Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

August 18, 2011
3F0811-01

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

Subject: Crystal River Unit 3 – Response to Request for Additional Information to Support NRC Instrumentation and Controls Branch Acceptance Review of the CR-3 Extended Power Uprate LAR (TAC No. ME6527)

References:
1. CR-3 to NRC letter dated June 15, 2011, "Crystal River Unit 3 – License Amendment Request #309, Revision 0, Extended Power Uprate" (Accession No. ML112070659)
2. Email from S. Lingam (NRC) to D. Westcott (CR-3) dated July 19, 2011, "Crystal River, Unit 3 EPU LAR - RAIs from Instrumentation and Controls Branch (EICB)"

Dear Sir:

By letter dated June 15, 2011, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., requested a license amendment to increase the rated thermal power level of Crystal River Unit 3 (CR-3) from 2609 megawatts (MWt) to 3014 MWt. The proposed license amendment is considered an Extended Power Uprate (EPU). On July 19, 2011, via electronic mail, the NRC provided a request for additional information (RAI) related to the new Inadequate Core Cooling Monitoring System (ICCMS), new Fast Cooldown System (FCS), and the new Atmospheric Dump Valves (ADVs) needed to support the Instrumentation and Controls Branch acceptance review of the CR-3 EPU License Amendment Request (LAR).

Attachment A to this submittal, "Response to Request for Additional Information to Support NRC Instrumentation and Controls Branch Acceptance Review of the CR-3 EPU LAR," provides the CR-3 formal response to the RAI.

In support of the EPU acceptance review RAI responses, four enclosures are provided. Enclosure 1, "Markup of Proposed ITS 3.3.19, Inadequate Core Cooling Monitoring System Instrumentation, and Associated Bases," provides proposed changes to the new ICCMS Improved Technical Specifications (ITS) and associated Bases to include ICCMS instrument Allowable Values. Enclosure 2, "ICCMS Instrumentation Setpoint Methodology and Summary Calculations," provides the setpoint methodology and summary calculations associated with the new ICCMS consistent with the guidance of Technical Specification Task Force (TSTF) Traveler – 493, "Clarify Application of Setpoint Methodology for LSSS Functions." Enclosure 3, "IEEE 603-1991 and IEEE 279-1971 Compliance Matrix," provides a summary of how the ICCMS, FCS, ADVs, and affected portions of the Emergency Feedwater Initiation and Control System will meet applicable clauses of IEEE 603-1991 and IEEE 279-1971. Enclosure 4,

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

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NRR

"ICCMS Simplified Schematic and Control Logic Diagrams," provides simplified schematic and control logic diagrams associated with the new ICCMS.

This correspondence contains no new regulatory commitments.

The information provided by this response letter does not change the intent or the justification for the requested EPU license amendment. FPC has determined that this supplement does not affect the basis for concluding that the proposed license amendment does not involve a Significant Hazards Consideration. As such, the 10 CFR 50.92 evaluation provided in the June 15, 2011 submittal remains valid.

If you have any questions regarding this submittal, please contact Mr. Dan Westcott, Superintendent, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Jeffrey Swartz
Director-Site Operations
Crystal River Nuclear Plant

JS/gwe

Attachment:

A. Response to Request for Additional Information to Support NRC Instrumentation and Controls Branch Acceptance Review of the CR-3 EPU LAR

Enclosures:

1. Markup of Proposed ITS 3.3.19, Inadequate Core Cooling Monitoring System Instrumentation, and Associated Bases
2. ICCMS Instrumentation Setpoint Methodology and Summary Calculations
3. IEEE 603-1991 and IEEE 279-1971 Compliance Matrix
4. ICCMS Simplified Schematic and Control Logic Diagrams

xc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector
State Contact

STATE OF FLORIDA

COUNTY OF CITRUS

Jeffrey Swartz states that he is the Director-Site Operations, Crystal River Nuclear Plant for Florida Power Corporation, doing business as Progress Energy Florida, Inc.; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Jeffrey Swartz
Director-Site Operations
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 18 day of August, 2011, by Jeffrey Swartz.

Signature of Notary Public
State of Florida

CAROLYN E. PORTMANN
Commission # DD 937553
Expires March 1, 2014
Bonded Thru Troy Fain Insurance 800-385-7019

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known ✓ -OR- Produced Identification ______

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ATTACHMENT A

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC INSTRUMENTATION AND CONTROLS BRANCH ACCEPTANCE REVIEW OF THE CR-3 EPU LAR

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC INSTRUMENTATION AND CONTROLS BRANCH ACCEPTANCE REVIEW OF THE CR-3 EPU LAR

By letter dated June 15, 2011, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., requested a license amendment to increase the rated thermal power level of Crystal River Unit 3 (CR-3) from 2609 megawatts (MWt) to 3014 MWt. The proposed license amendment is considered an Extended Power Uprate (EPU). On July 19, 2011, via electronic mail, the NRC provided a request for additional information (RAI) related to the new Inadequate Core Cooling Monitoring System (ICCMS), new Fast Cooldown System (FCS), and the new Atmospheric Dump Valves (ADVs) needed to support the Instrumentation and Controls Branch acceptance review of the CR-3 EPU License Amendment Request (LAR).

NRC Request for Additional Information

We need the responses for the following RAIs. Please note that RAI responses for 1 thru 4 are required for our acceptance review, and therefore, need your immediate attention.

1. LAR Attachment 2, Table 3.3.19-1, "Inadequate Core Cooling Monitoring System (ICCMS) Instrumentation" (Pages 3.3-48 and 3.3.49) and Table 3.3.20-1, "Inadequate Core Cooling Monitoring System Automatic Actuation Logic" do not list Allowable Values or Limiting Trip Setpoints. Provide Allowable values and/or Limiting Trip Setpoints for each FUNCTION in these two Tables, or provide your justification for not listing these values.

2. TSTF-493, Option A "with changes to setpoint values" requires the licensee to provide summary calculations for each type of setpoint being revised, including Limiting Trip Setpoint (LTSP), Nominal Trip Setpoint (NTSP), Allowable Value (AV), As-Found Tolerance (AFT), and As-Left Tolerance (ALT). Provide all these values and analytical safety limit value for each revised setpoint listed in Table 3.3.19-1, and Table 3.3.20-1 (the NRC staff prefers a table of values of all above variables for each LSSS setpoint). Also describe how these values were determined including examples and/or diagrams to support the determination.

3. The application did not describe how the new ICCMS, FCS, ADVs, and Emergency Feedwater Initiation and Control (EFIC) meet NRC's requirements for safety systems described in 10 CFR 50.55a(h), which endorses IEEE Standards 279, "Criteria for Protection Systems for Nuclear power Generating Stations," and 603-1991, "Criteria for Safety Systems for Nuclear power Generating Stations." Describe how these systems meet each applicable clause of the applicable industry standard, as well as all other regulatory requirements.

4. Provide instrument loop schematic diagrams and control logic diagrams including sufficient information to show the input, output parameter signal logic flow, and bistable devices which implement the setpoints for each FUNCTION of ICCMS to support the safety evaluation.

CR-3 Responses:

1. **LAR Attachment 2, Table 3.3.19-1, "Inadequate Core Cooling Monitoring System (ICCMS) Instrumentation" (Pages 3.3-48 and 3.3.49) and Table 3.3.20-1, "Inadequate Core Cooling Monitoring System Automatic Actuation Logic" do not list Allowable Values or Limiting Trip Setpoints. Provide Allowable values and/or Limiting Trip Setpoints for each FUNCTION in these two Tables, or provide your justification for not listing these values.**

As described in Attachment 1, "Description of Proposed Change, Background, Justification for the Request, Determination of No Significant Hazards Considerations," of the CR-3 EPU LAR (Reference 1), the ICCMS monitors specific parameters; High Pressure Injection (HPI) System flow, Reactor Coolant System (RCS) pressure, and core exit thermocouples (CETs). The ICCMS automatically trips the reactor coolant pumps (RCPs) and automatically adjusts the steam generator secondary side water level control setting to the inadequate subcooling margin (SCM) level when inadequate SCM is coincident with a reactor trip signal. Also, when a loss of SCM occurs concurrent with inadequate HPI flow and a reactor trip, the ICCMS automatically initiates the FCS which opens both ADVs to ensure sufficient core cooling during certain spectra of loss of coolant accidents. Core degrees of subcooling is compared to a reference curve of incore temperature versus RCS pressure to determine if a loss of SCM exists. Total HPI flow is compared to a reference curve of minimum HPI flow versus RCS pressure to determine inadequate HPI flow.

<u>ITS 3.3.19, ICCMS Instrumentation</u>

The only ICCMS instrument functions listed in Improved Technical Specifications (ITS) Table 3.3.19-1 that provide an initiation channel trip are Loss of Subcooling Margin Function (Functions 1.e, 2.d, and 3.d) and Inadequate HPI Flow Function (Function 1.f). All other instrument functions listed in ITS Table 3.3.19-1 are instrument inputs to either the Loss of Subcooling Margin Function or the Inadequate HPI Flow Function and have no trip settings. Additionally, the trip setting values associated with the Loss of Subcooling Margin and Inadequate HPI Flow Functions are a function of generated curves and thus do not have discrete instrument Allowable Values analogous to the RCS Variable Low Pressure Allowable Value in the Reactor Protection System Technical Specification (Reference 2). As a result, an Allowable Value column is not included in ITS Table 3.3.19-1.

Enclosure 1 provides changes to the new ICCMS instrumentation Technical Specification and associated Bases proposed in the CR-3 EPU LAR (Reference 1). SR 3.3.19.3 is modified and two new figures are added to indicate the Allowable Values associated with the Loss of Subcooling Margin and Inadequate HPI Flow Functions. Enclosure 1 includes a markup of the affected ITS 3.3.19 pages and affected Bases pages of ITS B 3.3.19.

<u>ITS 3.3.20, ICCMS Automatic Actuation Logic</u>

Consistent with the instrumentation presentation in NUREG-1430, "Standard Technical Specifications Babcock and Wilcox Plants" (Reference 3), ICCMS instrumentation requirements are covered by two specifications. ITS 3.3.19 provides requirements for the

ICCMS initiation channels and ITS 3.3.20 provides requirements for the ICCMS actuation logic. The ICCMS automatic actuation logic consists of analog relays and contacts which do not have discrete setpoints (i.e., logic trains are either tripped or untripped). As a result, no Allowable Values or trip setpoints are provided in ITS 3.3.20. This is consistent with CR-3 ITS 3.3.7, "Engineered Safeguards Actuation System (ESAS) Automatic Actuation Logic," and ITS 3.3.13, "EFIC Automatic Actuation Logic" (Reference 2).

2. **TSTF-493, Option A "with changes to setpoint values" requires the licensee to provide summary calculations for each type of setpoint being revised, including Limiting Trip Setpoint (LTSP), Nominal Trip Setpoint (NTSP), Allowable Value (AV), As-Found Tolerance (AFT), and As-Left Tolerance (ALT). Provide all these values and analytical safety limit value for each revised setpoint listed in Table 3.3.19-1, and Table 3.3.20-1 (the NRC staff prefers a table of values of all above variables for each LSSS setpoint). Also describe how these values were determined including examples and/or diagrams to support the determination.**

The only ICCMS instrument functions with Limiting Safety System Setting (LSSS) trip setpoint values are Loss of Subcooling Margin Function (Functions 1.e, 2.d, and 3.d) and Inadequate HPI Flow Function (Function 1.f). All other instrument functions listed in ITS Table 3.3.19-1 are instrument inputs to either the Loss of Subcooling Margin Function or the Inadequate HPI Flow Function. Also, ITS 3.3.20 provides requirements for the ICCMS actuation logic. The ICCMS automatic actuation logic does not have discrete setpoints (i.e., logic trains are either tripped or untripped). As a result, setpoint calculations are required to support only the Loss of Subcooling Margin and Inadequate HPI Flow Functions listed in ITS Table 3.3.19-1.

The proposed ICCMS instrumentation Channel Calibration requirement, SR 3.3.19.3, and associated Notes (Reference 1, Attachment 2) require measurement errors and bistable setpoint errors to be within the assumptions of the ICCMS instrumentation calculations, and the Channel Calibrations must also be performed consistent with the assumptions of the safety analyses in which the ICCMS Functions are assumed. These Notes are consistent with Notes (f) and (g) in CR-3 ITS Table 3.3.1-1, "Reactor Protection System Instrumentation," (Reference 2) and the guidance provided in Technical Specification Task Force (TSTF) Traveler – 493, "Clarify Application of Setpoint Methodology for LSSS Functions," (Reference 4).

Currently, the overall methodology used for safety-related instruments at CR-3 is described in CR-3 plant procedure ICDC-1, "I&C Design Criteria for Instrument Loop Uncertainty Calculations," (Reference 5). The existing RCS pressure input parameter is currently calibrated using Category A methodology, which is the most stringent method defined in ICDC-1 and meets the 95/95 tolerance limit as identified in Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," (Reference 6). A copy of this calculation is provided in Attachment 8, "Sample Instrumentation Setpoint Calculation," of the CR-3 EPU LAR (Reference 1). Calibrating the new ICCMS input parameters using this methodology ensures the generated curves for the Loss of Subcooling Margin and Inadequate HPI Flow Functions are within the required As-Left Tolerance (ALT). An overall summary of the methodology of calibrating the ICCMS instrumentation is provided in Enclosure 2, "ICCMS Instrumentation Setpoint Methodology and Summary

Calculations." Enclosure 2 includes summary calculations associated with the Loss of Subcooling Margin and Inadequate HPI Flow Functions. Each summary calculation provides a table indicating the Nominal Trip Setpoint/Limiting Trip Setpoint, Allowable Value, As-Found Tolerance, ALT and a description of how these values are determined. Enclosure 2 also includes the analytical limit curves assumed in the safety analyses for minimum subcooling margin and minimum required HPI System flow.

The new ICCMS design is being developed in accordance with the CR-3 engineering change (EC) process, with the conceptual design phase complete. Initial instrument calculations for the Loss of Subcooling Margin and Inadequate HPI Flow Functions required by ITS 3.3.19 have been established. Final instrument calculations will be completed during finalization of the ICCMS plant modification. The final calculations will preserve the Allowable Value established in the initial calculations. Further, CR-3 provides a commitment, as stated in the List of Regulatory Commitments of the CR-3 EPU LAR (Reference 1, Attachment 10), to implement EPU modifications prior to exceeding 2609 MWt. This includes installation of the ICCMS modification and calibration and testing of the ICCMS instrumentation in accordance with the Progress Energy design control processes.

3. **The application did not describe how the new ICCMS, FCS, ADVs, and Emergency Feedwater Initiation and Control (EFIC) meet NRC's requirements for safety systems described in 10 CFR 50.55a(h), which endorses IEEE Standards 279, "Criteria for Protection Systems for Nuclear power Generating Stations," and 603-1991, "Criteria for Safety Systems for Nuclear power Generating Stations." Describe how these systems meet each applicable clause of the applicable industry standard, as well as all other regulatory requirements.**

The CR-3 Final Safety Analysis Report Section 7.2.4 (Reference 7) states the EFIC System meets the requirements of IEEE 279-1971 as required by NUREG-0737, Item II.E.1.2. As stated in CR-3 EPU LAR Section 2.4.2.2, "Emergency Feedwater Initiation and Control (EFIC)," the EFIC pressure control circuitry is being modified to add the new safety-related FCS function for mitigating specific small break loss of coolant accidents (LOCAs) concurrent with inadequate HPI System flow. With the exception of the automatic transfer relaying scheme, the FCS function is separate from and independent of the EFIC System. No revision to the EFIC instrumentation requirements of CR-3 ITS 3.3.11, "Emergency Feedwater Initiation and Control System Instrumentation," (Reference 2) are required for EPU. Based on analysis, the control actions of the EFIC System will support the EPU. As a result, the EFIC System continues to meet applicable industry standards and other regulatory requirements as specified by the CR-3 current licensing and design basis.

The new ICCMS, FCS, ADVs, and affected portions of the EFIC System (e.g., automatic transfer relaying scheme) are currently being designed in accordance with the CR-3 EC process, with the conceptual design phase complete. The CR-3 EC process requires new safety-related systems be designed and installed in accordance with applicable industry codes and standards and other regulatory requirements as specified by the CR-3 current

licensing and design basis. As indicated in Appendix E, Enclosure 3 of the CR-3 EPU LAR (Reference 1, Attachment 7), the ICCMS is classified as a Class 1E, safety-related protection system, meeting the requirements of IEEE-603 and IEEE-279. The FCS and ADVs are also considered safety-related systems/components and are being designed/modified to meet the applicable industry codes and standards and other regulatory requirements as specified by the CR-3 current licensing and design basis in accordance with 10 CFR 50.55a(h)(2). The design specifications for the ICCMS, FCS, ADVs and affected portions of the EFIC System provide industry codes, standards, and regulatory requirements applicable to the design of each of these systems, including how these systems meet the relevant clauses of these documents. Enclosure 3, "IEEE 603-1991 and IEEE 279-1971 Compliance Matrix," provides a summary of how the ICCMS and FCS, including the protective system portions of the ADVs and affected portions of the EFIC System, will meet each applicable clause of IEEE 603-1991 and IEEE 279-1971. For clauses not met, the matrix identifies the CR-3 licensing basis alternative in accordance with 10 CFR 50.55a(h)(2). As stated in the List of Regulatory Commitments of the CR 3 EPU LAR (Reference 1, Attachment 10), EPU modifications will be installed prior to exceeding 2609 MWt. This includes installation of the ICCMS, FCS, and ADV modifications in accordance with the applicable industry codes and standards and other regulatory requirements as specified by the CR-3 current licensing and design basis.

4. **Provide instrument loop schematic diagrams and control logic diagrams including sufficient information to show the input, output parameter signal logic flow, and bistable devices which implement the setpoints for each FUNCTION of ICCMS to support the safety evaluation.**

Enclosure 4, "ICCMS Simplified Schematic and Control Logic Diagrams," provides simplified schematic diagrams showing the ICCMS input instruments (i.e., HPI flow, RCS pressure, and CETs), reactor trip status input, ICCMS initiation channel strings – including Loss of Subcooling Margin and Inadequate HPI Flow modules, ICCMS logic trains, and output logic flow to the actuated devices.

References

1. CR-3 to NRC letter dated June 15, 2011, "Crystal River Unit 3 – License Amendment Request #309, Revision 0, Extended Power Uprate." (Accession No. ML112070659)

2. Crystal River Unit 3 Improved Technical Specifications, Through Amendment 238.

3. NUREG-1430, "Standard Technical Specifications Babcock and Wilcox Plants," Revision 3.

4. Technical Specification Task Force (TSTF) Traveler – 493, "Clarify Application of Setpoint Methodology for LSSS Functions," Revision 4.

5. CR-3 plant procedure ICDC-1, "I&C Design Criteria for Instrument Loop Uncertainty Calculations," Revision 4.

6. NRC Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," Revision 3, December 1999.

7. Final Safety Analysis Report, Progress Energy Florida, Crystal River Unit 3, Revision 32.1.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ENCLOSURE 1

MARKUP OF PROPOSED ITS 3.3.19, INADEQUATE CORE COOLING MONITORING SYSTEM INSTRUMENTATION, AND ASSOCIATED BASES

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.19.3	------------------NOTES------------------ 1. If the as-found channel setpoint is conservative, but outside its predefined as-found acceptance criteria band, then the channel should be evaluated to verify that it is functioning as required before returning the channel to service. If the as-found instrument channel is not conservative, the channel shall be declared inoperable. 2. The instrument channel shall be reset to within, or more conservative than, the pre-established as-left tolerance: otherwise the channel shall not be returned to OPERABLE status. The pre-established tolerance and methodology used to determine the predefined as-found and as-left acceptance criteria are specified in the FSAR. -- Perform CHANNEL CALIBRATION.	24 months

The Allowable Value shall be:
a. Loss of Subcooling Margin Function: within the Acceptable Region specified in Figure 3.3.19-1; and
b. Inadequate HPI Flow Function: within the Acceptable Region specified in Figure 3.3.19-2.

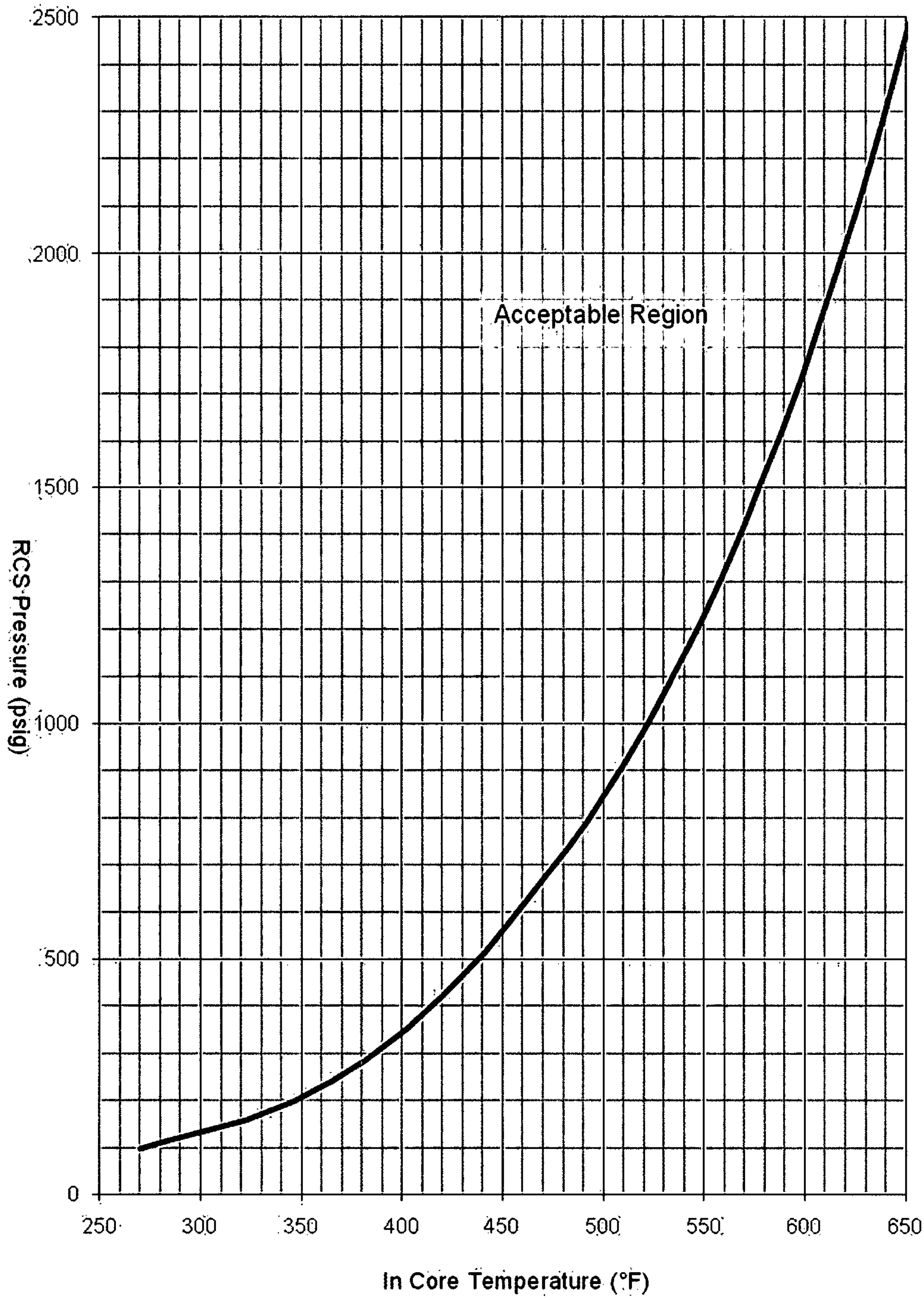


Figure 3.3.19-1 (page 1 of 1)
Loss of Subcooling Margin Allowable Value

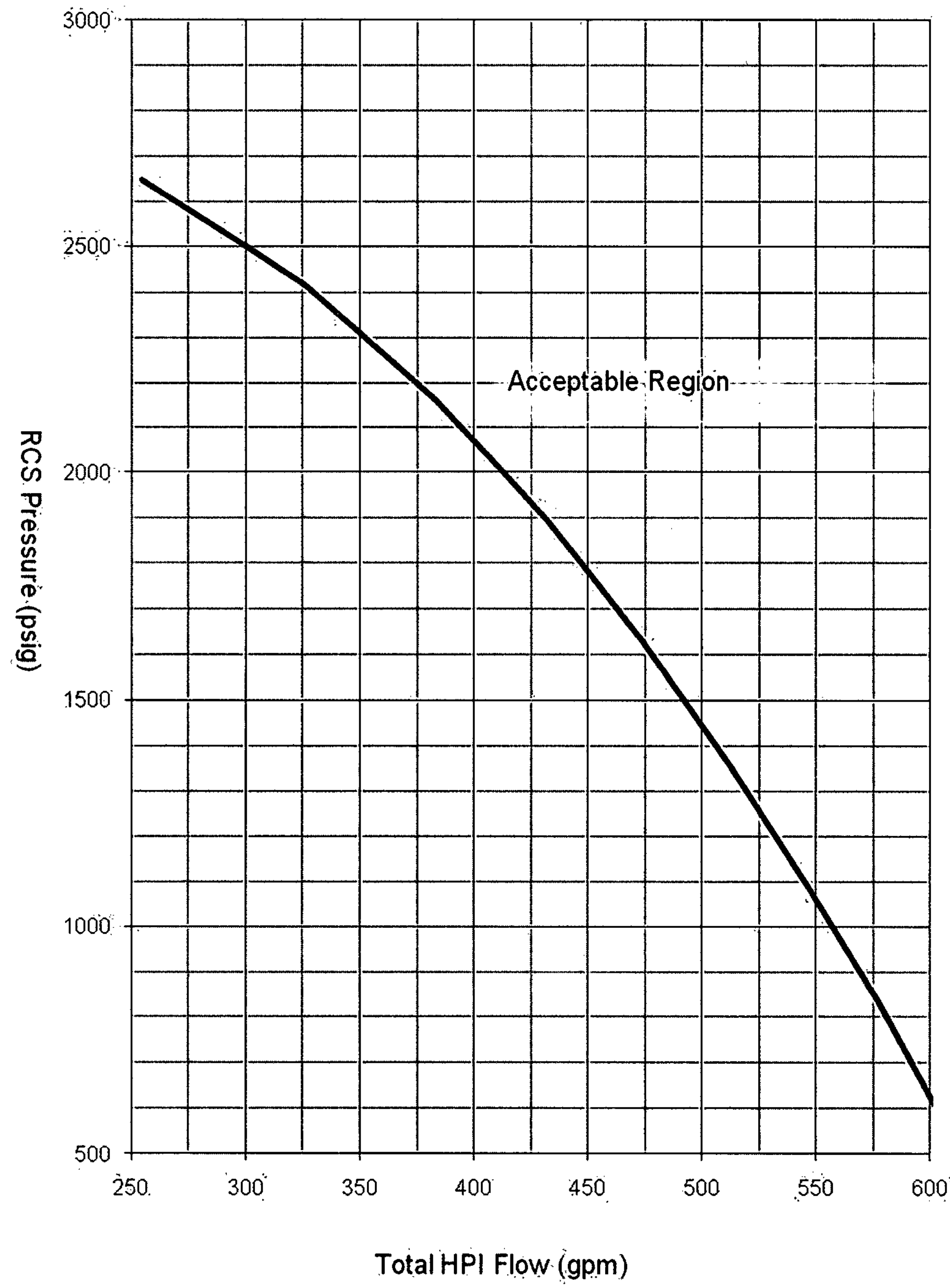


Figure 3.3.19-2 (page 1 of 1)
Inadequate HPI Flow Allowable Value

BASES

LCO

1.c, 2.b, 3.b Reactor Coolant Pressure - Wide Range (continued)

channel includes a sensor, function generator, and associated analog modules. The analog and bistable portions of each pressure channel are ICCMS initiation channel specific.

Therefore, failure of one channel renders one channel of the Reactor Coolant Pressure - Wide Range in one ICCMS initiation channel inoperable to each ICCMS actuation logic train.

Reactor Coolant Pressure - Wide Range Function is automatically selected when RCS pressure is > 500 psig. To ensure the Reactor Coolant Pressure - Wide Range Function is not bypassed when required to be OPERABLE by the safety analysis, each channel is required to be capable of automatically enabling on increasing RCS pressure when below the enabling setpoint.

1.d, 2.c, 3.c Core Exit Thermocouples (CETs)

One of two channels per core quadrant of CETs is required to be OPERABLE per ICCMS initiation channel. Each CET channel includes a sensor, temperature transmitter, and associated analog modules. Each CET channel is ICCMS initiation channel specific. Therefore, failure of one required CET in a core quadrant renders one required channel in one ICCMS initiation channel inoperable to each ICCMS actuation logic train.

1.e, 2.d, 3.d Loss of Subcooling Margin

One channel of Loss of Subcooling Margin is required to be OPERABLE per ICCMS initiation channel. Inputs are provided from the CETs and RCS pressure instruments. Actual saturation temperature is compared to a reference saturation temperature curve to determine a loss of subcooling margin. Each Loss of Subcooling Margin channel includes a comparator, function generator, and associated analog modules. Failure of one channel renders one ICCMS initiation channel inoperable to each ICCMS actuation logic train.

Insert B 3.3.19-1

Insert B 3.3.19-1

The Loss of Subcooling Margin Allowable Value is specified in Figure 3.3.19-1 and was selected to be conservative enough to detect a loss of subcooling margin thus ensuring the reactor coolant pumps trip will before reaching two phase conditions within the RCS during LOCAs with loss of offsite power available. The Allowable Value includes severe environment induced errors because ICCMS input sensors and associated instrumentation (e.g., RCS pressure sensors and transmitters) must function in a harsh environment as defined in 10 CFR 50.49 (Ref. 4).

BASES

LCO (continued)

1.f Inadequate HPI Flow

One channel of Inadequate HPI Flow is required to be OPERABLE per ICCMS initiation channel of the FCS Actuation Function. The total HPI flow input is compared to a generated curve of HPI flow versus RCS Pressure to determine inadequate HPI flow. Each Inadequate HPI Flow channel includes an actual HPI flow input, reference RCS pressure input, comparator, function generator, and associated analog modules. Failure of one channel renders one ICCMS initiation channel inoperable to each FCS actuation logic train.

Insert B 3.3.19-2

1.g, 2.e, 3.e Reactor Trip Status

Six channels of Reactor Trip Status are required to be OPERABLE per ICCMS initiation channel. Each Reactor Trip Status channel includes an auxiliary contact and associated analog modules. Each ICCMS initiation channel receives six independent auxiliary contacts from the CRD trip breakers. Therefore, the auxiliary contacts of the Reactor Trip Status Function channels are ICCMS initiation channel specific. Failure of an auxiliary contact renders one Reactor Trip Status Function channel in one ICCMS initiation channel inoperable.

APPLICABILITY

The ICCMS instrumentation channels are applicable as specified in Table 3.3.19-1.

FCS Actuation Functions

The ICCMS instrumentation required to actuate FCS shall be OPERABLE with THERMAL POWER > 2609 MWt. The FCS and operation of the ADVs are assumed with THERMAL POWER > 2609 MWt. With THERMAL POWER ≤ 2609 MWt, the ECCS provides sufficient core cooling during a small break LOCA assuming a single failure of one HPI subsystem without the need for the FCS function of the ADVs.

RCP Trip Functions

The ICCMS instrumentation required to trip the RCPs shall be OPERABLE in MODES 1, 2, and 3 to minimize the rate of inventory loss which would reduce the time to the core becoming uncovered during a LOCA.

Insert B 3.3.19-2

The Inadequate HPI Flow Allowable Value is specified in Figure 3.3.19-2 and was selected to be conservative enough to ensure adequate HPI flow is available during a SBLOCA. The Allowable Value includes severe environment induced errors because ICCMS input sensors and associated instrumentation (e.g., RCS pressure sensors and transmitters) must function in a harsh environment as defined in 10 CFR 50.49 (Ref. 4).

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.19.3 (continued)

instrument calculations. The purpose of the assessment is to ensure confidence in the channel performance prior to returning the channel to service. For channels determined to be OPERABLE but degraded after returning the channel to service, the performance of these channels will be evaluated under the plant Corrective Action Program (CAP). Entry into the CAP will ensure required review and documentation of the condition.

The second Note requires the as-left setting for the channel be returned to within, or more conservative than, the pre-established as-left tolerance. Where a setpoint more conservative than the pre-established as-left tolerance is used in the plant surveillance procedures, the as-left and as-found tolerances, as applicable will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the Safety Limit and/or Analytical Limit is maintained. If the as-left channel setting cannot be returned to a setting within the pre-established as-left tolerance, then the channel shall be declared inoperable. The second Note also requires the pre-established tolerance and the methodologies for calculating the as-left and the as-found tolerances be in the FSAR (Ref. 1).

REFERENCES

1. FSAR, Section [7.3.4].
2. CR-3 EPU Technical Report, Section 2.8.5.6.3.
3. FSAR, Chapter 14.2.2.
4. 10 CFR 50.49.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ENCLOSURE 2

ICCMS INSTRUMENTATION SETPOINT METHODOLOGY AND SUMMARY CALCULATIONS

ICCMS INSTRUMENTATION SETPOINT METHODOLOGY AND SUMMARY CALCULATIONS

1.0 INTRODUCTION

The purpose of this document is to provide a summary description of the Crystal River Unit 3 (CR-3) setpoint methodology used to determine the Limiting Trip Setpoint (LTSP), Nominal Trip Setpoint (NTSP), Allowable Value (AV), As-Found Tolerance (AFT), and As-Left Tolerance (ALT) for the Loss of Subcooling Margin and Inadequate HPI Flow Functions of the Inadequate Core Cooling Monitoring System (ICCMS) in support of the CR-3 Extended Power Uprate (EPU) Project.

The new CR-3 Improved Technical Specification (ITS) 3.3.19, "Inadequate Core Cooling Monitoring System (ICCMS) Instrumentation," ensures that adequate core protection is provided for a specific range of small break loss of coolant accidents (LOCAs). The ICCMS detects a loss of SCM and initiates mitigation functions based on this condition. The ICCMS also detects inadequate high pressure injection (HPI) flow and initiates a mitigation function based on this condition. As a result, these functions, Loss of Subcooling Margin and Inadequate HPI Flow Functions, are the only ICCMS instrument functions with Limiting Safety System Setting trip setpoint values. All other instrument functions listed in ITS Table 3.3.19-1 are instrument inputs to either the Loss of Subcooling Margin Function or the Inadequate HPI Flow Function.

The ICCMS consists of three initiation channels which provide input to two actuation logic trains. Each actuation logic train is initiated by two-out-of-three ICCMS initiation channels. Either actuation logic train initiates the associated equipment. The input parameters are processed in the ICCMS circuitry to determine subcooling margin and HPI flow margin.

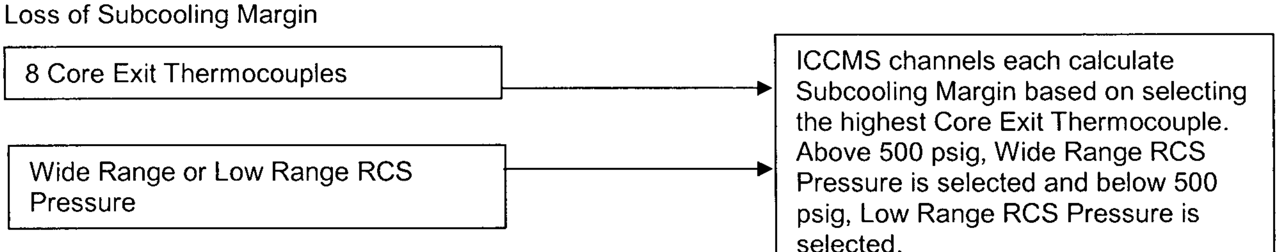
Each ICCMS initiation channel receives input from the core exit thermocouples and Reactor Coolant System (RCS) pressure instruments to determine if a loss of subcooling margin (SCM) exists. When inadequate SCM is coincident with a reactor trip signal, each ICCMS initiation channel will generate a loss of SCM signal.

Additionally, each ICCMS initiation channel receives HPI System flow input from each of the four HPI System injection lines. The four signals are summed and the total HPI flow is provided to determine inadequate HPI flow. Upon a sustained loss of SCM coincident with a reactor trip signal and inadequate HPI flow, each ICCMS initiation channel will generate a trip signal.

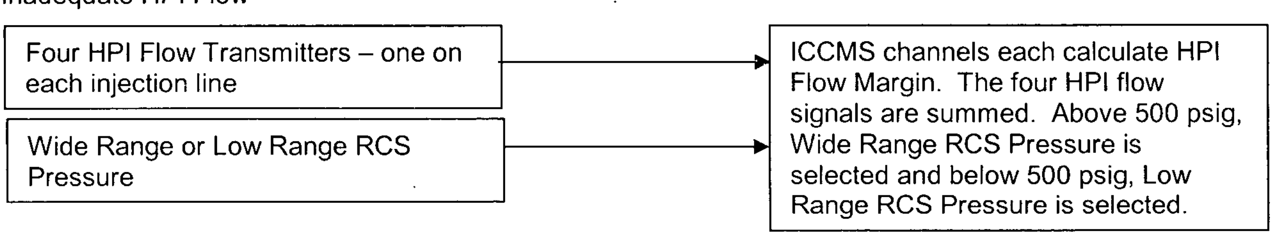
The following are simplified block diagrams of the ICCMS instrument loops indicating the input parameters associated with the Loss of Subcooling Margin and Inadequate HPI Flow Functions.

1.1 Instrument Loops

Loss of Subcooling Margin



Inadequate HPI Flow



2.0 SETPOINT METHODOLOGY

The CR-3 setpoint methodology is described in CR-3 plant procedure ICDC-1, "I&C Design Criteria for Instrument Loop Uncertainty Calculations," (Reference 1). Per ICDC-1, the CR-3 setpoint program establishes four category levels with Category A being the most stringent. Category A calculations are consistent with the calculation methodology of ISA-S67.04, Part I, "Setpoints for Nuclear Safety-Related Instrumentation," (Reference 2) and ISA-RP67.04, Part II, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," (Reference 3) and meet the 95/95 tolerance limit as identified in Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," (Reference 4).

At CR-3, Category A applies to, but is not limited to, the Reactor Protection System, Emergency Feedwater Initiation and Control System and Engineered Safeguards Actuation System instrumentation calculations.

The ICCMS instrumentation calculations associated with the Loss of Subcooling Margin and Inadequate HPI Flow Functions utilize ICDC-1 Category A setpoint methodology. The ICCMS instrument setpoints are derived from the safety analysis values (i.e., analytical limit) and are corrected for sources of uncertainty as defined in ICDC-1 (Reference 1). The methodology used for combining uncertainties for CR-3 Technical Specification setpoints utilizes the Square Root of the Sum of the Squares (SRSS) taken at 2 sigma (∑) confidence level for random uncertainties and taken at 3∑ confidence level for direct summation of systematic (correlated) uncertainties. The amount of uncertainty by which a setpoint can deviate from the Technical Specification setpoint is identified as allowable uncertainty. The field setting is the Technical Specification setpoint offset by the allowable uncertainty.

The instrument Calibrated Loop Error (CE_{LOOP}) is the overall instrument error and is used to determine setpoints (NTSP and LTSP) and Allowable Values from the analytical limit or design limit. The following algebraic expression is used to determine the overall instrument error:

$$CE_{LOOP} = \pm [(E_{LOOP})^2 + (AF_{LOOP})^2]^{1/2} \pm E_{BIAS} \pm E_{PROCESS}$$

Calculated Loop Error (E_{LOOP}) is the instrument channel error, not taking into account calibration, drift, process errors and known biases. The following algebraic expression is used to determine the calculated instrument channel error:

$$E_{LOOP} = \pm [(E_{COMP1})^2 + (E_{COMP2})^2 + (E_{COMPN})^2]^{1/2}$$

Component Error (E_{COMP}) is the SRSS of the errors associated with an individual component (i.e., Reference Accuracy, Temperature Effect, etc.), with the exception of Drift.

Bias Errors (E_{BIAS}) are known biases that affect the operation of an instrument loop, such as static pressure shifts, insulation resistance effects, etc.

Process Errors ($E_{PROCESS}$) are the errors that result from the range of process operation limits, based on the scaling of the sensing instruments. These errors include either normal or accident conditions.

