ATTACHMENTS 5, 6, AND 7

REVISED TECHNICAL SPECIFICATION AND BASES PAGES

Table 3.3.17-1 (page 1 of 1)
Post Accident Monitoring Instrumentation

| FUNCTION | REQUIRED CHANNELS | CONDITIONS REFERENCED FROM REQUIRED ACTION D.1 |
|---|---|---|
| 1. Wide Range Neutron Flux | 2 | E |
| 2. RCS Hot Leg Temperature | 2 | E |
| 3. RCS Pressure (Wide Range) | 2 | E |
| 4. Reactor Coolant Inventory | 2 | F |
| 5. Borated Water Storage Tank Level | 2 | E |
| 6. High Pressure Injection Flow | 2 per injection line | E |
| 7. Containment Sump Water Level (Flood Level) | 2 | E |
| 8. Containment Pressure (Expected Post-Accident Range) | 2 | E |
| 9. Containment Pressure (Wide Range) | 2 | E |
| 10. Containment Isolation Valve Position | 2 per penetration[(a)(b)] | E |
| 11. Containment Area Radiation (High Range) | 2 | F |
| 12. Containment Hydrogen Concentration | 2 | E |
| 13. Pressurizer Level | 2 | E |
| 14. Steam Generator Water Level (Start-up Range) | 2 per OTSG | E |
| 15. Steam Generator Water Level (Operating Range) | 2 per OTSG | E |
| 16. Steam Generator Pressure | 2 per OTSG | E |
| 17. Emergency Feedwater Tank Level | 2 | E |
| 18. Core Exit Temperature (Backup) | 3 per core quadrant | E |
| 19. Emergency Feedwater Flow | 2 per OTSG | E |
| 20. Low Pressure Injection Flow | 2 | E |
| 21. Degrees of Subcooling | 2 | E |

(a) Only one position indication is required for penetrations with one Control Room indicator.

(b) Not required for isolation valves whose associated penetration is isolated by at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured.

LCO (continued)

The following list is a discussion of the specified instrument Functions listed in Table 3.3.17-1.

1. Wide Range Neutron Flux

Two wide-range neutron flux monitors are provided for post-accident reactivity monitoring over the entire range of expected conditions. Each monitor provides indication over the range of $10^{-8}$ to 100% log rated power covering the source, intermediate, and power ranges. Each monitor utilizes a fission chamber neutron detector to provide redundant main control board indication. A single channel provides recorded information in the control room. The control room indication of neutron flux is considered one of the primary indications used by the operator following an accident. Following an event the neutron flux is monitored for reactivity control. The operator ensures that the reactor trips as necessary and that emergency boration is initiated if required. Since the operator relies upon this indication in order to take specified manual action, the variable is included in this LCO. Therefore, the LCO deals specifically with this portion of the string.

2. Reactor Coolant System (RCS) Hot Leg Temperature

Two wide range resistance temperature detectors (RTD's), one per loop, provide indication of reactor coolant system hot leg temperature ($T_H$) over the range of 120° to 920°F. Each $T_H$ measurement provides an input to a control room indicator. Channel B is also recorded in the control room. Since the operator relies on the control room indication following an accident, the LCO deals specifically with this portion of the string.

$T_H$ is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided. ~~This temperature measurement provides input to the inadequate core cooling instrumentation which is used to verify the~~

(continued)

BASES

LCO

2. Reactor Coolant System (RCS) Hot Leg Temperature
(continued)

~~existence of, or to take actions to ensure the restoration of subcooling margin. Specifically, a loss of adequate subcooling margin during a small break LOCA requires the operator to trip the reactor coolant pumps (RCP's), ensure high or low pressure injection, and raise the steam generator levels to the ECC level. Once subcooling margin is restored, the operator is instructed to restart at least one RCP and throttle injection flow to maintain a specified degree of subcooling. Another manual action based on $T_H$ follows~~ Following a steam generator tube rupture, ~~T~~the affected steam generator is to be isolated only after $T_H$ falls below the saturation temperature corresponding to the pressure setpoint of the main steam safety valves. For event monitoring once the RCP's are tripped, $T_H$ is used along with the core exit temperatures and RCS cold leg temperature to measure the temperature rise across the core for verification of core cooling.

3. RCS Pressure (Wide Range)

RCS pressure is measured by pressure transmitters with a span of 0-3000 psig. Redundant monitoring capability is provided by two trains of instrumentation. Control room and remote shutdown panel indications are provided. ~~The subcooling margin monitor can also display reactor coolant pressure upon demand.~~ The control room indications are the primary indications used by the operator during an accident. Therefore, the LCO deals specifically with this portion of the instrument string.

RCS pressure is a Type A variable because the operator uses this indication to adjust parameters such as steam generator (OTSG) level or pressure in order to monitor and maintain a controlled cooldown of the RCS following a steam generator tube rupture or small break LOCA. In addition, HPI flow is throttled based

(continued)

BASES

LCO

7. Containment Sump Water Level (Flood Level) (continued)

displayed in the control room on edgewise level indicators. Channel A and B sump flood level indication are recorded in the associated 'A' and 'B' EFIC Rooms. Each instrument encompasses a range of 0-10 feet above the sump and provides information to the operator related to gross leakage in the Reactor Building. This leakage may be indication of degradation in the reactor coolant pressure boundary (RCPB) which would require further investigation and action. These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

8,9. Containment Pressure (~~Narrow~~ Expected Post-Accident ~~Range~~ and Wide Range)

The containment pressure variable is monitored by two ranges of pressure indication. ~~Narrow~~ Expected post-accident range (-10 to ~~60~~ 70 psig) and wide range (0 to 200 psig) pressure indication each provide two channels of pressure indication. Channel A and B wide range containment pressure are recorded in the associated 'A' and 'B' EFIC Rooms. The low range is required in order to ensure instrumentation of the necessary accuracy is available to monitor conditions in the RB during DBAs. The wide range instrument was required by Regulatory Guide 1.97 to be capable of monitoring pressures over the range of atmospheric to three times containment design pressure (approximately 165 psig). Thus, it was intended to monitor the RB in the event of an accident not bounded by the plant safety analysis (i.e., a Severe Accident).

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis.

(continued)

BASES

LCO

18. Core Exit Temperature (Backup) (continued)

following a steam generator tube rupture or small break LOCA. Operator actions to maintain a controlled cooldown, such as adjusting OTSG level or pressure, would be prompted by this indication. ~~In addition, the core exit thermocouples provide input to the subcooling margin monitor, which is a Type A variable.~~

~~The subcooling margin monitor takes the average of the five highest CETs for each of the ICCM trains. Two channels ensure that a single failure will not disable the ability to determine the representative core exit temperature.~~

19. Emergency Feedwater Flow

EFW Flow instrumentation is provided to monitor operation of decay heat removal via the OTSGs. The EFW injection flow to each OTSG (2 channels per OTSG, one associated with each EFW injection line) is determined from a differential pressure measurement calibrated to a span of 0 gpm to 1000 gpm. Each differential pressure transmitter provides an input to a control room indicator and the plant computer.

