAFETY FEATURES  
 HECSW = HVAC EMERGENCY COOLING WATER  
 HECSW = HVAC EMERGENCY COOLING WATER  
 HVAC = HEATING, VENTILATING & AIR CONDITIONING  
 LDS = LEAK DETECTION & ISOLATION SYSTEM  
 MSIV = MAIN STEAM ISOLATION VALVE  
 NBS = NUCLEAR BOILER SYSTEM

NMS = NEUTRON MONITORING SYSTEM  
 PRM = PROCESS RADIATION MONITORING  
 RCIC = REACTOR CORE ISOLATION COOLING  
 RCW = REACTOR BUILDING CLOSED COOLING WATER  
 RHR = RESIDUAL HEAT REMOVAL  
 RPS = REACTOR PROTECTION SYSTEM  
 RSW = REACTOR SERVICE WATER  
 SGTSS = STANDBY GAS TREATMENT SYSTEM  
 SPTM = SUPPRESSION POOL TEMPERATURE MONITORING

NOTES:  
 1. NMS AND PRM (NOT SHOWN) ARE STANDALONE SYSTEMS WITH TRIP OUTPUTS TO RPS AND ESF CONTROLLERS OF SSSC

2. POWER SOURCES (PER DIVISION)  
 ECF: CLASS 1E, 125 VDC  
 ESF: CLASS 1E, 125 VDC  
 RPS/MSIV: CLASS 1E, 120 CVCF  
 NMS/PRM: CLASS 1E, 120 VDC

**RAI 07.02-1****QUESTION:**

Design specifications, such as reactor protection system, process computer function, etc., are referred to on FSAR Tier 2 IED and IBD figures. The NRC staff requests that STPNOC should provide information regarding whether those design specifications are affected by the departures proposed in the COLA, and if so, provide sufficient information on the affected design specifications for staff review.

**RESPONSE:**

The Instrument Engineering Diagrams (IEDs) and Interlock Block Diagrams (IBDs) figures are contained in the approved/certified ABWR DCD Tier 2 Chapter 21. The IEDs & IBDs contain the functional representations of the systems design, which also is described in the text of the DCD. Together the figures and text are the approved/certified ABWR design.

Under the 10 CFR Part 52 regulatory design certification process, the approved/certified design, as described in the DCD, represents the top hierarchal requirements to be implemented in the detailed design engineering documentation necessary to construct and operate an ABWR. Departures from the approved/certified design are captured, as appropriate, in the COLA documentation process portion of Part 52.

The IED & IBD figures in the DCD were created from existing engineering documents which contained the type of functional requirements consistent with the 10 CFR Part 52 design certification regulatory process. They were part of the design documents acknowledged by the NRC in the ABWR FSER Section 1.2.2 (NUREG-1503 Supplement 1) and were discussed more specifically in FSER Section 7.2.2 as I&C documents on the Master Parts List (MPL). Also on the MPLs were other documents, such as design specifications. Some of these design specifications, in addition to being on the MPLs, are identified on the IED & IBD figures as "Supporting Documents," and it is these supporting documents that the NRC staff has questioned in relation to the COLA departures.

The design specifications, identified on the IED & IBD figures, are now historical in nature under the 10 CFR Part 52 regulatory design certification process. They are historical because the DCD itself now contains the top level hierarchal requirements for the ABWR, not the information in the design specifications. During earlier nuclear power plant design evolutions, the design was engineered and captured in documents added to MPLs (at GE) and design specifications were one of the top level requirements documents. Such a top level document was then identified as a "Supporting Document" to other top level documents, like the IEDs & IBDs. Under Part 52, the top level document is the approved/certified DCD, which has included in it the IEDs & IBDs which remain top level documents. Furthermore, as explained in the statement of consideration for the ABWR design certification rule, not all secondary references in the DCD are intended to be requirements. Only those secondary references that, as indicated by their context within the DCD, were intended to be requirements have finality and are subject to the change process in Section VIII of the design certification rule. Therefore, it can be seen that

these "Supporting Documents" are much further removed from representing requirements, and as appropriate here, they are historic in nature.

Because the design specifications are historical in nature, STPNOC will not update them. However, System Design Descriptions (SDDs) are being prepared for STP 3&4. The SDDs will supersede these design specification historical documents on the ABWR MPLs and the effect of departures will be incorporated, as appropriate, in these SDDs.

STPNOC uses a Project Control Document List (PCDL) in place of the MPL for STP 3&4. STPNOC has performed Part 52 evaluations of all departures and requested NRC approval for any exemptions. The NRC can confirm, as necessary, implementation of departures in the SDDs and other PCDL documents as part of audits and/or inspections.

No COLA revision is required as a result of this RAI response.

**RAI 07.07-1**

**QUESTION:**

The ABWR DCD is based on a single unit. There are some shared balance of plant (BOP) systems between STP unit 3 and 4 or between the new units 3 & 4 and existing units 1 & 2. Figure 7.9S-1 in the STPNOC FSAR does not show any I&C for the shared BOP systems. The NRC Staff requests that STPNOC should provide sufficient information showing how the I&C system for the shared systems is designed and also on how to prevent the failure of the shared BOP systems from bringing down multiple units. The NRC staff also requests that Figure 7.9S-1 in the STPNOC FSAR be revised to include the I&C portion for the shared BOP systems.

**RESPONSE:**

The following balance of plant (BOP) systems are shared.

- Potable Water and Sanitary Treatment systems (Ref STP DEP 1.1-2 & STD DEP 9.2-8)
- Makeup Water Preparation (Ref STP DEP 1.1-2)
- Fire Protection Water Supply System (Ref STP DEP 1.1-2)
- Met Tower
- Communication System – nonsafety-related (Ref STP DEP 1.1-2)
- Hydrogen Gas Storage Facility (Ref STP DEP 1.1-2)
- Plant Grounding Grid (Ref STP DEP 1.1-2)

There are no shared I&C systems between Units 3&4 or between the new Units 3&4 and the existing Units 1&2 that are capable of bringing down multiple units. While the above systems are shared there is no common I&C failure that can cause a multiple unit transient or shutdown. These shared systems do not have a direct immediate impact on the units and actions can be taken to prevent an I&C-related issue from bringing down both units. For example if the makeup water system fails a package system can be temporary installed to provide make up water.

As mentioned in response to RAI 07.01-4, FSAR Figure 7.9S-1 is an upper level architecture diagram intended to show only primary interfaces. Not all components are shown. Implementing details will be shown on the design drawings.

No COLA revisions are required as a result of this RAI response.