The ALT or Calibration Tolerance (AL_{LOOP}) is the tolerance to which an instrument channel loop is left after calibration. This term is determined from the Reference Accuracy (E_{REF}) of the components. The following algebraic expression is used to determine the ALT:

$$AL_{LOOP} = \pm [(COMP1\text{-}E_{REF})^2 + (COMP2\text{-}E_{REF})^2 + (COMPN\text{-}E_{REF})^2]^{1/2}$$

The AFT (AF_{LOOP}) is the tolerance in which an instrument channel loop can be found after a period of operation, prior to calibration. This term includes the errors due to M&TE and Drift/Stability. The following algebraic expression is used to determine the AFT:

$$AF_{LOOP} = \pm \{ALT + [(MTE_{LOOP})^2 + (SB_{LOOP})^2]^{1/2}\}$$

Maintenance & Test Equipment (M&TE) error (MTE_{LOOP}) consists of the errors due to the M&TE used in the calibration of the instrument loop.

Stability/Drift (SB_{LOOP}) is the error due to the stability and drift of the components in the loop.

The new instrument calculations use the existing AFT and ALT from instrument loop uncertainty calculations associated with the existing ICCMS input instrumentation. The existing AFT and ALT are also assumed for the new ICCMS input instrumentation. These instrument tolerances form the basis for the AVs of the Loss of Subcooling Margin and Inadequate HPI Flow Margin Functions. Since the summary calculations are bounding calculations for the ICCMS instrumentation and no plant-specific margin has been added, the NTSP is equal to the LTSP. Future adjustments to these instrument calculations may be required as a result of instrument component changes. As a result, a less conservative LTSP may be established thereby allowing for additional instrument margin being available to maintain the trip setting at the existing NTSP. In this event, the NTSP may be more conservative than the LTSP. If the NTSP is set more conservative than the LTSP, the AFT and ALT will be maintained around the more conservative NTSP. For the purposes of this report, all references to the NTSP equate to the LTSP.

The Allowable Value is the limiting value at which an instrument trip setting may be found, when tested periodically, beyond which appropriate action must be taken. The Allowable Value is determined by the instrument calculations considering the maximum possible value for process measurement at which the analytical limit is protected. Maintaining the instrument channel within the Allowable Value ensures the analytical limit and associated safety limit are protected. For the ICCMS instrumentation, the AFT for the bounding calculations is conservative and therefore, the Allowable Value is equal to the AFT on the non-conservative side of the LTSP. Future adjustments to these instrument calculations may also result in a more conservative AFT or NTSP. In this event, the AFT will be more conservative than the Allowable Value.

The following provides a simplified visual presentation of the above terms consistent with the guidance of Regulatory Guide 1.105 (Reference 4):

Safety Limit ----------------------

Analytical Limit ----------------------

CE_{LOOP}

Difference between Analytical Limit AL and NTSP is CE_{LOOP}.

$$CE_{LOOP} = \pm [(E_{LOOP})^2 + (AF_{LOOP})^2]^{1/2} \pm E_{BIAS} \pm E_{PROCESS}$$

Allowable Value	----------------------	AFT+
ALT+	----------------------	ALT+
NTSP	----------------------	LTSP
ALT -	----------------------	ALT-
AFT-	----------------------	AFT-

NOTE: The Allowable Value is equivalent to AFT on the non-conservative side of the NTSP.

Normal Operating Point ----------------------

3.0 SUMMARY OF ICCMS INSTRUMENT CALCULATIONS

The analytical limit for ICCMS is based on meeting the Emergency Core Cooling System (ECCS) criteria to mitigate a small break LOCA as defined in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." The ICCMS initiates the Fast Cooldown System (FCS) to support the ECCS meeting the 10 CFR 50.46 criteria. The calculations begin with the identification of the analytical limits for Loss of Subcooling Margin and Inadequate HPI Flow Functions and derive the Allowable Value settings based on these analytical limits.

The analytical limit for the Inadequate HPI Flow Function is derived from small break LOCA analyses which determined the minimum required HPI flow, corrected for RCS pressure and HPI flow uncertainty. For the Loss of Subcooling Margin Function, the analytical limit is the T_{SAT} curve defined in American Society of Mechanical Engineers (ASME) Steam Tables (Reference 5).

3.1 Input Parameter Instrument Calculations

Current CR-3 approved instrument calculations provide the AFT and ALT for the RCS pressure transmitters, HPI flow transmitters, and in-core thermocouples that provide input to the ICCMS for determination of a loss of SCM and inadequate HPI flow. These calculations were performed in accordance with CR-3 plant procedure ICDC-1 setpoint methodology (Reference 1) and provide the AFT, ALT and CE_{LOOP}. ICCMS input parameter instrument calculations will be revised during finalization of the ICCMS modification. If the final calculations result in larger values for AFT, ALT, or CE_{LOOP}, the NTSP will be adjusted in the conservative direction maintaining the same Allowable Value.

For calculation purposes, a 30-month interval is used to compute CE_{LOOP} to account for a surveillance frequency interval of 24 months plus 25% as allowed by the CR-3 ITS.

3.2 Calculation of Allowable Values for Loss of Subcooling Function

A summary of the Loss of Subcooling Function initial instrument calculation is provided and a final calculation which will be completed during finalization of the ICCMS modification. The final calculation will preserve the Allowable Value established in the initial calculation.

The CE_{LOOP} from the input parameter instrument calculations are currently used to determine the display error for T_{SAT} on the CR-3 Safety Parameter Display System (SPDS). The SPDS instrument calculation uses the Monte Carlo method to establish the T_{SAT} display error and these display errors are used to generate the curves for T_{SAT} in the SPDS.

The current SPDS instrument calculation lists 32 data points from the SCM curve; both temperature and pressure points. The calculation uses linear interpolation for intermediate values. The SCM data points and methods of interpolation are also used to determine the AFT and Allowable Value for the Loss of Subcooling Margin Function. The following are the existing AFT and ALT from the existing SPDS calculation:

Table 3.2-1, SPDS Tolerances

Calculation	Recall Points	ALT	AFT
RCS Wide Range Pressure	Recall-4 and Recall-5	±11.3 psig ,±0.45%	±25.8 psig, ±1.03%
T_{INCORE}	N/A	±4.78°F, ±0.19%	±6.21°F, ±0.25%

The analytical limit is the T_{SAT} curve as indicated in Figure 3.2-1 and is obtained from the ASME Steam Tables. This ensures the reactor coolant pumps are tripped before reaching two phase conditions in the RCS during LOCAs with offsite power available. The Loss of Subcooling Function NTSP is conservatively established as the SCM curve from the SPDS instrument calculation as indicated on Figure 3.2-1. This SCM curve is obtained by calculating the total CE_{LOOP} and adding it to the T_{SAT} curve.

The AFT for the Loss of Subcooling Function is determined by using the AFT values from the RCS pressure and T_{INCORE} instrumentation calibration tolerances listed in Table 3.2-1. Pressures (P_{NTSP}) are selected from the data table in the current SPDS instrument calculation. The AL, AV, NTSP, AFT and ALT are expressed in units of temperature.

The Loss of Subcooling Allowable Value, in units of temperature, is obtained as follows:

- Select a P_{NTSP} from the SPDS data table (Table 3.2-3).
- Add AFT_{PRESS} (25.8 psig) to obtain P_{AV}.
- Using P_{AV} perform linear interpolation to obtain associated temperature T_A
- Add AFT_{TEMP} (6.21°F) to T_A to obtain T_{AV}
- The Allowable Value is T_{AV} and is for a given pressure - P_{AV}.

Example:

P_{NTSP} is 1967.3 psig. Add the AFT of 25.8 psig from Table 3.2-1 which results in 1993.1 psig. Linearly interpolate between $T_{(N)}$, $P_{(N)}$ and $T_{(N+1)}$, $P_{(N+1)}$ to obtain the temperature that corresponds to 1993.1 psig. This is 612.48°F. Add the AFT for the incore temperature (T_{INCORE}) from the incore thermocouple loop accuracy calculation and listed in Table 3.2-1 which is 6.21°F.

T_{AV} = 612.48°F + 6.21°F = 618.69°F
$T_{(N)}$ is the NTSP = 610.58°F
AFT = 618.69°F – NTSP = 618.69°F - 610.58°F = 8.11°F
Allowable Value = 618.69°F

A similar method is used to obtain the ALT.

- Select P_{NTSP} from the SPDS data table (Table 3.2-3).
- Add ALT_{PRESS} (11.3 psig) to obtain P_{AV}.
- Using P_{AV} perform linear interpolation to obtain associated temperature T_A
- Add ALT_{TEMP} (4.78°F) to T_A to obtain ALT

The following table provides a list of results from the above Loss of Subcooling Function instrument setpoint methodology using selected RCS pressure values:

Table 3.2-2

Selected Pressure (psig)	650.00	887.30	1187.30	1587.30	1967.30	2500
Analytical Limit (°F)	497.35	532.22	567.40	605.04	634.52	668.98
AV (°F)	471.54	510.15	548.06	587.87	618.69	654.52
NTSP (°F)	460.53	500.30	539.00	579.41	610.58	646.66
AFT (°F)	±11.01	±9.85	±9.06	±8.46	±8.11	±7.86
ALT (°F)	±6.88	±6.38	±6.03	±5.76	±5.61	±5.50

The following is a summary table using the 32 data points from the SCM curve of the SDPS instrument calculation. These data points are provided in the NTSP columns. The AL pressures are also provided from the SPDS instrument calculation and the temperatures (T_{SAT}) are from the ASME Steam Tables. The AV, AFT and ALT are generated using the methodology described above.

Table 3.2-3

Analytical Limit (AL)		**NTSP**		**Allowable Value (AV)**		**Tolerances**	
Pressure (psig)	**T_{SAT} (°F)**	**NTSP pressure (psig)**	**NTSP temperature (°F)**	**Allowable Value (psig)**	**Allowable Value (°F)**	**AFT (°F)**	**ALT (°F)**
72.30	317.89	72.3	212.96	83.60	239.93	56.88	26.97
91.16	331.96	91.16	250	102.46	267.70	35.71	17.70
132.30	356.84	132.3	297.04	143.60	310.08	25.06	13.04
172.30	376.21	172.3	326.27	183.60	337.19	20.23	10.92
213.30	392.94	213.3	348.55	224.60	357.81	16.45	9.26
259.30	409.12	259.3	366.8	270.60	375.29	14.68	8.49
328.30	429.81	328.3	389.44	339.60	397.31	13.27	7.87
397.30	447.50	397.3	408.31	408.60	415.70	12.18	7.39
489.30	467.83	489.3	429.6	500.60	436.70	11.50	7.10
535.30	476.94	535.3	439.03	546.60	445.94	11.06	6.91
604.30	489.57	604.3	452.01	615.60	458.90	11.02	6.89
650.00	497.35	650	460.53	661.30	467.41	11.01	6.88
707.30	506.54	707.3	471.2	718.60	477.93	10.67	6.73
767.30	515.60	767.3	481.57	778.60	488.17	10.36	6.60
827.30	524.13	827.3	491.23	838.60	497.72	10.11	6.49

Analytical Limit (AL)		NTSP		Allowable Value (AV)		Tolerances	
Pressure (psig)	T_{SAT} (°F)	NTSP pressure (psig)	NTSP temperature (°F)	Allowable Value (psig)	Allowable Value (°F)	AFT (°F)	ALT (°F)
887.30	532.22	887.3	500.3	898.60	506.68	9.85	6.38
967.30	542.38	967.3	511.6	978.60	517.88	9.63	6.28
1027.30	549.60	1027.3	519.56	1038.60	525.76	9.44	6.20
1107.30	558.74	1107.3	529.58	1118.60	535.69	9.25	6.11
1187.30	567.40	1187.3	539	1198.60	545.03	9.06	6.03
1287.30	577.62	1287.3	550.06	1298.60	556.01	8.88	5.95
1387.30	587.26	1387.3	560.42	1398.60	566.30	8.73	5.88
1487.30	596.38	1487.3	570.18	1498.60	576.00	8.59	5.82
1587.30	605.04	1587.3	579.41	1598.60	585.17	8.46	5.76
1707.30	614.89	1707.3	589.87	1718.60	595.58	8.33	5.71
1825.00	624.05	1825	599.55	1836.30	605.21	8.21	5.66
1967.30	634.52	1967.3	610.58	1978.60	616.19	8.11	5.61
2068.14	641.58	2068.14	618	2079.44	623.57	8.00	5.57
2247.30	653.47	2247.3	630.46	2258.60	635.96	7.86	5.50
2500.00	668.98	2500	646.66	2511.30	652.16	7.86	5.50

Figure 3.2-2 presents a graphical representation of the AL, AV and NTSP based on Table 3.2-3. The margin between the AV and the NTSP is the AFT and this margin increases as the pressure and temperature decrease.

3.3 Calculation for HPI Flow Margin

A summary of the Inadequate HPI Flow Function initial instrument calculation is provided and a final calculation which will be completed during finalization of the ICCMS modification. The final calculation will preserve the Allowable Value established in the initial calculation.

Conservative error corrected RCS pressure and total HPI flow were established in an analysis performed to determined the minimum required HPI flow for small break LOCAs at EPU conditions. The error corrections for RCS pressure and total HPI flow are 150 psig and 50 gpm, respectively, and are conservative and larger than the existing CE_{LOOP} for both parameters. Figure 3.3-1 shows the minimum required HPI flow for small break LOCAs at EPU conditions. The following tables (Tables 3.3-1 and 3.3-2) provide a list indicating the relationship between RCS pressure and total HPI flow:

Table 3.3-1
Non-error Corrected – Analytical Limit

RCS Pressure (psig)	Total Flow (gpm)
0	608.5
600	546.5
900	511.7
1200	473.6
1500	431.2
1800	383
2100	326.2
2400	254.4

Table 3.3-2
Error Corrected – NTSP

RCS Pressure (psig)	Total Flow (gpm)
150	658.5
750	596.5
1050	561.7
1350	523.6
1650	481.2
1950	433
2250	376.2
2550	304.4

These cardinal points are used to establish values at a given total HPI flow. The non-error corrected points represent the minimum required HPI flow for small break LOCAs at EPU conditions and therefore

are considered the analytical limit. The error corrected points are considered the NTSP and are represented by the following algebraic expression:

$y = -0.0095\,(x)^2 + 2.4222\,(x) + 2693$ Equation 3.3-1

where y corresponds to RCS Pressure and x corresponds to total HPI flow

The following table provides the AFT and ALT values used in the existing CR-3 HPI System flow loop accuracy instrument calculation:

Table 3.3-3

Calculation	Recall Points	ALT	AFT
RCS Wide Range Pressure	Recall-4 and Recall-5	±0.45%, ±11.3 psig	±1.03%, ±25.8 psig
HPI Flow	Recall-260, 261, 262 and 263	±1.0 gpm (one transmitter)	±4.0 gpm (one transmitter)

A flow AFT associated with the Inadequate HPI Flow instrument loop is established by considering the AFT of 4 gpm from each HPI flow instrument loop and combining the individual loop AFTs using the SRSS method which yields; $[(4.0)^2 + (4.0)^2 + (4.0)^2 + (4.0)^2]^{1/2}$ or ±8 gpm.

The pressure AFT associated with the Inadequate HPI Flow instrument loop is established by using a two-step process and an input pressure AFT of 25.8 psig from the existing wide range RCS pressure loop accuracy instrument calculation.

Similarly, the Inadequate HPI flow instrument loop flow ALT is derived by using the SRSS method and yields ±2.0 gpm. The Inadequate HPI flow instrument loop pressure ALT is derived from an input pressure ALT of 11.3 psig from the existing wide range RCS pressure loop accuracy instrument calculation.

To determine the Allowable Value a two step process is used. The Allowable Value, in units of pressure, is obtained as follows:

- Select HPI flow from non-corrected error total HPI flow value data table (Table 3.3-1).
- Add AFT_{HPI} (8 gpm) to obtain F_{NEW}.
- Using Equation 3.3-1 obtain P_{NEW}
- Subtract AFT_{PRESS} (25.8 psig) from P_{NEW} to obtain the Allowable Value
- The Allowable Value is for a given flow F_{AV}

Example:

The overall HPI flow AFT of 8 gpm is added to the non-corrected error total HPI flow value (Table 3.3.1) as follows:

473.6 gpm + 8 gpm = 481.6 gpm

The resulting HPI flow value is used to calculate a resulting RCS pressure

$y = -0.0095 * (481.6)^2 + 2.4222 * (481.6) + 2693$
$y = 1656.12$ psig

The RCS wide range pressure AFT of 25.8 psig is subtracted yielding:

Allowable Value = 1656.12 – 25.8 = 1630.32 psig

The overall Inadequate HPI Flow Function instrument loop pressure AFT is determined as follows:

For x = 473.6 gpm

$y = -0.0095 *(473.6)^2 + 2.4222*(473.6) + 2693$

$y = 1709.33$ psig (P_{NTSP})

AFT = $P_{NTSP} - P_{AV}$ = 1709.33 – 1630.32 psig = 79.02 psig

Table 3.3-4

Assumed HPI Total Flow (gpm)	546.50	511.70	473.60	431.20	383.00	326.20	254.40
Analytical Limit (psig)	600	900	1200	1500	1800	2100	2400
Allowable Value (psig)	1089.34	1360.18	1630.32	1898.51	2161.91	2415.65	2648.67
NTSP/LTSP (psig)	1179.44	1444.99	1709.33	1971.08	2227.16	2472.26	2694.37
AFT (psig)	±90.10	±84.81	±79.02	±72.57	±65.25	±56.61	±45.70
ALT (psig)	±27.26	±25.94	±24.49	±22.88	±21.05	±18.89	±16.16

To generate intermediate points, Excel 2007 was used to graph the selected pressure and Allowable Value temperatures as an X-Y scatter plot. A trend line was applied to the curve and a curve fit was performed for the Inadequate HPI flow Allowable Value and the following algebraic expression was obtained:

$y = -0.0095*x^2 + 2.2702*x + 2686$ Equation 3.3-2

where x represents total HPI flow in gpm and y represents RCS pressure in psig

This curve closely matches the calculated Allowable Values at selected RCS pressures and is off-set by less than 0.1 psig as shown in Table 3.3-5:

Table 3.3-5

RCS Pressure Analytical Limit (psig)	Total HPI Flow Analytical Limit (gpm)	RCS Pressure AV (psig)	Curve Fit (psig)	Error (Allowable Value – Curve Fit)
600	546.5	1089.34	1089.37	-0.03
900	511.7	1360.18	1360.21	-0.03
1200	473.6	1630.32	1630.35	-0.03
1500	431.2	1898.51	1898.54	-0.03
1800	383	2161.91	2161.94	-0.03
2100	326.2	2415.65	2415.68	-0.03
2400	254.4	2648.67	2648.70	-0.03

A curve fit was performed using Table 3.3-1 data from 600 psig to 2400 psig. 0 psig was not used since the small break LOCA analysis assumes FCS lowers and controls secondary pressure to approximately 350 psig. The curve fit resulted in the following algebraic expression:

$y = -0.0095*x^2 + 1.4755*x + 2639.5$ Equation 3.3-3

A comparison of the errors in this curve fit with the points from the minimum HPI flow analysis for small break LOCAs yield the following:

Table 3.3-6

Flow (gpm)	EPU Analysis Points (psig)	Curve fit (psig)	Error
608.5	0	19.76	-19.76
546.5	600	608.57	-8.57
511.7	900	907.06	-7.06
473.6	1200	1207.48	-7.48
431.2	1500	1509.37	-9.37
383	1800	1811.07	-11.07
326.2	2100	2109.95	-9.95
254.4	2400	2400.03	-0.03

As indicated by Table 3.3-6, the curve fit is conservative with respect to the minimum HPI flow analysis data table because the curve fit predicts a higher pressure at all points.

3.3.1 <u>Summary of algorithms for the Inadequate HPI Flow Function</u>

Analytical Limit: $y = -0.0095*x^2 + 1.4755*x + 2639.5$ Equation 3.3-3

Allowable Value: $y = -0.0095*x^2 + 2.2702*x + 2686$ Equation 3.3-2

NTSP: $y = -0.0095 (x)^2 + 2.4222 (x) + 2693$ Equation 3.3-1

where y corresponds to RCS Pressure
and x corresponds to total HPI flow

Figure 3.3-2 shows the resulting curves for the analytical limit, Allowable Value, and NTSP.

4.0 <u>RESULTS/CONCLUSIONS</u>

4.1 <u>Loss of Subcooling Margin Function</u>

Selected Pressure	650 psig	887.30 psig	1187.30 psig	1587.30 psig	1967.30 psig	2500 psig
Analytical Limit	497.35°F	532.22°F	567.40°F	605.04°F	634.52°F	668.98°F
Allowable Value	471.54°F	510.15°F	548.06°F	587.87°F	618.69°F	654.52°F
LTSP/ NTSP	460.53°F	500.30°F	539.00°F	579.41°F	610.58°F	646.66°F
AFT	±11.01°F	±9.85°F	±9.06°F	±8.46°F	±8.11°F	±7.86°F
ALT	±6.88°F	±6.38°F	±6.03°F	±5.56°F	±5.61°F	±5.50°F

Safety Limit	----------------------	N/A
Analytical Limit	----------------------	605.04°F
	CE_{LOOP}	
Allowable Value	----------------------	587.87°F
ALT +	----------------------	584.97°F
LTSP/NTSP	----------------------	579.41°F
ALT -	----------------------	573.85°F
AFT-	----------------------	570.95°F
Normal Operating Point	----------------------	~550°F

Difference between Analytical Limit AL and NTSP is CE_{LOOP}.
$CE_{LOOP} = \pm [(E_{LOOP})^2 + (AF_{LOOP})^2]^{1/2} \pm E_{BIAS} \pm E_{PROCESS}$

NOTE: The Normal Operating Point is the post reactor trip RCS temperature. For a normal trip ~550°F is the Normal Operating Point.

All of the temperature data points in this graphical representation assume an RCS pressure of 1587.30 psig.

4.2 <u>Inadequate HPI Flow Margin</u>

Assumed HPI Total Flow	546.50 gpm	511.70 gpm	473.60 gpm	431.20 gpm	383.00 gpm	326.20 gpm	254.40 gpm
Analytical Limit	600 psig	900 psig	1200 psig	1500 psig	1800 psig	2100 psig	2400 psig
Allowable Value	1089.34 psig	1360.18 psig	1630.32 psig	1898.51 psig	2161.91 psig	2415.65 psig	2648.67 psig
LTSP/NTSP	1179.44 psig	1444.99 psig	1709.33 psig	1971.08 psig	2227.16 psig	2472.26 psig	2694.37 psig
AFT	±90.10 psig	±84.81 psig	±79.02 psig	±72.57 psig	±65.25 psig	±56.61 psig	±45.70 psig
ALT	±27.26 psig	±25.94 psig	±24.49 psig	±22.88 psig	±21.05 psig	±18.89 psig	±16.16 psig

Safety Limit	----------------------	N/A
Analytical Limit	----------------------	1500 psig
	CE_{LOOP}	
Allowable Value	----------------------	1898.51 psig
ALT-	----------------------	1948.2 psig
LTSP/NTSP	----------------------	1971.08 psig
ALT+	----------------------	1993.96 psig
AFT+	----------------------	2043.65 psig
Normal Operating Point	----------------------	~2200 psig

Difference between Analytical Limit AL and NTSP is CE_{LOOP}.
$CE_{LOOP} = \pm [(E_{LOOP})^2 + (AF_{LOOP})^2]^{1/2} \pm E_{BIAS} \pm E_{PROCESS}$

NOTE: The Normal Operating Point is based on a 2-Pump curve operating curve.

All of the pressure data points in this graphical representation assume a total HPI flow of 431.2 gpm.

5.0 TECHNICAL SPECIFICATION APPLICATION OF INSTRUMENT SETPOINTS

The Loss of Subcooling Margin and Inadequate HPI Flow Functions are demonstrated Operable by applying the following guidance during instrument Channel Calibrations and Channel Functional Tests: If the instrument setting is found within the ALT, the results are recorded in the surveillance procedure and no further action is required for the instrument surveillance.

If the instrument setting is found outside the ALT but within the AFT, the instrument setting is reset to within the ALT, and no further action is required for the instrument surveillance.

If the instrument setting is found outside the AFT but conservative with respect to the Allowable Value, the channel is Operable, but considered degraded. The degraded condition must be further evaluated during performance of the surveillance. This evaluation, as a minimum, consists of resetting the instrument setting to the LTSP/NTSP (within the ALT) and evaluating the channel response. If the channel is functioning as required and expected to pass the next surveillance, then the channel is Operable and can be restored to service at the completion of the surveillance. Also, for channels determined to be Operable but degraded after returning the channel to service, the performance of these channels will be evaluated under the CR-3 Corrective Action Program (CAP). Entry into the CAP will ensure required review and documentation of the condition.

If the instrument setting is found non-conservative to the Allowable Value, the channel is inoperable until the instrument setting is reset to the LTSP/NTSP (within the ALT), and any evaluations necessary to return the channel to service are completed. The instrument setting may be more conservative than the LTSP provided the AFT and ALT are applied to the actual instrument setting (NSTP) used to confirm channel performance.

6.0 REFERENCES

1. CR-3 plant procedure ICDC-1, "I&C Design Criteria for Instrument Loop Uncertainty Calculations," Revision 4.
2. ISA-S67.04, Part I, "Setpoints for Nuclear Safety-Related Instrumentation," September 1994.
3. ISA-RP67.04, Part II, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," September 1994.
4. NRC Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," Revision 3, December 1999.
5. ASME Steam Tables For Industrial Use, Second Edition, 1967.

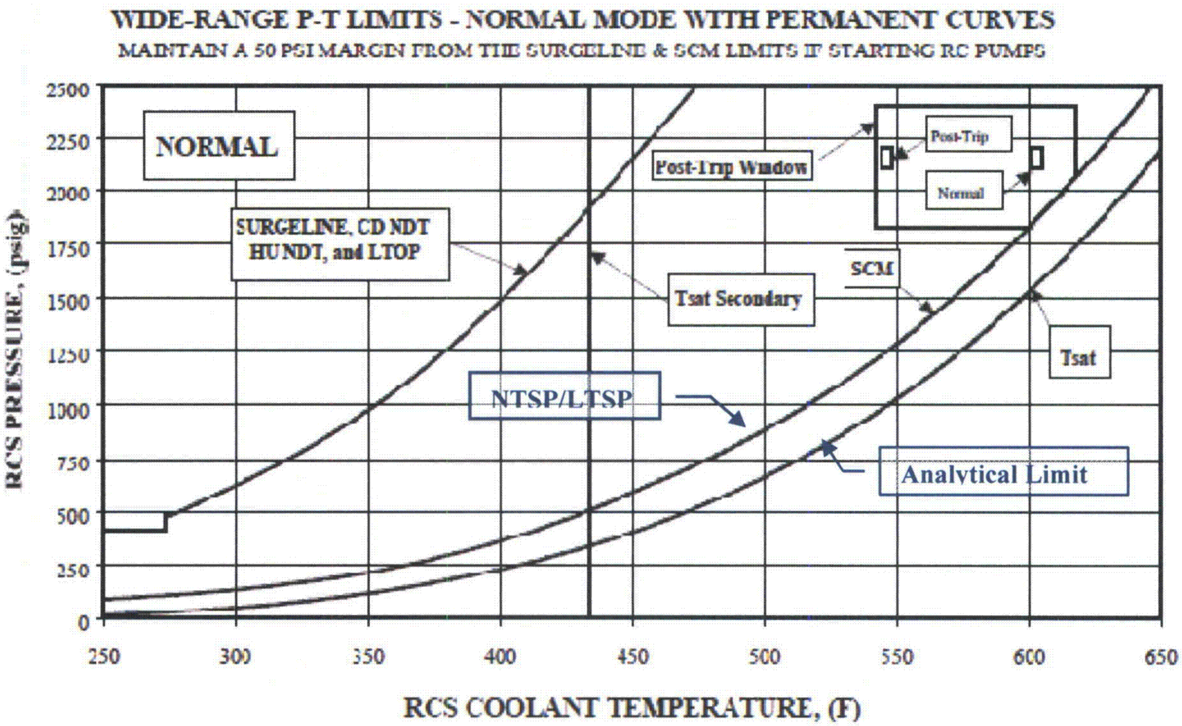

WIDE-RANGE P-T LIMITS - NORMAL MODE WITH PERMANENT CURVES
MAINTAIN A 50 PSI MARGIN FROM THE SURGELINE & SCM LIMITS IF STARTING RC PUMPS
NORMAL
SURGELINE, CD NDT HUNDT, and LTOP
Post-Trip Window
Post-Trip
Normal
Tsat Secondary
SCM
Tsat
NTSP/LTSP
Analytical Limit
RCS PRESSURE, (psig)
RCS COOLANT TEMPERATURE, (F)
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
250
300
350
400
450
500
550
600
650

Figure 3.2-1

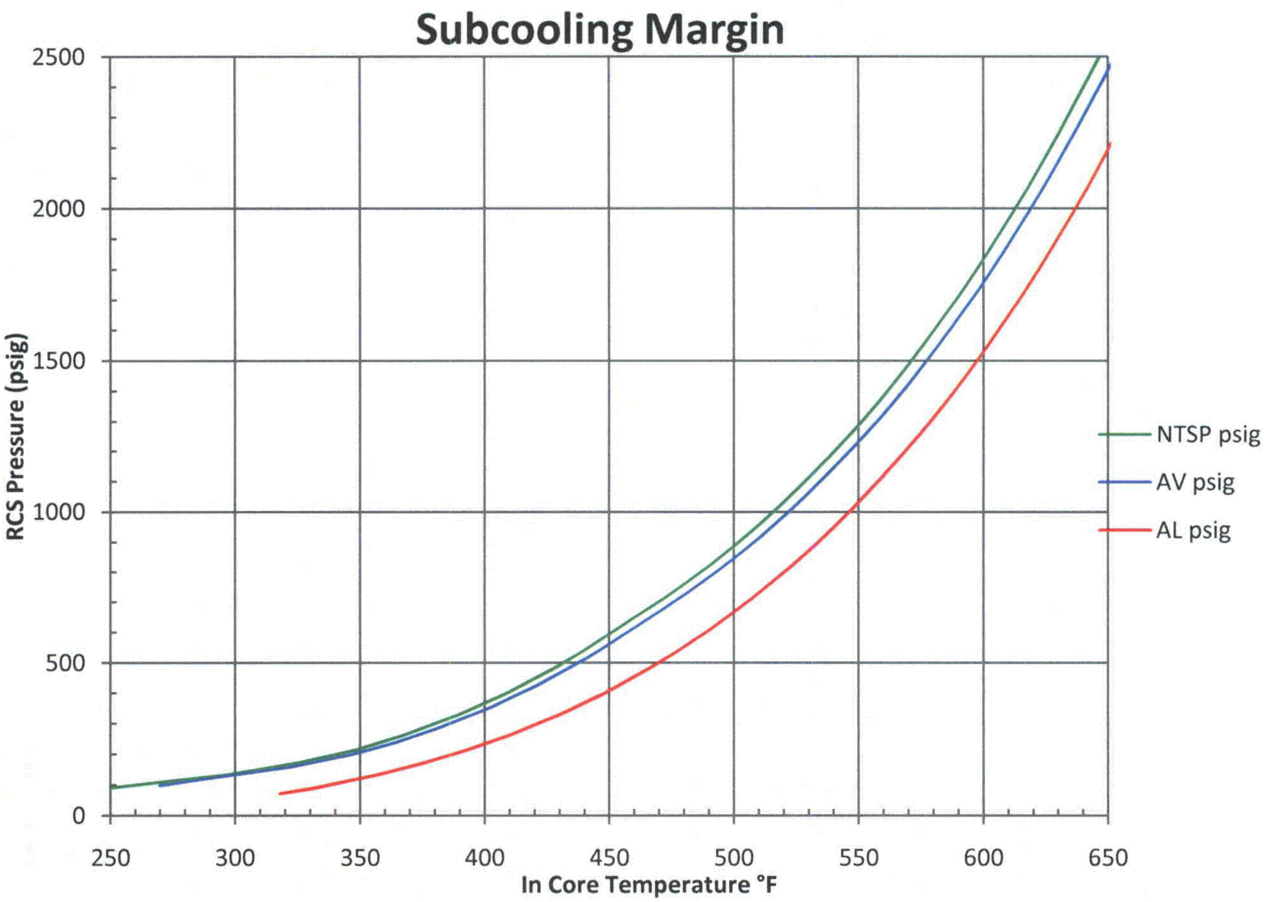

Subcooling Margin
2500
2000
1500
1000
500
0
RCS Pressure (psig)
250
300
350
400
450
500
550
600
650
In Core Temperature °F
NTSP psig
AV psig
AL psig

Figure 3.2-2

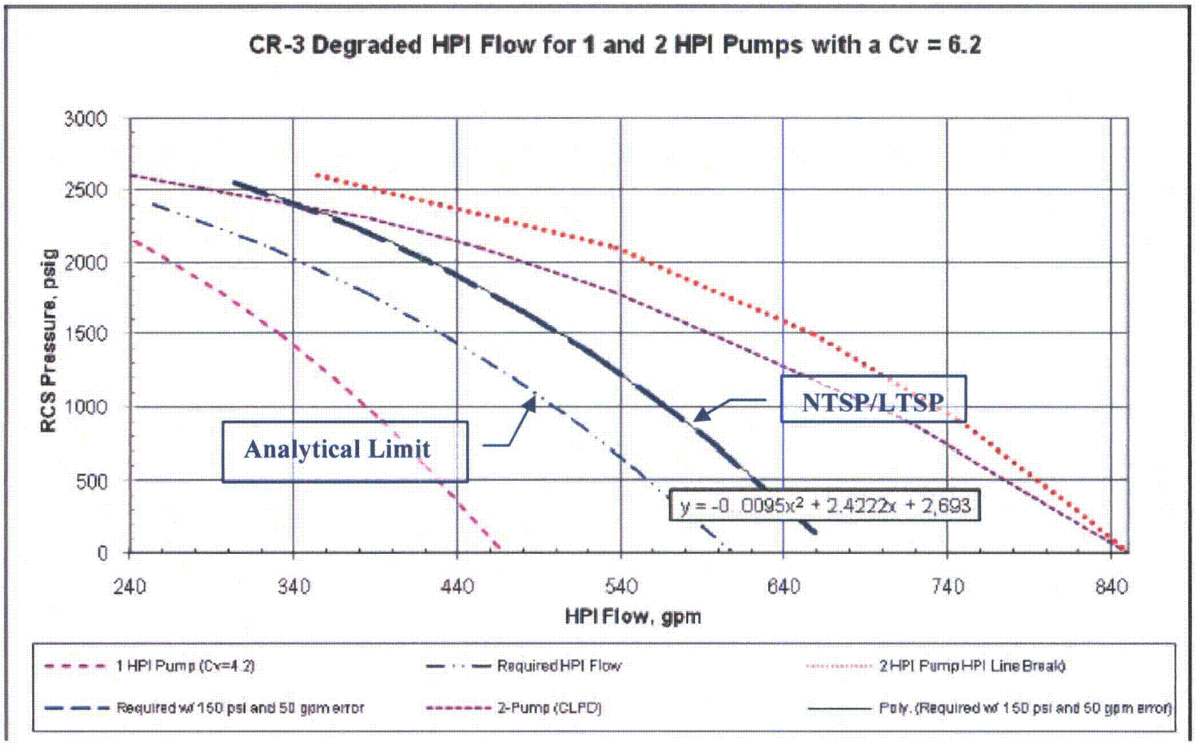

CR-3 Degraded HPI Flow for 1 and 2 HPI Pumps with a Cv = 6.2
RCS Pressure, psig
3000
2500
2000
1500
1000
500
0
240
340
440
540
640
740
840
HPI Flow, gpm
NTSP/LTSP
Analytical Limit
y = -0. 0095x² + 2.4222x + 2,693
1 HPI Pump (Cv=4.2)
Required HPI Flow
2 HPI Pump HPI Line Break)
Required w/ 150 psi and 50 gpm error
2-Pump (CLPD)
Poly. (Required w/ 150 psi and 50 gpm error)

Figure 3.3-1

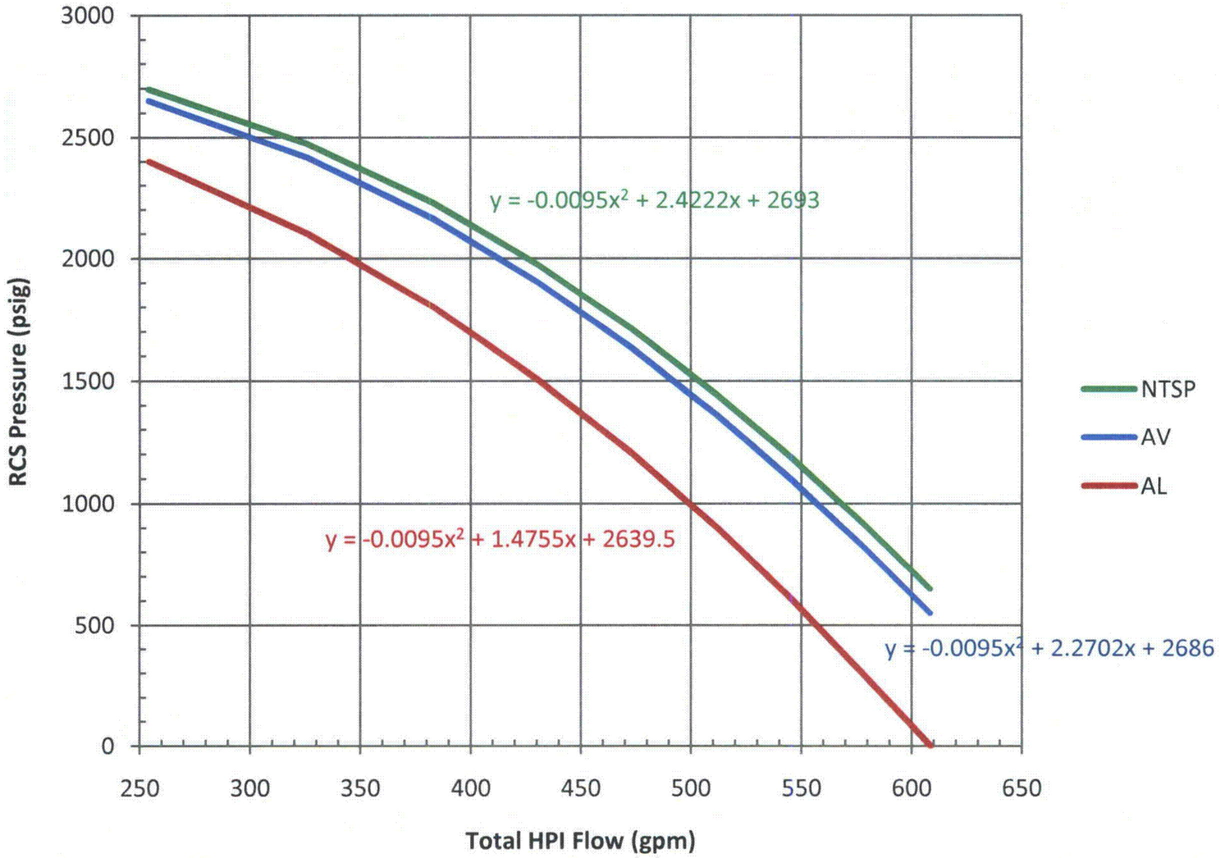

3000
2500
2000
1500
1000
500
0
RCS Pressure (psig)
250
300
350
400
450
500
550
600
650
Total HPI Flow (gpm)
y = -0.0095x² + 2.4222x + 2693
y = -0.0095x² + 1.4755x + 2639.5
y = -0.0095x² + 2.2702x + 2686
NTSP
AV
AL