EFW Flow is used by the operator to determine the need to throttle flow during accident or transient conditions to prevent the EFW pumps from operating in runout conditions or from causing excessive RCS cooldown rates when low decay heat levels are present. EFW Flow is also used by the operator to verify that the EFW System is delivering the correct flow to each OTSG. However, the primary indication of this function is provided by OTSG level.

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the safety analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

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BASES

LCO (continued)

The following list is a discussion of the specified instrument Functions listed in Table 3.3.17-1.

1. Wide Range Neutron Flux

Two wide-range neutron flux monitors are provided for post-accident reactivity monitoring over the entire range of expected conditions. Each monitor provides indication over the range of $10^{-8}$ to 100% log rated power covering the source, intermediate, and power ranges. Each monitor utilizes a fission chamber neutron detector to provide redundant main control board indication. A single channel provides recorded information in the control room. The control room indication of neutron flux is considered one of the primary indications used by the operator following an accident. Following an event the neutron flux is monitored for reactivity control. The operator ensures that the reactor trips as necess[illegible] and that emergency boration is initiated if requir[illegible] Since the operator relies upon this indication in order to take specified manual action, the variable is included in this LCO. Therefore, the LCO deals specifically with this portion of the string.

2. Reactor Coolant System (RCS) Hot Leg Temperature

Two wide range resistance temperature detectors (RTD's), one per loop, provide indication of reactor coolant system hot leg temperature ($T_H$) over the range of 120° to 920°F. Each $T_H$ measurement provides an input to a control room indicator. Channel B is also recorded in the control room. Since the operator relies on the control room indication following an accident, the LCO deals specifically with this portion of the string.

$T_H$ is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided. Following a steam generator tube rupture, the affected steam generator is to be isolated only after $T_H$ falls below the saturation temperature corresponding to the pressure

(continued)

BASES

LCO

2. Reactor Coolant System (RCS) Hot Leg Temperature (continued)

setpoint of the main steam safety valves. For event monitoring once the RCP's are tripped, $T_H$ is used along with the core exit temperatures and RCS cold leg temperature to measure the temperature rise across the core for verification of core cooling.

3. RCS Pressure (Wide Range)

RCS pressure is measured by pressure transmitters with a span of 0-3000 psig. Redundant monitoring capability is provided by two trains of instrumentation. Control room and remote shutdown panel indications are provided. The control room indications are the primary indications used by the operator during an accident. Therefore, the LCO deals specifically with this portion of the instrument string.

RCS pressure is a Type A variable because the operator uses this indication to adjust parameters such as steam generator (OTSG) level or pressure in order to monitor and maintain a controlled cooldown of the RCS following a steam generator tube rupture or small break LOCA. In addition, HPI flow is throttled based

(continued)

BASES

LCO

7. Containment Sump Water Level (Flood Level) (continued)

displayed in the control room on edgewise level indicators. Channel A and B sump flood level indication are recorded in the associated 'A' and 'B' EFIC Rooms. Each instrument encompasses a range of 0-10 feet above the sump and provides information to the operator related to gross leakage in the Reactor Building. This leakage may be indication of degradation in the reactor coolant pressure boundary (RCPB) which would require further investigation and action. These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

8,9 Containment Pressure (Expected Post-Accident and Wide Range)

The containment pressure variable is monitored by two ranges of pressure indication. Expected post-accident range (-10 to 70 psig) and wide range (0 to 200 psig) pressure indication each provide two channels of pressure indication. Channel A and B wide range containment pressure are recorded in the associated 'A' and 'B' EFIC Rooms. The low range is required in order to ensure instrumentation of the necessary accuracy is available to monitor conditions in the RB during DBAs. The wide range instrument was required by Regulatory Guide 1.97 to be capable of monitoring pressures over the range of atmospheric to three times containment design pressure (approximately 165 psig). Thus, it was intended to monitor the RB in the event of an accident not bounded by the plant safety analysis (i.e., a Severe Accident).

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis.

(continued)

BASES

LCO

18. Core Exit Temperature (Backup) (continued)

following a steam generator tube rupture or small break LOCA. Operator actions to maintain a controlled cooldown, such as adjusting OTSG level or pressure, would be prompted by this indication.

19. Emergency Feedwater Flow

EFW Flow instrumentation is provided to monitor operation of decay heat removal via the OTSGs. The EFW injection flow to each OTSG (2 channels per OTSG, one associated with each EFW injection line) is determined from a differential pressure measurement calibrated to a span of 0 gpm to 1000 gpm. Each differential pressure transmitter provides an input to a control room indicator and the plant computer.

EFW Flow is used by the operator to determine the need to throttle flow during accident or transient conditions to prevent the EFW pumps from operating in runout conditions or from causing excessive RCS cooldown rates when low decay heat levels are present. EFW Flow is also used by the operator to verify that the EFW System is delivering the correct flow to each OTSG. However, the primary indication of this function is provided by OTSG level.

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the safety analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

20. Low Pressure Injection Flow

Low pressure injection flow instrumentation is provided to monitor flow to the RCS following a large break LOCA. It is also used to monitor LPI flow during piggy back operation following a small break LOCA. The low pressure injection flow to the reactor (2 channels, one associated with each LPI injection

(continued)

BASES

LCO

20. Low Pressure Injection Flow (continued)

line) is determined from a differential pressure measurement calibrated to a span of 0 gpm to 5000 gpm.

The LPI flow indication is used by the operator to throttle the flow to ≤ 2000 gpm prior to switching the pump suction from the BWST to the RB sump. This assures adequate net positive suction head (NPSH) is maintained to the pump. The indication is also used to verify LPI flow to the reactor as a prerequisite to termination of HPI flow.

Since low pressure injection flow is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided, it has been included in this LCO.

21. Degrees of Subcooling

Two channels of subcooling margin with inputs from RCS hot leg temperature ($T_H$), core exit temperature, and RCS pressure are provided. Multiple core exit temperatures are auctioneered with only the highest temperature being input to the monitor. These two channels of subcooling margin are backed up by either of two indications of subcooling margin based on similar inputs through the Safety Parameter Display System (SPDS). At least one SPDS channel must be available to provide this backup. The $T_H$ inputs to the subcooling margin monitors and SPDS operate over a range of 150 to 920°F. The core exit temperature inputs operate over a range of 150 to 2000°F and 150 to 2500°F for the subcooling margin monitors and SPDS, respectively. RCS pressure inputs operate over a range of 200 to 2500 psig.

The subcooling margin monitors are used to verify the existence of, or to take actions to ensure the restoration of subcooling margin. Specifically, a loss of adequate subcooling margin during a LOCA requires the operator to trip the reactor coolant pumps (RCP's), to ensure high or low pressure injection, and raise the steam generator levels to the inadequate core cooling level. Once subcooling margin is restored, the operator is instructed to restart at

(continued)

BASES

LCO

21. Degrees of Subcooling (continued)

least one RCP and throttle injection flow to maintain a specified degree of subcooling. Since degrees of subcooling is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided, it has been included in this LCO.

(continued)

# EVALUATION OF SAFETY PARAMETER DISPLAY SYSTEM AGAINST DESIGN CRITERIA OF REGULATORY GUIDE 1.97 FOR USE AS A SUBCOOLING MARGIN MONITOR

## Introduction

Florida Power Corporation (FPC) is conducting an in-depth review of the Emergency Operating Procedure (EOP's). As part of this review, it was determined that the use of "degrees of subcooling" in the EOP's was consistent with a Reg. Guide 1.97 Type A variable. FPC had previously specified "degrees of subcooling" as a Reg. Guide 1.97 Type B variable. Due to the way the variable is used in the EOP's, it should be listed as a Type A variable. Reg. Guide 1.97 specifies that instrumentation that monitors Type A variables should be designed to Category 1 criteria. The design guidance in Reg. Guide 1.97 for Category 1 devices is equivalent to safety related devices. Many of the components associated with the current subcooling indication are non-safety related. An evaluation of the monitors' design was performed and the impact of the non-safety related devices was assessed. From this evaluation, it was concluded that the major impact on plant safety was from the core exit thermocouples which are input to the monitors. These thermocouples are not environmentally qualified.

As a compensatory measure, a modification was made to the plant Safety Parameter Display System (SPDS). Core exit thermocouple inputs were added to the pressures and temperatures already part of the system and programming was added to calculate subcooling margin. Alarms were included in the programming to alert operators when the subcooling margin does not meet minimum specified values. The SPDS displays are used to display the subcooling margin in several different formats including full screen when an alarm occurs. The control room operators have been trained on the use of the new system. All of the inputs used by SPDS to calculate subcooling margin are environmentally qualified. These interim enhancements were completed prior to startup from the Spring 1996 Refuel 10 outage and are described in our July 8, 1996 letter to the NRC (3F0796-03).

As a follow-up to the interim SPDS modification, FPC has evaluated alternatives for a permanent modification to upgrade the subcooling margin monitors. Alternatives from "do nothing" to installation of a fully qualified, safety related system were evaluated and discussed. The emphasis of the decision making process was on making changes that produced the greatest safety enhancement for the resources expended. Input from the Operations Department weighed heavily in the decision-making process. The operators have been very favorably impressed with the man-machine interface provided by the SPDS display. As a result, for the permanent resolution to this issue, FPC has decided to modify the SPDS a second time to enhance its reliability and gain further compliance with the design recommendations of Regulatory Guide 1.97 for Category 1 instruments. This report describes the current configuration of the SPDS relative to the Reg. Guide 1.97 design recommendations and also the planned enhancements. The enhancements will be installed during Refuel 11, currently scheduled for the Spring of 1998.

General

The subcooling margin monitoring instrumentation at Crystal River 3 (CR-3) is comprised of two trains of instruments, each with inputs as described below. The instrument string configurations are depicted graphically on the three figures included as Attachment 9 to this submittal.

Each train of subcooling margin monitoring instrumentation has the following inputs:

Two Reactor Coolant System (RCS) hot leg temperature signals
Two RCS pressure wide range signals
Two RCS pressure narrow range signals
Eight incore thermocouple signals

Two of the hot leg temperature signals. one for each monitor, originate at RC-4A-TE1 (Train A) and RC-4B-TE4 (Train B) and go to separate remote shutdown auxiliary cabinets in the respective 4160 volt engineered safeguards switchgear room These signals are fully qualified up to this point. From there they go into the non-nuclear instrumentation (NNI) cabinets in the main control room and to the SPDS where the subcooling margin calculation is performed. This information is displayed on the SPDS displays mounted above the main control board.

The other two hot leg temperature signals, one for each monitor, originate at RC-4B-TE1 (Train A) and RC-4A-TE4 (Train B) and go directly to separate NNI cabinets in the main control room and from there to the SPDS. The components associated with these signals, which are located in a harsh environment, are qualified to the requirements of 10 CFR 50.49.

Two wide range RCS pressure signals feed both trains of the subcooling margin monitor. They originate at RC-3A-PT3 and RC-3B-PT3 and go to separate engineered safeguards cabinets in the main control room. These signals are fully qualified up to this point. From there they go to the SPDS where they are used in subcooling margin calculations when RCS pressure is greater than 600 psig.

The "A" side narrow range RCS pressure signal feeds both trains of the subcooling margin monitor. It originates at RC-147-PT and goes to the "A" remote shutdown auxiliary cabinet in the "A" 4160 volt engineered safeguards switchgear room. This signal is fully qualified up to this point. From there it goes to the SPDS where it is used in subcooling margin calculations when RCS pressure is below 600 psig. As part of the enhancement to the subcooling margin instrumentation feeding the SPDS, a redundant, "B" side narrow range pressure signal will be provided to both trains of the subcooling margin monitor. This narrow range RCS pressure signal will originate at RC-148-PT, and go to the "B" remote shutdown auxiliary cabinet in the "B" 4160 volt engineered safeguards switchgear room. The signal will be fully qualified up to this point. From there it will go to the SPDS where it will be used in subcooling margin calculations when RCS pressure is below 600 psig.

The sixteen incore thermocouple signals go into the Reactor Coolant Inventory and Tracking System (RCITS) cabinets in the control complex. At this point, eight of the sixteen signals go to one subcooling margin monitor and the other eight go to the other monitor. These signals are fully qualified up to this point. The signals go from the RCITS cabinets to the SPDS, eight to each train, where they are auctioneered in software so that the highest reading incore temperature is used in the subcooling margin calculation.

## SPECIFIC CRITERIA FROM REGULATORY GUIDE 1.97

### 1. Equipment Qualification

**Environmental Qualification**

RG Recommendation

The instrumentation should be qualified in accordance with Regulatory Guide 1.89, "Qualification of Class 1E Equipment for Nuclear Power Plants," and the methodology described in NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment."

Instrumentation whose ranges are required to extend beyond those ranges calculated in the most severe design basis accident event for a given variable should be qualified using the guidance provided in paragraph 6.3.6 of ANS-4.5.

Qualification applies to the complete instrumentation channel from sensor to display where the display is a direct-indicating meter or recording device. If the instrumentation channel signal is to be used in a computer-based display, recording, or diagnostic program, qualification applies from the sensor up to and including the channel isolation device.