Figure 3.3-2

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ENCLOSURE 3

IEEE 603-1991 AND IEEE 279-1971 COMPLIANCE MATRIX

IEEE Standard Criterion	ICCMS	FCS
IEEE 603-1991		
4. Safety system design basis		
The design basis shall be consistent with the requirements of ANSI/ANS 51.1-1983 or ANSI/ANS 52.1-1983 and shall document as a minimum:		
4.1 The design basis events applicable to each mode of operation of the generating station along with the initial conditions and allowable limits of plant conditions for each such event.	**System Spec Intro -** The three LOCA mitigation actuations are 1) automatic tripping of the Reactor Coolant Pumps (RCPs) when there is a reactor trip coupled with a loss of sub cooling margin; 2) automatic raising of the Steam Generator (SG) level control to the Inadequate Sub Cooling Margin (ISCM) set point; and 3) automatic actuation of the Fast Cooldown System (FCS), which shall actuate the Atmospheric Dump Valves (ADVs) in Fast Cooldown mode. Actuation of the ADVs shall occur in response to a reactor trip, coupled with a Loss of Subcooling Margin (LOSCM) in the Reactor Coolant System (RCS), with an inadequate High Pressure Injection (HPI) flow as measured by the ICCMS. **System Spec 5.2.4** The FCS function of this system shall be required to operate whenever reactor pressure is greater than 350 PSIG. The reactor coolant pump trip actuation and the ISCM setpoint actuation are required in modes 1 through 4. Mode 4 at CR-3 is the average reactor coolant temperature above 200°F. The PAM functions shall be required when the Reactor Coolant temperature is greater than 200°F.	During normal plant operating temperature and pressure (NOT/NOP), with a Small-Break Loss of Coolant Accident (SBLOCA), and subsequent Loss of Subcooling Margin (LOSCM) and inadequate High Pressure Injection (HPI) system flow, the FCS responds automatically to a demand signal from the Inadequate Core Cooling Mitigation System (ICCMS) to open the ADVs to allow rapid RCS cool down and to subsequently control the ADVs at 325 psig. Reference EC Sections B.2.2, B.2.5, B.4.1.4, B.4.15, B.4.16, B.6.1.1, B.6.1.4, B.6.15, B.6.16 and EC Att X122 (FSAR Chapter 7 revision).
4.2 The safety functions and corresponding protective actions of the execute features for each design basis event.	**System Spec 3.2.1.1** On a measured confirmed Reactor Trip condition and a LOSCM, trip the RCPs within one (1) minute. **System Spec 3.2.1.2** On a measured confirmed Reactor Trip condition and a LOSCM, transfer EFIC to the Inadequate Subcooling Margin (ISCM) set point within ten (10) minutes. **System Spec 3.2.1.3** On a measured confirmed Reactor Trip condition, concurrent with a LOSCM and a calculated Inadequate HPI flow, initiate the FCS within ten (10) minutes. **System Spec 3.2.1.4** Perform Post Accident Monitoring of Degrees of Subcooling and Superheat which are RG 1.97 Category 1 Type A variables. **System Spec 3.2.1.5** Perform Post Accident Monitoring of HPI Flow adequacy which is a new RG 1.97 Category 1 Type A variable.	Following a SBLOCA with subsequent LOSCM) and inadequate HPI system flow, the FCS responds automatically to a demand signal from the ICCMS to open the ADVs to allow rapid RCS cool down and to subsequently control the ADVs at 325 psig. Reference EC Sections B.2.2, B.2.5, B.4.1.4, B.4.15, B.4.16, B.6.1.1, B.6.1.4, B.6.15, B.6.16 and EC Att X122 (FSAR Chapter 7 revision).
4.3 The permissive conditions for each operating bypass capability that is to be provided.	**System Spec 5.9.2.4** Channel Bypass shall be continuously indicated in the control room. The ICCMS utilizes administrative controls (i.e. locked enclosure) and procedures to allow placing any channel or train bypass switch into a bypass or trip condition.	This requirement is not applicable to the FCS system. Operating bypasses are not included in the design of the fast cooldown system or the Atmospheric dump valves.
4.4 The variables or combinations of variables, or both, that are to be monitored to manually or automat-ically, or both, control each protective action; the analytical limit associated with each variable, the ranges (normal, abnormal, and accident conditions); and the rates of change of these variables to be accommodated until proper completion of the protective action is ensured.	**System Spec 5.4.1 RCS Wide Range Pressure per channel** **System Spec 5.4.1.1** RCS wide range pressure shall be acquired by a single 0-2500 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.2 RCS In Core Thermocouple Temperature per channel** **System Spec 5.4.2.1** In Core temperature shall be provided by eight (8) 0°F to 2500°F thermocouple instruments per channel. SUPPLIER to supply the eight (8) temperature transmitters for each channel. **System Spec 5.4.2.2** System shall provide isolated 4-20mA outputs from each thermocouple signal. **System Spec 5.4.3 RCS Low Range Pressure per channel** **System Spec 5.4.3.1** RCS low range pressure shall be acquired by a single 0-600 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.4 RCS THOT Temperature for channel 1 and channel 2** **System Spec 5.4.4.1** RCS temperature shall also be provided by a single 120°F to 920°F THOT RTD instrument per channel providing a 4-20mA signal. **System Spec 5.4.5 HPI Flow per channel** **System Spec 5.4.5.1** HPI flow shall be acquired by four (4) 0-200 gpm D/P transmitters, one each located in the four HPI discharge lines providing 4-20mA signals. **System Spec 5.4.6 Reactor Trip Confirm Status per channel** **System Spec 5.4.6.1** The reactor trip status is determined by monitoring the status of the two safety-related 480 VAC Control Rod Drive (CRD) supply breakers and the four (two breaker pairs) safety-related 120VDC DC hold supply breakers used to interrupt power to the control rods. **System Spec 5.5.1 Subcooling Margin / Superheat** The ICCMS shall become the primary means of determining and displaying subcooling margin/degrees of superheat using safety related instruments and a safety-related platform in order to meet current NRC requirements for ESFAS and PAM instrumentation. **System Spec 5.5.2.1** The subcooling margin (SCM) shall be calculated using instrumentation inputs for RCS pressure and temperature and the SCM curve. **System Spec 5.5.2.4** The SCM curve is defined in calculation I84-0003, SPDS Description Document, and I96-0002, SPDS TSAT Display Errors. The SCM curve is based on ASME 1967 steam tables plus instrument uncertainty. **System Spec 5.5.2.6** Methods to program the curve will be determined during the design phase with approval by Progress Energy. **System Spec 5.5.3.3** The subcooling margin (degrees of subcooling) and degrees of superheat will be displayed on same panel meter located on the Main Control Board in the Inadequate Core Cooling Section.	The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, such that following initial automatic system actuation (from ICCMS) and main steam depressurization, the system can provide automatic pressure control of the ADVs at <350 psig (325 psig setpoint) for the 4 hour mission time. The main steam pressure inputs are from new system pressure control transmitters installed in the same sensing line as the existing pressure transmitters that supply main steam pressure signals for the EFIC cabinet ADV control. The transmitters output a 4-20 ma signal for a calibrated 0-1200 psig span which bounds the highest main steam safety valve setpoint of 1100 psig. Since the protective action is to provide automatic pressure control of the ADVs at a 325 psig setpoint, the transmitter range is appropriate and will allow the pressure control loop to perform its safety function. The pressure transmitters will be procured as safety-related instruments and will be qualified for EQ Harsh conditions per IEEE 323-1974. The transmitters will be Seismic Class I qualified per IEEE 344-1975 and will be qualified to operate during SBO conditions. The instrument accuracy and uncertainty has been evaluated in Areva Doc #32-9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty" which takes into account all uncertainties associated with process/environmental conditions for normal, abnormal and accident conditions. Thus, the transmitters are designed to provide the pressure control safety function in all postulated plant conditions.

IEEE Standard Criterion	ICCMS	FCS
	System Spec 5.5.5 Calculation of High Pressure Injection Flow Margin per channel **System Spec 5.5.5.1** The high pressure injection (HPI) flow margin is calculated using instrumentation inputs for the RCS pressure, HPI flow rates and the HPI flow margin curve. **System Spec 5.5.5.2** The HPI flow margin curve is defined in provided calculation 51-9144830-000 "CR-3 EPU Required SBLOCA HPI Flow without FCS". This calculation provides the acceptable HPI flow for a given RCS Pressure. This calculation accounts for instrument uncertainty. **System Spec 5.5.5.7** The display of HPI flow margin may be forced to zero until a sustained LOSCM and a reactor trip confirmed. **System Spec 5.11.2** The ICCMS shall provide the following signals for displays: **System Spec 5.11.2.1** Channel 1 Subcooling Margin Display **System Spec 5.11.2.2** Channel 2 Subcooling Margin Display **System Spec 5.11.2.3** Channel 1 THOT / In Core Selector Switch indication (2) **System Spec 5.11.2.4** Channel 2 THOT / In Core Selector Switch indication (2) **System Spec 5.11.2.5** Channel 1 HPI Flow Margin Display – display HPI flow margin **System Spec 5.11.2.6** Channel 2 HPI Flow Margin Display – display HPI flow margin	Reference EC Sections B.4.16, B.6.16 and Areva Doc #32-91379757.
4.5 The following minimum criteria for each action identified in 4.2 whose operation may be controlled by manual means initially or sub-sequently to initiation. See IEEE Std 494-1974 (R1990).	**System Spec 3.1.3.5** In addition, the ability to manually initiate ICCMS functions that is independent of automatic control shall be provided. **System Spec 5.9.3.1** All actuations performed by the ICCMS shall continue to have the capacity for manual actuation.	Although the actuation of the FCS is automatic, there will be capability for the operator to manually initiate operation of the ADVs from the FCS switches located in the Main Control Room, as described in EC71855 Section B.2.5. The method by which to facilitate and simplify operations personnel ability to monitor HPI flow adequacy or to determine if the FCS system must be manually actuated due to inadequate HPI flow, will be the development of a new SPDS display of HPI flow versus RCS pressure curve and a "live" data point showing adequate or inadequate flow above or below the display curve, as described in EC71855 Sections B.4.1.4, B.6.1.4.
4.5.1 The points in time and the plant conditions during which manual control is allowed.	**System Spec 5.9.3.1** All actuations performed by the ICCMS shall continue to have the capacity for manual actuation. (As required by clause 6.2 of IEEE 603-1991)	Automatic or manual operator action to open an ADV is credited at 10 minutes after LOSCM. Reference Section 5.8.4 of Areva Doc# 51-9061339-005, "CR-3 EPU LOCA AIS".
4.5.2 The justification for permitting initiation or control subsequent to initiation solely by manual means.	The 3 mitigation functions of the ICCMS system currently are performed manually by operator action. ICCMS automates these operator actions and is the primary means of monitoring SCM and HPI flow margin. SPDS provides backup indication of these variables. Manual action shall only be required if multiple failures occur to ICCMS, which means both trains of HPI should have worked making ICCMS unnecessary. If manual actions were required, all actions could be performed at the main control board.	The FCS will only be manually actuated during the design basis event (SBLOCA with a LOSCM and inadequate HPI flow) IF it has not been automatically initiated by ICCMS. This would be a very low probability event since it would require multiple failures. Reference EC Sections B.4.15, B.6.15.
4.5.3 The range of environmental conditions imposed upon the operator during normal, abnormal, and accident conditions throughout which the manual operations shall be performed.	**System Spec 3.1.7 Environmental Conditions** **System Spec 3.1.7.1.1** Temperature range of 40° F to 120° F. **System Spec 3.1.7.1.2** Relative humidity of 5% to 95%. **System Spec 3.1.7.1.3** Total integrated radiation dose of 350 Rads **System Spec 3.1.7.2 Seismic** **System Spec 3.1.7.2.1** The ICCMS and associated components shall be capable of withstanding and operating during and after a seismic event for the required response spectra (RRS) shown on Figure 18 of SP-5209 at 0.5% damping. **System Spec 3.1.7.3 EMI/RFI** **System Spec 3.1.7.3.1** EMI/RFI functional requirement- The platform and associated components shall be capable of operating unaffected in an environment bounded by the power levels and frequencies established by EPRI TR-102323 Revision 3 "Guidelines for Electromagnetic Interference testing of Power Plant Equipment". Additionally, the frequency range should be up to 10 GHz with an additional single frequency check at 60 GHz ISM (industrial, scientific and medical) band. **System Spec 3.1.7.3.2** The ICCMS and associated equipment shall be sufficiently free of radiated and conducted EMI / RFI, to prevent resultant mis-operation of instrumentation and communications equipment as described in Reg Guide 1.180.	This item is not applicable because the operator remains in the control room even if required to take manual action.
4.5.4 The variables in item 4.4 that shall be displayed for the operator to use in taking manual action.	**System Spec 5.3.8** The SCM/Superheat displays, inadequate HPI flow indicators, and associated lights and switches shall fit on the MCB in spaces identified by the OWNER. **System Spec 5.5.3.3** The subcooling margin (degrees of subcooling) and degrees of superheat will be displayed on same panel meter located on the Main Control Board in the Inadequate Core Cooling Section. Each parameter in item 4.5.4 is displayed on the MCB.	A new (SPDS) display of HPI flow versus RCS pressure curve and a "live" data point showing adequate or inadequate flow above or below the display curve, will be used by the operators in the determination of whether or not manual actuation of FCS is necessary. Reference EC Sections B.4.1.4, B.6.1.4.

IEEE Standard Criterion	ICCMS	FCS
4.6 For those variables in item 4.4 that have a spatial dependence (i.e., where the variable varies as a function of position in a particular region), the minimum number and locations of sensors required for protective purposes.	**System Spec 5.5.7.1** The conditions for an actuation of Loss of Sub Cooling Margin mitigation shall be a Reactor Trip confirm signal and a calculated loss of sustained subcooling margin utilizing the highest Core Exit thermocouple as independently determined by each channel. **System Spec 5.9.1.10** Loss of signal from any in core thermocouple shall result in that in core thermocouple signal being recognized as invalid in the online monitor. Note: Selection of each channel's thermocouple inputs was determined based on 4 quadrants, 2 thermocouples per quadrant for redundancy (e.g. 8 thermocouple inputs for each channel).	The FCS system design includes two new system pressure control transmitters which provide main steam pressure input to the new FCS Pressure Controllers. These new transmitters will be installed in the same sensing line as the existing pressure transmitters that supply the main steam pressure input the EFIC cabinet ADV Controllers. These main steam pressure inputs have no spatial dependence and therefore, this requirement is not applicable to the FCS system.
4.7 The range of transient and steady-state conditions of both motive and control power and the environ-ment (e.g., voltage, frequency, radiation, temperature, humidity, pressure, vibration, and electromag-netic interference) during normal, abnormal, and accident conditions throughout which the safety system shall perform.	**System Spec 3.3 Power Supply Electrical Requirements** **System Spec 3.3.1** 120-volt AC power for the ICCMS shall be provided by battery-backed inverter busses. This requirement is not in SUPPLIER's scope. **System Spec 3.3.2** Two independent sources of power shall be provided for each enclosure/channel. This requirement is not in SUPPLIER's scope. **System Spec 3.3.3** The ICCMS shall be capable of performing all functional requirements as specified herein with power supply variations of 120 VAC ± 10%, 60Hz ± 1%. **System Spec 3.3.4** The ICCMS power distribution shall be designed so that with the loss of one power supply or the loss of one incoming power source there will be no affect on the system's functional operation or plant operation. **System Spec 3.3.5** Each power supply shall be monitored and alarm actuated if a failure occurs. Loss of power detector(s) shall be provided as required to detect and alarm on a loss of power condition. **System Spec 3.3.6** The ICCMS shall transmit loss of power alarm signal(s) to an event point which shall drive an annunciator in the Control Room. **System Spec 3.3.7** An additional 120VAC power supply shall be provided in each cabinet to power non-safety related equipment (i.e. multiplexers, switches, and Online Monitor system.) This requirement is not in SUPPLIER's scope. (See 4.5.3 above for environmental conditions)	Appendix 7.1-C: Clause 4.7 of IEEE Std. 603-1991 requires in part that the range of transient and steady-state conditions be identified for both the energy supply and the environment during normal, abnormal, and accident conditions under which the system must perform. The range of conditions both transient and steady-state has been assessed in the FCS design. Reference EC 71855 Sections B.4.4, B.4.6 B.6.4, and B.6.6.
4.8 The conditions having the potential for functional degradation of safety system performance and for which provisions shall be incorporated to retain the capability for performing the safety functions (e.g., missiles, pipe breaks, fires, loss of ventilation, spurious operation of fire suppression systems, operator error, failure in non-safety-related systems).	**System Spec 3.1.7.4 Tornado/ Wind** **System Spec 3.1.7.4.1** ICCMS equipment and instrumentation shall be mounted in locations that will prevent damage to the system and instrumentation during tornados and high wind events. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.5 Missiles** **System Spec 3.1.7.5.1** The channel equipment shall be mounted in locations that are protected from turbine missiles and missiles generated by natural phenomena. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.6 Penetrations** **System Spec 3.1.7.6.1** The design of the ICCMS shall incorporate the use of existing plant electrical penetrations, as much as possible, to provide a path for signals to the ICCMS. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.7 Fire Protection/ Appendix R** **System Spec 3.1.7.7.1** The ICCMS shall be prevented from actuating due to an Appendix R fire induced short. This requirement is not in SUPPLIER's scope. **3.1.4 Redundancy** **System Spec 3.1.4.1** All safety related ICCMS functions shall be implemented through the use of redundant sensors, measuring channels, logic, and actuation devices. Each initiation channel shall be powered from a different power source. **System Spec 3.1.4.2** There shall be two (2) trains of actuation logic, each with three (3) functional outputs. Each train takes inputs from the three (3) initiation channels and performs the actuation logic. The power sources for the actuation trains must be independent. **System Spec 3.1.4.3** Redundant initiation channels shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.4.4** Redundant actuation trains shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.8.5** The redundant power supplies shall have auctioneered output such that should one fail the other shall be capable of supplying ICCMS loads.	The FCS system components have been evaluated for all applicable adverse conditions (i.e. loss of HVAC, EQ conditions, Seismic events, App R events, etc) and is documented in EC 71855, Sections B.4.5, B.4.6, B.4.13, B.4.15, B.4.16, B.4.24, B.6.5, B.6.6, B.6.13, B.6.15, B.6.16 and B.6.24 as well as in the FMEAs in EC Attachments X64 and X120."

IEEE Standard Criterion	ICCMS	FCS
4.9 The methods to be used to determine that the reliability of the safety system design is appropriate for each safety system design and any qualitative or quantitative reliability goals that may be imposed on the system design.	**System Spec 3.1.5 Reliability** **System Spec 3.1.5.1** The safety system shall be designed to meet a reliability goal of 99.9% given a mission time of 40 years. **System Spec 3.1.5.2** The SUPPLIER shall determine that the reliability of the safety system design is appropriate and is able to meet the reliability goal stated above by performing an analysis of the design. IEEE 352-1987 and IEEE 577-1976 provide guidance for reliability analysis.	The reliability of the FCS design is shown qualitatively with the incorporation of the following "methods" or features: - Single Failure - Equipment Quality - Equipment Qualification - Independence - Diversity **Single Failure** FCS design incorporates redundant battery banks and DC bus assemblies for each ADV pressure control circuit so that I one bank fails or is being tested, the redundant bank will insure fast cooldown pressure control operability. (EC 71855 Section B.2.3). FMEA was performed to determine component failure effect and potential failures due to interfacing or support systems such as control complex HVAC. (Attachments X64 and X120) **Equipment Quality** The FCS equipment enclosures and subcomponents, battery banks, FCS pressure control transmitters and ADV (and associated subcomponents) will have a 40 year design life and be purchased as Safety-Related per IEEE 323-1974. An OE (operating experience) search was documented in EC Section A for the major components of the fast cooldown system. AREVA specification 08-9154212, item 3.1.7 requires enclosure design to minimize EMI/RFI. Additionally all DC bus and control components are located inside their own steel enclosures to provide separation and minimize any environmental EMI/RFI effect. **Equipment Qualification** The FCS equipment enclosures and subcomponents, battery banks, FCS pressure control transmitters and ADV (and associated subcomponents) will be Seismically qualified per IEEE 344- 1975 (reference Areva FCS Equipment Spec 08-9154212 and CR3 Spec CR3-M-0022). Additionally, the pressure control transmitters and ADV components will be EQ qualified. Per the specifications, the vendor will provide the qualification documentation. **Independence** FCS design incorporates separate, independent, diverse components between those used in ES actuation of HPI pump in ES cabinets and those used in fast cooldown actuation.(EC 71855 Section B.2.2, B.6.18) Different locations of functionally redundant equipment minimizes common mode failures due to abnormal environment conditions. ADVs are located in intermediate building elevation 119 while the HPI pumps are located in auxiliary building elevation 95. FCS design incorporates independent separate DC power source for the fast cooldown pressure control circuitry that is not connected and does not have any interface with the HPI control or power sources.(EC 71855 Section B.2.3, B.6.1.6, B.6.2.5, B.6.18) **Diversity** The FCS design incorporates diverse methods of mitigating SBLOCA and LOSCM using different types of components (HPI pump versus ADV) that are located in different locations of the generating station. (EC 71855 Section B.2.2, B.6.18)
4.10 The critical points in time or the plant conditions, after the onset of a design basis event, including:		Following a LSCM and inadequate HPI flow signal, the FCS must be actuated in 10 minutes or earlier. In addition, the ADVs must remain operational for at least 4 hours after Reactor Trip, as described in EC71855 Section B.2.5.
4.10.1 The point in time or plant conditions for which the protective actions of the safety system shall be initiated	**System Spec 3.2.1.1** On a measured confirmed Reactor Trip condition and a LOSCM, trip the RCPs within one (1) minute. **System Spec 3.2.1.2** On a measured confirmed Reactor Trip condition and a LOSCM, transfer EFIC to the Inadequate Subcooling Margin (ISCM) set point within ten (10) minutes. **System Spec 3.2.1.3** On a measured confirmed Reactor Trip condition, concurrent with a LOSCM and a calculated Inadequate HPI flow, initiate the FCS within ten (10) minutes. **System Spec 3.2.1.4** Perform Post Accident Monitoring of Degrees of Subcooling and Superheat which are RG 1.97 Category 1 Type A variables. **System Spec 3.2.1.5** Perform Post Accident Monitoring of HPI Flow adequacy which is a new RG 1.97 Category 1 Type A variable.	Following a sustained loss of subcooling margin and inadequate HPI system flow, FCS is automatically actuated by ICCMS within 10 minutes which opens the ADVs to allow rapid RCS cool down to ensure sufficient core cooling during a SBLOCA. If automatic actuation has not occurred as expected, manual action must be taken at the main control board to actuate FCS within 10 minutes of the LOSCM. Reference Section 5.8.4 of Areva Doc# 51-9061339-005, "CR-3 EPU LOCA AIS".
4.10.2 The point in time or plant conditions that define the proper completion of the safety function.	**System Spec 5.1.16** Two (2) actuation train reset pushbuttons (one (1) for Train A and one (1) for Train B) shall be provided on the MCB to allow resetting the actuation train trip functions. The reset pushbutton shall only clear those train trip functions which are not still activated by the 2 out of 3 channel trip functions.	There is not a specified point in time when the safety function is complete. Once initiated, automatically or manually, the FCS will continue to operate until operators take manual action to terminate the automatic cooldown or until primary temperature has reached the DH initiation point (280 degrees F).

IEEE Standard Criterion	ICCMS	FCS
4.10.3 The point in time or the plant conditions that require automatic control of protective actions.	**System Spec 5.2.4** The FCS function of this system shall be required to operate whenever reactor pressure is greater than 350 PSIG. The reactor coolant pump trip actuation and the ISCM setpoint actuation are required in modes 1 through 4. Mode 4 at CR-3 is the average reactor coolant temperature above 200°F. The PAM functions shall be required when the Reactor Coolant temperature is greater than 200°F.	The FCS is required to be OPERABLE when core thermal power is > 2609 Mth. Reference CR3 Tech Spec 3.7.20.
4.10.4 The point in time or the plant conditions that allow returning a safety system to normal.	**System Spec 5.2.4** The FCS function of this system shall be required to operate whenever reactor pressure is greater than 350 PSIG. The reactor coolant pump trip actuation and the ISCM setpoint actuation are required in modes 1 through 4. Mode 4 at CR-3 is the average reactor coolant temperature above 200°F. The PAM functions shall be required when the Reactor Coolant temperature is greater than 200°F. Design of the ICCMS system provides the actuation train FCS trip to be locked in until conditions clear (i.e. RCS pressure lss than 350 psig and reactor coolant temperature below 200°F) unless manually bypassed at the cabinet through the use of administrative controls.	Per Section 5.16 of Areva Doc# 51-9061339-005, "CR-3 EPU LOCA AIS", following FCS actuation, the ADVs will remain open until secondary side is depressurized to 350 psig and they will be modulated at the 350 psig pressure for at least 4 hours.
4.11 The equipment protective provisions that prevent the safety systems from accomplishing their safety functions.	There are no equipment protective provisions that prevent the ICCMS system from accomplishing its safety functions due to redundancy in the ICCMS system design. Any failures resulting in an ICCMS channel failure will not result in a train failure, multiple failures would be required to result in a train failure.	The FCS design contains both circuit breakers and fuses which will operate to protect the equipment and cables, but also preventing the FCS from performing its design function. The safety function of limiting the PCT from a SBLOCA however would still be accomplished by having both HPI trains available.
4.12 Any other special design basis that may be imposed on the system design (e.g., diversity, interlocks, regulatory agency criteria).	**3.1.4 Redundancy** **System Spec 3.1.4.1** All safety related ICCMS functions shall be implemented through the use of redundant sensors, measuring channels, logic, and actuation devices. Each initiation channel shall be powered from a different power source. **System Spec 3.1.4.2** There shall be two (2) trains of actuation logic, each with three (3) functional outputs. Each train takes inputs from the three (3) initiation channels and performs the actuation logic. The power sources for the actuation trains must be independent. **System Spec 3.1.4.3** Redundant initiation channels shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.4.4** Redundant actuation trains shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.8.5** The redundant power supplies shall have auctioneered output such that should one fail the other shall be capable of supplying ICCMS loads.	The FCS design contains no other special design basis that may be imposed on the system design (e.g., diversity, interlocks, regulatory agency criteria). However, FCS components have diversity of equipment type as compared to the functionally redundant HPI components.
5. Safety system criteria		
The safety systems shall, with precision and reliability, maintain plant parameters within acceptable limits established for each design basis event. The power, instrumentation, and control portions of each safety system shall be comprised of more than one safety group of which any one safety group can accomplish the safety function.	**System Spec 5.1.7** The ICCMS shall be a three (3) initiation channel system with two (2) redundant actuation trains. **System Spec 5.1.8** The three (3) initiation channels shall be denoted as Channel "1", Channel "2", and Channel "3". The two (2) actuation trains shall be denoted as Train "A" and Train "B". The three (3) cabinets shall be denoted as Cabinet "1", Cabinet "2", and Cabinet "3". **System Spec 5.1.9** Each channel shall independently acquire inputs and calculate Sub Cooling Margin, Degrees of Superheat, and High Pressure Injection Flow Margin. **System Spec 5.1.10** Each channel shall be capable of independently producing outputs of Sub Cooling Margin, Degrees of Superheat, and HPI Flow Margin. **System Spec 5.1.11** Each channel shall be capable of independently producing trip signals for tripping the RCP pumps, setting the ISCM set point, and Initiating the Fast Cooldown System. **System Spec 5.1.13** The trip signals may be processed through a "2 out of 3" relay logic scheme or a trip module scheme which provides the same functionality as shown in Figure 3. **System Spec 5.1.14** The "2 out of 3" actuation logic may be performed external to the channel trip equipment or a trip module scheme which provides the same functionality as shown in Figure 2 and 3.	For SBLOCA with LOSCM, the "safety groups" are (1) FCS (2 ADVs) and one HPI pump and (2) two HPI pumps. Either of these safety groups can accomplish the safety function. In order to ensure at least of these groups are always available, the power, instrumentation, and control portions are designed to be independent and physically separated from each other per IEEE-603, 5.6 and designed to meet the single failure criteria of IEEE-603, 5.1. Reference EC Sections B.4.1.6, B.4.2.5, B.4.13, B.4.15, B.6.1.6, B.6.2.5, B.6.13.D and B.6.15 and EC Attachment X64 (FMEA).
5.1 Single-failure criterion		
The safety systems shall perform all safety functions required for a design basis event in the presence of:	**System Spec 3.1.3.1** The ICCMS shall meet the single failure criterion of IEEE-279 and IEEE-603 to the extent that: **System Spec 3.1.3.1.1** No single component failure shall prevent a protective system from fulfilling its protective function when action is required. **System Spec 3.1.3.1.2** No single component failure shall initiate unnecessary protective system action where implementation does not conflict with the criterion above.	The FCS system when used in conjunction with the HPI system will meet the single failure criteria to perform SBLOCA and LOSCM mitigation in the presence of any single detectable failure within the safety systems concurrent with all identifiable but non-detectable failures. It should be noted that the FCS system itself will not be actuated and utilized unless there is already a HPI failure. The FMEA performed (Attachment X64 to EC 71855) has not identified any single detectable failure that will affect the operability of a fast cooldown pressure control channel and at the same time affect the operability of an HPI injection train. Thus either of two methods of mitigating a SBLOCA and LOSCM event a) FCS system with both ADVs capable of control with the FCS pressure control circuitry and one HPI pump train operable or b) both HPI pump trains will be operable in the event of a single failure. There are no known identified failures in the FCS system that could go non-detected by alarms, surveillance testing, periodic testing , or channel checks. Reference FMEA (EC Att X64) and EC Att X120
1) Any single detectable failure within the safety systems concurrent with all identifiable but non--detectable failures.	**Procurement Spec 6.1.2** The SUPPLIER shall identify single components whose failure could result in an undesirable condition or event. If this requirement is not considered practical for SUPPLIER's design, SUPPLIER shall provide justification for common mode equipment within the system.	

IEEE Standard Criterion	ICCMS	FCS
2) All failures caused by the single failure.	**System Spec 3.1.3.1.1** No single component failure shall prevent a protective system from fulfilling its protective function when action is required.	Any single failure in the fast cooldown DC supply, pressure control circuitry, or transfer relay will affect only the fast cooldown control of a single ADV or the EFIC control of a single ADV. The single failure will not create any failure of any motive (motor) power or control power that would impact the operability and flow capacity of the HPI pumps to mitigate a SBLOCA and LOSCM event. With the functional redundancy of either a)) FCS system with both ADVs capable of control with the FCS pressure control circuitry and one HPI pump train operable or b) both HPI pump trains , any single failure will not create failures in the other system or other FCS channel such that a SBLOCA and LOSCM event cannot be mitigated. The interface design using a transfer relay with contacts for the fast cooldown ADV demand signal and with contacts for the existing EFIC demand signal for the ADV will not migrate back into the EFIC system and will not create any failures internal to the EFIC Cabinets since the transfer relays are adequately isolated from the EFIC Cabinets by two isolation device components in series. A single failure of a transfer relay or an ADV in which the ADV fails open would result in a main steam line break type event but would not create any failures in the EFIC capability to actuate MSLI, MFWI, and FOGG to respond to the event. Reference FMEA (EC Att X64) and EC Att X120.
3) All failures and spurious system actions that cause or are caused by the design basis event requiring the safety functions.	**System Spec 3.1.3.1.2** No single component failure shall initiate unnecessary protective system action where implementation does not conflict with the criterion above. All input signals for ICCMS are from environmentally qualified transmitters, sensors, connectors and cables. HPI flow transmitters, RCS pressure transmitters and In Core thermocouple signals are qualified for accident conditions. The 'reactor trip confirm' signals originate in the Control Complex which is a mild environment.	The fast cooldown system components are qualified for the environmental conditions in the control complex and in the intermediate building resulting from a LOCA (SBLOCA) event. The SPDS display of HPI low range flow and RCS pressure that would be used for manual actuation in the event of a failure of ICCM are derived from existing differential transmitters in the auxiliary building and from RCS pressure transmitters installed in the reactor building that are already qualified for the LOCA environmental conditions. Thus the SBLOCA event will not create a failure of the fast cooldown system components to mitigate the SBLOCA. Manual actuation of FCS in itself would only occur from multiple failures to the ICCM auto actuation and thus is not applicable to the single failure criteria. However, since operations personnel are expected to use the SPDS for monitoring the event, the failure potential is being evaluated as noted above. There are no identified single failures of the fast cooldown system or ADV which would create a SBLOCA event. There are no identified failures of the fast cooldown system or of the ADV which would result in the inability to adequately protect fuel cladding temperatures during a SBLOCA and LOSCM event. Reference FMEA (EC Att X64) and EC Att X120
The single failure could occur prior to, or at any time during, the design basis event for which the safety sys-tem is required to function. The single-failure criterion applies to the safety systems whether control is by automatic or manual means. IEEE Std 379-1988 provides guidance on the application of the single-failure criterion.	**Procurement Spec 6.1.1** The SUPPLIER shall identify the limitations of the system under different failure scenarios. "Two-out-of three" logic is used to actuate all mitigation functions. Either actuation train will actuate all functions. This satisfies single failure for actuations.	

IEEE Standard Criterion	ICCMS	FCS
This criterion does not invoke coincidence (or multiple-channel) logic within a safety group; however, the application of coincidence logic may evolve from other criteria or considerations to maximize plant avail-ability or reliability. An evaluation has been performed and documented in other standards to show that cer¬tain fluid system failures need not be considered in the application of this criterion [B3]. The performance of a probabilistic assessment of the safety systems may be used to demonstrate that certain postulated failures need not be considered in the application of the criterion. A probabilistic assessment is intended to eliminate consideration of events and failures that are not credible; it shall not be used in lieu of the single-failure cri¬terion. IEEE Std 352-1987 and IEEE Std 577-1976 provide guidance for reliability analysis.	**System Spec 3.1.5.2** The SUPPLIER shall determine that the reliability of the safety system design is appropriate and is able to meet the reliability goal stated above by performing an analysis of the design. IEEE 352-1987 and IEEE 577-1976 provide guidance for reliability analysis.	
Where reasonable indication exists that a design that meets the single-failure criterion may not satisfy all the reliability requirements specified in 4.9 of the design basis, a probabilistic assessment of the safety system shall be performed. The assessment shall not be limited to single failures. If the assessment shows that the design basis requirements are not met, design features shall be provided or corrective modifi-cations shall be made to ensure that the system meets the specified reliability requirements.	**Procurement Spec 6.1 Failure Analysis** **Procurement Spec 6.1.1** The SUPPLIER shall identify the limitations of the system under different failure scenarios. **Procurement Spec 6.1.2** The SUPPLIER shall identify single components whose failure could result in an undesirable condition or event. If this requirement is not considered practical for SUPPLIER's design, SUPPLIER shall provide justification for common mode equipment within the system. **Procurement Spec 6.1.3** SUPPLIER concerns and requirements concerning single failure tolerant design and plant interfaces should be identified in writing to the OWNER for resolution. **Procurement Spec 6.1.4** The single failure analysis shall state the failure, the system response to the failure, and the required operator actions. This single failure requirement is required to maintain conformance to the strict standards of a class IE safety system and to assure highly reliable ICCMS operation commensurate with its vital role in reliable plant operation and electrical generation. **Procurement Spec 6.1.5** The SUPPLIER shall also perform a Failure Modes and Effects Analysis (FMEA) of the ICCMS in accordance with principles set forth in IEEE 352-1987 and IEEE 379-2000. This analysis shall demonstrate that the ICCMS meets single failure requirements as set forth in this document. **Procurement Spec 6.1.6** For the FMEA, the SUPPLIER shall provide: **Procurement Spec 6.1.6.1** Identification of any assumptions used as a basis for meeting the single failure requirements. **Procurement Spec 6.1.6.2** Identification of any single failure or common failure modes **Procurement Spec 6.1.6.3** A common mode failure analysis, which analyzes the ICCMS power configurations and other potential common mode failures that may occur. **Procurement Spec 6.1.6.4** A ranking of the ICCMS components in relation to their Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR), which shall include values based on operating experience where available. In this context, "component" is understood to mean a functional grouping, such as a module or a power supply. **Procurement Spec 6.2 Availability** **Procurement Spec 6.2.1** The system design shall be capable of supporting a mean time to repair and restore system operation in less than 24 hours when spare parts are available and on hand. **Procurement Spec 6.2.2** The ICCMS design shall have the capability to take a channel out of service and restore it to service with the system in operation. **Procurement Spec 6.2.3** The SUPPLIER shall provide documented information on the MTBF and MTTR of all the critical components of the system and shall calculate an overall availability and reliability. **Procurement Spec 6.2.4** An overall system availability report shall be provided describing the ability of the ICCMS to perform its intended function. **Procurement Spec 6.2.5** Any analysis for MTBF and MTTR is not required to address interfacing equipment outside the scope of supply. **Procurement Spec 6.2.6** Given a mission time of 40 years, the automatic features shall meet a minimum reliability goal of 99.9% reliability. **Procurement Spec 6.2.7** The SUPPLIER shall determine that the reliability of the safety system design is appropriate and is able to meet the reliability goal stated in system requirements specification by performing an analysis of the design. IEEE Std 352- 1987 and IEEE Std 577-1976 provide guidance for reliability analysis. **Procurement Spec 6.2.8** The SUPPLIER shall identify and describe all Fatal and Non Fatal faults. Fatal Faults are those that will cause the affected channel to fail to perform within specifications whereas Non-Fatal will not.	

IEEE Standard Criterion	ICCMS	FCS
5.2 Completion of protective action		
The safety systems shall be designed so that, once initiated automatically or manually, the intended sequence of protective actions of the execute features shall continue until completion. Deliberate operator action shall be required to return the safety systems to normal. This requirement shall not preclude the use of equipment protective devices identified in 4.11 of the design basis or the provision for deliberate operator interventions. Seal-in of individual channels is not required.	**System Spec 3.1.10.1** The safety systems shall be designed so that, once initiated automatically or manually, the intended sequence of protective actions of the execute features shall continue until completion. **System Spec 3.1.10.2** The ICCMS shall be designed such that when it is determined that Fast Cooldown is required, an output from the ICCMS shall activate a seal in contact in the FCS for actuation. The balance of the FCS system is outside SUPPLIER's scope. **System Spec 3.1.10.3** Deliberate operator action shall be required to return the safety systems to normal. FCS provides seal-in. EFIC provides seal-in for ISCM setpoint. RCP trip does not need seal-in as manual action is needed to restart RCPs.	Appendix 7.1-C: Ensure that "seal-in" features are provided to enable system-level protective actions to go to completion. FCS automatic initiation is from the ICCMS which energizes an FCS relay closing a "seal-in" contact which enables protective actions to go to completion. Reference EC 71855 B.4.16 and B.6.16.
5.3 Quality		
Components and modules shall be of a quality that is consistent with minimum maintenance requirements and low failure rates. Safety system equipment shall be designed, manufactured, inspected, installed, tested, operated, and maintained in accordance with a prescribed quality assurance program (See ASME NQA-I- 1989).	**Procurement Spec 7.1.1** The SUPPLIER is required to provide equipment and perform work in a quality manner in full accordance with recognized industry codes and standards as specified in this specification and the System Requirements Specification. The SUPPLIER shall certify that all equipment supplied and work is performed in accordance with the provisions of this specification and the System Requirements Specification. **Procurement Spec 7.4.1** Measures shall be established to assure that applicable regulatory requirements and design basis for the system, equipment, components, and software defined by the System Requirements Specification are correctly translated into specifications, drawings, procedures, and instructions. **Procurement Spec 7.4.3** Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the critical functions of the system, equipment, components, and software defined by the System Requirements Specification. **Procurement Spec 7.4.4** Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations. These measures shall include the establishment of procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces. **Procurement Spec 7.4.5** The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculation methods, or by the performance of a suitable testing program. **Procurement Spec 7.4.7** Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions.	Appendix 7.1-C: Confirm that quality assurance provisions of Appendix B to 10 CFR 50 are applicable to the safety system. The electrical and I&C equipment and control enclosures are procured as 1E which requires the suppliers to maintain an Appendix B QA program. Reference EC 71855 Sections B.4.13, B.4.15, B.4.16, B.6.13, B.6.15, and B.6.16.
5.4 Equipment qualification		
Safety system equipment shall be qualified by type test, previous operating experience, or analysis, or any combination of these three methods, to substantiate that it will be capable of meeting, on a continuing basis, the performance requirements as specified in the design basis. Qualification of Class 1E equipment shall be in accordance with the requirements of IEEE Std 323-1983 and IEEE Std 627-1980.	**Procurement Spec 7.12 Factory Acceptance Test (FAT) Control** **Procurement Spec 7.12.1** The SUPPLIER shall provide a FAT test program to confirm that the ICCMS will perform satisfactorily in service. **Procurement Spec 7.12.2** A series of FAT test documents shall be written by the SUPPLIER and approved by the OWNER and shall contain all of the requirements and acceptance limits contained in applicable design documents. **Procurement Spec 7.12.3** The FAT test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. **Procurement Spec 7.12.4** Test results shall be documented, evaluated, and traceable back to the System Requirements Specification as required, assuring that all requirements have been tested satisfactorily.	AREVA equipment specification 08-9154212 section 6.0 describes examination and testing requirements. Section 6.1.3 of the specification states tests shall be performed to verify the required outputs for the required inputs. Section B.6.20 of EC 71855 provides a list of testing to be performed both factory and installed in the plant. Reference EC Sections B.4.2, B.4.4, B.4.5, B.4.6, B.6.2, B.6.4, B.6.5 and B.6.6.
5.5 System integrity		
The safety systems shall be designed to accomplish their safety functions under the full range of applicable conditions enumerated in the design basis.	The three redundant initiation channels fail in the tripped state and the two redundant actuation trains are energize to actuate per NUREG 0800 Appendix 7.1-C. This ensures the system is single failure tolerant while also minimizing spurious actuation.	Appendix 7.1-C: Confirm that the design includes the qualification of equipment for the conditions identified in the design bases. The FCS system is designed to meet the full range of conditions in the design basis. Reference EC 71855 Sections B.4.2, B.4.4, B.6.2, and B.6.4
5.6 Independence		
5.6.1 Between redundant portions of a safety system		
Redundant portions of a safety system provided for a safety function shall be independent of, and physically separated from, each other to the degree necessary to	**System Spec 3.1.8.1** Physical separation shall be maintained as it relates to IEEE-384 separation criteria between safety related (1E) and non-safety components. SUPPLIER's scope will include appropriate physical and electrical isolation of redundant channels and trains. Separation outside of the ICCMS cabinets is not in SUPPLIER's scope. **System Spec 3.1.8.2** The need for physical separation shall be met in the physical arrangement of each channel within a separate enclosure(s) and wiring within the enclosures separating power and signal wiring so as to reduce the possibility of some physical event impairing system functions. **System Spec 3.1.8.3** System sensors shall be physically separated from each other. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.4** Physical separation shall be maintained between redundant power supplies of ICCMS enclosure power supplies. The input power wiring and the actual power supplies shall be physically and electrically separated. The output wiring of	The fast cooldown control components and their associated DC power supplies are independent and electrically separate from the functionally redundant HPI pumps, valves, and control power. The fast cooldown system DC power is supplied by separate and independent sets of battery banks that are not electrically connected to the station batteries that will close switchgear breakers for the HPI pumps and diesel switchgear supply to ES buses. The fast cooldown electrical and pressure control components and the ADVs are physically separated from the HPI pumps, the ES system that actuated the HPI pumps, and the switchgear and DC controls that actuate the switchgear.