Degree of Compliance - Full (Subsequent to Modifications)

All equipment used for subcooling margin monitoring which is located in a harsh environment has been reviewed. The sensing devices for core exit temperature, wide range RCS pressure, RCS hot leg temperature and associated cables, connections, and building penetrations are all qualified to the requirements of 10 CFR 50.49. Presently the "A" side narrow range RCS pressure sensing device, cables, connections and penetrations are qualified to the requirements of 10 CFR 50.49. Following enhancements to the SPDS subcooling margin instrumentation, the "B" side narrow range RCS pressure signal will be qualified to these requirements as well.

**Equipment Qualification (continued)**

**Seismic Qualification**

RG Recommendation

The seismic portion of qualification should be in accordance with Regulatory Guide 1.100, "Seismic Qualification of Electric Equipment for Nuclear Power Plants." Instrumentation should continue to read within the required accuracy following, but not necessarily during, a safe shutdown earthquake.

Degree of Compliance - Partial

The safety related portions of the system are all seismically designed in accordance with the CR-3 seismic licensing basis. This includes the RCITS cabinets, which are equally qualified. The remote shutdown auxiliary cabinets and NNI cabinets have been evaluated as part of the resolution of USI A-46. The remote shutdown auxiliary cabinets were determined to be seismically adequate. Two of the four NNI cabinets were determined to be seismically adequate. The remaining two cabinets are not bolted together and were therefore classified as outliers. This deficiency will be corrected in accordance with FPC's USI A-46 outlier resolution program.

The "A" and "B" SPDS multiplexers and multiplexer servers are not seismically qualified but are housed in seismically qualified cabinets. The SPDS computers and displays are not seismically qualified but are either supported seismically, seismically restrained from becoming missiles, or housed in seismically qualified cabinets. All major components necessary for the operation of the system will be physically restrained to prevent motion and minimize the probability of damage during a seismic event.

Justification for Deviation

The p .t is located in a very low seismic risk regio . The probability that a seismic event will occur and damage this equipment is very low. In the unlikely event damage does occur as a result of a seismic event, corrective actions will be initiated to restore the equipment in accordance with the actions required by the technical specifications.

**2. Redundancy**

RG Recommendation

No single failure within either the accident monitoring instrumentation, its auxiliary supporting features, or its power sources concurrent with the failures that are a condition or result of a specific accident should prevent the operators from being presented the information necessary for them to determine the safety status of the plant and to bring the plant to and maintain it in a safe condition following that accident. Where failure of one accident-monitoring channel results in information ambiguity (that is, the redundant displays disagree) that could lead operators to defeat or fail to accomplish a required safety function, additional information should be provided to allow the operators

to deduce the actual conditions in the plant. This may be accomplished by providing additional independent channels of information of the same variable (addition of an identical channel) or by providing an independent channel to monitor a different variable that bears a known relationship to the multiple channels (addition of a diverse channel). Redundant or diverse channels should be electrically independent and physically separated from each other and from equipment not classified important to safety in accordance with Regulatory Guide 1.75, "Physical Independence of Electric Systems," up to and including any isolation device. Within each redundant division of a safety system, redundant monitoring channels are not needed except for steam generator level instrumentation in two-loop plants.

Degree of Compliance - Full (Subsequent to Modification)

In the final configuration, two independent channels of subcooling margin information are provided. The two channels will be electrically independent. No single active component failure can result in the loss of both channels. In the event of failure one of the channels resulting in ambiguous information, diverse subcooling margin information is available from the use of steam tables using fully qualified and redundant pressure and temperature indications.

**3. Power Source**

RG Recommendation

The instrumentation should be energized from station standby power sources as provided in Regulatory Guide 1.32, "Criteria for Safety-Related Electrical Power Systems for Nuclear Power Plants," and should be backed up by batteries where momentary interruption is not tolerable.

Degree of Compliance - Full (Subsequent to Modification)

In the final configuration, the AC power for the redundant channels will be supplied from independent, safety related inverters backed up by the station standby power sources (emergency diesel generators). The DC for the inverters is from independent, safety related station batteries. The AC power supply for the NNI cabinets is from these same sources and is also auctioneered with redundant supplies (VBDP-1 and VBDP-7) fed from non-safety related regulated instrument buses. One of these supplies (VBDP-7) is powered by an inverter with AC and DC power from non-safety related supplies.

**4. Channel Availability**

RG Recommendation

The instrumentation channel should be available prior to an accident except as provided in paragraph 4.11, "Exception," as defined in IEEE Std 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," or as specified in the technical specifications.

Degree of Compliance - Full

FPC is proposing a technical specification change to add the subcooling margin monitors to Technical Specification LCO 3.3.17, Post-Accident Monitoring Instrumentation. The Required Actions for one or two channels inoperable are delineated in the technical specifications.

**5. Quality Assurance**

RG Recommendation

The recommendations of the following regulatory guides pertaining to quality assurance should be followed:

| | |
|---|---|
| Regulatory Guide 1.28 | "Quality Assurance Program Requirements (Design and Construction)" |
| Regulatory Guide 1.30 (Safety Guide 30) | "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment" |
| Regulatory Guide 1.38 | "Quality Assurance Requirements for Packing, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants" |
| Regulatory Guide 1.58 | "Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel" |
| Regulatory Guide 1.64 | "Quality Assurance Requirements for the Design of Nuclear Power Plants" |
| Regulatory Guide 1.74 | "Quality Assurance Terms and Definitions" |
| Regulatory Guide 1.88 | "Collection, Storage, and Maintenance of Nuclear Power Plant Quality Assurance Records" |
| Regulatory Guide 1.123 | "Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants" |
| Regulatory Guide 1.144 | "Auditing of Quality Assurance Programs for Nuclear Power Plants" |
| Regulatory Guide 1.146 | "Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants" |

Reference to the above regulatory guides (except Regulatory Guides 1.30 and 1.38) is being made pending issuance of a revision to Regulatory Guide 1.28 that is under development (Task RS 002-5) and that will endorse ANSI/ASME NQA-1-1979, "Quality Assurance Program Requirements for Nuclear Power Plants."

Degree of Compliance - Partial

The safety related portions of the system have been qualified in accordance with the FPC Quality Assurance Program which complies with the requirements of 10 CFR 50, Appendix B and has been approved by the NRC. FPC has committed to all of the Regulatory Guides listed above except for Regulatory Guide 1.28. FPC's commitment to this guidance is documented and clarified in Table 1-3 of the CR-3 Final Safety Analysis Report (FSAR). Commitments related to Regulatory Guide 1.28 are contained in FPC's commitment to Regulatory Guide 1.33 and through FPC's compliance with 10 CFR 50, Appendix B. The recommendation is fully met for these components.

The two RCS pressure channels (narrow range and wide range) are safety related up through an isolation device in the engineered safeguards cabinets. One of the RCS hot leg temperature channels is safety related up through an isolation device in a remote shutdown auxiliary cabinet. All 16 incore temperature channels (8 per SPDS train) are safety related through the Reactor Coolant Inventory & Tracking (RCITS) cabinets.

The remainder of the components are non-safety related, but satisfy the quality assurance recommendations of Reg. Guide 1.97 for Category 2 variables.

Justification for Deviation

The human factors advantages of this personal computer-based system more than outweigh the loss of quality resulting from a lack of 10 CFR 50, Appendix B qualification for all equipment. The equipment is continually in service and monitored for proper operation by control room operators. Any malfunction will be promptly detected. There will be a high degree of confidence that the system will function when called upon to do so. Since the SPDS functions continuously, virtually all failures will be "self-annunciating" and corrective actions can be initiated before the system is needed to respond to an event.

**6. Display and Recording**

RG Recommendation

Continuous real-time display should be provided. The indication may be on a dial, digital display, CRT, or stripchart recorder. Recording of instrumentation readout information should be provided for at least one redundant channel.

If direct and immediate trend or transient information is essential for operator information or action, the recording should be continuously available on redundant dedicated recorders. Otherwise, it may be continuously updated, stored in computer memory, and displayed on demand. Intermittent displays such as data loggers and scanning recorders may be used if no significant transient response information is likely to be lost by such devices.

Degree of Compliance - Full (Subsequent to Modification)

Continuous real-time display is provided on two redundant SPDS displays. Recording of subcooling margin is done at one second intervals and stored in computer memory. In the final configuration, this information will have the capability to be displayed in trend format.

**7. Range**

RG Recommendation

If two or more instruments are needed to cover a particular range, overlapping of instrument span should be provided. If the required range of monitoring instrumentation results in a loss of instrumentation sensitivity in the normal operating range separate instruments should be used.

Degree of Compliance - Full

Reg. Guide 1.97, Table 3, recommends a range of 200°F subcooling to 35°F superheat. The SPDS range exceeds this recommendation.

**8. Equipment Identification**

RG Recommendation

Types A, B, and C instruments designated as Categories 1 and 2 should be specifically identified with a common designation on the control panels so that the operator can easily discern that they are intended for use under accident conditions.

Degree of Compliance - Full

The SPDS displays will be labeled as Reg. Guide 1.97 instruments on the main control board.

**9. Interfaces**

RG Recommendation

The transmission of signals for other use should be through isolation devices that are designed as part of the monitoring instrumentation and that meet the provisions of this document.

Degree of Compliance - None

Where signals are fed from safety related systems for use by the subcooling margin monitors, isolation devices are provided to protect the safety related systems from faults in the SPDS. No isolation devices are provided to protect signals to the SPDS from faults in other safety or non-safety related components.

Justification for Deviation

Since this system is in operation and displays continuously, any malfunction caused by components connected to the system will be promptly detected by the plant operators. Prompt corrective actions can be taken to restore the equipment. Failure of interconnected components during an event has a very low probability. Also, since the system is redundant, failure of a single channel will not cause a loss of function.

**J. Servicing, Testing, and Calibration**

RG Recommendation

Servicing, testing, and calibration programs should be specified to maintain the capability of the monitoring instrumentation. If the required interval between testing is less than the normal time interval between plant shutdowns, a capability for testing during power operation should be provided.

Whenever means for removing channels from service are included in the design, the design should facilitate administrative control of the access to such removal means.

The design should facilitate administrative control of access to all setpoint adjustments, module calibration adjustments, and test points.

Periodic checking, testing, calibration, and calibration verification should be in accordance with the applicable portions of Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems," pertaining to testing of instrument channels. (Note: Response time testing not usually needed.)

The location of the isolation device should be such that it would be accessible for maintenance during accident conditions.

Degree of Compliance - Full

The subcooling margin monitors' design and FPC's program for calibrating and maintaining them complies with all of the above recommendations. In addition, the post-accident monitoring instrumentation technical specification Surveillance Requirements require a CHANNEL CHECK every 31 days and a CHANNEL CALIBRATION every 24 months.

**11. Human Factors**

RG Recommendation

The instrumentation should be designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.

The monitoring instrumentation design should minimize the development of conditions that would cause meters, annunciators, recorders, alarms, etc., to

give anomalous indications potentially confusing to the operator. Human factors analysis should be used in determining type and location of displays. To the extent practicable, the same instruments should be used for accident monitoring as are used for the normal operations of the plant to enable the operators to use, during accident situations, instruments with which they are most familiar.

Degree of Compliance - Full

Subcooling margin is displayed on the SPDS displays mounted above the main control board. Real time indication of subcooling margin is the most desirable method of monitoring the variable from a human factors perspective. Operators will be trained to use the SPDS displays as the primary means of determining subcooling margin. Providing subcooling margin data on the SPDS displays provides unique flexibility in the presentation of information to the operator:

- Subcooling margin is automatically calculated from incore temperatures when SPDS determines no reactor coolant pumps are running.
- The SPDS display indicates if subcooling margin is being calculated from hot leg temperature or incore temperature.
- In the event of an alarm, subcooling margin information is enlarged to cover the entire display. The display colors change to white characters on a red background with the characters being as large as possible and still display the margin.
- A timer starts, in the event of an alarm, to aid the operators in determining how long adequate subcooling margin has been lost. This is useful in determining the need to trip all reactor coolant pumps within two minutes of the loss of adequate subcooling margin.

**12. Direct Measurement**

RG Recommendation

To the extent practicable, monitoring instrumentation inputs should be from sensors that directly measure the desired variables. An indirect measurement should be made only when it can be shown by analysis to provide unambiguous information.

Degree of Compliance - Full

Subcooling margin is not directly measurable. However the temperature and pressure that determine the degree of subcooling are measured directly.