IEEE Standard Criterion	ICCMS	FCS
retain the capability of accomplishing the safety func-tion during and following any design basis event requiring that safety function.	both power supplies shall feed a common auctioneering circuit to power the module power bus. **System Spec 3.1.8.6** Failure of a single redundant enclosure power supply shall be alarmed. **System Spec 3.1.8.7** Outside the ICCMS enclosures, redundant signals and wiring shall be separated and physically protected to preserve channel independence and maintain system redundancy against physical hazards. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.8** Electrical separation between safety and non-safety shall be maintained by the use of qualified 1E isolators and relays. Input signals are from three safety channels. They will be routed independently of each other and meet separation requirements.	The fast cooldown system and the HPI system use diverse types of equipment to perform the mitigation of SBLOCA and LOSCM. With this independence and physical separation, either a) two HPI pumps or b) one HPI pump and two fast cooldown systems with associated ADVs can accomplish the safety function of mitigation of the design basis event of SBLOCA and LOSCM. Reference EC Sections B.6.1.6, B.6.2.5, B.6.13.D and B.6.15.
5.6.2 Between safety systems and effects of design basis event		
Safety system equipment required to mitigate the consequences of a specific design basis event shall be independent of, and physically separated from, the effects of the design basis event to the degree necessary to retain the capability of meeting the requirements of this standard. Equipment qualification in accordance with 5.4 is one method that can be used to meet this requirement.	**System Spec 5.8.3** Each ICCMS channel shall develop status signals to input into two-out-of-three logic for actuation of RCP pump trip, raising EFIC steam generator setpoint to ISCM level and actuating the FCS. Contacts will also be provided for alarms. All input signals for ICCMS are from environmentally qualified transmitters, sensors, connectors and cables.	The fast cooldown equipment is substantially physically separated from the effects of a SBLOCA and are independent of those effects and capable of mitigating the SBLOCA event concurrent with a single failure of an HPI train. The fast cooldown system components are located in the control complex and the intermediate building elevation 119. The effects of a SBLOCA on the equipment is bounded by the EQ designation of LOCA conditions. The fast cooldown components are qualified/rated for the temperatures and radiation effects of the LOCA designation in the particular EQ zone of their location with the LOCA effects designated by the CR3 EQPPD. Even with the SBLOCA, the fast cooldown components (not including ADV control air components) being installed are in mild environments. The ADV components are located in the intermediate building and are qualified/rated for the temperatures and radiation effects of the LOCA. Although the SPDS display would only be used for manual actuation of fast cooldown if multiple failures occurred in the auto actuation of the ICCM, it would be used for control room monitoring and is therefore evaluated below. The SPDS display used for manual actuation of FCS would display using RCS pressure transmitters located in the reactor building but which are existing equipment and are qualified for LOCA conditions. The SPDS would also use HPI injection low range flow indication from existing aux. building transmitters qualified for LOCA conditions. Thus this equipment although not physically separated from the effects of SBLOCA are adequately designed to be independent from adverse effects. Reference EC Section B.6.6.
5.6.3 Between safety systems and other systems		
The safety system design shall be such that credible failures in and consequential actions by other systems, as documented in 4.8 the design basis, shall not prevent the safety systems from meeting the requirements of this standard.	**System Spec 5.8.1** The ICCMS will interface with the Fast Cooldown System (FCS), the RCP's and the EFIC system. These interfaces will be with contact outputs only. ICCMS will not have contact inputs from these systems or digital communication, such as RS-485, to or from these systems.	The fast cooldown system in conjunction with the HPI system is not known to be susceptible to any credible failures of other systems such that the interfacing system would inhibit both the fast cooldown system including ADVs and the HPI system and its power and control. In the event of loss of an ES bus in conjunction with a LOOP, the fast cooldown system with its independent DC power source and independent pressure control circuitry is available to mitigate a SBLOCA accident. In the event of a loss of instrument air in a LOOP, the fast cooldown system provides backup air bottles for the ADVs sized for 4 hour SBO operation. One interfacing system that supports both impact the fast cooldown batteries and station batteries that provide control power for HPI switchgear and diesel switchgear closure is the control complex HVAC. Evaluation of the control complex HVAC system and CR3 DBD92 for single failure criteria has determined that the fusible link fire dampers which would require a structural failure to close without a high temperature fire are passive components and not a credible failure. A loss of HVAC due to a fire and due to SBO is beyond the licensing basis for a FSAR Chapter 14 accident. With the fast cooldown system being automatically actuated by the ICCM, evaluation is there is no potential for operator error unless there is already a single failure in ICCM. Reference EC Sections B.6.7.14, B.6.16, B.6.6 and FMEA Attach X64

IEEE Standard Criterion	ICCMS	FCS
5.6.3.1 Interconnected equipment		
Classification. Equipment that is used for both safety and non-safety functions shall be classified as part of the safety systems. Isolation devices used to effect a safety system boundary shall be classi-fied as part of the safety system.	With the exception of the Online Monitor, the ICCMS system is classified as Class 1E safety related. **System Spec Introduction** This system is classified as Class 1E nuclear safety-related performing Engineered Safeguards Features Actuation System functions as well as Post-Accident Monitoring functions. **System Spec 3.1.1.2** The Online Monitor shall be classified as non-safety. The custom screens developed for CR3 shall be designated as software control level 1 to establish configuration control requirements.	The equipment such as battery chargers and alarm circuits are classified as part of the safety related fast cooldown system. The non-safety battery chargers are included as part of the safety related fast cooldown system. Isolation devices of fuses and analog isolators are part of the safety related fast cooldown system and are safety related components in classification The ADV and its control air components are classified as safety related. Safety related Backup air supply is isolated from the non-safety instrument air by check valves that are safety related. Reference EC Sections B.6.7.2, B.6.7.6, B.6.7.9 and B.6.13.D
Isolation. No credible failure on the non-safety side of an isolation device shall prevent any portion of a safety system from meeting its minimum performance requirements during and following any design basis event requiring that safety function. A failure in an isolation device shall be evaluated in the same manner as a failure of other equipment in a safety system.	This requirment shall be adhered to in the detail design phase. The following concerning failure analysis is provided: **Procurement Spec 6.1.1** The SUPPLIER shall identify the limitations of the system under different failure scenarios. **Procurement Spec 6.1.2** The SUPPLIER shall identify single components whose failure could result in an undesirable condition or event. If this requirement is not considered practical for SUPPLIER's design, SUPPLIER shall provide justification for common mode equipment within the system. **Procurement Spec 6.1.3** SUPPLIER concerns and requirements concerning single failure tolerant design and plant interfaces should be identified in writing to the OWNER for resolution. required operator actions. **Procurement Spec 6.1.4** This single failure requirement is required to maintain conformance to the strict standards of a class IE safety system and to assure highly reliable ICCMS operation commensurate with its vital role in reliable plant operation and electrical generation. **Procurement Spec 6.1.5** The SUPPLIER shall also perform a Failure Modes and Effects Analysis (FMEA) of the ICCMS in accordance with principles set forth in IEEE 352-1987 and IEEE 379-2000. This analysis shall demonstrate that the ICCMS meets single failure requirements as set forth in this document. **Procurement Spec 6.1.6** For the FMEA, the SUPPLIER shall provide: **Procurement Spec 6.1.6.1** Identification of any assumptions used as a basis for meeting the single failure requirements. **Procurement Spec 6.1.6.2** Identification of any single failure or common failure modes **Procurement Spec 6.1.6.3** A common mode failure analysis, which analyzes the ICCMS power configurations and other potential common mode failures that may occur. **Procurement Spec 6.1.6.4** A ranking of the ICCMS components in relation to their Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR), which shall include values based on operating experience where available. In this context, "component" is understood to mean a functional grouping, such as a module or a power supply.	There are no credible failures of non-safety equipment in the fast cooldown system that would prevent a channel of fast cooldown from performing its design function during or following a design bases event. Any failure on the non-safety side is designed to be isolated and protected from creating failure on the safety related side by isolation and separation. Fusing failures are evaluated in the same manner in the FMEA as other fast cooldown components . A single failure of a non-safety related battery charger is alarmed and will not result in loss of the redundant DC bus supply to the fast cooldown pressure control circuitry. A single failure of the ACDP-10 breaker providing power to two battery chargers of the same MSV-25 or MSV-26 DC bus, would result in annunciator alarms and result in two battery banks starting to discharge but with each having a design evaluated rating of over 10 hours each to provide fast cooldown pressure control circuitry power and could mitigate a SBLOCA and LOSCM event evaluated as 4 hours operability time. Such a tripping of the ACDP-10 breaker would not affect the HPI capability to mitigate SBLOCA and LOSCM. Failures in a non-safety alarm contact or alarm relay are separated from safety related circuits by distance or barriers. Any circuit interface such as between alarm relay and safety related circuits is isolated with fusing. The ADVs and their control air components are safety related. A failure in the non-safety related instrument air system is isolated from the backup safety related air bottle supply with check valves. The non-safety EM (RECALL) system is isolated by analog isolators from safety related circuits. Moved two paragraphs to beginning of response. Reference EC Sections B.6.2.2, B.6.2.4, B.6.7.6, B.6.13.D and FMEA Attach X64.

IEEE Standard Criterion	ICCMS	FCS
5.6.3.2 Equipment In proximity		
1)Separation. Equipment in other systems that is in physical proximity to safety system equipment, but that is neither an associated circuit nor another Class 1E circuit, shall be physically separated from the safety system equipment to the degree necessary to retain the safety systems' capability to accomplish their safety functions in the event of the failure of non-safety equipment. Physical separation may be achieved by physical barriers or acceptable separation distance. The separation of Class 1E equipment shall be in accordance with the requirements of IEEE Std 384-1981)	**System Spec 3.1.4.3** Redundant initiation channels shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.4.4** Redundant actuation trains shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds.. **System Spec 3.1.8.1** Physical separation shall be maintained as it relates to IEEE-384 separation criteria between safety related (1E) and non-safety components. SUPPLIER's scope will include appropriate physical and electrical isolation of redundant channels and trains. Separation outside of the ICCMS cabinets is not in SUPPLIER's scope. **System Spec 3.1.8.2** The need for physical separation shall be met in the physical arrangement of each channel within a separate enclosure(s) and wiring within the enclosures separating power and signal wiring so as to reduce the possibility of some physical event impairing system functions. **System Spec 3.1.8.3** System sensors shall be physically separated from each other. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.4** Physical separation shall be maintained between redundant power supplies of ICCMS enclosure power supplies. The input power wiring and the actual power supplies shall be physically and electrically separated. The output wiring of both power supplies shall feed a common auctioneering circuit to power the module power bus. **System Spec 3.1.8.7** Outside the ICCMS enclosures, redundant signals and wiring shall be separated and physically protected to preserve channel independence and maintain system redundancy against physical hazards. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.8** Electrical separation between safety and non-safety shall be maintained by the use of qualified 1E isolators and relays. Input signals are from three safety channels. They shall be routed independently of each other and other non-safety equipment and shall meet separation requirements.	Separation of equipment in other systems is separated to the degree necessary to retain the fast cooldown component operability. In most cases, the electrical and control components are installed in their own separate enclosures. The location and separation of fast cooldown batteries does not meet the IEEE 384, section 5.3.1of separate safety class structures. The fast cooldown safety related batteries are installed in the battery rooms with the 1E station batteries and separated from non 1E systems. However, the location and separation of the fast cooldown batteries and the 1E station batteries meet the EDC02 cable criteria of 36 inches. The batteries are located in safety class structures and have been evaluated that a battery explosion is not credible with the battery design and typical maintenance practices. The batteries have been evaluated for credible HVAC failures and operator actions after restoration from SBO conditions. Cable routing separation is assured with the use of dedicated separate conduit for fast cooldown safety related circuits which are separate from any conduit used by Crystal River Train A, Train B, Channel A,B,C,D and non-safety circuits. AREVA specification 08-9154212-000 (Attachment X109) specifies internal cabinet wiring separation to be designed as per IEEE 384-1992. The fast cooldown system utilizes 6 inches between safety trains and 1 inch between 1E and non 1E wiring inside enclosures and cabinets or barriers. One other potential exception to IEEE 384 separation criteria is the use of a single relay and relay contacts to separate the fast cooldown 1E instrument circuit for 4-20 ma demand signal from the EFIC 1E instrument circuits. This is in reference to Figure 8.d for relay isolation of IEEE 384. The acceptability of this is evaluated in Attachment X120. Failure of this transfer relay affects only the control signal for one ADV and thus does not inhibit the ability of the functionally redundant HPI system to mitigate SBLOCA and LOSCM and perform its safety function. The EFIC demand signal to the ADV is not used for the same safety function as the fast cooldown signal to the ADV and therefore does not perform a redundant function to the fast cooldown signal. For all ADV functions except for fast cooldown, the ADVS are redundant and failure of one does not affect operability of the other. Reference EC Sections B.6.7.8, B.6.3.3, B.6.3.4, B.6.7.8, B.6.10.13, B.6.13.D, B.6.14 and B.6.18 and FMEA Att X64, EC Att X65, X109, X120.
2) Barrier. Physical barriers used to effect a safety system boundary shall meet the requirements of 5.3, 5.4 and 5.5 for the applicable conditions specified in 4.7 and 4.8 of the design basis.	**Procurement Spec 3.12.2.2** The SUPPLIER shall allow separating space or suitable barriers between different electrical divisions, channels or trains (6 inches horizontal and 6 inches vertical) within the enclosure.	The fast cooldown system design and component location in conjunction with the HPI system design and component location is such that the safety system boundaries and capability to mitigate a SBLOCA and LOSCM event are acceptable for protection against transient and steady state conditions of motive and control power and environment as well as protection against degradation from missiles, credible loss of ventilation events, spurious operation of fire suppression systems, failure in non-safety related systems. Fast cooldown components are enclosed in their own separate dedicated enclosures and not located physically in the same cabinets as other 1E instruments or DC bus components. In cases in which physical separation of circuits internally in a control or DC bus enclosure cannot be attained, physical barriers are being used for 1E to non1E separation as noted in AREVA specification 08-9154212-000 (Attachment X109). This specification also requires fabrication of the enclosures to meet IEEE 384-1992 criteria. The safety related 1E fast cooldown circuits are routed in their separate dedicated circuits and as per applicable conduit separation distances. The circuits for the ADV demand signal (MSS62 and MSS66) are routed in their own dedicated conduit with no other circuits. Reference EC Sections B.6.3.3, B.6.3.4, B.6.7.8, B.6.13.D, B.6.13.E and EC Att X109

IEEE Standard Criterion	ICCMS	FCS
5.6.3.3 Effects of a single random failure		
Where a single random failure in a non-safety system can result in a design basis event, and also prevent proper action of a portion of the safety system designed to protect against that event, the remaining portions of the safety system shall be capable of providing the safety function even when degraded by any separate single failure. See IEEE Std 379-1988 for the application of this requirement.	With the exception of the Online Monitor, the ICCMS system is classified as Class 1E safety related.	There is no identified non-safety system failure that can prevent fast cooldown system from mitigating the SBLOCA and LOSCM event. With the fast cooldown system installed as separate and independent DC power supplies and pressure control circuitry, there is a limited number of non-safety systems with which the fast cooldown system has an interface. The non-safety systems with which there is some interface are as follows: main steam system, instrument air, ICS for ADV limit switch interface, annunciator system, AC system (ACDP-10) for battery charger 120V power, and EM/SPDS system. None of these non-safety system interfaces can create a failure of the fast cooldown system. The fusing and analog isolators that provide isolation between safety related and non-safety related circuits are safety related components . Additionally, a failure in the EM system or annunciator system cannot result in a design basis event. Reference EC Sections B.6.7.13, B.6.7.9 and FMEA Att X64, EC Att X38
5.6.4 Detailed criteria		
IEEE Std 384-1981 provides detailed criteria for the independence of Class 1E equipment and circuits.	**System Spec 3.1.8.1** Physical separation shall be maintained as it relates to IEEE-384 separation criteria between safety related (1E) and non-safety components. SUPPLIER's scope will include appropriate physical and electrical isolation of redundant channels and trains. Separation outside of the ICCMS cabinets is not in SUPPLIER's scope. **System Spec 3.1.8.8** Electrical separation between safety and non-safety shall be maintained by the use of qualified 1E isolators and relays. Input signals are from three safety channels. They will be routed independently of each other and non-safety equipment. Separation requirements will be met.	The fast cooldown system DC power for the pressure control circuits is a separate and independent DC supply that does not electrically connect or interface with the existing Train A and Train B DC power for HPI pump motor power or controls. Per guidance of IEEE 384, the following design is incorporated in the fast cooldown system. There are no associated circuits that interface with the fast cooldown circuits. Non 1E circuits are separated or isolated from the 1E circuits of fast cooldown system. AREVA specification 08-9154212-000 (Attachment X109) specifies internal cabinet wiring separation to be designed as per IEEE 384-1992. All fast cooldown DC bus components and pressure control circuitry are installed in their own separate enclosures. Use of two ADVs in the fast cooldown mode in the event of a SBLOCA and loss of an HPI pump/train is the independence and redundancy provided by this design. These two diverse methods utilize diverse and independent mechanical equipment that are located in physically separate buildings and whose power sources are diverse and independent. The battery banks for the fast cooldown system are installed in the same battery rooms as the battery banks for HPI and diesel switchgear control power. However, the battery rooms are seismic qualified and evaluated as not susceptible to missiles, With fusible link fire dampers in the HVAC system which have been evaluated as passive components which would require a (non-fire related) a failure of structural integrity, the fire dampers are not evaluated as credible for failure as per CR3 single failure criteria requirements in DBD92. Reference EC Sections B.6.1.6, B.6.3.3, B.6.3.4, B.6.13.D, EC Atts X109, X02, X03, X105, X106 and FMEA Attach X64.

IEEE Standard Criterion	ICCMS	FCS
5.7 Capability for testing and calibration		
Capability for testing and calibration of safety system equipment shall be provided while retaining the capa-bility of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practi-cable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station. In this case:	**System Spec 3.1.6.1** Manual testing facilities shall be built into the ICCMS to provide the capability of periodic testing to assure that the system can fulfill its required functions. This capability shall include on-line testing to prove proper operation and to demonstrate reliability without interfering with normal reactor or plant operation or trip functions. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station. Channel Functional Tests will be performed every 92 days per SR 3.3.19.2 and 3.3.20.1. The cabinet inputs will be simulated at the cabinet to functionally test channel trips for 3.3.19.2. For 3.3.20.1 the "two-out-of-three" logic will be tested by using high frequency pulses. This will test the logic without actuating plant equipment. If a real initiation signal comes in during the testing an actuation will occur. The final actuation devices are not actuated for the Functional testing.	Guidance on periodic testing of the fast cooldown system is provided in Regulatory Guide 1.22 and in Regulatory Guide 1.118, Revision 3 which endorses IEEE Std. 338-1987. The extent of test and calibration capability provided bears heavily on whether the design meets the single-failure criterion. Any failure that is not detectable must be considered concurrently with any random postulated, detectable, single failure. As described in EC71855, Section B.4.16, B.6.16, B.4.20, and B.6.20, capability is provided for testing and calibrating channels and the devices used to derive the final fast cooldown system output signal from the various channel signals. Periodic testing duplicates, as closely as practical, the overall performance required of the FCS system and confirms operability of both the automatic and manual circuitry. There are no parts of the system where the required interval between testing will be less than the normal time interval between generating station shutdowns. A System Functional test is performed every 24 months per CR3 Technical Specifications SR 3.7.20.5. This SR demonstrates that each ADV actuates and controls at its associated OTSG pressure setpoint on an actual or simulated FCS actuation signal at least once per fuel cycle. The test includes verifying overlap with each required FCS actuation logic train tested in SR 3.3.20.1 and FCS controller circuit to ensure the entire FCS circuit will perform the intended function. An overlapping test of the automatic FCS actuation circuit is included as part of this test to provide complete testing of the associated safety function. Per the SR 3.7.20.5 bases, the 24 month periodicity is based on the need to perform the surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the surveillance is performed with the reactor at power. A Channel Calibration is performed every 24 months CR3 Technical Specifications SR 3.7.20.3. This SR is a complete check of each FCS OTSG pressure control channel, including the sensors. The test verifies that the channel responds to the measured parameter within the necessary range and accuracy. Per the SR 3.7.20.3 bases, the 24 month periodicity is based on the expected magnitude of equipment drift in the FCS instrumentation calculations (reference Areva Doc# 9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty"). As discussed in EC Section B.6.16, the FCS design does include test circuitry and switches which could be used for troubleshooting/ functional testing of the transfer relays and of the pressure controllers with the reactor at power. However, as discussed previously, due to the potential of unplanned transients with the reactor at power, the required functional testing is performed during a plant outage (reference SR 3.7.20.5 bases). Test procedures that require disconnecting wires, installing jumpers, or other similar modifications of the installed equipment are not acceptable test procedures for use during power operation and are not used in the FCS design.
1) appropriate justification shall be provided (e.g., demonstration that no practical design exists),	**System Spec 5.3.10.1** Appropriate justification shall be provided (for example, demonstration that no practical design exists),	Technical Specification 3.7.20.3 (controller calibration), 3.7.20.4 (battery duty cycle), and 3.7.20.5 (ADV actuation on simulated FCS signal) are conducted every 24 months.
2) Acceptable reliability of equipment operation shall be otherwise demonstrated, and	**System Spec 5.3.10.2** Acceptable reliability of equipment operation shall be otherwise demonstrated, and	After initial testing, ongoing verification of system capability is demonstrated by Technical Specifications 3.7.20.2 (weekly battery terminal voltage checks).
3) The capability shall be provided while the generating station is shut down.	**System Spec 5.3.10.3** The capability shall be provided while the generating station is shutdown Full calibration will be performed every refueling outage.	The FCS will perform system testing and calibration during plant outages.
5.8 Information displays		
5.8.1 Displays for manually controlled actions		
The display instrumentation provided for manually controlled actions for which no automatic control is pro-vided and the display instrumentation required for the safety systems to accomplish their safety functions shall be part of the safety systems and shall meet the requirements of IEEE Std 497-1981. The design shall minimize the possibility of ambiguous indications that could be confusing to the operator.	**System Spec 5.3.8** The SCM/Superheat displays, inadequate HPI flow indicators, and associated lights and switches shall fit on the MCB in spaces identified by the OWNER. **System Spec 5.3.9** The ICCMS status lights shall fit on the MCB in spaces identified by the OWNER.	The FCS design does not employ manual actions for which no automatic control is provided. This requirement is not applicable to the FCS design.

IEEE Standard Criterion	ICCMS	FCS
5.8.2 System status Indication		
Display instrumentation shall provide accurate, complete, and timely information pertinent to safety system status. This information shall include indication and identification of protective actions of the sense and command features and execute features. The design shall minimize the possibility of ambiguous indications that could be confusing to the operator. The display instrumentation provided for safety system status indica-tion need not be part of the safety systems.	**System Spec 5.10 ICCMS Status Display** **System Spec 5.10.1** The ICCMS status display shall receive output signals from all three (3) channels of the system. **System Spec 5.10.2** The ICCMS status display shall be located on the MCB and provide the following indications: **System Spec 5.10.2.1** Initiation Channel Bypassed (3) **System Spec 5.10.2.2** Actuation Train Bypassed (2) **System Spec 5.10.2.3** ICCM Trouble (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.4** Rx Trip received by Initiation Channel (3) **System Spec 5.10.2.5** LOSCM received by Initiation Channel (3) **System Spec 5.10.2.6** LOHPIFM by Initiation Channel (3) **System Spec 5.10.2.7** RCP Trip (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.8** EFIC ISCM Init (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.9** FCS Init Initiation Channel and Actuation Train) (5) **System Spec 5.10.3** The inputs to the ICCMS status display shall be electrically isolated.	The fast cooldown system design provides new SPDS displays (HPI flow versus RCS pressure curve and a "live" data point showing adequate or inadequate flow above or below the display curve), new SPDS points to monitor main steam pressure from the new main steam pressure transmitters, and main control room annunciation for FCS Actuation, FCS Bypassed and FCS Trouble. This display instrumentation is located in the main control room thus providing the operator with timely information. Display accuracy is ensured by periodic calibration of the display instrumentation including, main steam pressure transmitters, FCS pressure controllers and SPDS points. The FCS design will minimize the development of conditions which would cause meters, annunciators, recorders, alarms, etc. to give anomalous indications confusing to the operator. Reference EC Sections B.4.1, B.4.7, B.4.13, B.4.15, B.4.16, B.4.18, B.4.19, B.4.20, B.6.1, B.6.7, B.6.13, B.6.15 , B.6.16, B.6.18, B.6.19 and B.6.20.
5.8.3 Indication of bypasses		
If the protective actions of some part of a safety system have been bypassed or deliberately rendered inoper-ative for any purpose other than an operating bypass, continued indication of this fact for each affected safety group shall be provided in the control room.	**System Spec 5.9.2.1** Fifteen (15) TRIP/AUTO/BYPASS Switches shall be provided to allow bypassing or tripping each output trip function in each initiation channel and bypassing or tripping each output trip function in each actuation train. The TRIP/AUTO/BYPASS Switches shall be located in the channel enclosure. The individual bypass switches are as follows: **System Spec 5.9.2.1.1** Channel 1 RCP TRIP/AUTO/BYPASS Switch. **System Spec 5.9.2.1.2** Channel 2 RCP TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.3** Channel 3 RCP TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.4** Channel 1 EFIC TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.5** Channel 2 EFIC TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.6** Channel 3 EFIC TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.7** Channel 1 FCS TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.8** Channel 2 FCS TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.9** Channel 3 FCS TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.10** Train A RCP TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.11** Train B RCP TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.12** Train A EFIC TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.13** Train B EFIC TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.14** Train A FCS TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.1.15** Train B FCS TRIP/AUTO/BYPASS Switch **System Spec 5.9.2.2** The channel bypass switches stated above shall also have the capability of placing the corresponding ICCMS channel in a trip state. **System Spec 5.9.2.3** A signal shall be sent to an event point when any channel bypass switch is placed in bypass. **System Spec 5.9.2.4** Channel Bypass shall be continuously indicated in the control room. **System Spec 5.9.2.5** Two (2) actuation train reset pushbuttons (one (1) for Train A and one (1) for Train B) shall be provided on the MCB to allow resetting the actuation train trip functions. The reset pushbutton shall only clear those train trip functions which are not still activated by the 2 out of 3 channel trip functions. **System Spec 5.10.2** The ICCMS status display shall be located on the MCB and provide the following indications: **System Spec 5.10.2.1** Initiation Channel Bypassed (3) **System Spec 5.10.2.2** Actuation Train Bypassed (2)	Appendix 7.1-C: Confirm that the information displayed and the characteristics of the displays support operator awareness of system and plant status and will allow plant operators to make appropriate decisions. FCS system status information is available on the main control board. Reference EC 71855 Sections B.4.13, B.4.16, B.6.13, and B.6.16.
5.8.3.1 This display instrumentation need not be part of the safety systems.		The alarm contact is actuated directly from the bypass switch. Reference EC 71855 Sections B.4.13 and B.6.13.
5.8.3.2 This indication shall be automatically actuated if the bypass or inoperative condition is a)expected to occur more frequently than once a year, b)is expected to occur when the affected system is required to be operable.	**System Spec 5.10.5** The "CHANNEL IN BYPASS" amber light is illuminated when any one of the specific initiation channel's or actuation channel's bypass switches have been placed in bypass.	The alarm contact is actuated directly from the bypass switch however; the bypass position is not expected to be frequently used. Reference EC 71855 Sections B.4.13 and B.6.13.
5.8.3.3 The capability shall exist in the control room to manually activate this display indication.	The ICCMS Status Display is always active.	The FCS design provides a control room annunciator only when the FCS selector switches are placed in bypass. Reference EC 71855 Sections B.4.13 and B.6.13.

IEEE Standard Criterion	ICCMS	FCS
5.8.4 Location		
Information displays shall be located accessible to the operator. Information displays provided for manually controlled protective actions shall be visible from the location of the controls used to affect the actions.	Current location for the ICCMS Status Display panel is directly above and to the right of the SCM and HPI displays on the PSA section of the MCB.	The FCS design provides new SPDS displays (HPI flow versus RCS pressure curve and a "live" data point showing adequate or inadequate flow above or below the display curve), new SPDS points to monitor main steam pressure from the new system pressure control transmitters, and main control room annunciation for FCS Actuation, FCS Bypassed and FCS Trouble which are all located in the main control room and thus, accessible to the operator. There are no information displays provided for manually controlled protective actions in the FCS design. The FCS meets this requirement and is documented EC Sections B.4.1.4, B.4.7.13 and B.6.16 and in EC Attachments X74 and X112.
5.9 Control of access		
The design shall permit the administrative control of access to safety system equipment. These administra-tive controls shall be supported by provisions within the safety systems, by provision in the generating sta-tion design, or by a combination thereof.	**System Spec 4.3.1** The ICCMS shall contain security features, including but not limited to authentication, access control, lock and alarmed enclosures, event and communication logging, monitoring, and alarming to protect the system and any configuration/monitoring computer from unauthorized modification or use. **System Spec 4.3.2** The ICCMS shall be designed so that no remote access, no wireless access, no modems and no VPN connections are present. **System Spec 4.3.3** No wireless technology will be used in the ICCMS. **System Spec 4.3.4** The ICCMS enclosures shall be designed with keyed locks for greater security to the system. **System Spec 4.3.5** The ICCMS enclosures shall be alarmed upon opening and send status to the Main Control Room (MCR) and/or Central Alarm Station (CAS). **System Spec 4.3.6** The ICCMS shall alarm in the MCR and/or CAS when placed in any mode that allows system modification or changes.	The FCS equipment will be installed within the Protected Area and access controlled by Plant Physical Security design and plant badging processes. The FCS meets this requirement and is documented EC Sections B.4.17 and B.6.17.
5.10 Repair		
The safety systems shall be designed to facilitate timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.	**System Spec 3.1.6.1** Manual testing facilities shall be built into the ICCMS to provide the capability of periodic testing to assure that the system can fulfill its required functions. This capability shall include on-line testing to prove proper operation and to demonstrate reliability without interfering with normal reactor or plant operation or trip functions. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station. **System Spec 5.7.2 Self Test and Online Diagnostics** **System Spec 5.7.2.1** The ICCMS shall be capable of identifying a fault down to the module level, including power supplies. **System Spec 5.7.2.2** The ICCMS diagnostics shall include a "heartbeat" function ensuring the system is in continuous operation. Failure of this function shall be annunciated.	The FCS is designed to facilitate timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment as documented in EC Sections B.4.21 and B.6.21.
5.11 Identification		
In order to provide assurance that the requirements given in this standard can be applied during the design, construction, maintenance, and operation of the plant, the following requirements shall be met:		
1) Safety system equipment shall be distinctly identified for each redundant portion of a safety system in accordance with the requirements of IEEE Std 384-1981 and IEEE Std 420-1982.	**Procurement 3.11.1** Each equipment tag shall clearly identify each device and reflect the same nomenclature as used on the drawings. SUPPLIER shall conform to CR-3 Human Factors Guidelines in tagging equipment. **Procurement 3.11.2** The equipment tags shall use markings that cannot be easily altered. The markings should have a life of 35 years and shall not fade. **Procurement Spec 3.11.3** All operator devices mounted on the face of enclosure shall include nameplates. **Procurement Spec 3.11.4** Each enclosure, control panel, and major equipment item shall have an equipment tag affixed to it. If mounted in an enclosure, an equipment tag shall be provided on the panel so it can be accessed without opening the panel. **Procurement Spec 3.11.5** Equipment tags for the enclosure shall be securely attached with screws or adhesive.	Appendix 7.1-C: Guidance on identification is provided in Regulatory Guide 1.75, which endorses IEEE Std. 384-1992. The preferred identification method is color coding of components, cables, and cabinets.
2) Components or modules mounted in equipment or assemblies that are clearly identified as being in a single redundant portion of a safety system do not themselves require identification.	**Procurement Spec 3.11.6** Rows inside the enclosure shall be labeled and indexed from top to bottom. **Procurement Spec 3.11.7** Module mounting positions within the enclosure shall be labeled and indexed from left to right.	

IEEE Standard Criterion	ICCMS	FCS
3) Identification of safety system equipment shall be distinguishable from any identifying markings placed on equipment for other purposes (e.g., identification of fire protection equipment, phase iden-tification of power cables).	**Procurement Spec 3.11.9** Specific equipment and software identification and tags shall be defined by OWNER during the detailed engineering and construction phase. Non-safety related software used in the online monitor shall comply with this requirement.	FCS system safety-related components use appropriate color coding for cables/conduits along with equipment tags that clearly identify the equipment and its purpose. Reference EC 71855 Section D.
4) Identification of safety system equipment and its divisional assignment shall not require frequent use of reference material.	**Procurement Spec 3.11.9** Specific equipment and software identification and tags shall be defined by OWNER during the detailed engineering and construction phase. Non-safety related software used in the online monitor shall comply with this requirement.	
5) The associated documentation shall be distinctly identified in accordance with the requirements of IEEE Std 494-1974.	**Procurement Spec 4.1.13 Format for drawings:** **Procurement Spec 4.1.13.1** Drawings submittal by SUPPLIER shall be in PDF format for OWNER's review, comment, approval, and design package development. **Procurement Spec 4.1.13.2** Include on each drawing the title, number, date, and revision. **Procurement Spec 4.1.13.3** Revisions to drawings shall be clouded and identified with the revision number adjacent to the revised information. **Procurement Spec 4.1.13.4** Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with OWNER connections to scale. Identify materials and products for work shown.	
5.12 Auxiliary features		
5.12.1 Auxiliary supporting features shall meet all requirements of this standard.		
Other auxiliary features that 1) perform a function that is not required for the safety systems to accomplish their safety functions, 2) and are part of the safety systems by association (i.e., not isolated from the safety system) shall be designed to meet those criteria necessary to ensure that these components, equipment, and systems do not degrade the safety systems below an acceptable level. Examples of these other auxiliary features are shown in Figure 3 and an illustration of the application of this criteria is contained in Appendix A.	There are no auxiliary features or components that are not isolated from the safety system. The wiring from the associated card outputs to the multiplexer in each cabinet utilized for import of signals into the online monitor are isolated at the individual card outpus.	The FCS design does not provide any auxiliary features that perform a function that is not required for the safety systems to accomplish their safety functions, and are part of the safety systems by association (i.e., not isolated from the safety system). This requirement is therefore not applicable to the FCS design.
5.13 Multi-unit stations		
The sharing of structures, systems, and components between units at multi-unit generating stations is per-missible provided that the ability to simultaneously perform required safety functions in all units is not impaired Guidance on the sharing of electrical power systems between units is contained in IEEE Std 308--1980. Guidance on the application of the single failure criterion to shared systems is contained in IEEE Std 379-1988.	The ICCMS does not share structures, systems, and components or electircal power supplies.	The FCS design does not share structures, systems, and components between units. This requirement is therefore not applicable to the FCS design.
5.14 Human factors considerations		
Human factors shall be considered at the initial stages and throughout the design process to assure that the functions allocated in whole or in part to the human operator(s) and maintainer(s) can be successfully accomplished to meet the safety system design goals, in accordance with IEEE Std 1023-1988.	The following are utilized as references to the System Spec: 3. NUREG-0700, "Human System -Interface Design Review Guidelines" 4. NUREG-0711, "Human Factors Engineering Program Review Model", July 1994. 39. SP5145, Human Factors Design Conventions for the Control Room These factors have been and will be considered in the detailed design phase.	The FCS design installs new FCS Selector Switches and associated fast cooldown status indicating lights at the main control board in the main control room. Additionally, the existing FWV-34 and FWV-35 selector switches and associated valve position indication lights on the PSA section of the control board are being removed and the indication lights are relocated to another control board section. The location of the fast cooldown selector switches and of the FWV-34/35 indicating lights were reviewed by operations personnel for consistency with human factors criteria and meets the requirements of CR3 Doc# SP5145, "Human Factors Design Conventions for the Control Room", which is based on NRC NUREG-0700, "Guidelines for Control Room Design Reviews", 1981. The switches are designed and installed per SP5145. The FCS meets this requirement and is documented in EC Sections B.4.7.11 and B.6.14.