# SPDS TSAT Train "A"

Reactor Bldg | Control Complex 108 ft. El | Control Complex 124 ft. El | Control Complex 145 ft. El

RC-4B-TE1 Loop "B" Th NSR EQ-Y NNI [X]

RC-4A-TE1 Loop "A" Th SR EQ-Y Vital Bus 3A

RC-4A-TY1-1 Loop "A" Th SR EQ-N/A Vital Bus 3A

RC-4A-TY1-3 Loop "A" Th SR EQ-N/A Vital Bus 3A

RC-3A-PT3 "A" WR Press SR EQ-Y Vital Bus 3A

RC-3B-PT3 "B" WR Press SR EQ-Y Vital Bus 3D

RC-147-PT "A" LR Press SR EQ-Y Vital Bus 3A

RC-147-PY1 "A" LR Press SR EQ-N/A Vital Bus 3A

RC-147-PY2 "A" LR Press SR EQ-N/A Vital Bus 3A

RC-148-PT "B" LR Press SR EQ-Y Vital Bus 3B

RC-148-PY1 "B" LR Press SR EQ-N/A Vital Bus 3B

RC-148-PY2 "B" LR Press SR EQ-N/A Vital Bus 3B

IM-2G-TE SR & EQ

IM-5G-TE SR & EQ

IM-9E-TE SR & EQ

IM-10C-TE SR & EQ

IM-9H-TE SR & EQ

IM-10M-TE SR & EQ

IM-3L-TE SR & EQ

IM-4N-TE SR & EQ

RC-165K-TY1 Incore Temp SR Vital Bus 3B

RC-165K-TY2 Incore Temp SR Vital Bus 3B

RC-165A-TY1 Incore Temp SR Vital Bus 3B

RC-165A-TY2 Incore Temp SR Vital Bus 3B

RC-165F-TY1 Incore Temp SR Vital Bus 3B

RC-165F-TY2 Incore Temp SR Vital Bus 3B

RC-165L-TY1 Incore Temp SR Vital Bus 3B

RC-165L-TY2 Incore Temp SR Vital Bus 3B

RC-4B-TT1 Loop "B" Th NSR EQ-N/A NNI Cab 4 [X]

RC-4B-MV/V3 Loop "B" Th NSR EQ-N/A NNI Cab 4 [X]

RC-4B-EB3 Loop "B" Th NSR EQ-N/A NNI Cab 5 [X]

RC-4A-IB1 Loop "A" Th NSR EQ-N/A NNI Cab 4 [X]

RC-4A-MV/V3 Loop "A" Th NSR EQ-N/A NNI Cab 4 [X]

RC-4A-TY5 Loop "A" Th NSR EQ-N/A NNI Cab 4 [X]

RC-3A-JX3 "A" Press SR EQ-N/A Vital Bus 3A

RC-3A-PY3 "A" Press SR EQ-N/A Vital Bus 3A

RC-3B-JX3 "B" Press SR EQ-N/A Vital Bus 3D

RC-3B-PY3 "B" Press SR EQ-N/A Vital Bus 3D

RC-165C-TY1 Incore Temp SR Vital Bus 3B

RC-165C-TY2 Incore Temp SR Vital Bus 3B

RC-165I-TY1 Incore Temp SR Vital Bus 3B

RC-165I-TY2 Incore Temp SR Vital Bus 3B

RC-165E-TY1 Incore Temp SR Vital Bus 3B

RC-165E-TY2 Incore Temp SR Vital Bus 3B

RC-165M-TY1 Incore Temp SR Vital Bus 3B

RC-165M-TY2 Incore Temp SR Vital Bus 3B

NSR and Non-EQ

Envir. Qualified (EQ)

Safety Related (and EQ for primary sensor)

[X] NNI-X Power is from Vital Bus 3C or Inst. Bus 3A (auto. transfer)

"A" SPDS Computer 1E Vital Bus

To "B" Side SPDS Display

From "B" Side SPDS Display

"A" SPDS Display 1E Vital Bus

## NNI X Power Supply

VBDP-1

VBXS-2A (Norm / Alt)

VBDP-5

To 118vac Field Loads

24 vdc

24 vdc

Auctioneer

-24vdc Bus

Auctioneer

+24vdc Bus

# SPDS TSAT Train "B"

Attachment to 3F0996-05

Reactor Bldg | Control Complex 108 ft. El. | Control Complex 124 ft. El. | Control Complex 145 ft. El.

RC-4A-TE4 Loop "A" Th NSR EQ-Y NNI [Y]

RC-4B-TE4 Loop "B" Th SR EQ-Y Vital Bus 3B

RC-4B-TY4-1 Loop "B" Th SR EQ-N/A Vital Bus 3B

RC-4B-TY4-2 Loop "B" Th SR EQ-N/A Vital Bus 3B

RC-3A-PT3 "A" Press SR EQ-Y Vital Bus 3A

RC-3B-PT3 "B" Press SR EQ-Y Vital Bus 3D

RC-147-PT "A" NR Press SR EQ-Y Vital Bus 3A

RC-147-PY1 "A" NR Press SR EQ-N/A Vital Bus 3A

RC-147-PY2 "A" NR Press SR EQ-N/A Vital Bus 3A

RC-148-PT "B" NR Press SR EQ-Y Vital Bus 3B

RC-148-PY1 "B" NR Press SR EQ-N/A Vital Bus 3B

RC-148-PY2 "B" NR Press SR EQ-N/A Vital Bus 3B

IM-7F-TE SR & EQ

IM-8L-TE SR & EQ

IM-13G-TE SR & EQ

IM-11G-TE SR & EQ

IM-6C-TE SR & EQ

IM-6O-TE SR & EQ

IM-10O-TE SR & EQ

IM-13L-TE SR & EQ

RC-165B-TY1 Incore Temp SR Vital Bus 3B

RC-165B-TY2 Incore Temp SR Vital Bus 3B

RC-165G-TY1 Incore Temp SR Vital Bus 3B

RC-165G-TY2 Incore Temp SR Vital Bus 3B

RC-165J-TY1 Incore Temp SR Vital Bus 3B

RC-165J-TY2 Incore Temp SR Vital Bus 3B

RC-165O-TY1 Incore Temp SR Vital Bus 3B

RC-165O-TY2 Incore Temp SR Vital Bus 3B

RC-4A-TT4 Loop "A" Th NSR EQ-N/A NNI Cab 6 [Y]

RC-4A-MV/V4 Loop "A" Th NSR EQ-N/A NNI Cab 6 [Y]

RC-4A-EB3 Loop "A" Th NSR EQ-N/A NNI Cab 6 [Y]

RC-4B-1B4 Loop "B" Th NSR EQ-N/A NNI Cab 7 [Y]

RC-4B-MV/V4 Loop "B" Th NSR EQ-N/A NNI Cab 7 [Y]

RC-4B-TY5 Loop "A" Th NSR EQ-N/A NNI Cab 6 [Y]

RC-3A-JX3 "A" Press SR EQ-N/A Vital Bus 3A

RC-3A-PY3 "A" Press SR EQ-N/A Vital Bus 3A

RC-3B-JX3 "B" Press SR EQ-N/A Vital Bus 3D

RC-3B-PY3 "B" Press SR EQ-N/A Vital Bus 3D

RC-165D-TY1 Incore Temp SR Vital Bus 3B

RC-165D-TY2 Incore Temp SR Vital Bus 3B

RC-165H-TY1 Incore Temp SR Vital Bus 3B

RC-165H-TY2 Incore Temp SR Vital Bus 3B

RC-165N-TY1 Incore Temp SR Vital Bus 3B

RC-165N-TY2 Incore Temp SR Vital Bus 3B

RC-165P-TY1 Incore Temp SR Vital Bus 3B

RC-165P-TY2 Incore Temp SR Vital Bus 3B

"B" SPDS Computer 1E Vital Bus

To "A" Side SPDS Display

"B" SPDS Display 1E Vital Bus

From "A" Side SPDS Display

NSR and Non-EQ

Envir. Qualified (EQ)