IEEE Standard Criterion	ICCMS	FCS
5.15 Reliability		
For those systems for which either quantitative or qualitative reliability goals have been established, appro-priate analysis of the design shall be performed in order to confirm that such goals have been achieved. IEEE Std 352-1987 and IEEE Std 577-1976 provide guidance for reliability analysis.	**System Spec 3.1.5.2** The SUPPLIER shall determine that the reliability of the safety system design is appropriate and is able to meet the reliability goal stated above by performing an analysis of the design. IEEE 352-1987 and IEEE 577-1976 provide guidance for reliability analysis.	The reliability of the FCS design is shown qualitatively by the incorporation of the following features: The FCS design incorporates diverse methods of mitigating SBLOCA and LOSCM using different types of components (HPI pump versus ADV) that are located in different locations of the generating station. (EC 71855 Section B.2.2, B.6.18) Different locations of functionally redundant equipment minimizes common mode failures due to abnormal environment conditions. ADVs are located in intermediate building elevation 119 while the HPI pumps are located in auxiliary building elevation 95. FCS design incorporates separate, independent, diverse components between those used in ES actuation of HPI pump in ES cabinets and those used in fast cooldown actuation.(EC 71855 Section B.2.2, B.6.18) FCS design incorporates independent separate DC power source for the fast cooldown pressure control circuitry that is not connected and does not have any interface with the HPI control or power sources.(EC 71855 Section B.2.3, B.6.1.6, B.6.2.5, B.6.18) FCS design incorporates redundant battery banks and DC bus assemblies for each ADV pressure control circuit so that I one bank fails or is being tested, the redundant bank will insure fast cooldown pressure control operability. (EC 71855 Section B.2.3). AREVA specification 08-9154212, item 3.1.7 requires enclosure design to minimize EMI/RFI. Additionally all DC bus and control components are located inside their own steel enclosures to provide separation and minimize any environmental EMI/RFI effect.
6. Sense and command features-functional and design requirements		
In addition to the functional and design requirements in Section 5, the following requirements shall apply to the sense and command features:		
6.1 Automatic control		
Means shall be provided to automatically initiate and control all protective actions except as justified in 4.5. The safety system design shall be such that the operator is not required to take any action prior to the time and plant conditions specified in 4.5 following the onset of each design basis event. At the option of the safety system designer, means may be provided to automatically initiate and con¬trol those protective actions of 4.5	**System Spec Intro** The three LOCA mitigation actuations are 1) automatic tripping of the Reactor Coolant Pumps (RCPs) when there is a reactor trip coupled with a loss of sub cooling margin; 2) automatic raising of the Steam Generator (SG) level control to the Inadequate Sub Cooling Margin (ISCM) set point; and 3) automatic actuation of the Fast Cooldown System (FCS), which shall actuate the Atmospheric Dump Valves (ADVs) in Fast Cooldown mode. Actuation of the ADVs shall occur in response to a reactor trip, coupled with a Loss of Subcooling Margin (LOSCM) in the Reactor Coolant System (RCS), with an inadequate High Pressure Injection (HPI) flow as measured by the ICCMS. **System Spec 3.1.3.2** The ICCMS shall be a single failure proof system designed to automatically actuate the fast cooldown system when system parameters indicate a reactor trip, a loss of subcooling margin and inadequate HPI flow.	The FCS design provides transfer relays which automatically transfers control of the ADV demand signal from the EFIC control modules (setpoint of 1025 psig) to the FCS pressure controllers (setpoint of 350 psig) upon receiving an actuation signal from ICCMS (contact closure upon an Inadequate Core Cooling event. Once initiated, the FCS will continue to operate until operators take manual action to terminate the automatic cooldown or until primary temperature has reached the DH initiation point (280 degrees F): The FCS meets this requirement and is documented in EC Sections B.2.5, B.4.1.4, B.6.1.4.

IEEE Standard Criterion	ICCMS	FCS
6.2 Manual control		
6.2.1 Means shall be provided in the control room to implement manual initiation at the division level of the automatically initiated protective actions. The means provided shall minimize the number of discrete operator manipulations and shall depend on the operation of a minimum of equipment consistent with the constraints of 5.6.1.	**System Spec 3.1.3.5** In addition, the ability to manually initiate ICCMS functions that is independent of automatic control shall be provided. **System Spec 5.9.3.1** All actuations performed by the ICCMS shall continue to have the capacity for manual actuation.	
6.2.2 Means shall be provided in the control roomt to implement manual initiation and control of the protective actions identified in 4.5 that have not been selected for automatic control under 6.1. The displays provided for these actions shall meet the requirements of 5.8.1.	There are no other protective actions which are not initiated by automatic control.	Appendix 7.1-C: Features for manual initiation of protective action should conform with Regulatory Guide 1.62, "Manual Initiation of Protection Action." Regulatory Guide 1.62: Manual initiation of a protective action on a division-level basis should perform all actions performed by automatic initiation, such as starting auxiliary or supporting systems, sending signals to appropriate valve-actuating mechanisms to ensure correct valve position, and providing the credited action-sequencing functions and interlocks. The fast cooldown system includes means for manual initiation of the protective action with the switches on the main control board. Reference EC 71855 Sections B.4.15 and B.6.15.
6.2.3 Means shall be provided in the control roomt to Implement the manual actions necessary to maintain safe conditions after the protective actions are completed as specified in 4.10. The information provided to the operators, the actions required of these operators, and the quantity and location of associated displays and controls shall be appropriate for the time period within which the actions shall be accomplished and the number of available qualified operators. Such displays and controls shall be located in areas that are accessible, located in an environment suitable for the operator, and suitably arranged for operator surveillance and action.	**System Spec 5.3.8** The SCM/Superheat displays, inadequate HPI flow indicators, and associated lights and switches shall fit on the MCB in spaces identified by the OWNER. **System Spec 5.3.9** The ICCMS status lights shall fit on the MCB in spaces identified by the OWNER. Current location for the ICCMS Status Display panel is directly above and to the right of the SCM and HPI displays on the MCB.	
6.3 Interaction between the sense and command features and other systems		
6.3.1 Where a single credible event, including all direct and consequential results of that event, can cause a non-safety system action that results in a condition requiring protective action, and can concurrently prevent the protective action in those sense and command feature channels designated to provide principal protection against the condition, one of the following requirements shall be met:		
(1) Alternate channels not subject to failure resulting from the same single event shall be provided to limit the consequences of this event to a value specified by the design basis. Alternate channels shall be selected from the following:	**System Spec 5.1.7** The ICCMS shall be a three (3) initiation channel system with two (2) redundant actuation trains. **System Spec 5.1.8** The three (3) initiation channels shall be denoted as Channel "1", Channel "2", and Channel "3". The two (2) actuation trains shall be denoted as Train "A" and Train "B". The three (3) cabinets shall be denoted as Cabinet "1", Cabinet "2", and Cabinet "3".	
(a) Channels that sense a set of variables different from the principal channels. (b) Channels that use equipment different from that of the principal channels to sense the same variable. (c) Channels that sense a set of variables different from those of the principal channels using equipment different from that of the principal channels. Both the principal and alternate channels shall be part of the sense and command features.	**System Spec 5.1.9** Each channel shall independently acquire inputs and calculate Sub Cooling Margin, Degrees of Superheat, and High Pressure Injection Flow Margin. **System Spec 5.1.10** Each channel shall be capable of independently producing outputs of Sub Cooling Margin, Degrees of Superheat, and HPI Flow Margin. **System Spec 5.1.11** Each channel shall be capable of independently producing trip signals for tripping the RCP pumps, setting the ISCM set point, and Initiating the Fast Cooldown System.	There is no identified non-safety system action that can prevent fast cooldown system from mitigating the SBLOCA and LOSCM event.
(2) Equipment not subject to failure caused by the same single credible event shall be provided to detect the event and limit the consequences to a value specified by the design bases. Such equipment is considered a part of the safety system. See Fig. 5 for a decision chart for applying the requirements of this section.	**System Spec 5.1.9** Each channel shall independently acquire inputs and calculate Sub Cooling Margin, Degrees of Superheat, and High Pressure Injection Flow Margin. **System Spec 5.1.10** Each channel shall be capable of independently producing outputs of Sub Cooling Margin, Degrees of Superheat, and HPI Flow Margin. **System Spec 5.1.11** Each channel shall be capable of independently producing trip signals for tripping the RCP pumps, setting the ISCM set point, and Initiating the Fast Cooldown System.	
6.3.2 Provisions shall be included so that the requirements in 6.3.1 can be met in conjunction with the requirements of 6.7 if a channel is in maintenance bypass. These provisions include reducing the required coincidence, defeating the non-safety system signals taken from the redundant channels, or initiating a protective action from the bypassed channel.	**System Spec 5.2.2** While any part of the system is out of operation for maintenance or testing, this system shall not cause adverse actions with spurious operation. **System Spec 5.2.3** While any part of the system is out of operation for planned maintenance or testing, the system shall still remain capable of performing the required safety system actuation functions at all times while the system is required to be in operation.	This requirement is not applicable to the FCS system. Maintenance bypasses are not included in the design of the fast cooldown system.

IEEE Standard Criterion	ICCMS	FCS
6.4 Derivation of system inputs		
To the extent feasible and practical, sense and command feature inputs shall be derived from signals that are direct measures of the desired variables as specified in the design basis.	All channels utilize direct measurements of desired values. Channel C has necessitated the installation of additional pressure and flow instruments for this system. SCM and HPI flow margin are both indirectly sensed variables obtained by the best available instrumentation per channel and applied with analytical margin	The FCS design installs new system pressure control transmitters in the same sensing line as the existing pressure transmitters that supply main steam pressure signal for the EFIC cabinet ADV control. Thus, the new transmitters are a direct measure of main steam pressure. The pressure transmitters are qualified per IEEE 323-1974 for 1E qualification and per IEEE 344-1975 for seismic qualification. The transmitters output a 4-20 ma signal for a calibrated 0-1200 psig span which bounds the highest main steam safety valve setpoint of 1100 psig. The instrument accuracy and uncertainty has been evaluated in Areva Doc #32-9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty" Reference EC Sections B.4.16, B.6.16 and Areva Doc #32-9137975.
6.5 Capability for testing and calibration		
6.5.1 Means shall be provided for checking, with a high degree of confidence, the operational availability of each sense and command feature input sensor required for a safety function during reactor operation. This may be accomplished in various ways; for example:	**System Spec 3.1.6.1** Manual testing facilities shall be built into the ICCMS to provide the capability of periodic testing to assure that the system can fulfill its required functions. This capability shall include on-line testing to prove proper operation and to demonstrate reliability without interfering with normal reactor or plant operation or trip functions. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station.	The FCS design adds SPDS points for the new system pressure control transmitters which can be used to cross-check the FCS transmitters with existing main steam pressure transmitters installed at the same instrument tap. The FCS meets this requirement and is documented in EC Sections B.4.16 and B.6.16.
(1) By perturbing the monitored variable,	Technical Specification 3.3.19-1 requires channel checks of each input function every 12 hours. HPI Flow, RCS Pressure Low Range, RCS Pressure Wide Range Pressure and Core Exit Thermocouples are	
(2) Within the constraints of 6.6, by introducing and varying, as appropriate, a substitute input to the sensor of the same nature as the measured variable, or (3) By cross-checking between channels that bear a known relationship to each other and that have read-outs available.	input functions. The signals are isolated and sent to the On-Line Monitor which in turn sends them to the plant computer. The computer points are used in the channel check. A backup method for the channel check is available. All input and output points can be monitored by a voltmeter at the cabinets. The output functions for Loss of Subcooling Margin and Inadequate HPI Flow are also checked every 12 hours by a channel check. The output parameters can be read on main control board indicators.	
6.5.2 One of the following means shall be provided for assuring the operational availability of each sense and command feature required during the post-accident period:		
(1) Checking the operational availability of sensors by use of the methods described in 6.5.1.	Technical Specification 3.3.19-1 requires channel checks of each input function every 12 hours. HPI Flow, RCS Pressure Low Range, RCS Pressure Wide Range Pressure and Core Exit Thermocouples are input functions. The signals are isolated and sent to the On-Line Monitor which in turn sends them to the plant computer. The computer points are used in the channel check. A backup method for the channel check is available. All input and output points can be monitored by a voltmeter at the cabinets. The output functions for Loss of Subcooling Margin and Inadequate HPI Flow are also checked every 12 hours by a channel check. The output parameters can be read on main control board indicators.	The FCS design provides for the availability of cross-checking the new system pressure control transmitters (SPDS points) with existing main steam pressure transmitters (SPDS points) which are installed at the same instrument tap as discussed in IEEE-603, Item 6.5.1. Additionally, the new FCS system pressure control transmitters will be purchased as Nuclear Safety-Related, Class 1E components per IEEE 323-1974, seismically qualified to IEEE 344-1975 and will be designed to accommodate the environmental parameters (temperature, humidity, radiation, etc) in their installed local during normal and accident conditions. This will ensure they remain available following a Small Break Loss of Coolant Accident (SBLOCA) with subsequent Loss of Subcooling Margin (LOSCM). The FCS meets this requirement and is documented EC Sections B.4.16, B.6.5 and B.6.16.
(2) Specifying equipment that is stable and the period of time it retains its calibration during the post-accident time period.	**System Spec 5.3.4** The uncertainty of any ICCMS trip function shall not exceed □0.64% span from input to trip, including as a minimum reference accuracy, temperature effect, power supply effect, 90 day drift, and M&TE, but excluding sensor accuracy.	
6.6 Operating bypasses		
Whenever the applicable permissive conditions are not met, a safety system shall automatically prevent the activation of an operating bypass or initiate the appropriate safety function(s). If plant conditions change so that an activated operating bypass is no longer permissible, the safety system shall automatically accomplish one of the following actions: (1) Remove the appropriate active operating bypass(es). (2) Restore plant conditions so that permissive conditions once again exist (3) Initiate the appropriate safety function(s).	**System Spec 5.9.2.5** Two (2) actuation train reset pushbuttons (one (1) for Train A and one (1) for Train B) shall be provided on the MCB to allow resetting the actuation train trip functions. The reset pushbutton shall only clear those train trip functions which are not still activated by the 2 out of 3 channel trip functions.	This requirement is not applicable to the FCS system. Operating bypasses are not included in the design of the fast cooldown system.

IEEE Standard Criterion	ICCMS	FCS
6.7 Maintenance bypass		
Capability of a safety system to accomplish its safety function shall be retained while sense and command features equipment is in maintenance bypass. During such operation, the sense and command features should continue to meet the requirements of 5.1 and 6.3.	**System Spec 5.2.3** While any part of the system is out of operation for planned maintenance or testing, the system shall still remain capable of performing the required safety system actuation functions at all times while the system is required to be in operation. **System Spec 5.2.5** The proposed system shall have a maintenance channel bypass function available.	This requirement is not applicable to the FCS system. Maintenance bypasses are not included in the design of the fast cooldown system.
EXCEPTION: One-out-of-two portions of the sense and command features are not required to meet 5.1 and 6.3 when one portion is rendered inoperable, provided that acceptable reliability of equipment operation is otherwise demonstrated (that is, that the period allowed for removal from service for maintenance bypass is sufficiently short to have no significantly detrimental effect on overall sense and command features availability).		
6.8 Setpoints		
6.8.1 The allowance for uncertainties between the process analytical limit documented in Section 4.4 and the device setpoint shall be determined using a documented methodology. Refer to ISA S67.040-19987 [18] 6.8.2 Where it is necessary to provide multiple setpoints for adequate protection for a particular mode of operation or set of operating conditions, the design shall provide positive means of ensuring that the more restrictive setpoint is used when required. The devices used to prevent improper use of less restrictive setpoints shall be part of the sense and command features.	**System Spec 5.5.2.1** The subcooling margin (SCM) shall be calculated using instrumentation inputs for RCS pressure and temperature and the SCM curve. **System Spec 5.5.2.4** The SCM curve is defined in calculation I84-0003, SPDS Description Document, and I96-0002, SPDS TSAT Display Errors. The SCM curve is based on ASME 1967 steam tables plus instrument uncertainty. **System Spec 5.5.2.5** The SCM curve, with the adjustment for instrument uncertainty, shall be provided by Progress Energy. **System Spec 5.5.2.6** Methods to program the curve will be determined during the design phase with approval by Progress Energy **System Spec 5.5.2.11** The superheat curve with the adjustment for instrument uncertainty shall be provided by Progress Energy. **System Spec 5.5.2.12** Methods to program the SH curve will be determined during the design phase with approval by Progress Energy. **System Spec 5.5.5.1** The high pressure injection (HPI) flow margin is calculated using instrumentation inputs for the RCS pressure, HPI flow rates and the HPI flow margin curve. **System Spec 5.5.5.2** The HPI flow margin curve is defined in provided calculation 51-914483 "CR-3 EPU Required SBLOCA HPI Flow without FCS". This calculation provides the acceptable HPI flow for a given RCS Pressure. This calculation accounts for instrument uncertainty.	The nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value". The FCS System pressure control setpoint uncertainty (± 20.9 psig) has been calculated per Areva Doc #32-91379757, "Fast Cooldown Main Steam Pressure Control Uncertainty" and is in accordance with the CR3 I&C Design Criteria document ICDC-1. ICDC-1 uses NRC Reg Guide 1.105, R2, "Instrument Setpoint" and ISA S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation" as its basis. The FCS safety system value of 325 psig is derived from the 350 psig nominal setpoint minus the 20.9 psig uncertainty minus an additional margin. The FCS meets this requirement and is documented in EC Sections B.4.16 and B.6.16 and in Areva Docs #32-9139532 and #32-91379757. The nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value". The FCS System pressure control setpoint uncertainty (± 20.9 psig) has been calculated per Areva Doc #32-91379757, "Fast Cooldown Main Steam Pressure Control Uncertainty" and is in accordance with the CR3 I&C Design Criteria document ICDC-1. ICDC-1 uses NRC Reg Guide 1.105, R2, "Instrument Setpoint" and ISA S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation" as its basis. The FCS safety system value of 325 psig is derived from the 350 psig nominal setpoint minus the 20.9 psig uncertainty minus an additional margin. The FCS meets this requirement and is documented in EC Sections B.4.16 and B.6.16 and in Areva Docs #32-9139532 and #32-91379757.
7. Execute features (functional and design requirements)		
In addition to the functional and design requirements in Section 5, the following requirements shall apply to the execute features.		
7.1 Automatic control		
Capability shall be incorporated in the execute features to receive and act upon automatic control signals from the sense and command features consistent with 4.4 of the design basis.	**System Spec Intro** The three LOCA mitigation actuations are 1) automatic tripping of the Reactor Coolant Pumps (RCPs) when there is a reactor trip coupled with a loss of sub cooling margin; 2) automatic raising of the Steam Generator (SG) level control to the Inadequate Sub Cooling Margin (ISCM) set point; and 3) automatic actuation of the Fast Cooldown System (FCS), which shall actuate the Atmospheric Dump Valves (ADVs) in Fast Cooldown mode. Actuation of the ADVs shall occur in response to a reactor trip, coupled with a Loss of Subcooling Margin (LOSCM) in the Reactor Coolant System (RCS), with an inadequate High Pressure Injection (HPI) flow as measured by the ICCMS.	The FCS design provides transfer relays which automatically transfers control of the ADV demand signal from the EFIC control modules (setpoint of 1025 psig) to the FCS pressure controllers (setpoint of 350 psig) upon receiving an actuation signal from ICCMS (contact closure upon an Inadequate Core Cooling event). As discussed in response to IEEE-603, Item #6.8, the nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value" and the FCS System pressure control setpoint uncertainty has been calculated per Areva Doc #32-91379757, "Fast Cooldown Main Steam Pressure Control Uncertainty. The FCS safety system value of 325 psig is derived taking into account the nominal setpoint minus total loop uncertainty and an additional conservative margin. The FCS meets this requirement and is documented in EC Sections B.2.5, B.4.1.4, B.6.1.4 and in Areva Docs #32-9139532 and #32-91379757.

IEEE Standard Criterion	ICCMS	FCS
7.2 Manual control		
If manual control of any actuated component in the execute features is provided, the additional design features in the execute features necessary to accomplish such manual control shall not defeat the requirements of 5.1 and 6.2. Capability shall be provided in the execute features to receive and act upon manual control signals from the sense and command features consistent with the design basis.	**System Spec 3.1.3.5** In addition, the ability to manually initiate ICCMS functions that is independent of automatic control shall be provided. **System Spec 5.9.3.1** All actuations performed by the ICCMS shall continue to have the capacity for manual actuation. The ICCMS is designed to automate the actuation of components which the plant presently actuates manually (i.e. trip the RCP's and change the EFIC setpoint). Automatic actuation of the FCS by ICCMS (in the specific case of a loss of SCM. coupled with a Reactor trip and an inadequate HPI flow) does not provide for nor defeat the capability of manually actuating FCS from the MCB.	Appendix 7.1-C: Features for manual initiation of protective action should conform with Regulatory Guide 1.62, "Manual Initiation of Protection Action." Regulatory Guide 1.62: Manual initiation of a protective action on a division-level basis should perform all actions performed by automatic initiation, such as starting auxiliary or supporting systems, sending signals to appropriate valve-actuating mechanisms to ensure correct valve position, and providing the credited action-sequencing functions and interlocks. The fast cooldown system includes means for manual initiation of the protective action with the switches on the main control board. Reference EC 71855 Sections B.4.15 and B.6.15.
7.3 Completion of protective action		
The design of the execute features shall be such that, once initiated, the protective actions of the execute features shall go to completion. This requirement shall not preclude the use of equipment protective devices identified in 4.11 of the design basis or the provision for deliberate operator interventions. When the sense and command features reset, the execute features shall not automatically return to normal; they shall require separate, deliberate operator action to be returned to normal. After the initial protective action has gone to completion, the execute features may require manual control or automatic control (that is., cycling) of specific equipment to maintain completion of the safety function.	**System Spec 3.1.10.1** The safety systems shall be designed so that, once initiated automatically or manually, the intended sequence of protective actions of the execute features shall continue until completion. **System Spec 3.1.10.2** The ICCMS shall be designed such that when it is determined that Fast Cooldown is required, an output from the ICCMS shall activate a seal in contact in the FCS for actuation. The balance of the FCS system is outside SUPPLIER's scope. **System Spec 3.1.10.3** Deliberate operator action shall be required to return the safety systems to normal. FCS provides seal-in. EFIC provides seal-in for ISCM setpoint. RCP trip does not need seal-in as manual action is needed to restart RCPs.	Appendix7-1C: Review functional and logic diagrams to ensure that "seal-in" features are provided to enable system-level protective actions to go to completion. FCS energizes a "seal-in" contact which enables protective actions to go to completion. Reference EC 71855 B.4.16 and B.6.16.
7.4 Operating bypass		
Whenever the applicable permissive conditions are not met, a safety system shall automatically prevent the activation of an operating bypass or initiate the appropriate safety function(s). If plant conditions change so that an activated operating bypass is no longer permissible, the safety system shall automatically accomplish one of the following actions: (1) Remove the appropriate active operating bypass(es). (2) Restore plant conditions so that permissive conditions once again exist (3) Initiate the appropriate safety function(s).	The ICCMS utilizes administrative controls (i.e. locked enclosure) and procedures to allow placing any channel or train bypass switch into a bypass or trip condition.	This requirement is not applicable to the FCS system. Operating bypasses are not included in the design of the fast cooldown system.
7.5 Maintenance bypass		
The capability of a safety system to accomplish its safety function shall be retained while execute features equipment is in maintenance bypass. Portions of the execute features with a degree of redundancy of one shall be designed such that when a portion is placed in maintenance bypass (that is, reducing temporarily its degree of redundancy to zero), the remaining portions provide acceptable reliability.	**System Spec 5.9.1.9** One channel of ICCMS must be able to be placed into test or maintenance mode and the remaining system still meet single failure criteria for safety system actuation.	This requirement is not applicable to the FCS system. Maintenance bypasses are not included in the design of the fast cooldown system.

IEEE Standard Criterion	ICCMS	FCS
8. Power source requirements		
8.1 Electrical power sources		
Those portions of the Class IE power system that are required to provide the power to the many facets of the safety system are governed by the criteria of this document and are a portion of the safety systems. Specific criteria unique to the Class IE power systems are given in IEEE Std 308-1980 [1].	**System Spec 3.3.1** 120-volt AC power for the ICCMS shall be provided by battery-backed inverter busses. This requirement is not in SUPPLIER's scope. **System Spec 3.3.2** Two independent sources of power shall be provided for each enclosure/channel. This requirement is not in SUPPLIER's scope. **System Spec 3.3.3** The ICCMS shall be capable of performing all functional requirements as specified herein with power supply variations of 120 VAC ± 10%, 60Hz ± 1%. **System Spec 3.3.4** The ICCMS power distribution shall be designed so that with the loss of one power supply or the loss of one incoming power source there will be no affect on the system's functional operation or plant operation. **System Spec 3.3.5** Each power supply shall be monitored and alarm actuated if a failure occurs. Loss of power detector(s) shall be provided as required to detect and alarm on a loss of power condition. **System Spec 3.3.6** The ICCMS shall transmit loss of power alarm signal(s) to an event point which shall drive an annunciator in the Control Room. **System Spec 3.3.7** An additional 120VAC power supply shall be provided in each cabinet to power non-safety related equipment (i.e. multiplexers, switches, and Online Monitor system.) This requirement is not in SUPPLIER's scope. **System Spec 5.3.3** Power requirements for each enclosure shall not exceed 120VAC 300 watts per supply without OWNER approval. The 300 watt limit does not apply to the portions of the system on non-1E power.	Per the ADV Fast Cooldown Equipment Specification (Areva Doc# 08-9154212), the FCS equipment (Enclosures) are to be designed and tested to the requirements of IEEE Standard 308-2001, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations" (reference Spec sections 1.3.2 and A.1.2) The FCS DC busses are to be purchased as Nuclear Safety-Related, Class 1E components qualified to IEEE 323-1974. The FCS meets this requirement and is documented in EC Sections B.4.3.3, B.4.3.4, B.4.7.9, B.4.18 and B.6.3.3 as well as the Areva FCS Equipment Spec 08-9154212 (EC Attachment X109).
8.2 Non-electrical power sources		
Non-electrical power sources, such as control-air systems, bottled-gas systems, and hydraulic systems, required to provide the power to the safety systems are a portion of the safety systems and shall provide power consistent with the requirements of this standard. Specific criteria unique to non-electrical power sources are outside the scope of this standard and can be found in other standards. [B4, B5]	There are no non-electrical power sources to the ICCMS.	The FCS controls the ADVs which are Air Operated Valves. Air is supplied by either Instrument Air or a back-up bottled air system. Reference EC 71855 sections B.4.2.4, B.4.2.6, B.6.2.4, and B.6.2.6.
8.3 Maintenance bypass		
The capability of the safety systems to accomplish their safety functions shall be retained while power sources are in maintenance bypass. Portions of the power sources with a degree of redundancy of one shall be designed such that when a portion is placed in maintenance bypass (i.e., reducing temporarily its degree of redundancy to zero), the remaining portions provide acceptable reliability.	**System Spec 5.9.1.1** A loss of both power supplies to an enclosure/channel shall place that channel in a tripped state and actuate an event point to drive an annunciator. **System Spec 5.9.1.2** Loss of a single enclosure power supply shall not cause loss of function of an enclosure or channel and shall be recognized by that channel's diagnostic function. **System Spec 5.9.1.3** The loss of power to a single ESFAS instrument input or initiation channel will not cause an automatic actuation. System Spec 5.9.1.4 A loss of power to an input module of any channel shall result in all of the input signals for that module to be recognized as invalid in the online monitor. **System Spec 5.9.1.5** A loss of power to a channel enclosure results in a reduction of coincident logic (i.e.,1 out of the remaining 2 unaffected channels) are then required for the ICCMS functions/actuations. **System Spec 5.9.1.6** Redundant ICCMS channels remain functional upon loss of power to another ICCMS channel. **System Spec 5.9.1.7** The ICCMS channel shall not initialize to an inadvertent trip state. The ICCMS does not require or have the capability to place a power supply in maintenance bypass. Redundancy of power sources is discussed above in 8.1	This requirement is not applicable to the FCS system. Maintenance bypasses are not included in the design of the fast cooldown system

IEEE Standard Criterion	ICCMS	FCS
IEEE 279-1971		
3. Design Basis		
A specific protection system design basis shall be provided for each nuclear power generating station. The information thus provided shall be available, as needed, for making judgments on system functional adequacy.		
The design basis shall document as a minimum, the following:		
(1) the generating station conditions which require protective action;	**System Spec Intro** - The three LOCA mitigation actuations are 1) automatic tripping of the Reactor Coolant Pumps (RCPs) when there is a reactor trip coupled with a loss of sub cooling margin; 2) automatic raising of the Steam Generator (SG) level control to the Inadequate Sub Cooling Margin (ISCM) set point; and 3) automatic actuation of the Fast Cooldown System (FCS), which shall actuate the Atmospheric Dump Valves (ADVs) in Fast Cooldown mode. Actuation of the ADVs shall occur in response to a reactor trip, coupled with a Loss of Subcooling Margin (LOSCM) in the Reactor Coolant System (RCS), with an inadequate High Pressure Injection (HPI) flow as measured by the ICCMS. **System Spec 5.2.4** The FCS function of this system shall be required to operate whenever reactor pressure is greater than 350 PSIG. The reactor coolant pump trip actuation and the ISCM setpoint actuation are required in modes 1 through 4. Mode 4 at CR-3 is the average reactor coolant temperature above 200°F. The PAM functions shall be required when the Reactor Coolant temperature is greater than 200°F.	During normal plant operating temperature and pressure (NOT/NOP), with a Small-Break Loss of Coolant Accident (SBLOCA), and subsequent Loss of Subcooling Margin (LOSCM) and inadequate High Pressure Injection (HPI) system flow, the FCS responds automatically to a demand signal from the Inadequate Core Cooling Mitigation System (ICCMS) to open the ADVs to allow rapid RCS cool down and to subsequently control the ADVs at 325 psig. Reference EC Sections B.2.2, B.2.5, B.4.1.4, B.4.15, B.4.16, B.6.1.1, B.6.1.4, B.6.15, B.6.16 and EC Att X122 (FSAR Chapter 7 revision).
(2) the generating station variables (for example, neutron flux, coolant flow, pressure, etc.) that are required. to be monitored in order to provide protective actions;	**System Spec 5.4 System Inputs** **System Spec 5.4.1 RCS Wide Range Pressure per channel** **System Spec 5.4.1.1** RCS wide range pressure shall be acquired by a single 0-2500 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.2 RCS In Core Thermocouple Temperature per channel** **System Spec 5.4.2.1** In Core temperature shall be provided by eight (8) 0°F to 2500°F thermocouple instruments per channel. SUPPLIER to supply the eight (8) temperature transmitters for each channel. **System Spec 5.4.2.2** System shall provide isolated 4-20mA outputs from each thermocouple signal. **System Spec 5.4.3 RCS Low Range Pressure per channel** **System Spec 5.4.3.1** RCS low range pressure shall be acquired by a single 0-600 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.4 RCS THOT Temperature for channel 1 and channel 2** **System Spec 5.4.4.1** RCS temperature shall also be provided by a single 120°F to 920°F THOT RTD instrument per channel providing a 4-20mA signal. **System Spec 5.4.5 HPI Flow per channel** **System Spec 5.4.5.1 HPI flow shall be acquired by four (4) 0-200 gpm D/P transmitters, one each located in the four HPI discharge lines providing 4-20mA signals.System Spec 5.4.6 Reactor Trip Confirm Status per channel** **System Spec 5.4.6.1** The reactor trip status is determined by monitoring the status of the two safety-related 480 VAC Control Rod Drive (CRD) supply breakers and the four (two breaker pairs) safety-related 120VDC DC hold supply breakers used to interrupt power to the control rods. **System Spec 5.5.1 Subcooling Margin / Superheat** The ICCMS shall become the primary means of determining and displaying subcooling margin/degrees of superheat using safety related instruments and a safety-related platform in order to meet current NRC requirements for ESFAS and PAM instrumentation. **System Spec 5.5.2.1** The subcooling margin (SCM) shall be calculated using instrumentation inputs for RCS pressure and temperature and the SCM curve. **System Spec 5.5.2.4** The SCM curve is defined in calculation I84-0003, SPDS Description Document, and I96-0002, SPDS TSAT Display Errors. The SCM curve is based on ASME 1967 steam tables plus instrument uncertainty. **System Spec 5.5.2.6** Methods to program the curve will be determined during the design phase with approval by Progress Energy. **System Spec 5.5.3.3** The subcooling margin (degrees of subcooling) and degrees of superheat will be displayed on same panel meter located on the Main Control Board in the Inadequate Core Cooling Section.	The FCS actuates automatically from a demand signal from the ICCMS only and does not provide any variables which are used in the automatic initiation of protective actions. The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, to allow the system to control the ADVs automatically at 325 psig following initial automatic system actuation and blowdown. For determination of the necessity for manual FCS actuation, a new Safety Parameter Display System (SPDS) display of HPI flow versus RCS pressure curve and a "live" data point showing adequate or inadequate flow above or below the display curve SPDS will be developed in EC 71855 and implemented in EC 75574 to facilitate and simplify operations personnel ability to monitor HPI flow adequacy. Reference EC Sections B.4.1.4, B.4.16, B.6.1.4 and B.6.16.
(3) the minimum number and location of the sensors requited to monitor adequately, for protective function purposes, those variables listed in Section 3(2) that have a spatial . dependence;	**System Spec 5.5.7.1** The conditions for an actuation of Loss of Sub Cooling Margin mitigation shall be a Reactor Trip confirm signal and a calculated loss of sustained subcooling margin utilizing the highest Core Exit thermocouple as independently determined by each channel. **System Spec 5.9.1.10** Loss of signal from any in core thermocouple shall result in that in core thermocouple signal being recognized as invalid in the online monitor. Note: Selection of each channel's thermocouple inputs was determined based on 4 quadrants, 2 thermocouples per quadrant for redundancy (e.g. 8 thermocouple inputs for each channel).	The FCS system design includes two new system pressure control transmitters which provide main steam pressure input to the new FCS Pressure Controllers. These new transmitters will be installed in the same sensing line as the existing pressure transmitters that supply the main steam pressure input the EFIC cabinet ADV Controllers. These main steam pressure inputs have no spatial dependence and therefore, this requirement is not applicable to the FCS system.

IEEE Standard Criterion	ICCMS	FCS
(4) prudent operational limits for each variable listed in Section 3(2) in each applicable reactor operation mode:	**System Spec 5.4 System Inputs** **System Spec 5.4.1 RCS Wide Range Pressure per channel** **System Spec 5.4.1.1** RCS wide range pressure shall be acquired by a single 0-2500 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.2 RCS In Core Thermocouple Temperature per channel** **System Spec 5.4.2.1** In Core temperature shall be provided by eight (8) 0°F to 2500°F thermocouple instruments per channel. SUPPLIER to supply the eight (8) temperature transmitters for each channel. **System Spec 5.4.2.2** System shall provide isolated 4-20mA outputs from each thermocouple signal. **System Spec 5.4.3 RCS Low Range Pressure per channel** **System Spec 5.4.3.1** RCS low range pressure shall be acquired by a single 0-600 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.4 RCS THOT Temperature for channel 1 and channel 2** **System Spec 5.4.4.1** RCS temperature shall also be provided by a single 120°F to 920°F THOT RTD instrument per channel providing a 4-20mA signal. **System Spec 5.4.5 HPI Flow per channel** **System Spec 5.4.5.1** HPI flow shall be acquired by four (4) 0-200 gpm D/P transmitters, one each located in the four HPI discharge lines providing 4-20mA signals.	The FCS actuates automatically from a demand signal from the ICCMS only and does not provide any variables which are used in the automatic initiation of protective actions. The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, to allow the system to control the ADVs automatically at <350 psig (325 psig setpoint) following initial automatic system actuation and blowdown. The nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value". The FCS System pressure control setpoint uncertainty (± 20.9 psig) has been calculated per Areva Doc #32-91379757, "Fast Cooldown Main Steam Pressure Control Uncertainty" and is in accordance with the CR3 I&C Design Criteria document ICDC-1. ICDC-1 uses NRC Reg Guide 1.105, R2, "Instrument Setpoint" and ISA S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation" as its basis. The FCS safety system value of 325 psig is derived from the 350 psig nominal setpoint minus the 20.9 psig uncertainty minus an additional margin. Reference EC Sections B.4.16 and B.6.16 and Areva Docs #32-9139532 and #32-91379757.
(5) the margin, with appropriate interpretive information, between each operational limit and the level considered to mark the onset of unsafe conditions;	**System Spec 5.5.2.1** The subcooling margin (SCM) shall be calculated using instrumentation inputs for RCS pressure and temperature and the SCM curve. **System Spec 5.5.2.4** The SCM curve is defined in calculation I84-0003, SPDS Description Document, and I96-0002, SPDS TSAT Display Errors. The SCM curve is based on ASME 1967 steam tables plus instrument uncertainty. **System Spec 5.5.2.5** The SCM curve, with the adjustment for instrument uncertainty, shall be provided by Progress Energy. **System Spec 5.5.2.6** Methods to program the curve will be determined during the design phase with approval by Progress Energy **System Spec 5.5.2.11** The superheat curve with the adjustment for instrument uncertainty shall be provided by Progress Energy. **System Spec 5.5.2.12** Methods to program the SH curve will be determined during the design phase with approval by Progress Energy. **System Spec 5.5.5.1** The high pressure injection (HPI) flow margin is calculated using instrumentation inputs for the RCS pressure, HPI flow rates and the HPI flow margin curve. **System Spec 5.5.5.2** The HPI flow margin curve is defined in provided calculation 51-914483 "CR-3 EPU Required SBLOCA HPI Flow without FCS". This calculation provides the acceptable HPI flow for a given RCS Pressure. This calculation accounts for instrument uncertainty.	The FCS actuates automatically from a demand signal from the ICCMS only and does not provide any variables which are used in the automatic initiation of protective actions. The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, to allow the system to control the ADVs automatically at <350 psig (325 psig setpoint) following initial automatic system actuation and blowdown. The nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value". The FCS System pressure control setpoint uncertainty (± 20.9 psig) has been calculated per Areva Doc #32-91379757, "Fast Cooldown Main Steam Pressure Control Uncertainty" and is in accordance with the CR3 I&C Design Criteria document ICDC-1. ICDC-1 uses NRC Reg Guide 1.105, R2, "Instrument Setpoint" and ISA S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation" as its basis. The FCS safety system value of 325 psig is derived from the 350 psig nominal setpoint minus the 20.9 psig uncertainty minus an additional margin. Reference EC Sections B.4.16 and B.6.16 and Areva Docs #32-9139532 and #32-91379757.
(6) the levels that, when reached, will require protective action;	**System Spec 5.5.2.1** The subcooling margin (SCM) shall be calculated using instrumentation inputs for RCS pressure and temperature and the SCM curve. **System Spec 5.5.2.4** The SCM curve is defined in calculation I84-0003, SPDS Description Document, and I96-0002, SPDS TSAT Display Errors. The SCM curve is based on ASME 1967 steam tables plus instrument uncertainty. **System Spec 5.5.2.5** The SCM curve, with the adjustment for instrument uncertainty, shall be provided by Progress Energy. **System Spec 5.5.2.6** Methods to program the curve will be determined during the design phase with approval by Progress Energy **System Spec 5.5.2.11** The superheat curve with the adjustment for instrument uncertainty shall be provided by Progress Energy. **System Spec 5.5.2.12** Methods to program the SH curve will be determined during the design phase with approval by Progress Energy. **System Spec 5.5.5.1** The high pressure injection (HPI) flow margin is calculated using instrumentation inputs for the RCS pressure, HPI flow rates and the HPI flow margin curve. **System Spec 5.5.5.2** The HPI flow margin curve is defined in provided calculation 51-914483 "CR-3 EPU Required SBLOCA HPI Flow without FCS". This calculation provides the acceptable HPI flow for a given RCS Pressure. This calculation accounts for instrument uncertainty.	The FCS actuates automatically from a demand signal from the ICCMS only and does not provide any "levels" or setpoints where the system provides the protective actions. Once the FCS is actuated by ICCMS, FCS opens the ADVs and reduces the main steam pressure to 325 psig. FCS then controls the ADVs at the 325 psig setpoint. Reference EC Sections B.4.16 and B.6.16 and Areva Docs #32-9139532 and #32-91379757.