Safety Related (and EQ for primary sensor)

[Y] NNI-Y Power is from Vital Bus 3D or VBDP-7 (VBIT-1E) with auto xfer

## NNI Y Power Supply

VBDP-6

VBXS-4A (Norm / Alt)

VBDP-7

24 vdc

To 118vac Field Loads

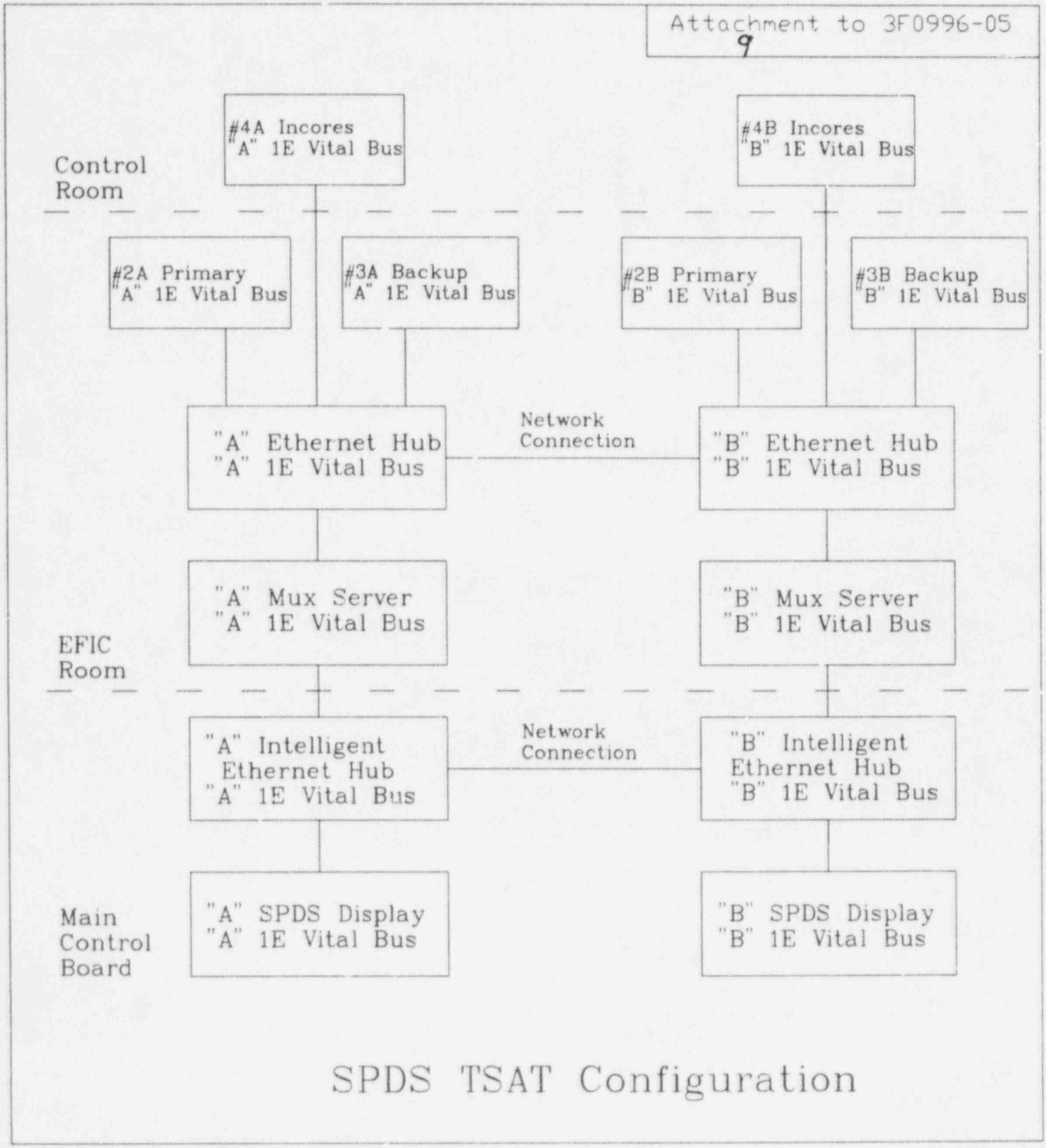
24 vdc

Auctioneer

-24vdc Bus

Auctioneer

+24vdc Bus




SPDS TSAT Configuration

Table 3.3.17-1 (page 1 of 1)
Post Accident Monitoring Instrumentation

| FUNCTION | REQUIRED CHANNELS | CONDITIONS REFERENCED FROM REQUIRED ACTION D.1 |
|---|---|---|
| 1. Wide Range Neutron Flux | 2 | E |
| 2. RCS Hot Leg Temperature | 2 | E |
| 3. RCS Pressure (Wide Range) | 2 | E |
| 4. Reactor Coolant Inventory | 2 | F |
| 5. Borated Water Storage Tank Level | 2 | E |
| 6. High Pressure Injection Flow | 2 per injection line | E |
| 7. Containment Sump Water Level (Flood Level) | 2 | E |
| 8. Containment Pressure (Expected Post-Accident Range) | 2 | E |
| 9. Containment Pressure (Wide Range) | 2 | E |
| 10. Containment Isolation Valve Position | 2 per penetration[(a)(b)] | E |
| 11. Containment Area Radiation (High Range) | 2 | F |
| 12. Containment Hydrogen Concentration | 2 | E |
| 13. Pressurizer Level | 2 | E |
| 14. Steam Generator Water Level (Start-up Range) | 2 per OTSG | E |
| 15. Steam Generator Water Level (Operating Range) | 2 per OTSG | E |
| 16. Steam Generator Pressure | 2 per OTSG | E |
| 17. Emergency Feedwater Tank Level | 2 | E |
| 18. Core Exit Temperature (Backup) | 3 per core quadrant | E |
| 19. Emergency Feedwater Flow | 2 per OTSG | E |
| 20. Low Pressure Injection Flow | 2 | E |
| 21. Degrees of Subcooling | 2 | E |

(a) Only one position indication is required for penetrations with one Control Room indicator.

(b) Not required for isolation valves whose associated penetration is isolated by at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured.

BASES

LCO (continued)

The following list is a discussion of the specified instrument Functions listed in Table 3.3.17-1.

1. Wide Range Neutron Flux

Two wide-range neutron flux monitors are provided for post-accident reactivity monitoring over the entire range of expected conditions. Each monitor provides indication over the range of $10^{-8}$ to 100% log rated power covering the source, intermediate, and power ranges. Each monitor utilizes a fission chamber neutron detector to provide redundant main control board indication. A single channel provides recorded information in the control room. The control room indication of neutron flux is considered one of the primary indications used by the operator following an accident. Following an event the neutron flux is monitored for reactivity control. The operator ensures that the reactor trips as necessary and that emergency boration is initiated if required. Since the operator relies upon this indication in order to take specified manual action, the variable is included in this LCO. Therefore, the LCO deals specifically with this portion of the string.

2. Reactor Coolant System (RCS) Hot Leg Temperature

Two wide range resistance temperature detectors (RTD's), one per loop, provide indication of reactor coolant system hot leg temperature ($T_H$) over the range of 120° to 920°F. Each $T_H$ measurement provides an input to a control room indicator. Channel B is also recorded in the control room. Since the operator relies on the control room indication following an accident, the LCO deals specifically with this portion of the string.

$T_H$ is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided. Following a steam generator tube rupture, the affected steam generator is to be isolated only after $T_H$ falls below the saturation temperature corresponding to the pressure

(continued)

BASES

LCO

2. Reactor Coolant System (RCS) Hot Leg Temperature (continued)

setpoint of the main steam safety valves. For event monitoring once the RCP's are tripped, $T_H$ is used along with the core exit temperatures and RCS cold leg temperature to measure the temperature rise across the core for verification of core cooling.

3. RCS Pressure (Wide Range)

RCS pressure is measured by pressure transmitters with a span of 0-3000 psig. Redundant monitoring capability is provided by two trains of instrumentation. Control room and remote shutdown panel indications are provided. The control room indications are the primary indications used by the operator during an accident. Therefore, the LCO deals specifically with this portion of the instrument string.

RCS pressure is a Type A variable because the operator uses this indication to adjust parameters such as steam generator (OTSG) level or pressure in order to monitor and maintain a controlled cooldown of the RCS following a steam generator tube rupture or small break LOCA. In addition, HPI flow is throttled based

(continued)

BASES

LCO

7. Containment Sump Water Level (Flood Level) (continued)

displayed in the control room on edgewise level indicators. Channel A and B sump flood level indication are recorded in the associated 'A' and 'B' EFIC Rooms. Each instrument encompasses a range of 0-10 feet above the sump and provides information to the operator related to gross leakage in the Reactor Building. This leakage may be indication of degradation in the reactor coolant pressure boundary (RCPB) which would require further investigation and action. These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

8,9 Containment Pressure (Expected Post-Accident and Wide Range)

The containment pressure variable is monitored by two ranges of pressure indication. Expected post-accident range (-10 to 70 psig) and wide range (0 to 200 psig) pressure indication each provide two channels of pressure indication. Channel A and B wide range containment pressure are recorded in the associated 'A' and 'B' EFIC Rooms. The low range is required in order to ensure instrumentation of the necessary accuracy is available to monitor conditions in the RB during DBAs. The wide range instrument was required by Regulatory Guide 1.97 to be capable of monitoring pressures over the range of atmospheric to three times containment design pressure (approximately 165 psig). Thus, it was intended to monitor the RB in the event of an accident not bounded by the plant safety analysis (i.e., a Severe Accident).

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the accident analysis.

(continued)

BASES

LCO

18. Core Exit Temperature (Backup) (continued)

following a steam generator tube rupture or small break LOCA. Operator actions to maintain a controlled cooldown, such as adjusting OTSG level or pressure, would be prompted by this indication.

19. Emergency Feedwater Flow

EFW Flow instrumentation is provided to monitor operation of decay heat removal via the OTSGs. The EFW injection flow to each OTSG (2 channels per OTSG, one associated with each EFW injection line) is determined from a differential pressure measurement calibrated to a span of 0 gpm to 1000 gpm. Each differential pressure transmitter provides an input to a control room indicator and the plant computer.

EFW Flow is used by the operator to determine the need to throttle flow during accident or transient conditions to prevent the EFW pumps from operating in runout conditions or from causing excessive RCS cooldown rates when low decay heat levels are present. EFW Flow is also used by the operator to verify that the EFW System is delivering the correct flow to each OTSG. However, the primary indication of this function is provided by OTSG level.

These instruments are not assumed to provide information required by the operator to take a mitigation action specified in the safety analysis. As such, they are not Type A variables. However, the monitors are deemed risk significant (Category 1) and are included within the LCO based upon this consideration.

20. Low Pressure Injection Flow

Low pressure injection flow instrumentation is provided to monitor flow to the RCS following a large break LOCA. It is also used to monitor LPI flow during piggy back operation following a small break LOCA. The low pressure injection flow to the reactor (2 channels, one associated with each LPI injection

(continued)

BASES

LCO

20. Low Pressure Injection Flow (continued)

line) is determined from a differential pressure measurement calibrated to a span of 0 gpm to 5000 gpm.

The LPI flow indication is used by the operator to throttle the flow to ≤ 2000 gpm prior to switching the pump suction from the BWST to the RB sump. This assures adequate net positive suction head (NPSH) is maintained to the pump. The indication is also used to verify LPI flow to the reactor as a prerequisite to termination of HPI flow.

Since low pressure injection flow is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided, it has been included in this LCO.

21. Degrees of Subcooling

Two channels of subcooling margin with inputs from RCS hot leg temperature ($T_H$), core exit temperature, and RCS pressure are provided. Multiple core exit temperatures are auctioneered with only the highest temperature being input to the monitor. These two channels of subcooling margin are backed up by either of two indications of subcooling margin based on similar inputs through the Safety Parameter Display System (SPDS). At least one SPDS channel must be available to provide this backup. The $T_H$ inputs to the subcooling margin monitors and SPDS operate over a range of 150 to 920°F. The core exit temperature inputs operate over a range of 150 to 2000°F and 150 to 2500°F for the subcooling margin monitors and SPDS, respectively. RCS pressure inputs operate over a range of 200 to 2500 psig.

The subcooling margin monitors are used to verify the existence of, or to take actions to ensure the restoration of subcooling margin. Specifically, a loss of adequate subcooling margin during a LOCA requires the operator to trip the reactor coolant pumps (RCP's), to ensure high or low pressure injection, and raise the steam generator levels to the inadequate core cooling level. Once subcooling margin is restored, the operator is instructed to restart at

(continued)

BASES

LCO

21. Degrees of Subcooling (continued)

least one RCP and throttle injection flow to maintain a specified degree of subcooling. Since degrees of subcooling is a Type A variable on which the operator bases manual actions required for event mitigation for which no automatic controls are provided, it has been included in this LCO.

(continued)