IEEE Standard Criterion	ICCMS	FCS
(7) the range of transient and steady-state conditions of both the energy supply and the environment (for example, voltage, frequency, temperature, humidity, pressure, vibration, etc) during normal, abnormal, and accident circumstances throughout which the system must perform;	**System Spec 3.3 Power Supply Electrical Requirements** **System Spec 3.3.1** 120-volt AC power for the ICCMS shall be provided by battery-backed inverter busses. This requirement is not in SUPPLIER's scope. **System Spec 3.3.2** Two independent sources of power shall be provided for each enclosure/channel. This requirement is not in SUPPLIER's scope. **System Spec 3.3.3** The ICCMS shall be capable of performing all functional requirements as specified herein with power supply variations of 120 VAC ± 10%, 60Hz ± 1%. **System Spec 3.3.4** The ICCMS power distribution shall be designed so that with the loss of one power supply or the loss of one incoming power source there will be no affect on the system's functional operation or plant operation. **System Spec 3.3.5** Each power supply shall be monitored and alarm actuated if a failure occurs. Loss of power detector(s) shall be provided as required to detect and alarm on a loss of power condition. **System Spec 3.3.6** The ICCMS shall transmit loss of power alarm signal(s) to an event point which shall drive an annunciator in the Control Room. **System Spec 3.3.7** An additional 120VAC power supply shall be provided in each cabinet to power non-safety related equipment (i.e. multiplexers, switches, and Online Monitor system.) This requirement is not in SUPPLIER's scope. (See e 3 above for environmental conditions)	Clause 3(7) of IEEE Std. 279-1971 requires in part that the range of transient and steady-state conditions be identified for both the energy supply and the environment during normal, abnormal, and accident conditions under which the system must perform. The range of conditions both transient and steady-state has been assessed in the FCS design. Reference EC 71855 Sections B.4.4, B.4.6 B.6.4, and B.6.6.
(8) the malfunctions, accidents, or other unusual events (for example, fire. explosion, missiles. lightning, flood, earthquake. wind, etc) which could physically damage protection system components or could cause environmental changes leading to functional degradation of system performance, and for which provisions must be incorporated to retain necessary protective action;	**System Spec 3.1.7.4 Tornado/ Wind** **System Spec 3.1.7.4.1** ICCMS equipment and instrumentation shall be mounted in locations that will prevent damage to the system and instrumentation during tornados and high wind events. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.5 Missiles** **System Spec 3.1.7.5.1** The channel equipment shall be mounted in locations that are protected from turbine missiles and missiles generated by natural phenomena. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.6 Penetrations** **System Spec 3.1.7.6.1** The design of the ICCMS shall incorporate the use of existing plant electrical penetrations, as much as possible, to provide a path for signals to the ICCMS. This requirement is not in SUPPLIER's scope. **System Spec 3.1.7.7 Fire Protection/ Appendix R** **System Spec 3.1.7.7.1** The ICCMS shall be prevented from actuating due to an Appendix R fire induced short. This requirement is not in SUPPLIER's scope.	The FCS system components have been evaluated for all applicable adverse conditions (i.e. loss of HVAC, EQ conditions, Seismic events, App R events, etc) and is documented in EC 71855, Sections B.4.5, B.4.6, B.4.13, B.4.15, B.4.16, B.4.24, B.6.5, B.6.6, B.6.13, B.6.15, B.6.16 and B.6.24 as well as in the FMEAs in EC Attachments X64 and X120."
(9) minimum performance requirements including the following:		
(a) system response times;	**System Spec 3.2.1.1** On a measured confirmed Reactor Trip condition and a LOSCM, trip the RCPs within one (1) minute. **System Spec 3.2.1.2** On a measured confirmed Reactor Trip condition and a LOSCM, transfer EFIC to the Inadequate Subcooling Margin (ISCM) set point within ten (10) minutes. **System Spec 3.2.1.3** On a measured confirmed Reactor Trip condition, concurrent with a LOSCM and a calculated Inadequate HPI flow, initiate the FCS within ten (10) minutes	Following the LSCM and inadequate HPI signals, the FCS must actuate at or before 10 minutes, as described in Section 5.8.4 of Areva Doc# 51-9061339-005, "CR-3 EPU LOCA AIS".
(b) system accuracies;	**System Spec 5.3.4** The uncertainty of any ICCMS trip function shall not exceed □0.64% span from input to trip, including as a minimum reference accuracy, temperature effect, power supply effect, 90 day drift, and M&TE, but excluding sensor accuracy.	The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, to allow the system to control the ADVs automatically at <350 psig (325 psig setpoint) following initial automatic system actuation and blowdown. The nominal FCS safety system setpoint value of 350 psig was calculated in Areva Doc #32-9139532, "CR-3 EPU SBLOCA ADV Control Pressure Analysis Value". The FCS System pressure control setpoint uncertainty (± 20.9 psig) has been calculated per Areva Doc #32-9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty" which takes into account all uncertainties associated with process/environmental conditions for normal, abnormal and accident conditions. This calculation was prepared in accordance with the CR3 I&C Design Criteria document ICDC-1. ICDC-1 uses NRC Reg Guide 1.105, R2, "Instrument Setpoint" and ISA S67.04-1994, Part I, "Setpoints for Nuclear Safety-Related Instrumentation" as its basis. The FCS safety system value of 325 psig is derived from the 350 psig nominal setpoint minus the 20.9 psig uncertainty minus an additional margin. The pressure transmitters will be procured as safety-related instruments and will be qualified for EQ Harsh conditions per IEEE 323-1974. The transmitters will be Seismic Class I qualified per IEEE 344-1975 and will be qualified to operate during SBO conditions. Thus, the transmitters will maintain their desired accuracy in all postulated plant conditions. Reference EC Sections B.4.16 and B.6.16 and Areva Docs #32-9139532 and #32-91379757.

IEEE Standard Criterion	ICCMS	FCS
(c) ranges (normal, abnormal, and accident conditions) of the magnitudes and rates of change of sensed variables to be accommodated until proper conclusion of the protective action is assured.	**System Spec 5.4 System Inputs** **System Spec 5.4.1 RCS Wide Range Pressure per channel** **System Spec 5.4.1.1** RCS wide range pressure shall be acquired by a single 0-2500 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.2 RCS In Core Thermocouple Temperature per channel** **System Spec 5.4.2.1** In Core temperature shall be provided by eight (8) 0°F to 2500°F thermocouple instruments per channel. SUPPLIER to supply the eight (8) temperature transmitters for each channel. **System Spec 5.4.2.2** System shall provide isolated 4-20mA outputs from each thermocouple signal. **System Spec 5.4.3 RCS Low Range Pressure per channel** **System Spec 5.4.3.1** RCS low range pressure shall be acquired by a single 0-600 psig instrument per channel providing a 4-20mA signal **System Spec 5.4.4 RCS THOT Temperature for channel 1 and channel 2** **System Spec 5.4.4.1** RCS temperature shall also be provided by a single 120°F to 920°F THOT RTD instrument per channel providing a 4-20mA signal. **System Spec 5.4.5 HPI Flow per channel** **System Spec 5.4.5.1** HPI flow shall be acquired by four (4) 0-200 gpm D/P transmitters, one each located in the four HPI discharge lines providing 4-20mA signals.	The FCS provides 2 main steam pressure inputs, one for each ADV pressure controller, such that following initial automatic system actuation (from ICCMS) and main steam depressurization, the system can provide automatic pressure control of the ADVs at <350 psig (325 psig setpoint) for the 4 hour mission time. The main steam pressure inputs are from new system pressure control transmitters installed in the same sensing line as the existing pressure transmitters that supply main steam pressure signals for the EFIC cabinet ADV control. The transmitters output a 4-20 ma signal for a calibrated 0-1200 psig span which bounds the highest main steam safety valve setpoint of 1100 psig. Since the protective action is to provide automatic pressure control of the ADVs at a 325 psig setpoint, the transmitter range is appropriate and will allow the pressure control loop to perform its safety function. The pressure transmitters will be procured as safety-related instruments and will be qualified for EQ Harsh conditions per IEEE 323-1974. The transmitters will be Seismic Class I qualified per IEEE 344-1975 and will be qualified to operate during SBO conditions. The instrument accuracy and uncertainty has been evaluated in Areva Doc #32-9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty" which takes into account all uncertainties associated with process/environmental conditions for normal, abnormal and accident conditions. Thus, the transmitters are designed to provide the pressure control safety function in all postulated plant conditions. Reference EC Sections B.4.16, B.6.16 and Areva Doc #32-91379757.
4. Requirements		
4.1 General Functional Requirement.		
The nuclear power generating station protection system shall, with precision and reliability, automatically initiate appropriate protective action whenever a condition monitored by the system reaches a preset level. This requirement applies for the full range of conditions and performance enumerated in Sections 3(7). 3(8), and 3(9).	**System Spec Intro** The three LOCA mitigation actuations are 1) automatic tripping of the Reactor Coolant Pumps (RCPs) when there is a reactor trip coupled with a loss of sub cooling margin; 2) automatic raising of the Steam Generator (SG) level control to the Inadequate Sub Cooling Margin (ISCM) set point; and 3) automatic actuation of the Fast Cooldown System (FCS), which shall actuate the Atmospheric Dump Valves (ADVs) in Fast Cooldown mode. Actuation of the ADVs shall occur in response to a reactor trip, coupled with a Loss of Subcooling Margin (LOSCM) in the Reactor Coolant System (RCS), with an inadequate High Pressure Injection (HPI) flow as measured by the ICCMS. **System Spec 3.1.3.2** The ICCMS shall be a single failure proof system designed to automatically actuate the fast cooldown system when system parameters indicate a reactor trip, a loss of subcooling margin and inadequate HPI flow.	The fast cooldown system, with precision and reliability, automatically initiates appropriate protective action whenever a condition monitored by the system reaches a preset level. This requirement applies for the full range of conditions and performance enumerated in Sections 3(7). 3(8), and 3(9) as described in EC71855, Sections B.4.1., B.4.1.2, B.4.1.3, B.4.1.4, B.4.1.5, B.4.1.6, B.4.1.15, and B.4.1.16 and evaluated in B.6.1, B.6.1.2, B.6.1.3, B.6.1.4, B.6.1.5, B.6.1.6, B.6.1.15 and B.6.1.16.
4.2 Single Failure Criterion.		
		It should be noted that the FCS system itself will not be actuated and utilized unless there is already a HPI failure. All safety related components will be seismically qualified and are rated for the temperature and radiation environment of a LOCA condition as per the specific EQ zone and as per the CR3 EQPPD. There are no known non-safety components or interfacing systems that can create failure of the protection system performance of the fast cooldown system. As per the Standard Review Plan guidance for IEEE 279 which endorses IEEE 379-2000: **IEEE 379, Section 5.1 Independence and redundancy** The FCS system when used in conjunction with the HPI system will meet the single failure criteria to perform SBLOCA and LOSCM mitigation in the presence of any single failure within the fast cooldown system or single failure within the HPI system or associated HPI control and switchgear power sources for the HPI system. The fast cooldown system DC power for the pressure control circuits is a separate and independent DC supply that does not electrically connect or interface with the existing Train A and Train B DC power. Any single failure in the fast cooldown DC supply, pressure control circuitry, or transfer relay will affect only the fast cooldown control of a single ADV. The single failure will not create any failure of any motive (motor) power or control power that would impact the operability and flow capacity of the HPI pumps to mitigate a SBLOCA and LOSCM event. A single failure of an ADV, its control air components, or its demand signal from the fast cooldown pressure control circuitry will not prevent proper protective action from the HPI system since the equipment, controls, and power are diverse, independent, and separate. The equipment used in the fast cooldown system is of diverse design and independent of any power source or control components used by the HPI pumps. The use of two ADVs controlled by fast cooldown pressure control circuitry is redundant to the use of one HPI train in the

IEEE Standard Criterion	ICCMS	FCS
Any single failure within the protection system shall not prevent proper protective action at the system level when required. NOTE: "Single failure" includes such events as the shorting or opening of interconnecting signal or power cables. It also includes single credible malfunctions or events that cause a number of consequential component, module. or channel failures. For example, the overheating of an amplifier module is a "single failure" even though several transistor failures result. Mechanical damage to a mode switch would be a "single failure" although several channels might become involved.	**System Spec 3.1.3.1.1** No single component failure shall prevent a protective system from fulfilling its protective function when action is required.	event of a SBLOCA and LOSCM event. **IEEE 379, Section 5.2 Nondetectable failure** There are no known identified failures in the fast cooldown system that are not detectable by alarm, periodic testing, or channel check/instrument surveillance monitoring. **IEEE 379, Section 5.3 Cascaded failures** While there are a few postulated failures in the fast cooldown DC supply that would additionally create failure of the fast cooldown pressure control circuit and the actuation/transfer relay, these failures have been evaluated as a failure to one of the fast cooldown channels. The fast cooldown DC supply failure and the fast cooldown pressure control circuitry and actuation failure is a safety related system failure but would not affect the capability of the HPI system or its control power to mitigate a SBLOCA event. **IEEE 379, Section 5.4 Design Basis Events** The fast cooldown system components are located in the control complex and the intermediate building elevation 119. The effects of a SBLOCA on the equipment is bounded by the EQ designation of LOCA conditions. The fast cooldown components are qualified/rated for the temperatures and radiation effects of the LOCA designation in the particular EQ zone of their location with the LOCA effects designated by the CR3 EQPPD. Although the SPDS display would only be used for manual actuation of fast cooldown if multiple failures occurred in the auto actuation of the ICCM, it would be used for control room monitoring and is therefore evaluated below. The SPDS display used for manual actuation of FCS would display using RCS pressure transmitters located in the reactor building but which are existing equipment and are qualified for LOCA conditions. The SPDS would also use HPI injection low range flow indication from existing aux. building transmitters qualified for LOCA conditions. **5.5 Common Cause failures** The components of fast cooldown and HPI are located in different physically separate areas with the exception of the DC power within the battery rooms. There are no identified credible common cause failures due to environmental conditions or due to common shared power sources or common shared actuation or control components that will affect both the HPI system operability and the fast cooldown operability. The only identified potential source of common cause failure is the location of the fast cooldown system battery banks and the station battery banks. The battery banks for the fast cooldown system are installed in the same battery rooms as the battery banks for HPI and diesel switchgear control power. However, the battery rooms are seismic qualified and evaluated as not susceptible to missiles. Explosion of batteries have been evaluated as not a credible event with this design battery and with typical standard maintenance. The fusible link fire dampers in the HVAC system which have been evaluated as passive components which would require (non-fire related) a failure of structural integrity, the fusible link fire dampers are not evaluated as applicable for failure as per CR3 single failure criteria requirements in DBD92. Additionally, CR3 licensing basis does not postulate a fire or SBO concurrent with an accident. Evaluation of IEEE 379, Section 5.5 revealed the following consistencies of the fast cooldown design with the IEEE 379 guidelines. As per IEEE 379, Section 5.5, failure modes and effects analysis has been performed on the fast cooldown design. There is significant diversity of fast cooldown types of equipment as compared to that of the HPI and its actuation system. Maintenance and surveillance procedures will be written to minimize potential for maintenance errors.

IEEE Standard Criterion	ICCMS	FCS
		With the ICCM providing automatic actuation for fast cooldown, operator error in actuating fast cooldown system is minimized. For control board selector switch operation, annunciator alarms will actuate if fast cooldown system is bypassed or if it is inadvertently actuated by operator error. The fast cooldown components are evaluated in B.6.6 to be qualified for the temperature and radiation levels of their environment. **5.6 Shared Systems** CR3 has no shared power plant unit or system that affects the fast cooldown system. Reference EC Sections B.6.1.4, B6.1.6, B.6.3, B.6.5, B.6.6, B.6.7.8, B.6.7.14, B.6.13.D and FMEA EC Attachment X64 and EC Attachment X120
4.3 Quality of Components and Modules.		
Components and modules shall be of a quality that is consistent with minimum maintenance requirements and low failure rates. Quality levels shall be achieved through the specification of requirements known to promote high quality, such as requirements for design, for the derating of components, for manufacturing, quality control, inspection, calibration, and test.	**Procurement Spec 6.1.4** The single failure analysis shall state the failure, the system response to the failure, and the required operator actions. This single failure requirement is required to maintain conformance to the strict standards of a class IE safety system and to assure highly reliable ICCMS operation commensurate with its vital role in reliable plant operation and electrical generation. **Procurement Spec 7.1.1** The SUPPLIER is required to provide equipment and perform work in a quality manner in full accordance with recognized industry codes and standards as specified in this specification and the System Requirements Specification. The SUPPLIER shall certify that all equipment supplied and work is performed in accordance with the provisions of this specification and the System Requirements Specification. **Procurement Spec 7.4.1** Measures shall be established to assure that applicable regulatory requirements and design basis for the system, equipment, components, and software defined by the System Requirements Specification are correctly translated into specifications, drawings, procedures, and instructions. **Procurement Spec 7.4.3** Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the critical functions of the system, equipment, components, and software defined by the System Requirements Specification. **Procurement Spec 7.4.4** Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations. These measures shall include the establishment of procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces. **Procurement Spec 7.4.5** The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculation methods, or by the performance of a suitable testing program.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.3, the quality assurance provisions of Appendix B to 10 CFR Part 50 are applicable to the fast cooldown system. Therefore, components and modules of the fast cooldown system are of a quality that is consistent with minimum maintenance requirements and low failure rates. Quality levels are achieved through the specification of requirements known to promote high quality, such as requirements for design, for the derating of components, for manufacturing, quality control, inspection, calibration, and test as described in EC71855, Section B.4.8, B.4.9, B.4.10, B.4.11, B.4.12, B.4.13, B.4.15, and B.4.16 and evaluated in B.6.8, B.6.9, B.6.10, B.6.11, B.6.12, B.6.13, B.6.15, and B.6.16. Reference AREVA FCS Equipment Specification 08-9154212 ADV Specification CR3-M-022.
4.4 Equipment Qualification.		
Type test data or reasonable engineering extrapolation based on test data shall be available to verify that protection system equipment shall meet, on a continuing basis, the performance requirements determined to be necessary for achieving the system requirements.	**Procurement Spec 7.12 Factory Acceptance Test (FAT) Control** **Procurement Spec 7.12.1** The SUPPLIER shall provide a FAT test program to confirm that the ICCMS will perform satisfactorily in service. **Procurement Spec 7.12.2** A series of FAT test documents shall be written by the SUPPLIER and approved by the OWNER and shall contain all of the requirements and acceptance limits contained in applicable design documents. **Procurement Spec 7.12.3** The FAT test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. **Procurement Spec 7.12.4** Test results shall be documented, evaluated, and traceable back to the System Requirements Specification as required, assuring that all requirements have been tested satisfactorily.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.4, the fast cooldown system system equipment is designed to meet the functional performance requirements over the range of environmental conditions for the area in which it is located, as identified by Clauses 3(7) and 3(8) of IEEE Std. 279-1971. Mild environment qualification conforms with the applicable guidance of IEEE Std. 323-1974, and environmental protection of instrument sensing lines conforms with the guidance of Regulatory Guide 1.151. These requirements are met as described in EC71855, Section B.4.2, B.4.4, B.4.5, B.4.6, B.6.2, B.6.4, B.6.5 and B.6.6 which describe type test data or reasonable engineering extrapolation based on test data that is available to verify that fast cooldown system equipment meets, on a continuing basis, the performance requirements determined to be necessary for achieving the system requirements. Reference AREVA FCS Equipment Specification 08-9154212 and AD V Specification CR3-M-022.
NOTE - Attention is directed particularly to the requirements of Sections 3(7) and 3(9).		

IEEE Standard Criterion	ICCMS	FCS
4.5 Channel Integrity.		
All protection system channels shall be designed to maintain necessary functional capability under extremes of conditions (as applicable) relating to environment, energy supply, malfunctions, and accidents.	**System Spec 3.1.7 Environmental Conditions** **System Spec 3.1.7.1.1** Temperature range of 40° F to 120° F. **System Spec 3.1.7.1.2** Relative humidity of 5% to 95%. **System Spec 3.1.7.1.3** Total integrated radiation dose of 350 Rads **System Spec 3.1.7.2 Seismic** **System Spec 3.1.7.2.1** The ICCMS and associated components shall be capable of withstanding and operating during and after a seismic event for the required response spectra (RRS) shown on Figure 18 of SP-5209 at 0.5% damping. **System Spec 3.1.7.3 EMI/RFI** **System Spec 3.1.7.3.1** EMI/RFI functional requirement- The platform and associated components shall be capable of operating unaffected in an environment bounded by the power levels and frequencies established by EPRI TR-102323 Revision 3 "Guidelines for Electromagnetic Interference testing of Power Plant Equipment". Additionally, the frequency range should be up to 10 GHz with an additional single frequency check at 60 GHz ISM (industrial, scientific and medical) band. **System Spec 3.1.7.3.2** The ICCMS and associated equipment shall be sufficiently free of radiated and conducted EMI / RFI, to prevent resultant mis-operation of instrumentation and communications equipment as described in Reg Guide 1.180.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.5, information provided in Clauses 3(7) and 3(8) of IEEE Std. 279-1971 has been reviewed to confirm that the design includes the qualification of equipment for the conditions identified in the design bases. The review confirmed that tests have been conducted on the fast cooldown system equipment components and the system racks and panels as a whole and the automatic dump valves to demonstrate the functional performance requirements of the FCS system and automatic dump valves over the range of transient and steady-state conditions of both the energy supply and the environment. It is also confirmed that the protection system components are conservatively designed to operate over the range of service conditions. All fast cooldown system channels are designed to maintain necessary functional capability under extremes of conditions (as applicable) relating to environment, energy supply, malfunctions, and accidents as described in EC71855, Section B.4.6 and evaluated in B.4.6
4.6 Channel Independence.		
Channels that provide signals for the same protective function shall be independent and physically separated to accomplish decoupling of the effects of unsafe environmental factors, electric transients, and physical accident consequences documented in the design basis, and to reduce the likelihood of interactions between channels during maintenance operations or in the event of channel malfunction.	**System Spec 3.1.8.1** Physical separation shall be maintained as it relates to IEEE-384separation criteria between safety related (1E) and non-safety components. SUPPLIER's scope will include appropriate physical and electrical isolation of redundant channels and trains. Separation outside of the ICCMS cabinets is not in SUPPLIER's scope. **System Spec 3.1.8.2** The need for physical separation shall be met in the physical arrangement of each channel within a separate enclosure(s) and wiring within the enclosures separating power and signal wiring so as to reduce the possibility of some physical event impairing system functions. **System Spec 3.1.8.3** System sensors shall be physically separated from each other. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.4** Physical separation shall be maintained between redundant power supplies of ICCMS enclosure power supplies. The input power wiring and the actual power supplies shall be physically and electrically separated. The output wiring of both power supplies shall feed a common auctioneering circuit to power the module power bus. **System Spec 3.1.8.6** Failure of a single redundant enclosure power supply shall be alarmed.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.6, two aspects of independence addressed are: Physical independence and electrical independence. Guidance for evaluation of physical and electrical channel independence is provided in Regulatory Guide 1.75, Revision 3 which endorses IEEE Std. 384-1992 The fast cooldown system design, including the automatic dump valves, precludes the use of components that are common to redundant channels, such as common switches for actuation, reset, mode, or test; common sensing lines; or any other features that could compromise the independence of redundant channels. Physical independence is attained by physical separation and physical barriers. Electrical independence includes the utilization of separate power sources. As described in EC71855, Sections B.4.18, B.4.19, B.6.18, and B.6.19, channels that provide signals for the same protective function are independent and physically separated to accomplish decoupling of the effects of unsafe environmental factors, electric transients, and physical accident consequences documented in the design basis, and reduces the likelihood of interactions between channels during maintenance operations or in the event of channel malfunction.
4.7 Control and Protection System Interaction		
4.7.1 Classification of Equipment		
Any equipment that is used for both protective and control functions shall be classified as part of the protection system and shall meet all the requirements of this document.	**System Spec Introduction** This system is classified as Class 1E nuclear safety-related performing Engineered Safeguards Features Actuation System functions as well as Post-Accident Monitoring functions.	All equipment in the fast cooldown system including any equipment of the automatic dump valve that is used for both protection and control is classified as part of the protection system and meets the requirements of IEEE Std. 279-1971 Clause 4.7.1. As described in EC71855, Section B.4.1.4, B.4.1.6, B.6.1.4, and B.6.1.6, there is no equipment of the fast cooldown system that is used for both protective and control functions therefore all equipment is classified as part of the fast cooldown system and shall meet all the requirements of this document. As described in EC71855, Section B.6.1.1, B.6.1.3, B.6.1.4, B.6.1.5, and B.6.1.6, any equipment of the Atmospheric dump valves that is used for both protective and control functions is classified as part of the protection system and meets all the requirements of this document.

IEEE Standard Criterion	ICCMS	FCS
4.7.2 Isolation Devices		
The transmission of signals from protection system equipment for control system use shall be through isolation devices which shall be classified as part of the protection system and shall meet all the requirements of this document. No credible failure at the output of an isolation device shall prevent the associated protection system channel from meeting the minimum performance requirements specified in the design bases. Examples of credible failures include short circuits, open circuits, grounds, and the application of the maximum credible ac or dc potential. A failure in an isolation device is evaluated in the same manner as a failure of other equipment in the protection system.	**System Spec 3.1.8.7** Outside the ICCMS enclosures, redundant signals and wiring shall be separated and physically protected to preserve channel independence and maintain system redundancy against physical hazards. This requirement is not in SUPPLIER's scope. **System Spec 3.1.8.8** Electrical separation between safety and non-safety shall be maintained by the use of qualified 1E isolators and relays. **System Spec 3.1.7.7 Fire Protection/ Appendix R** **System Spec 3.1.7.7.1** The ICCMS shall be prevented from actuating due to an Appendix R fire induced short. This requirement is not in SUPPLIER's scope. **Procurement Spec 6.1.1** The SUPPLIER shall identify the limitations of the system under different failure scenarios. **Procurement Spec 6.1.2** The SUPPLIER shall identify single components whose failure could result in an undesirable condition or event. If this requirement is not considered practical for SUPPLIER's design, SUPPLIER shall provide justification for common mode equipment within the system. **Procurement Spec 6.1.3** SUPPLIER concerns and requirements concerning single failure tolerant design and plant interfaces should be identified in writing to the OWNER for resolution. **Procurement Spec 6.1.4** The single failure analysis shall state the failure, the system response to the failure, and the required operator actions. This single failure requirement is required to maintain conformance to the strict standards of a class IE safety system and to assure highly reliable ICCMS operation commensurate with its vital role in reliable plant operation and electrical generation. **Procurement Spec 6.1.5** The SUPPLIER shall also perform a Failure Modes and Effects Analysis (FMEA) of the ICCMS in accordance with principles set forth in IEEE 352-1987 and IEEE 379-2000. This analysis shall demonstrate that the ICCMS meets single failure requirements as set forth in this document.	As described in EC71855, Section B.4.15 and evaluated in B.6.15, there is no transmission of signals from the fast cooldown system equipment for any control system use. Additionally as described in EC71855, Section B.4.15 and evaluated in B.6.15, the transmission of signals to Atmospheric Dump Valve equipment for control system use is through isolation devices which are classified as part of the fast cooldown system and meet all the requirements of this document. No credible failure at the output of an isolation device will prevent the associated protection system channel from meeting the minimum performance requirements specified in the design bases.
4.7-3 Single Random Failure		
Where a single random failure can cause a control system action that results in a generating station condition requiring protective action and can also prevent proper action of a protection system channel designed to protect against the condition, the remaining redundant protection channels shall be capable of providing the protective action even when degraded by a second random failure. Provisions shall be included so that this requirement can still be met if a channel is bypassed or removed from service for test or maintenance purposes. Acceptable provisions include reducing the required coincidence, defeating the control signals taken from the redundant channels, or initiating a protective action from the bypassed channel.	**System Spec 5.1.7** The ICCMS shall be a three (3) initiation channel system with two (2) redundant actuation trains. **System Spec 5.1.8** The three (3) initiation channels shall be denoted as Channel "1", Channel "2", and Channel "3". The two (2) actuation trains shall be denoted as Train "A" and Train "B". The three (3) cabinets shall be denoted as Cabinet "1", Cabinet "2", and Cabinet "3". **System Spec 5.2.2** While any part of the system is out of operation for maintenance or testing, this system shall not cause adverse actions with spurious operation. **System Spec 5.2.3** While any part of the system is out of operation for planned maintenance or testing, the system shall still remain capable of performing the required safety system actuation functions at all times while the system is required to be in operation.	There were no single random failures discovered that would cause a control system action and create a station condition requiring protective action and that would also prevent proper action of a protection system channel designed to protect against the condition There are no known single failures of fast cooldown components or of ADV that would also defeat or prevent a protection system channel from performing it's safety function. There were no single random failures that if occurring during a SBLOCA would be expected to result in excessive fuel cladding temperatures. There were three potential failures (one which is present in existing ADV demand signal and ADV components installation) which could open one ADV and create a main steam type break. The failure would not affect any HPI actuation or flow capabilities and would not affect EFIC protective channel capability to actuate MSLI, MFWI, and FOGG logic in response to the decreasing steam line pressure. One failure of the ADV that was noted in the FMEA analysis that could create a generating station condition requiring protective action were a failure of ADV I/P or ADV positioner to a high air signal output state that would open the ADV full open and depressurize the associated ROTSG to zero psig. It should be noted that this condition could now occur due to existing ADV I/P or ADV positioner failing high or even an EFIC pressure transmitter or control module failure. A new potential failure introduced by the fast cooldown modification is a transfer relay failure in which due to mechanical damage two sets of contacts changed state (as in a spurious relay energization) and blow down one OTSG to 325 psig and create a station condition similar to a MSLI event. Due to the design of the fast cooldown system such that there are two isolation modules in the circuit between the transfer relay and the EFIC Cabinets and the ¼ amp fusing of the modules, the transfer relay failure will not migrate back into the EFIC Cabinet nor adversely impact the VBDP powering the modules. A second new potential failure (second introduced by the fast cooldown modification) is a failure of the control board selector switch due to mechanical damage in which the normally open set of contacts for the "ACTUATE" position fail closed and blow down one OTSG to 325 psig and create a station condition similar to a MSLI event. This would not impact any protective function of EFIC.

IEEE Standard Criterion	ICCMS	FCS
		All three of these failures would result in a station condition similar to a MSLI event. In this case, EFIC would actuate MSLI, MFWI, and FOGG logic to "bottle up" the faulted ROTSG. This condition would not prevent the proper action of the protective EFIC system. This failure if it occurred during normal operating conditions would be bounded by Chapter 14 main steam line break analysis or by a turbine bypass valve failing open. This would not create a LOSCM event. If either of the two failures that would result in one OTSG blowing down to 325 psig occurred during a SBLOCA and LOSCM when HPI was mitigating the accident, evaluation of existing SBLOCA modeling of document 32-9129593-000 by safety analysis personnel reveals that this failure would be expected to be beneficial in RCS cooldown and mitigation of SBLOCA. If the failure in which one OTSG blowing down with uncontrolled pressure to zero psig occurred during a SBLOCA and LOSCM when HPI was mitigating the accident, evaluation of existing SBLOCA modeling document 32-9129593-000 by safety analysis personnel reveals that it would be expected that adequate cooling of fuel clad temperatures would occur but damage to ROTSG tube could occur. Reference EC Attachments X02, X03, X120 and FMEA Attachment X64.
4.7.4 Multiple Failures Resulting from a Credible Single Event.		
Where a credible single event can cause a control system action that results in a condition requiring protective action and can concurrently prevent the protective action from those protection system channels designated to provide principal protection against the condition, one of the following must be met.		FMEA analysis did not discover any single event creating a fast cooldown pressure control of ADVs to a main steam pressure to 325 psig that would concurrently result in a condition requiring protective action with the fast cooldown pressure control then concurrently preventing the protective action. The cooldown of main steam header pressure to 325 psig by the fast cooldown system does not prevent the EFIC protective functions of MSLI, MFWI, or FOGG from performing their design function. A MSLI or MFWI event in which depressurization of main steam header pressure occurs will not actuate fast cooldown and will not affect the capability of fast cooldown pressure control circuitry to control ADV position to maintain 325 psig. If there is a total depressurization of main steam header pressure to zero psig , the fast cooldown system would appropriately close the ADV for the affected ROTSG. Reference EC Attachment X120 and FMEA Attachment X64.
4.7.4.1 Alternate channels, not subject to failure resulting from the same single event, shall be provided to limit the consequences of this event to a value specified by the design bases. In the selection of alternate channels, consideration should be given to (1) channels that sense a set of variables different from the principal channels, (2) channels that use equipment different from that of the principal channels to sense the same variable, and (3) channels that sense a set of variables different from those of the principal protection channels using equipment different from that of the principal protection channels. Both the principal and alternate protection channels shall meet all the requirements of this document.	**3.1.4 Redundancy** **System Spec 3.1.4.1** All safety related ICCMS functions shall be implemented through the use of redundant sensors, measuring channels, logic, and actuation devices. Each initiation channel shall be powered from a different power source. **System Spec 3.1.4.2** There shall be two (2) trains of actuation logic, each with three (3) functional outputs. Each train takes inputs from the three (3) initiation channels and performs the actuation logic. The power sources for the actuation trains must be independent. **System Spec 3.1.4.3** Redundant initiation channels shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.4.4** Redundant actuation trains shall be physically separated and electrically isolated from each other. Electrical isolation includes isolation of grounds. **System Spec 3.1.8.5** The redundant power supplies shall have auctioneered output such that should one fail the other shall be capable of supplying ICCMS loads. **System Spec 5.1.7** The ICCMS shall be a three (3) initiation channel system with two (2) redundant actuation trains.	This requirement is not applicable to the FCS design.
4.7.4.2 Equipment, not subject to failure caused by the same credible single event, shall be provided to detect the event and limit the consequences to a value specified by the design bases. Such equipment shall meet all the requirements of this document.	**System Spec 5.2.7** The ICCMS shall include signal validation features, so as to be able to detect invalid inputs and outputs as a minimum. **System Spec 5.2.9** The system shall have the ability to perform range checking and flagging of "out-of-range" signals	This requirement is not applicable to the FCS design.
4.8 Derivation of System Inputs.		
To the extent feasible and practical, protection system inputs shall be derived from signals that are direct measures of the desired variables.	All channels utilize direct measurements of desired values. Channel C has necessitated the installation of additional pressure and flow instruments for this system.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ",Clause 4.8, any indirect parameters utilized by the fast cooldown system including the automatic dump valves are valid representations of the desired direct parameters for all events. Directly measured variables have been reviewed and their responses to postulated events compared with the credit taken for the parameter in the events for which it provides protection. For both direct and indirect parameters, the characteristics (e.g., range, accuracy, resolution, response time) of the instruments that produce the protection system inputs are consistent with the analysis provided in Chapter 15 of the SAR. As described in 71855, Section B.4.16 and B.6.16, to the extent feasible and practical, the fast cooldown system inputs shall be derived from signals that are direct measures of the desired variables.

IEEE Standard Criterion	ICCMS	FCS
4.9 Capability for Sensor Checks.		
Means shall be provided for checking, with a high degree of confidence, the operational availability of each system input sensor during reactor operation. This may be accomplished in various ways, for example;	**System Spec 3.1.6.1** Manual testing facilities shall be built into the ICCMS to provide the capability of periodic testing to assure that the system can fulfill its required functions. This capability shall include on-line testing to prove proper operation and to demonstrate reliability without interfering with normal reactor or plant operation or trip functions. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station.	The most common method used to verify the availability of the input sensors is by cross checking between redundant channels that have available readout. For the FCS system there are four sensors which provide readout capability. Means shall be provided for checking, with a high degree of confidence, the operational availability of each system input sensor during reactor operation. This is accomplished in the fast cooldown system by cross checking between channels that bear a known relationship to each other and that have read-outs available as described in B.4.16 and B.6.16.
(1) by perturbing the monitored variable; or	Requirement understood and beyond what is stated above (6.5.1) this requirement shall be elaborated further in detail design.	
(2) within the constraints of paragraph 4.11, by introducing and varying, as appropriate, a substitute input to the sensor of the same nature as the measured variable: or	Requirement understood and beyond what is stated above (6.5.1) this requirement shall be elaborated further in detail design.	
(3) by cross checking between channels that bear a known relationship to each other and that have read-outs available.	Technical Specification 3.3.19-1 requires channel checks of each input function every 12 hours. HPI Flow, RCS Pressure Low Range, RCS Pressure Wide Range Pressure and Core Exit Thermocouples are input functions. The signals are isolated and sent to the On-Line Monitor which in turn sends them to the plant computer. The computer points are used in the channel check. A backup method for the channel check is available. All input and output points can be monitored by a voltmeter at the cabinets. The output functions for Loss of Subcooling Margin and Inadequate HPI Flow are also checked every 12 hours by a channel check. The output parameters can be read on main control board indicators.	
4.10 Capability for Test and Calibration.		
Capability shall be provided for testing and calibrating channels and the devices used to derive the final system output signal from the various channel signals. For those parts of the system where the required interval between testing will be less than the normal time interval between generating station shutdowns, there shall be capability for testing during power operation.	**System Spec 3.1.6.1** Manual testing facilities shall be built into the ICCMS to provide the capability of periodic testing to assure that the system can fulfill its required functions. This capability shall include on-line testing to prove proper operation and to demonstrate reliability without interfering with normal reactor or plant operation or trip functions. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station.	Guidance on periodic testing of the fast cooldown system is provided in Regulatory Guide 1.22 and in Regulatory Guide 1.118, Revision 3 which endorses IEEE Std. 338-1987. The extent of test and calibration capability provided bears heavily on whether the design meets the single-failure criterion. Any failure that is not detectable must be considered concurrently with any random postulated, detectable, single failure. As described in EC71855, Section B.4.16, B.6.16, B.4.20, and B.6.20, capability is provided for testing and calibrating channels and the devices used to derive the final fast cooldown system output signal from the various channel signals. Periodic testing duplicates, as closely as practical, the overall performance required of the FCS system and confirms operability of both the automatic and manual circuitry. There are no parts of the system where the required interval between testing will be less than the normal time interval between generating station shutdowns. A System Functional test is performed every 24 months per CR3 Technical Specifications SR 3.7.20.5. This SR demonstrates that each ADV actuates and controls at its associated OTSG pressure setpoint on an actual or simulated FCS actuation signal at least once per fuel cycle. The test includes verifying overlap with each required FCS actuation logic train tested in SR 3.3.20.1 and FCS controller circuit to ensure the entire FCS circuit will perform the intended function. An overlapping test of the automatic FCS actuation circuit is included as part of this test to provide complete testing of the associated safety function. Per the SR 3.7.20.5 bases, the 24 month periodicity is based on the need to perform the surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the surveillance is performed with the reactor at power. A Channel Calibration is performed every 24 months CR3 Technical Specifications SR 3.7.20.3. This SR is a complete check of each FCS OTSG pressure control channel, including the sensors. The test verifies that the channel responds to the measured parameter within the necessary range and accuracy.

IEEE Standard Criterion	ICCMS	FCS
		Per the SR 3.7.20.3 bases, the 24 month periodicity is based on the expected magnitude of equipment drift in the FCS instrumentation calculations (reference Areva Doc# 9137975, "Fast Cooldown Main Steam Pressure Control Uncertainty"). As discussed in EC Section B.6.16, the FCS design does include test circuitry and switches which could be used for troubleshooting/ functional testing of the transfer relays and of the pressure controllers with the reactor at power. However, as discussed previously, due to the potential of unplanned transients with the reactor at power, the required functional testing is performed during a plant outage (reference SR 3.7.20.5 bases). Test procedures that require disconnecting wires, installing jumpers, or other similar modifications of the installed equipment are not acceptable test procedures for use during power operation and are not used in the FCS design.
4.11 Channel Bypass or Removal from Operation.		
The system shall be designed to permit any one channel to be maintained, and when required, tested or calibrated during power operation without initiating a protective action at the system a level. During such operation the active parts of the system shall of themselves continue to meet the single failure criterion.	**System Spec 5.2.3** While any part of the system is out of operation for planned maintenance or testing, the system shall still remain capable of performing the required safety system actuation functions at all times while the system is required to be in operation. **System Spec 5.3.10 Capability for Test and Calibration.** Capability for testing and calibration of safety system equipment shall be provided while retaining the capability of the safety systems to accomplish their safety functions. The capability for testing and calibration of safety system equipment shall be provided during power operation and shall duplicate, as closely as practicable, performance of the safety function. Testing of Class 1E systems shall be in accordance with the requirements of IEEE Std 338-1987 [3]. Exceptions to testing and calibration during power operation are allowed where this capability cannot be provided without adversely affecting the safety or operability of the generating station.	The review of bypass and removal from operations has been confirmed that the provisions for this bypass are consistent with the required actions of the proposed plant technical specifications. For SBLOCA with LOSCM, the protective channels are FCS, HPI Train A, and HPI Train B. Therefore one channel (FCS, HPI "A", or HPI "B") can be maintained, and when required, tested or calibrated during power operation without initiating a protective action at the system a level. During such operation the active parts of the system will of themselves continue to meet the single failure criterion. However, during the period one train is not in service, The ITS requires that the plant be placed in an LCO condition. This requirement is not applicable to the FCS system. Operating bypasses are not included in the design of the fast cooldown system or the Atmospheric dump valves.
Exception: "One-out-of-two" systems are permitted to violate the single failure criterion during channel bypass provided that acceptable reliability of operation can be otherwise demonstrated. For example, the bypass time interval required for a test, calibration, or maintenance operation could be shown to be so short that the probability of failure of the active channel would be commensurate with the probability of failure of the "one-out-of-two" system during its normal interval between tests		
4.12 Operating Bypasses.		
Where operating requirements necessitate automatic or manual bypass of a protective function, the design shall be such that the bypass will be removed automatically whenever permissive conditions are not met. Devices used to achieve automatic removal of the bypass of a protective function are part of the protection system and shall be designed in accordance with these criteria.	**System Spec 5.9.2.5** Two (2) actuation train reset pushbuttons (one (1) for Train A and one (1) for Train B) shall be provided on the MCB to allow resetting the actuation train trip functions. The reset pushbutton shall only clear those train trip functions which are not still activated by the 2 out of 3 channel trip functions.	The requirement for automatic removal of operational bypasses means that the reactor operator shall have no role in such removal. The operator may take action to prevent the unnecessary initiation of a protective action. For the FCS system including the automatic dump valves, operational bypasses are not included in the design. This requirement is not applicable to the FCS system. Operating bypasses are not included in the design of the fast cooldown system or the Atmospheric dump valves.
4.13 Indication of Bypasses.		
If the protective action of some part of the system has been bypassed or deliberately rendered inoperative for any purpose, this fact shall be continuously indicated in the control room.	**System Spec 5.9.2.3** A signal shall be sent to an event point when any channel bypass switch is placed in bypass. **System Spec 5.9.2.4** Channel Bypass shall be continuously indicated in the control room.	Guidance on bypasses and inoperable status indication is provided in Regulatory Guide 1.47, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety System." The FCS switch has a bypass position which removes power from the transfer relay as described in EC 71855 sections B.6.14 and B.6.16. The bypass position of the FCS switch causes and annunciator alarm in the control room. The switch is also shown on the elementary diagram for FCS, 208-039. A planned revision will also add an Appendix R circuit to prevent actuation during an Appendix R fire in the control complex.
4.14 Access to Means for Bypassing.		
The design shall permit the administrative control of the means for manually bypassing channels or protective functions.	The ICCMS utilizes administrative controls (i.e. locked enclosure) and procedures to allow placing any channel or train bypass switch into a bypass or trip condition.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279." Administrative control is acceptable to ensure that access to the means for bypassing is limited to qualified plant personnel and that permission of the control room operator is obtained to gain access. The FCS switch has a bypass position which removes power from the transfer relay as described in EC 71855 sections B.6.14 and B.6.16. These switches will be located on the main control board and their positioning by operators will be controlled by procedure.

IEEE Standard Criterion	ICCMS	FCS
4.15 Multiple Set Points.		
Where it is necessary to change to a more restrictive set point to provide adequate protection for a particular mode of operation or set of operating conditions, the design shall provide positive means of assuring that the more restrictive set point is used. The devices used to prevent improper use of less restrictive set points shall be considered a part of the protection system and shall be designed in accordance with the other provisions of these criteria regarding performance and reliability.	The ICCMS utilizes curves for SCM and HPI flow margin to which the systems continuously monitors to detect setpoint for actuations.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.15, The staff interpretation of "positive means" is that automatic action is provided to ensure that the more restrictive setpoint is used when required. SRP BTP 7-3 provides additional guidance on multiple setpoints used to allow operation with reactor coolant pumps out of service. This issue is not applicable to the fast cooldown system and the automatic dump valves. This systems operation is based on initiating actions to establish the reactor coolant system at a pressure of 325 psig in the event of a SBLOCA with LOSCM and a single failure of an HPI pump as described in EC71855, Sections B.4.1.4, B.6.1.4, B.4.2, B.6.2, B.4.15, and B.6.15.
4.16 Completion of Protective Action Once It Is Initiated.		
The protection system shall be so designed that once initiated, a protective action at the system level shall go to completion. Return to operation shall require subsequent deliberate operator action.	**System Spec 3.1.10.1** The safety systems shall be designed so that, once initiated automatically or manually, the intended sequence of protective actions of the execute features shall continue until completion. **System Spec 3.1.10.2** The ICCMS shall be designed such that when it is determined that Fast Cooldown is required, an output from the ICCMS shall activate a seal in contact in the FCS for actuation. The balance of the FCS system is outside SUPPLIER's scope. **System Spec 3.1.10.3** Deliberate operator action shall be required to return the safety systems to normal.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.16, review of this item should include review of functional and logic diagrams to ensure that "seal-in" features are provided to enable system-level protective actions to go to completion. The seal-in feature may incorporate a time delay as appropriate for the safety function. Additionally, the seal-in feature need not function until it is confirmed that a valid protective command has been received, provided the system meets response time requirements. The fast cooldown system is designed that once initiated, a FCS action at the system level will go to completion. Return to operation shall require subsequent deliberate operator action as described in EC71855, Section B.4.1, B.6.1, B.4.15, and B.6.15.
4.17 Manual Initiation.		
The protection system shall include means for manual initiation of each protective action at the system level (for example, reactor trip, containment isolation, safety injection, core spray, etc:). No single failure, as defined by the note following Section 4.2, within the manual, automatic, or common portions of the protection system shall prevent initiation of protective action by manual or automatic means. Manual initiation should depend upon the operation of a minimum of equipment.	**System Spec 3.1.3.5** In addition, the ability to manually initiate ICCMS functions that is independent of automatic control shall be provided. **System Spec 5.9.3.1** All actuations performed by the ICCMS shall continue to have the capacity for manual actuation.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.17, features for manual initiation of protective action should conform with Regulatory Guide 1.62, "Manual Initiation of Protection Action." The review of manual controls should include the review of human factors to confirm that the functions controlled and the characteristics of the controls (e.g., location, range, type, and resolution) allow plant operators to take appropriate manual actions. The review of manual controls should include confirmation that the controls will be functional (e.g., power will be available and command equipment is appropriately qualified) during plant conditions under which manual actions may be necessary. As described in EC71855, Section B.4.15 and B.6.15, the fast cooldown system (including the automatic dump valves) includes means for manual initiation of each protective action at the system level (for example, reactor trip, containment isolation, safety injection, core spray, etc:). No single failure, as defined by the note following Section 4.2, within the manual, automatic, or common portions of the protection system will prevent initiation of protective action by manual or automatic means. Manual initiation requires the operation of a minimum of equipment.
4.18 Access to Set Point Adjustments, Calibration, and Test Points.		
The design shall permit the administrative control of access to all set point adjustments, module calibration adjustments, and test points.	The ICCMS utilizes administrative controls (i.e. locked enclosure) and procedures to allow any testing or maintenance on the system to be conducted.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.18, the review of access control should confirm that design features provide the means to control physical access to protection system equipment, including access to test points and means for changing setpoints. Typically such access control includes provisions such as alarms and locks on protection system panel doors, or control of access to rooms in which protection system equipment is located. Initial testing is provided and controlled by the requirements of the EC package to verify the capability of the FCS. After initial testing ongoing verification of system capability is demonstrated and controlled by Technical Specifications: 3.7.20.2 (battery terminal voltage) is conducted weekly. Technical Specification 3.7.20.3 (controller calibration), 3.7.20.4 (battery duty cycle), and 3.7.20.5 (ADV actuation on simulated FCS signal) are conducted every 24 months. Additionally, all FCS equipment including the ADVs is located inside the plant protected/vital area which requires Keycard access for personnel cleared for these areas.
4.19 Identification of Protective Actions.		
Protective actions shall be indicated and identified down to the channel level.	**System Spec 5.7.2 Self Test and Online Diagnostics** **System Spec 5.7.2.1** The ICCMS shall be capable of identifying a fault down to the module level, including power supplies. **System Spec 5.7.2.2** The ICCMS diagnostics shall include a "heartbeat" function ensuring the system is in continuous operation. Failure of this function shall be annunciated.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.19 and 4.20, the review of information displays confirm that the information displayed and characteristics of the displays (e.g., location, range, type, and resolution) support operator awareness of system and plant status and will allow plant operators to make appropriate decisions. The review of information displays for manually controlled actions confirm that displays will be functional (e.g., power will be available and sensors are appropriately qualified) during plant conditions under which manual actions may be necessary. Protection system bypass and inoperable status indication conforms with the guidance of Regulatory Guide 1.47. FCS protective actions cannot be indicated and identified down to the channel level since neither FCS nor the ADVs incorporate this design concept.

IEEE Standard Criterion	ICCMS	FCS
4.20 Information Read-Out.		
The protection system shall be designed to provide the operator with accurate, complete, and timely information pertinent to its own status and to generating station safety. The design shall minimize the development of conditions which would cause meters, annunciators, recorders, alarms, etc. to give anomalous indications confusing to the operator.	**System Spec 5.10 ICCMS Status Display** **System Spec 5.10.1** The ICCMS status display shall receive output signals from all three (3) channels of the system. **System Spec 5.10.2** The ICCMS status display shall be located on the MCB and provide the following indications: **System Spec 5.10.2.1** Initiation Channel Bypassed (3) **System Spec 5.10.2.2** Actuation Train Bypassed (2) **System Spec 5.10.2.3** ICCM Trouble (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.4** Rx Trip received by Initiation Channel (3) **System Spec 5.10.2.5** LOSCM received by Initiation Channel (3) **System Spec 5.10.2.6** LOHPIFM by Initiation Channel (3) **System Spec 5.10.2.7** RCP Trip (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.8** EFIC ISCM Init (Initiation Channel and Actuation Train) (5) **System Spec 5.10.2.9** FCS Init Initiation Channel and Actuation Train) (5)	As stated in response to clause 4.19, above, the fast cooldown system is designed to provide the operator with accurate, complete, and timely information pertinent to its own status and to generating station safety as described in EC71855, Section B.4.1.4, B.6.1.4, B.4.7.7, B.6.7.7, B.4.7.13 and B.6.7.13. The design will minimize the development of conditions which would cause meters, annunciators, recorders, alarms, etc. to give anomalous indications confusing to the operator as described in EC71855, Section B.4.1, B.6.1, B.4.13, B.6.13, B.4.15, B.6.15, B.4.16, B.6.16, B.4.18, B.6.18, B.4.19, and B.6.19. The Atmospheric dump valves are designed to provide the operator with accurate, complete, and timely information pertinent to its own status and to generating station safety as described in EC71855, Section B.4.7.7 and B.6.7.7. The requirement that the design shall minimize the development of conditions which would cause meters, annunciators, recorders, alarms, etc. to give anomalous indications confusing to the operator is not applicable to the ADVs.
4.21 System Repair.		
The system shall be designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.	**System Spec 5.7.2 Self Test and Online Diagnostics** **System Spec 5.7.2.1** The ICCMS shall be capable of identifying a fault down to the module level, including power supplies. **System Spec 5.7.2.2** The ICCMS diagnostics shall include a "heartbeat" function ensuring the system is in continuous operation. Failure of this function shall be annunciated.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.21, protection systems may include self-diagnostic capabilities to aid in troubleshooting. This design concept is not incorporated in the design of the FCS system. The fast cooldown system including the automatic dump valves is designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules as described in EC71855, Section B.4.21 and B.6.21.
4.22 Identification.		
In order to provide assurance that the requirements given in this document can be applied during the design, construction, maintenance, and operation of the plant, the protection system equipment (for example. interconnecting wiring, components, modules. etc), shall be identified3 distinctively as being in the protection system. This identification shall distinguish between redundant portions of the protection system. In the installed equipments, components, or modules mounted in assemblies that are clearly identified as being in the protection system do not themselves require identification.	**Procurement Spec 3.11.1** Each equipment tag shall clearly identify each device and reflect the same nomenclature as used on the drawings. SUPPLIER shall conform to CR-3 Human Factors Guidelines in tagging equipment. **Procurement Spec 3.11.2** The equipment tags shall use markings that cannot be easily altered. The markings should have a life of 35 years and shall not fade. **Procurement Spec 3.11.3** All operator devices mounted on the face of enclosure shall include nameplates. **Procurement Spec 3.11.4** Each enclosure, control panel, and major equipment item shall have an equipment tag affixed to it. If mounted in an enclosure, an equipment tag shall be provided on the panel so it can be accessed without opening the panel. **Procurement Spec 3.11.5** Equipment tags for the enclosure shall be securely attached with screws or adhesive. **Procurement Spec 3.11.9** Specific equipment and software identification and tags shall be defined by OWNER during the detailed engineering and construction phase. Non-safety related software used in the online monitor shall comply with this requirement.	As stated in SRP, NUREG-0800, Appendix 7.1-B, "Guidance for the Evaluation of Conformance to IEEE Std. 279 ", Clause 4.22, guidance on identification is provided in Regulatory Guide 1.75, which endorses IEEE Std. 384-1992. The preferred identification method is color coding of components, cables, and cabinets. Color coding is the method used for the identification of conduit and cables of the fast cooldown system including the automatic dump valves. EC 71855 section D, installation, describes the method used to mark both wiring and conduits for circuit separation. Additionally, EC 71855 section D, installation, describes the method used to label the FCS components contained in enclosures.
[3]Work is in progress to establish a criterion for identification of protection system equipment or drawings and other documentation and the extent to which such identification would be required.		

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

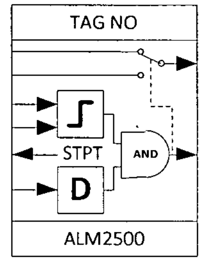
ENCLOSURE 4

ICCMS SIMPLIFIED SCHEMATIC AND CONTROL LOGIC DIAGRAMS

NOTES

1. MODULES ARE TAGGED ICC-[CABINET]-[ROW]-[SLOT] NUMBERED FROM THE TOP LEFT. EQUIPMENT IN THE REAR OF THE CABINETS ON THE MCB IS LISTED ON SHEET 12.
2. EQUIPMENT NOT IN THE ICCM SYSTEM IS SHOWN WITH DOTTED OUTLINES.
3. MODULE CONNECTIONS TO THE MULTIPLEXERS ARE NOT SHOWN.
4. MODULE CONNECTIONS TO +24 VDC POWER ARE NOT SHOWN. ALL TRAIN MODULES ARE POWERED FROM THE TRAIN POWER SUPPLY MONITOR. ALL CHANNEL MODULES ARE POWERED FROM THE CHANNEL POWER SUPPLY MONITOR.
5. UNLESS OTHERWISE NOTED, DIAGRAMS SHOW CHANNEL 1 AND TRAIN A. TABLES SHOW THE EQUIVILENT MODULES FOR CHANNELS 2 AND 3 AND TRAIN B.

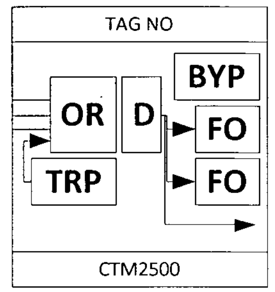
NAME	MODEL NUMBER	PART NO.
ANALOG INPUT MODULE	AIM2500	NUS-A323PA-1
ANALOG OUTPUT MODULE	AOM2500	NUS-A324PA-1
CONTACT INPUT MODULE	CIM2500	NUS-A325PA-1
CONTACT OUTPUT MODULE	COM2500	NUS-A326PA-1
FUNCTION GENERATOR	GEN2500	NUS-A327PA-1
POWER SUPPLY MONITOR	PSM2500	NUS-A328PA-1
BISTABLE MODULE	ALM2500	NUS-A329PA-1
REACTOR TRIP LOGIC	RXT2500	NUS-A330PA-1
SUMMER MODULE	SUM2500	NUS-A331PA-1
DISPLAY SELECT MODULE	DSM2500	NUS-A332PA-1
HI AUCTIONEER MODULE	AUC2500	NUS-A333PA-1
CHANNEL TRIP MODULE	CTM2500	NUS-A334PA-1
TRAIN TRIP MODULE	TTM2500	NUS-A335PA-1
CABINET TEMP MODULE	CAB2500	NUS-A338PA-1
DIFFERENCE MODULE	DIF2500	NUS-A339PA-1



THE ALARM MODULE ACCEPTS A INPUT AND A SETPOINT; WHEN THE INPUT EXCEEDS THE SETPOINT, THE COMPARATOR TRIPS. WHEN THE INPUT DROPS BELOW THE SETPOINT BY A SMALL FIXED HYTERESIS, THE COMPARATOR RESETS. AN INTERNAL VOLTAGE IS PROVIDED FOR USE AS A SETPOINT.

A PERMISSIVE SIGNAL STARTS A VARIABLE DELAY. IF THE PERMISSIVE CLEARS THE DELAY TIMER RESETS. A TRIP REQUIRES THE PERMISSIVE AND THE COMPARATOR OUTPUT; THE TRIP OUTPUT IS A 0-12 VDC ICCMS STATUS SIGNAL. THE MODULE DOES NOT TRIP ON LOSS OF POWER.

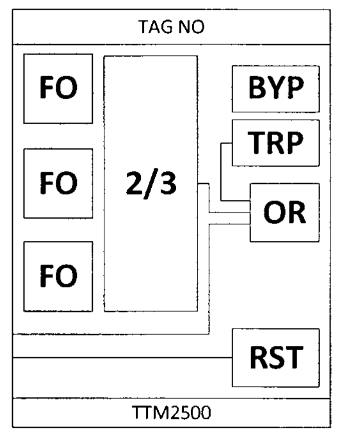
THE TRIP ALSO SELECTS ONE OF TWO ANALOG INPUTS AS AN 2-10 VDC ICCMS ANALOG OUTPUT.



THE CHANNEL TRIP MODULE ACCEPTS UP TO THREE 0-12 VDC ICCMS STATUS SIGNALS. WHEN ANY OF THE THREE SIGNALS GO HIGH, OR WHEN THE MODULE TRIP SWITCH CLOSES, A TRIP OCCURES AFTER A VARIABLE DELAY. THE TRIP RESETS AUTOMATICALLY IF ALL TRIP SIGNALS RETURN TO THEIR UNTRIPPED STATE. THE MODULE TRIPS ON LOSS OF POWER.

THE TRIP OUTPUTS A 0-12 VDC ICCMS STATUS SIGNAL AND INTERRUPTS THE OUTPUT OF TWO FIBER OPTIC SIGNAL TRANSMITTERS (NO FIBER OPTIC SIGNAL = TRIP).

THE MODULE INCLUDES A CHANNEL BYPASS SWITCH WHICH PREVENTS THE MODULE FROM TRIPPING REGARDLESS OF THE STATE OF THE INPUTS. THE BYPASS SWITCH WILL OVERRIDE AN EXISTING TRIP CONDITION.



THE TRAIN TRIP MODULE ACCEPTS THREE FIBER OPTIC INPUT SIGNALS. WHEN TWO-OUT-OF-THREE OF THE SIGNALS TRIP OR WHEN THE MODULE TRIP SWITCH CLOSES OR WHEN A 0-12 VDC ICCMS STATUS SIGNAL GOES HIGH, THE MODULE TRIPS. THE TRIP OUTPUTS A 0-12 VDC ICCMS STATUS SIGNAL .

ONCE TRIPPED, THE MODULE REMAINS TRIPPED REGARDLESS OF THE STATUS OF THE TRIP INPUTS. ONCE THE TRIP CONDITION NO LONGER EXISTS, EITHER A REMOTE RESET SIGNAL OR THE MODULE RESET SWITCH WILL CLEAR THE TRIP CONDITION. THE MODULE DOES NOT TRIP ON LOSS OF POWER.

THE MODULE INCLUDES A TRAIN BYPASS SWITCH WHICH PREVENTS THE MODULE FROM TRIPPING REGARDLESS OF THE STATE OF THE INPUTS. THE BYPASS SWITCH WILL OVERRIDE AN EXISTING TRIP CONDITION.

	ICC-01-CAB	ICC-02-CAB	ICC-03-CAB	ICC-04
ROW 1	MULTIPLEXER	MULTIPLEXER	MULTIPLEXER	MAIN CONTROL BOARD EQUIPMENT
ROW 2	BLANK	BLANK	ONLINE MONITOR	
ROW 3	TRAIN A	TRAIN B	BLANK	
ROW 4	CHANNEL 1	CHANNEL 2	CHANNEL 3	
ROW 5	CHANNEL 1	CHANNEL 2	CHANNEL 3	
ROW 6	CHANNEL 1	CHANNEL 2	CHANNEL 3	
ROW 7	CHANNEL 1	CHANNEL 2	CHANNEL 3	
ROW 8	CHANNEL 1	CHANNEL 2	CHANNEL 3	

RECORD OF REVISIONS

1	DIVIDED INTO SEPARATE SHEETS; ADDED ONLINE MONITOR EQUIPMENT; ADDED TAG NUMBERS; ADDED MODULE INTERIOR DETAILS; ADDED SHEET 1 INFORMATION; ADDRESSED CLIENT COMMENTS ON REV 0.	PREP	
		ENG	
		CHK	
		PM	

DRAWING INDEX

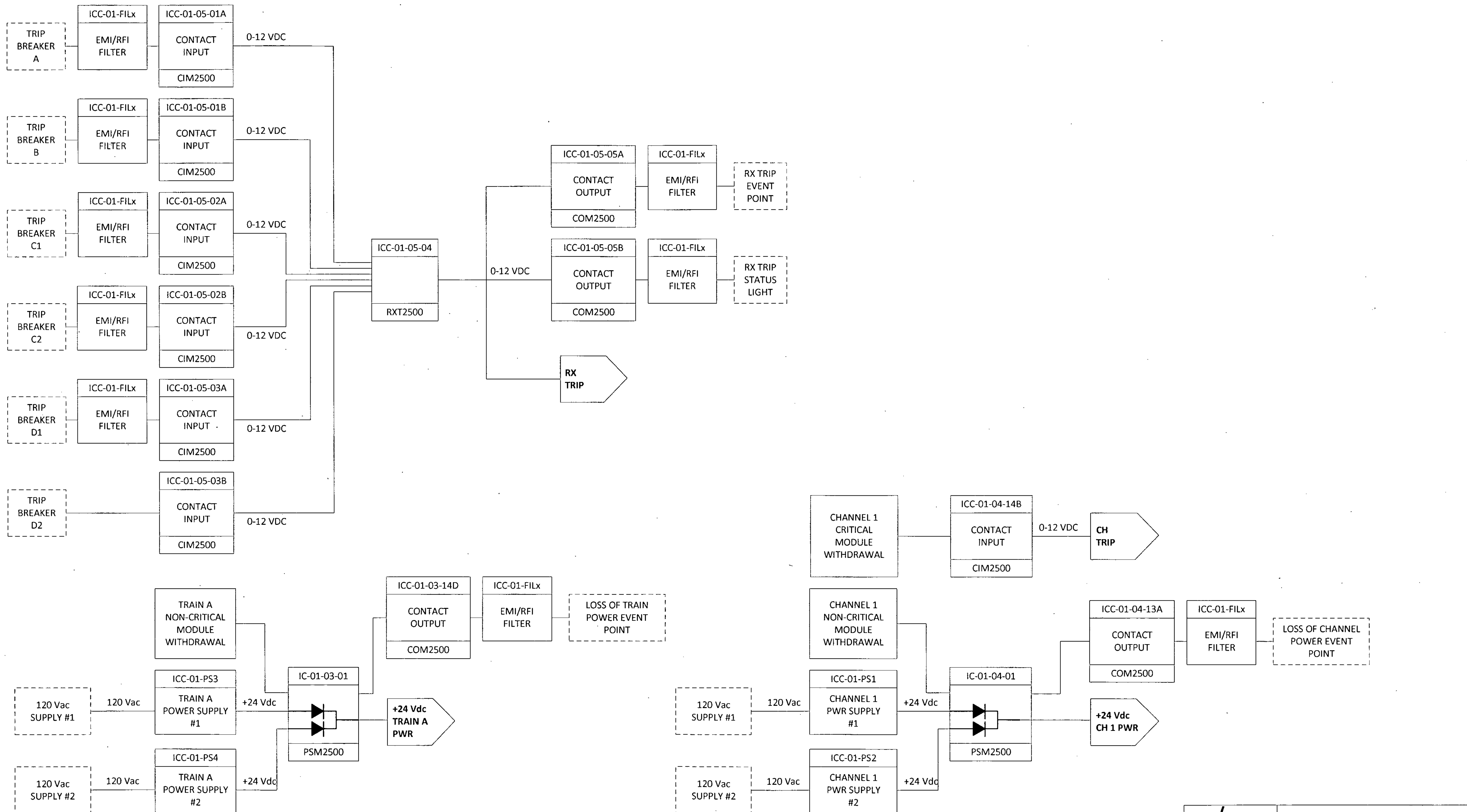
PREP	R.M.QUEENAN	
ENGR	R.M.QUEENAN	6/21/11
REVIEWER	H.LEUNG	6/21/11
PROJ MGR	K.L.SAUL	6/21/11

CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
GENERAL

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 1 OF 14

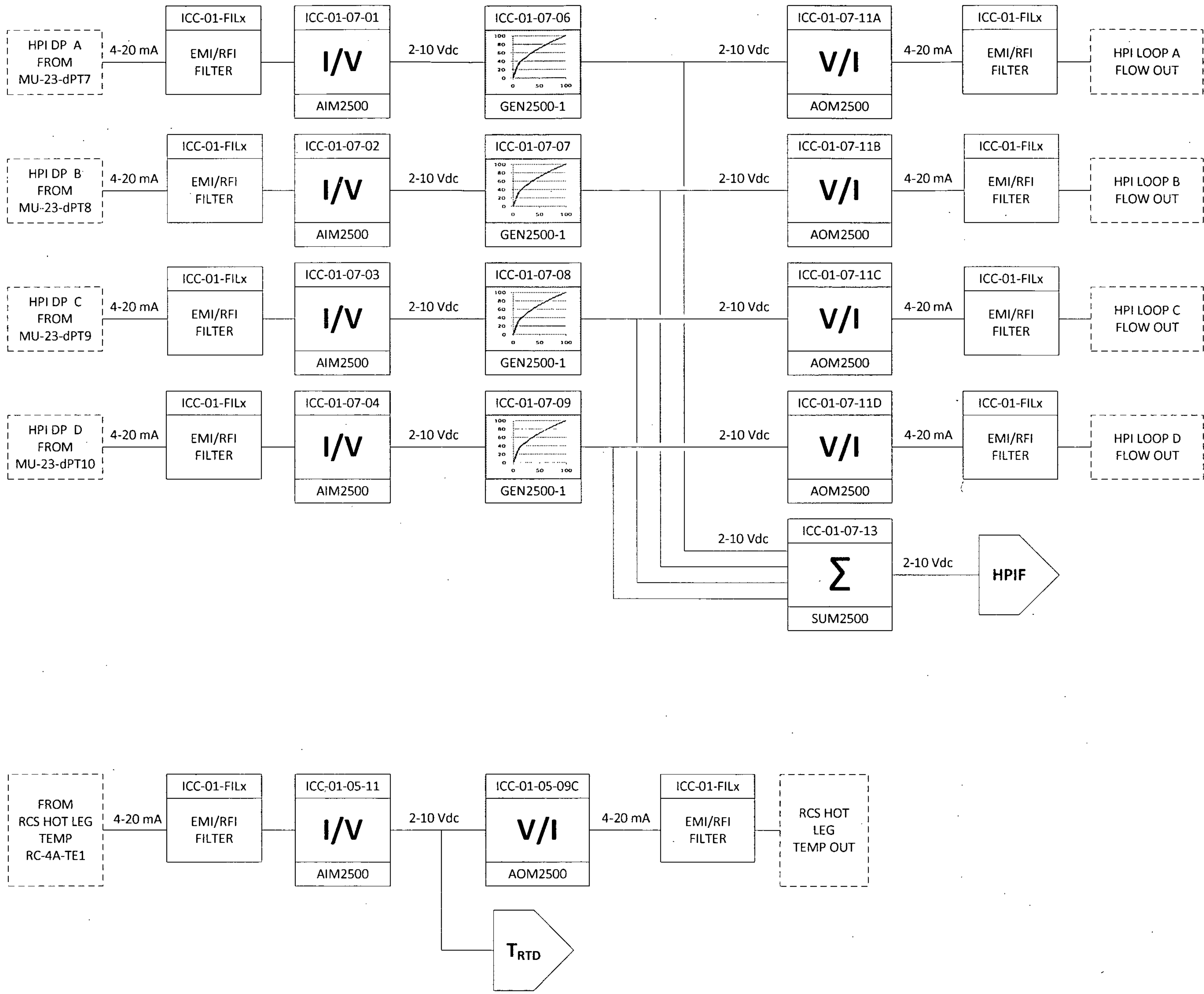


CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
REACTOR TRIP CONFIRM & MISC CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 2 OF 14

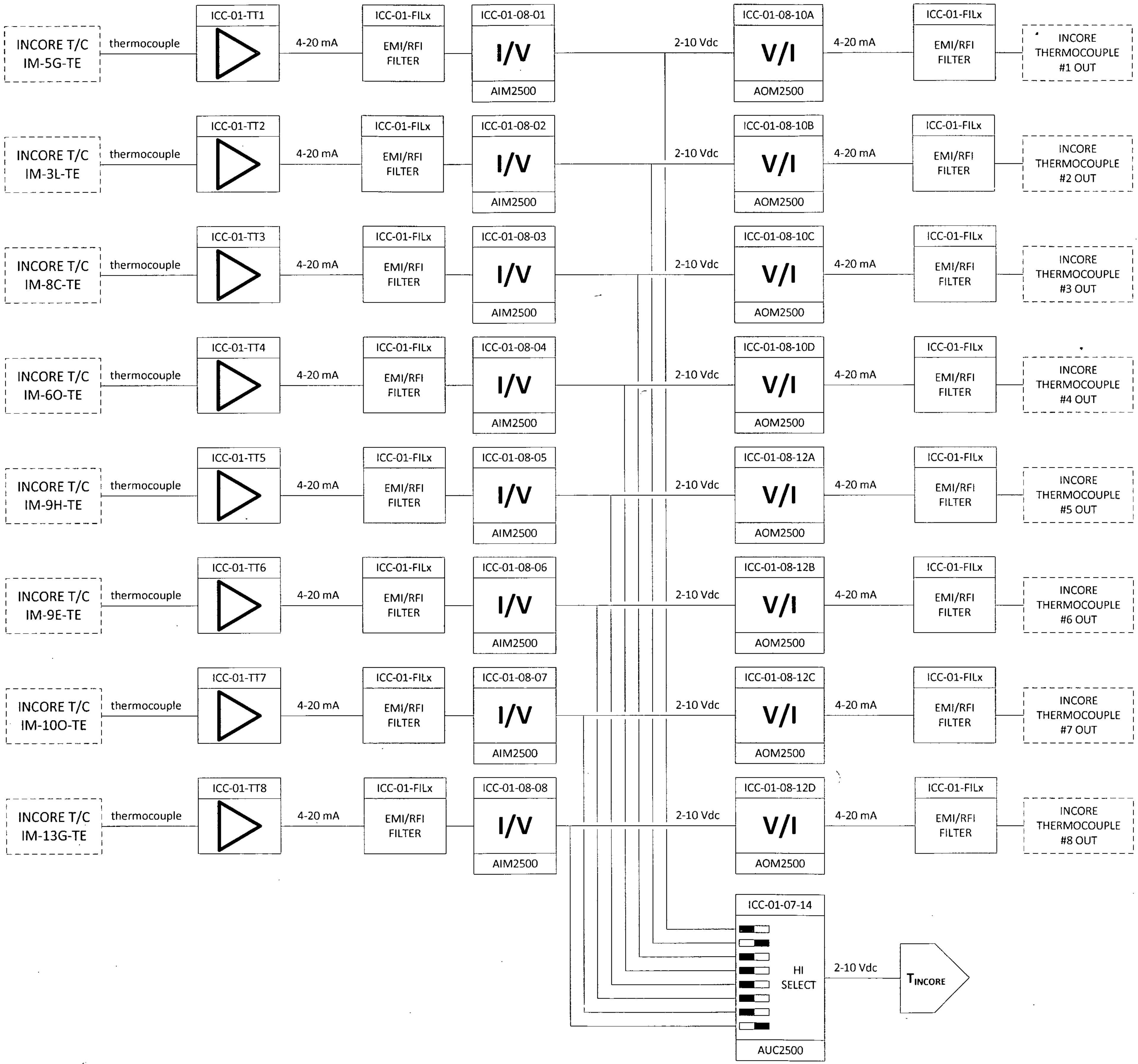


CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
HPI FLOW AND RTD CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 3 OF 14



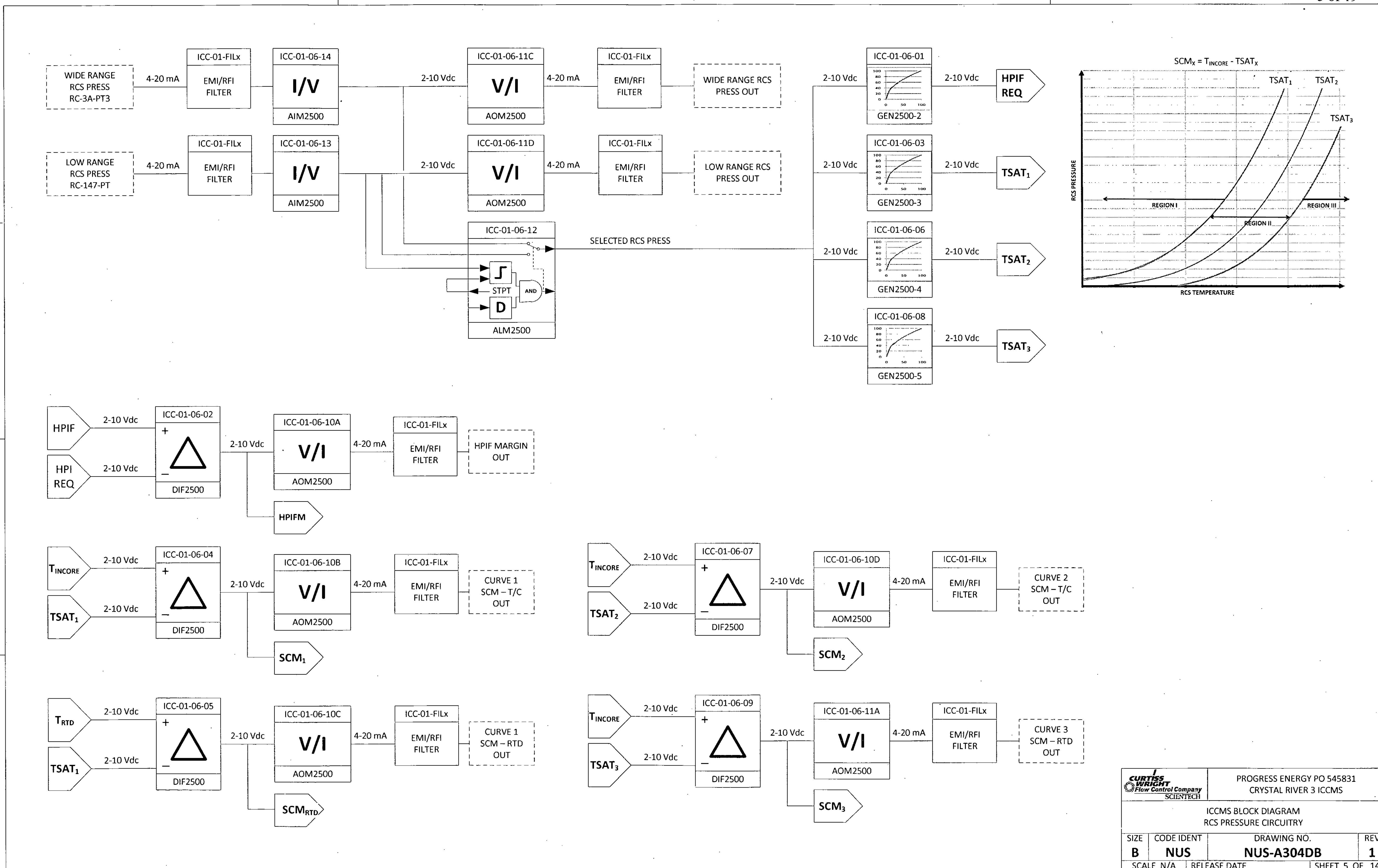
CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
INCORE THERMOCOUPLE CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1

SCALE N/A | RELEASE DATE | SHEET 4 OF 14

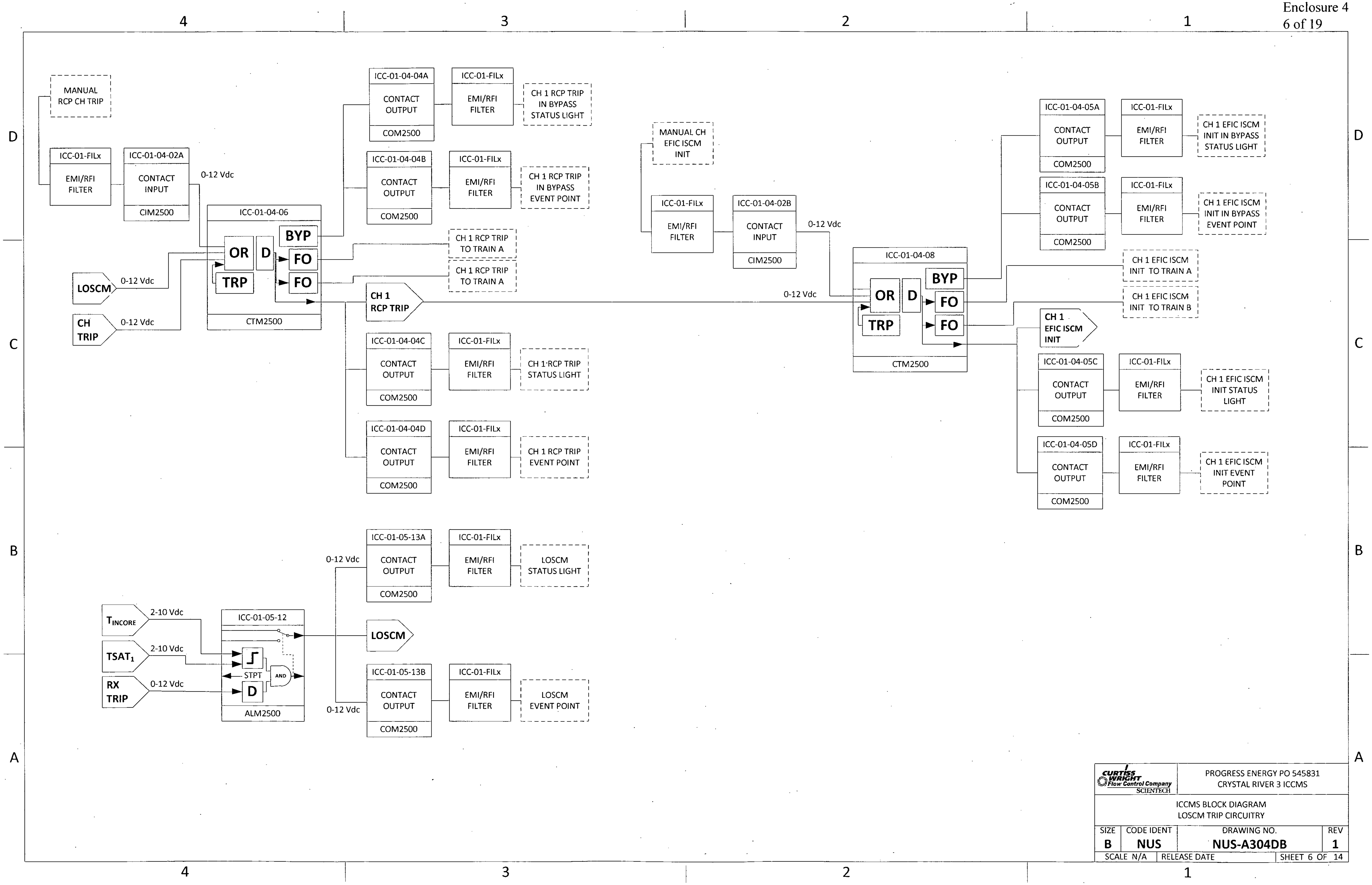


CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
RCS PRESSURE CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 5 OF 14

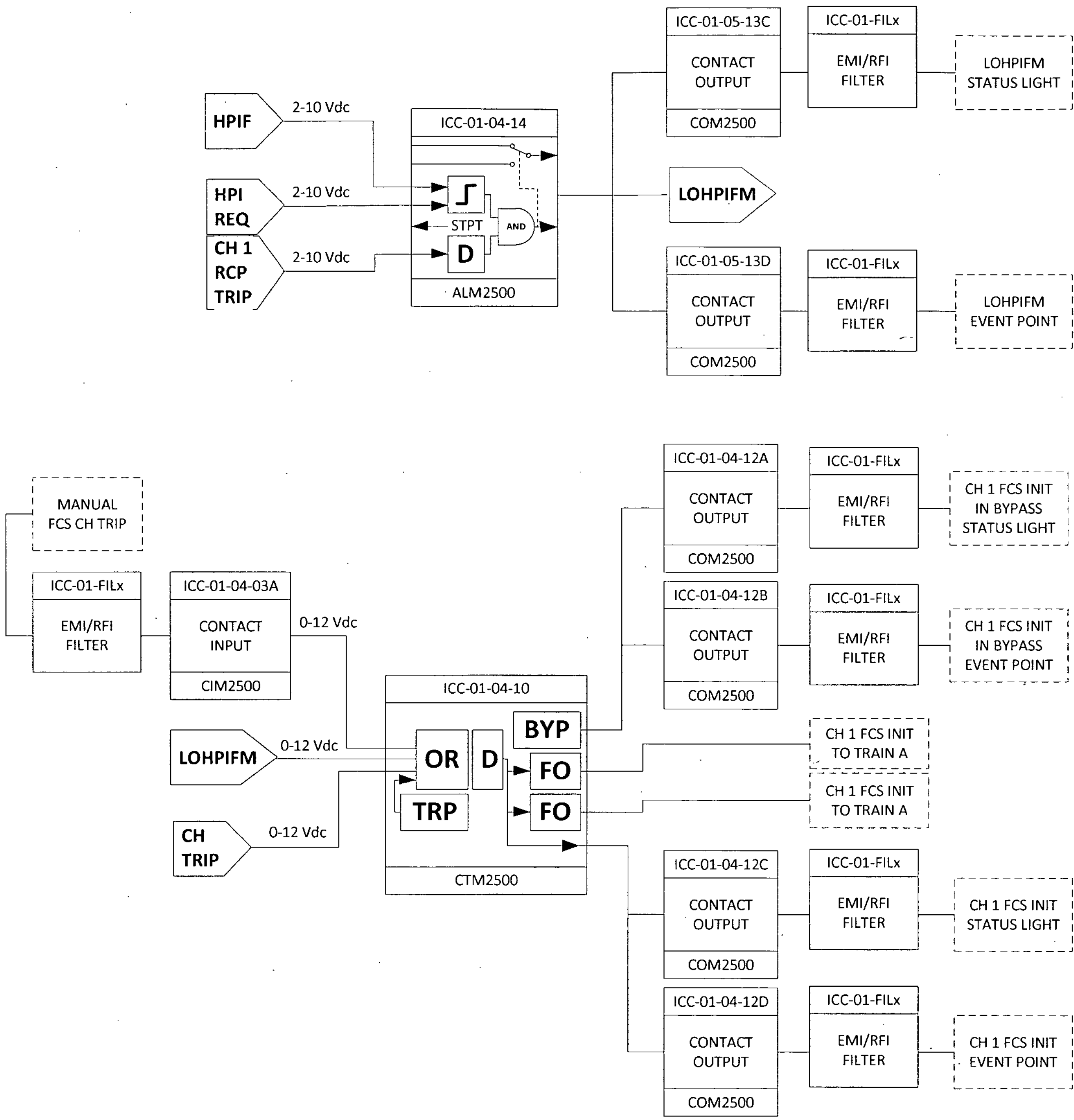


CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
LOSCM TRIP CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 6 OF 14



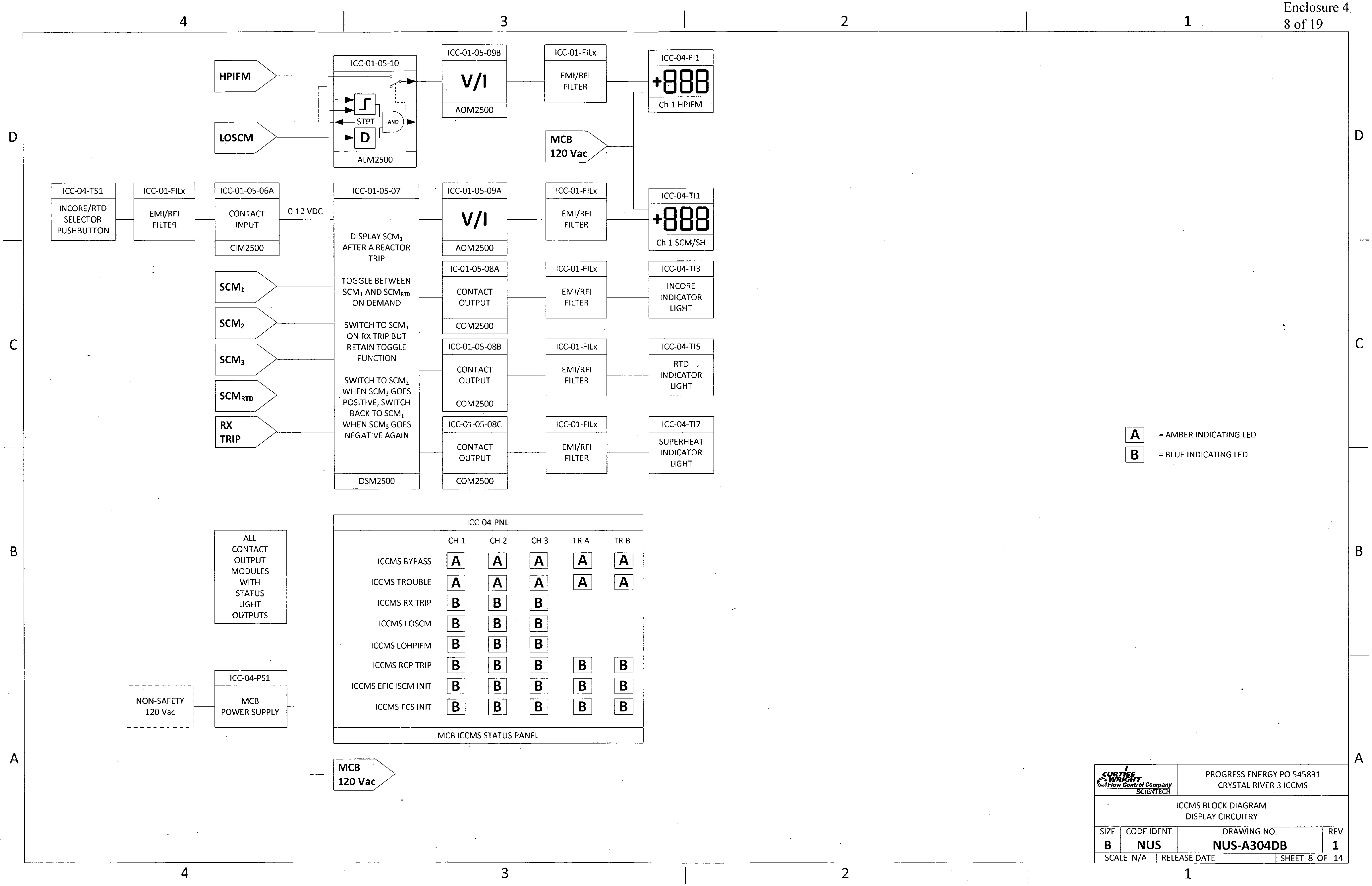
CURTISS WRIGHT Flow Control Company SCIENTECH

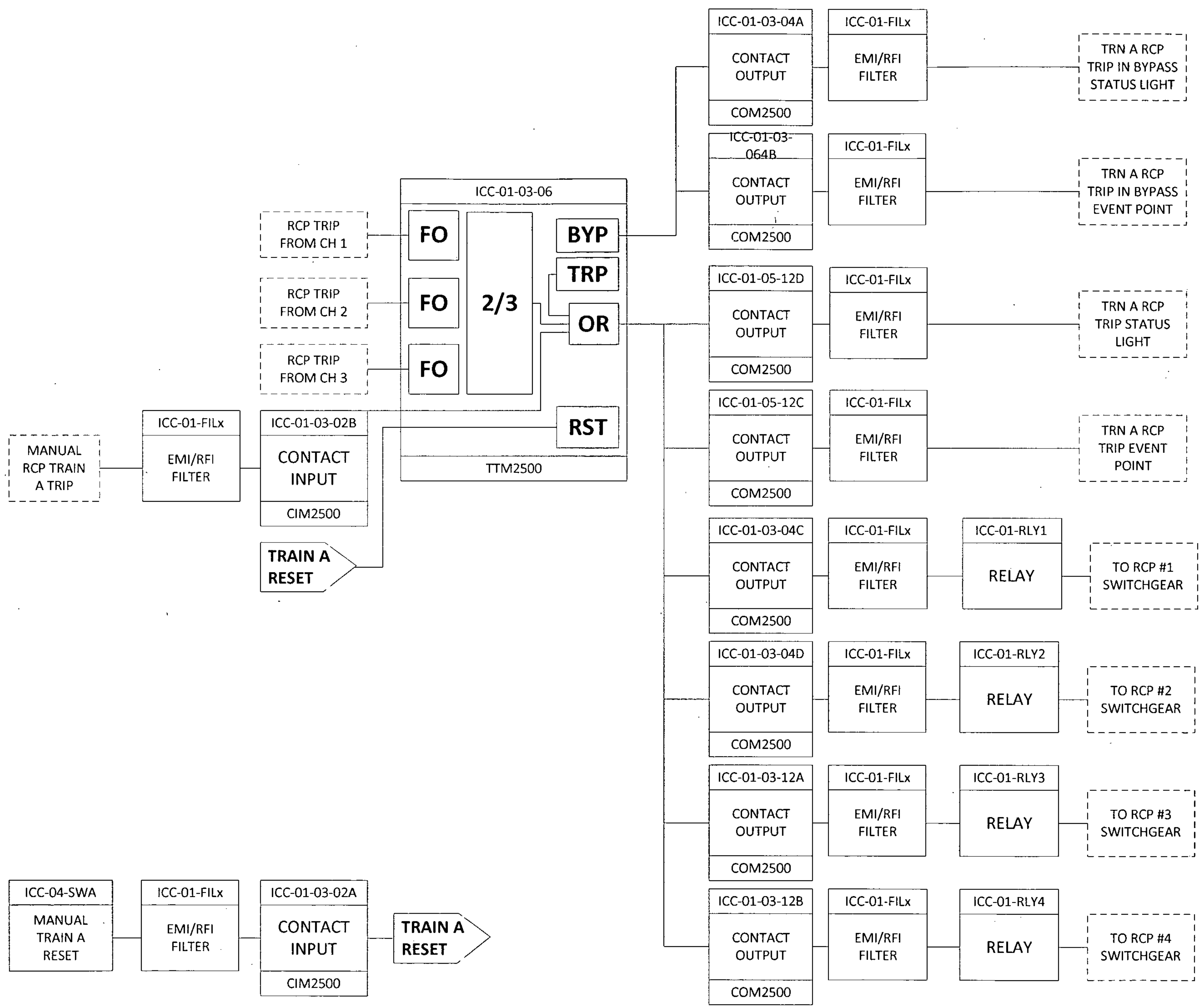
PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
LOHPIFM TRIP CIRCUITRY

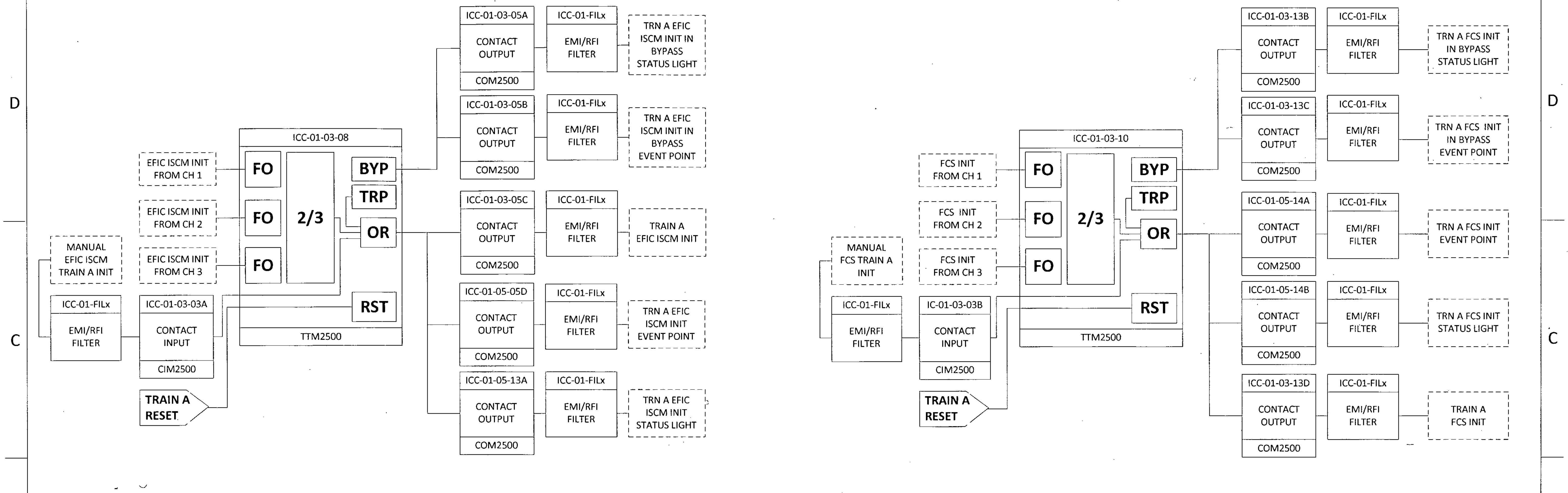
SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1

SCALE N/A | RELEASE DATE | SHEET 7 OF 14


HPIFM
LOSCM
ICC-01-05-10
STPT
AND
D
ALM2500
ICC-01-05-09B
V/I
AOM2500
ICC-01-FILx
EMI/RFI FILTER
ICC-04-FI1
+888
Ch 1 HPIFM
MCB 120 Vac
ICC-04-TS1
INCORE/RTD SELECTOR PUSHBUTTON
ICC-01-FILx
EMI/RFI FILTER
ICC-01-05-06A
CONTACT INPUT
CIM2500
0-12 VDC
ICC-01-05-07
DISPLAY SCM1 AFTER A REACTOR TRIP
TOGGLE BETWEEN SCM1 AND SCMRTD ON DEMAND
SWITCH TO SCM1 ON RX TRIP BUT RETAIN TOGGLE FUNCTION
SWITCH TO SCM2 WHEN SCM3 GOES POSITIVE, SWITCH BACK TO SCM1 WHEN SCM3 GOES NEGATIVE AGAIN
DSM2500
ICC-01-05-09A
V/I
AOM2500
ICC-01-FILx
EMI/RFI FILTER
ICC-04-TI1
+888
Ch 1 SCM/SH
SCM1
SCM2
SCM3
SCMRTD
RX TRIP
IC-01-05-08A
CONTACT OUTPUT
COM2500
ICC-01-FILx
EMI/RFI FILTER
ICC-04-TI3
INCORE INDICATOR LIGHT
ICC-01-05-08B
CONTACT OUTPUT
COM2500
ICC-01-FILx
EMI/RFI FILTER
ICC-04-TI5
RTD INDICATOR LIGHT
ICC-01-05-08C
CONTACT OUTPUT
COM2500
ICC-01-FILx
EMI/RFI FILTER
ICC-04-TI7
SUPERHEAT INDICATOR LIGHT
A = AMBER INDICATING LED
B = BLUE INDICATING LED
ALL CONTACT OUTPUT MODULES WITH STATUS LIGHT OUTPUTS
ICC-04-PNL
CH 1
CH 2
CH 3
TR A
TR B
ICCMS BYPASS A A A A A
ICCMS TROUBLE A A A A A
ICCMS RX TRIP B B B
ICCMS LOSCM B B B
ICCMS LOHPIFM B B B
ICCMS RCP TRIP B B B B B
ICCMS EFIC ISCM INIT B B B B B
ICCMS FCS INIT B B B B B
MCB ICCMS STATUS PANEL
NON-SAFETY 120 Vac
ICC-04-PS1
MCB POWER SUPPLY
MCB 120 Vac
CURTISS WRIGHT Flow Control Company SCIENTECH
PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS
ICCMS BLOCK DIAGRAM
DISPLAY CIRCUITRY
SIZE B
CODE IDENT NUS
DRAWING NO. NUS-A304DB
REV 1
SCALE N/A
RELEASE DATE
SHEET 8 OF 14



CURTISS WRIGHT Flow Control Company SCIENTECH	PROGRESS ENERGY PO 545831 CRYSTAL RIVER 3 ICCMS		
ICCMS BLOCK DIAGRAM RCP TRAIN TRIP CIRCUITRY			
SIZE B	CODE IDENT NUS	DRAWING NO. NUS-A304DB	REV 1
SCALE N/A	RELEASE DATE		SHEET 9 OF 14

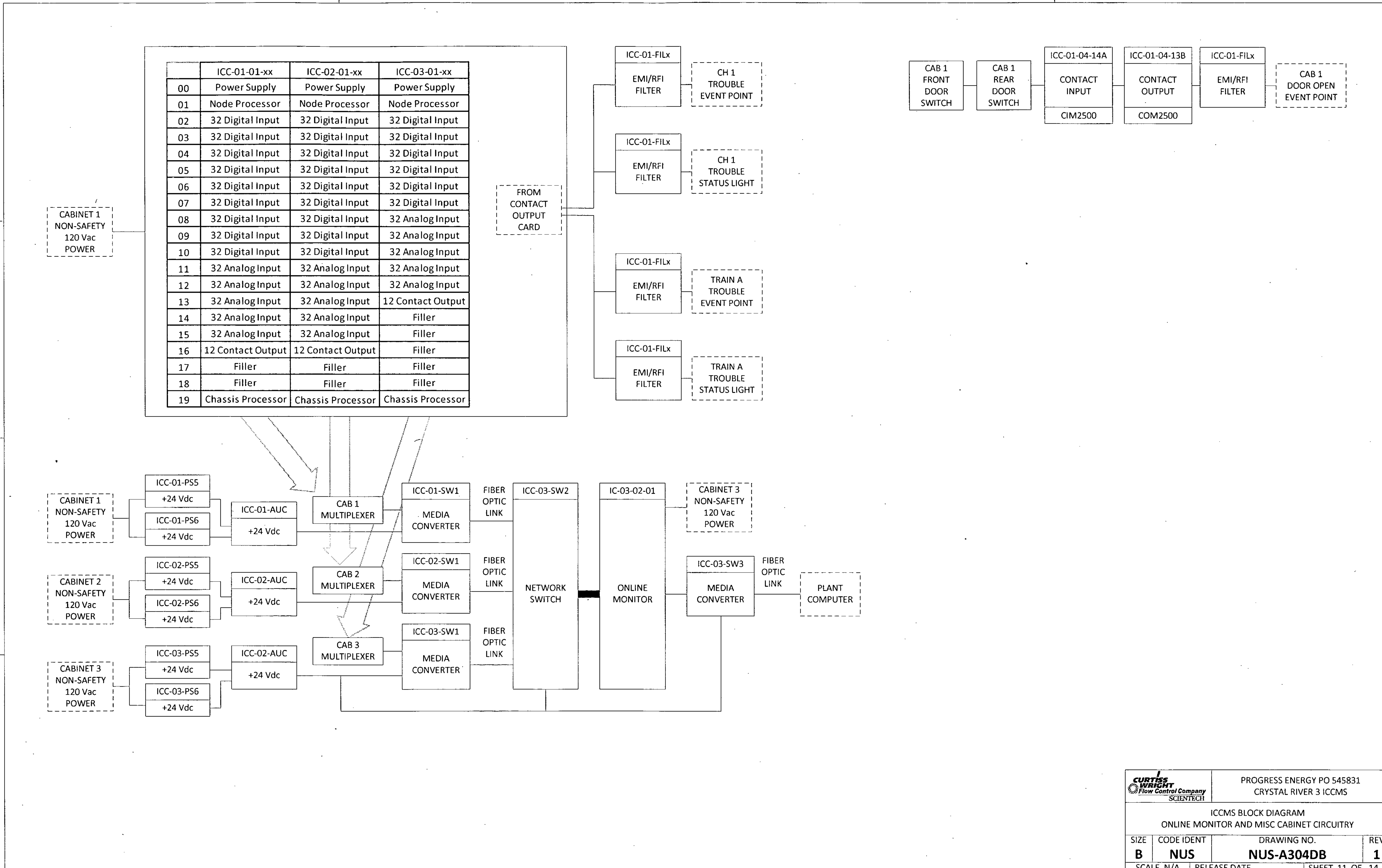


CURTISS WRIGHT Flow Control Company SCIENTECH	PROGRESS ENERGY PO 545831 CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
EFIC ISCM INIT AND FCS INIT CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 10 OF 14

	ICC-01-01-xx	ICC-02-01-xx	ICC-03-01-xx
00	Power Supply	Power Supply	Power Supply
01	Node Processor	Node Processor	Node Processor
02	32 Digital Input	32 Digital Input	32 Digital Input
03	32 Digital Input	32 Digital Input	32 Digital Input
04	32 Digital Input	32 Digital Input	32 Digital Input
05	32 Digital Input	32 Digital Input	32 Digital Input
06	32 Digital Input	32 Digital Input	32 Digital Input
07	32 Digital Input	32 Digital Input	32 Digital Input
08	32 Digital Input	32 Digital Input	32 Analog Input
09	32 Digital Input	32 Digital Input	32 Analog Input
10	32 Digital Input	32 Digital Input	32 Analog Input
11	32 Analog Input	32 Analog Input	32 Analog Input
12	32 Analog Input	32 Analog Input	32 Analog Input
13	32 Analog Input	32 Analog Input	12 Contact Output
14	32 Analog Input	32 Analog Input	Filler
15	32 Analog Input	32 Analog Input	Filler
16	12 Contact Output	12 Contact Output	Filler
17	Filler	Filler	Filler
18	Filler	Filler	Filler
19	Chassis Processor	Chassis Processor	Chassis Processor



CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
ONLINE MONITOR AND MISC CABINET CIRCUITRY

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1

SCALE N/A | RELEASE DATE | SHEET 11 OF 14

4 3 2 1

TAG NO	LOCATION	DESCRIPTION
ICC-01-AUC	CABINET 1 REAR	OLM POWER SUPPLY AUCTIONEER
ICC-01-PS1	CABINET 1 REAR	CHANNEL POWER SUPPLY #1
ICC-01-PS2	CABINET 1 REAR	CHANNEL POWER SUPPLY #2
ICC-01-PS3	CABINET 1 REAR	TRAIN POWER SUPPLY #1
ICC-01-PS4	CABINET 1 REAR	TRAIN POWER SUPPLY #2
ICC-01-PS5	CABINET 1 REAR	OLM POWER SUPPLY #1
ICC-01-PS6	CABINET 1 REAR	OLM POWER SUPPLY #2
ICC-01-RLY1	CABINET 1 REAR	CH 1 RCP #1 TRIP RELAY
ICC-01-RLY2	CABINET 1 REAR	CH 1 RCP #2 TRIP RELAY
ICC-01-RLY3	CABINET 1 REAR	CH 1 RCP #3 TRIP RELAY
ICC-01-RLY4	CABINET 1 REAR	CH 1 RCP #4 TRIP RELAY
ICC-01-SW1	CABINET 1 REAR	CH 1 MUX MEDIA CONVERTER
ICC-01-TTX	CABINET 1 REAR	THERMOCOUPLE TRANSMITTER X
ICC-02-AUC	CABINET 2 REAR	OLM POWER SUPPLY AUCTIONEER
ICC-02-PS1	CABINET 2 REAR	CHANNEL POWER SUPPLY #1
ICC-02-PS2	CABINET 2 REAR	CHANNEL POWER SUPPLY #2
ICC-02-PS3	CABINET 2 REAR	TRAIN POWER SUPPLY #1
ICC-02-PS4	CABINET 2 REAR	TRAIN POWER SUPPLY #2
ICC-02-PS5	CABINET 2 REAR	OLM POWER SUPPLY #1
ICC-02-PS6	CABINET 2 REAR	OLM POWER SUPPLY #2
ICC-02-SW1	CABINET 2 REAR	CH 2 MUX MEDIA CONVERTER
ICC-02-TTX	CABINET 2 REAR	THERMOCOUPLE TRANSMITTER X
ICC-03-02-01	CABINET 3 ROW 2	OLM SERVER
ICC-03-AUC	CABINET 3 REAR	OLM POWER SUPPLY AUCTIONEER
ICC-03-PS1	CABINET 3 REAR	CHANNEL POWER SUPPLY #1
ICC-03-PS2	CABINET 3 REAR	CHANNEL POWER SUPPLY #2
ICC-03-PS3	CABINET 3 REAR	TRAIN POWER SUPPLY #1
ICC-03-PS4	CABINET 3 REAR	TRAIN POWER SUPPLY #2
ICC-03-PS5	CABINET 3 REAR	OLM POWER SUPPLY #1
ICC-03-PS6	CABINET 3 REAR	OLM POWER SUPPLY #2
ICC-03-SW1	CABINET 3 REAR	CH 3 MUX MEDIA CONVERTER
ICC-03-SW3	CABINET 3 REAR	OLM NETWORK SWITCH
ICC-03-TTX	CABINET 3 REAR	THERMOCOUPLE TRANSMITTER X
ICC-04-PS1	MCB	MCB POWER SUPPLY #1
ICC-04-SW2	MCB	ICCMS STATUS PANEL LAMP TEST SWITCH
ICC-04-SWA	MCB	TRAIN A TRIP RESET SWITCH
ICC-04-SWB	MCB	TRAIN B TRIP RESET SWITCH
ICC-04-TI1	MCB	CH 1 SCM/SH DIGITAL DISPLAY
ICC-04-TI2	MCB	CH 2 SCM/SH DIGITAL DISPLAY
ICC-04-TI3	MCB	CH 1 RTD INDICATOR LIGHT
ICC-04-TI4	MCB	CH 2 RTD INDICATOR LIGHT
ICC-04-TI5	MCB	CH 1 T/C INDICATOR LIGHT
ICC-04-TI6	MCB	CH 2 T/C INDICATOR LIGHT
ICC-04-TI7	MCB	CH 1 SH INDICATOR LIGHT
ICC-04-TI8	MCB	CH 2 SH INDICATOR LIGHT
ICC-04-TS1	MCB	CH 1 RTD/TC SELECTOR SWITCH
ICC-04-TS2	MCB	CH 2 RTD/TC SELECTOR SWITCH

CABINET 1	CABINET 2		CABINET 3	
ICC-01-03-01	ICC-02-03-01	TRAIN POWER SUPPLY MONITOR	ICC-01-03-01	FILLER
ICC-01-03-02A	ICC-02-03-02	MANUAL TRAIN RESET	ICC-01-03-02	FILLER
ICC-01-03-02B	ICC-00-00-00	MANUAL RCP TRAIN TRIP		
ICC-01-03-03A	ICC-02-03-03	MANUAL EFIC ISCM TRAIN TRIP	ICC-01-03-03	FILLER
ICC-01-03-03B	ICC-00-00-00	MANUAL FCS TRAIN TRIP		
ICC-01-03-04A	ICC-02-03-04A	RCP TRAIN TRIP BYPASS STATUS LIGHT	ICC-01-03-04	FILLER
ICC-01-03-04B	ICC-02-03-04B	RCP TRAIN TRIP BYPASS EVENT POINT		
ICC-01-03-04C	ICC-02-03-04C	RCP #1 TRIP		
ICC-01-03-04D	ICC-02-03-04D	RCP #2 TRIP		
ICC-01-03-05A	ICC-02-03-05A	EFIC ISCM TRAIN TRIP BYPASS STATUS LIGHT	ICC-01-03-05	FILLER
ICC-01-03-05B	ICC-02-03-05B	EFIC ISCM TRAIN TRIP BYPASS EVENT POINT		
ICC-01-03-05C	ICC-02-03-05C	EFIC ISCM TRAIN TRIP		
ICC-01-03-05D	ICC-02-03-05D	EFIC ISCM TRAIN TRIP EVENT POINT		
ICC-01-03-06	ICC-02-03-06	RCP TRAIN TRIP	ICC-01-03-06	FILLER
ICC-01-03-07			ICC-01-03-07	FILLER
ICC-01-03-08	ICC-02-03-08	EFIC ISCM TRAIN TRIP	ICC-01-03-08	FILLER
ICC-01-03-09			ICC-01-03-09	FILLER
ICC-01-03-10	ICC-02-03-10	FCS TRAIN TRIP	ICC-01-03-10	FILLER
ICC-01-03-11			ICC-01-03-11	FILLER
ICC-01-03-12A	ICC-02-03-12A	RCP #3 TRIP	ICC-01-03-12	FILLER
ICC-01-03-12B	ICC-02-03-12B	RCP #4 TRIP		
ICC-01-03-12C	ICC-02-03-12C	RCP TRAIN TRIP STATUS LIGHT		
ICC-01-03-12D	ICC-02-03-12D	RCP TRAIN TRIP EVENT POINT		
ICC-01-03-13A	ICC-02-03-13A	EFIC ISCM TRAIN TRIP STATUS LIGHT	ICC-01-03-13	FILLER
ICC-01-03-13B	ICC-02-03-13B	FCS TRAIN TRIP BYPASS LIGHT		
ICC-01-03-13C	ICC-02-03-13C	FCS TRAIN TRIP EVENT POINT		
ICC-01-03-13D	ICC-02-03-13D	FCS TRAIN TRIP		
ICC-01-03-14A	ICC-02-03-14A	FCS TRAIN TRIP EVENT POINT	ICC-01-03-14	FILLER
ICC-01-03-14B	ICC-02-03-14B	FCS TRAIN TRIP STATUS LIGHT		
ICC-01-03-14C	ICC-02-03-14C	(NOT USED)		
ICC-01-03-14D	ICC-02-03-14D	LOSS OF TRAIN POWER		

Cabinet 1	Cabinet 2	Cabinet 3
MU-23-dPTt7	MU-23-dPT5	MU-23-dPT13
MU-23-dPT8	MU-23-dPT6	MU-23-dPT14
MU-23-dPT9	MU-23-dPT11	MU-23-dPT15
MU-23-dPT10	MU-23-dPT12	MU-23-dPT16
IM-5G-TE	IM-2G-TE	IM-7E-TE
IM-3L-TE	IM-4N-TE	IM-5K-TE
IM-8C-TE	IM-7F-TE	IM-3F-TE
IM-6O-TE	IM-6L-TE	IM-7M-TE
IM-9H-TE	IM-10M-TE	IM-11K-TE
IM-9E-TE	IM-10C-TE	IM-13F-TE
IM-10O-TE	IM-11G-TE	IM-9M-TE
IM-13G-TE	IM-13L-TE	IM-9G-TE
RC-147-PT	RC-148-PT	RC-244-PT
RC-3A-PT3	RC-3B-PT3	RC-223-PT3
RC-4A-TE1	RC-4B-TE4	N/A

CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
TAG NUMBERS AND MODULE CROSS REFERENCE

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 12 OF 14

CABINET 1	CABINET 2	CABINET 3	
ICC-01-04-01	ICC-02-04-01	ICC-03-04-01	CHANNEL POWER SUPPLY MONITOR
ICC-01-04-02A	ICC-02-04-02A	ICC-03-04-02A	RCP MANUAL TRIP
ICC-01-04-02B	ICC-02-04-02B	ICC-03-04-02B	EFIC ISCM MANUAL TRIP
ICC-01-04-03A	ICC-02-04-03A	ICC-03-04-03A	FCS MANUAL TRIP
ICC-01-04-03B	ICC-02-04-03B	ICC-03-04-03B	NON CRITICAL MODULE WITHDRAWAL
ICC-01-04-04A	ICC-02-04-04A	ICC-03-04-04A	RCP TRIP BYPASS STATUS LIGHT
ICC-01-04-04B	ICC-02-04-04B	ICC-03-04-04B	RCP TRIP BYPASS EVENT POINT
ICC-01-04-04C	ICC-02-04-04C	ICC-03-04-04C	RCP TRIP STATUS LIGHT
ICC-01-04-04D	ICC-02-04-04D	ICC-03-04-04D	RCP TRIP EVENT POINT
ICC-01-04-05A	ICC-02-04-05A	ICC-03-04-05A	EFIC ISCM TRIP BYPASS STATUS LIGHT
ICC-01-04-05B	ICC-02-04-05B	ICC-03-04-05B	EFIC ISCM TRIP BYPASS EVENT POINT
ICC-01-04-05C	ICC-02-04-05C	ICC-03-04-05C	EFIC ISCM TRIP STATUS LIGHT
ICC-01-04-05D	ICC-02-04-05D	ICC-03-04-05D	EFIC ISCM TRIP EVENT POINT
ICC-01-04-06	ICC-02-04-06	ICC-03-04-06	RCP TRIP
ICC-01-04-07	ICC-02-04-07	ICC-03-04-07	
ICC-01-04-08	ICC-02-04-08	ICC-03-04-08	EFIC ISCM TRIP
ICC-01-04-09	ICC-02-04-09	ICC-03-04-09	
ICC-01-04-10	ICC-02-04-10	ICC-03-04-10	FCS TRIP
ICC-01-04-11	ICC-02-04-11	ICC-03-04-11	
ICC-01-04-12A	ICC-02-04-12A	ICC-03-04-12A	FCS TRIP BYPASS STATUS LIGHT
ICC-01-04-12B	ICC-02-04-12B	ICC-03-04-12B	FCS TRIP BYPASS EVENT POINT
ICC-01-04-12C	ICC-02-04-12C	ICC-03-04-12C	FCS TRIP STATUS LIGHT
ICC-01-04-12D	ICC-02-04-12D	ICC-03-04-12D	FCS TRIP EVENT POINT
ICC-01-04-13A	ICC-02-04-13A	ICC-03-04-13A	LOSS OF CHANNEL POWER
ICC-01-04-13B	ICC-02-04-13B	ICC-03-04-13B	DOOR SWITCH
ICC-01-04-13C	ICC-02-04-13C	ICC-03-04-13C	(NOT USED)
ICC-01-04-13D	ICC-02-04-13D	ICC-03-04-13D	(NOT USED)
ICC-01-04-14A	ICC-02-04-14A	ICC-03-04-14A	DOOR SWITCH
ICC-01-04-14B	ICC-02-04-14B	ICC-03-04-14B	CRITICAL MODULE WITHDRAWAL

CABINET 1	CABINET 2		CABINET 3	
ICC-01-05-01A	ICC-02-05-01A	TRIP BREAKER A INPUT	ICC-03-05-01A	TRIP BREAKER A INPUT
ICC-01-05-01B	ICC-02-05-01B	TRIP BREAKER B INPUT	ICC-03-05-01B	TRIP BREAKER B INPUT
ICC-01-05-02A	ICC-02-05-02A	TRIP BREAKER C1 INPUT	ICC-03-05-02A	TRIP BREAKER C1 INPUT
ICC-01-05-02B	ICC-02-05-02B	TRIP BREAKER C2 INPUT	ICC-03-05-02B	TRIP BREAKER C2 INPUT
ICC-01-05-03A	ICC-02-05-03A	TRIP BREAKER D1 INPUT	ICC-03-05-03A	TRIP BREAKER D1 INPUT
ICC-01-05-03B	ICC-02-05-03B	TRIP BREAKER D2 INPUT	ICC-03-05-03B	TRIP BREAKER D2 INPUT
ICC-01-05-04	ICC-02-05-04	REACTOR TRIP CONFIRM	ICC-03-05-04	REACTOR TRIP CONFIRM
ICC-01-05-05A	ICC-02-05-05A	RX TRIP EVENT POINT	ICC-03-05-05A	RX TRIP EVENT POINT
ICC-01-05-05B	ICC-02-05-05B	RX TRIP STATUS LIGHT	ICC-03-05-05B	RX TRIP STATUS LIGHT
ICC-01-05-05C	ICC-02-05-05C	(NOT USED)	ICC-03-05-05C	(NOT USED)
ICC-01-05-05D	ICC-02-05-05D	(NOT USED)	ICC-03-05-05D	(NOT USED)
ICC-01-05-06A	ICC-02-05-06A	T/C - RTD SELECTOR	ICC-03-05-06	FILLER
ICC-01-05-06B	ICC-02-05-06B	(NOT USED)		
ICC-01-05-07	ICC-02-05-07	DISPLAY SELECT	ICC-03-05-07	FILLER
ICC-01-05-08A	ICC-02-05-08A	T/C LIGHT	ICC-03-05-08	FILLER
ICC-01-05-08B	ICC-02-05-08B	RTD LIGHT		
ICC-01-05-08C	ICC-02-05-08C	SH LIGHT		
ICC-01-05-08D	ICC-02-05-08D	(NOT USED)		
ICC-01-05-09A	ICC-02-05-09A	TSAT DISPLAY	ICC-03-05-09	FILLER
ICC-01-05-09B	ICC-02-05-09B	HPIFM DISPLAY		
ICC-01-05-09C	ICC-02-05-09C	THOT RTD		
ICC-01-05-09D	ICC-02-05-09D	(NOT USED)		
ICC-01-05-10	ICC-02-05-10	HPIFM DISPLAY	ICC-03-05-10	FILLER
ICC-01-05-11	ICC-02-05-11	THOT RTD	ICC-03-05-11	FILLER
ICC-01-05-12	ICC-02-05-12	LOSCM	ICC-03-05-12	LOSCM
ICC-01-05-13A	ICC-02-05-13A	LOSCM STATUS LIGHT	ICC-03-05-13A	LOSCM STATUS LIGHT
ICC-01-05-13B	ICC-02-05-13B	LOSCM EVENT POINT	ICC-03-05-13B	LOSCM EVENT POINT
ICC-01-05-13C	ICC-02-05-13C	LOHPIFM STATUS LIGHT	ICC-03-05-13C	LOHPIFM STATUS LIGHT
ICC-01-05-13D	ICC-02-05-13D	LOHPIFM EVENT POINT	ICC-03-05-13D	LOHPIFM EVENT POINT
ICC-01-05-14	ICC-02-05-14	LOHPIFM	ICC-03-05-14	LOHPIFM

CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

ICCMS BLOCK DIAGRAM
MODULE CROSS REFERENCE

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 13 OF 14

CABINET 1	CABINET 2	CABINET 3	
ICC-01-06-01	ICC-02-06-01	ICC-03-06-01	HPIF REQ
ICC-01-06-02	ICC-02-06-02	ICC-03-06-02	HPIFM
ICC-01-06-03	ICC-02-06-03	ICC-03-06-03	TSAT-1
ICC-01-06-04	ICC-02-06-04	ICC-03-06-04	SCM TC
ICC-01-06-05	ICC-02-06-05	ICC-03-06-05	SCM RTD
ICC-01-06-06	ICC-02-06-06	ICC-03-06-06	TSAT-2
ICC-01-06-07	ICC-02-06-07	ICC-03-06-07	SCM-2 (SH NOM)
ICC-01-06-08	ICC-02-06-08	ICC-03-06-08	TSAT-3
ICC-01-06-09	ICC-02-06-09	ICC-03-06-09	SCM-3 (SH ERR)
ICC-01-06-10A	ICC-02-06-10A	ICC-03-06-10A	HPIF MARGIN
ICC-01-06-10B	ICC-02-06-10B	ICC-03-06-10B	SCM-1 (T/C)
ICC-01-06-10C	ICC-02-06-10C	ICC-03-06-10C	SCM RTD
ICC-01-06-10D	ICC-02-06-10D	ICC-03-06-10D	SCM-2 (SH NOM)
ICC-01-06-11A	ICC-02-06-11A	ICC-03-06-11A	SCM-3 (SH ERR)
ICC-01-06-11B	ICC-02-06-11B	ICC-03-06-11B	(NOT USED)
ICC-01-06-11C	ICC-02-06-11C	ICC-03-06-11C	WIDE PRESSURE
ICC-01-06-11D	ICC-02-06-11D	ICC-03-06-11D	LOW PRESSURE
ICC-01-06-12	ICC-02-06-12	ICC-03-06-12	PRESSURE SELECT
ICC-01-06-13	ICC-02-06-13	ICC-03-06-13	LOW PRESSURE RANGE
ICC-01-06-14	ICC-02-06-14	ICC-03-06-14	WIDE PRESSURE RANGE

CABINET 1	CABINET 2	CABINET 3	
ICC-01-07-01	ICC-02-07-01	ICC-03-07-01	HPI DP 1A
ICC-01-07-02	ICC-02-07-02	ICC-03-07-02	HPI DP 1B
ICC-01-07-03	ICC-02-07-03	ICC-03-07-03	HPI DP 1C
ICC-01-07-04	ICC-02-07-04	ICC-03-07-04	HPI DP 1D
ICC-01-07-05	ICC-02-07-05	ICC-03-07-05	FILLER
ICC-01-07-06	ICC-02-07-06	ICC-03-07-06	HPI 1A SQRT
ICC-01-07-07	ICC-02-07-07	ICC-03-07-07	HPI 1B SQRT
ICC-01-07-08	ICC-02-07-08	ICC-03-07-08	HPI 1C SQRT
ICC-01-07-09	ICC-02-07-09	ICC-03-07-09	HPI 1D SQRT
ICC-01-07-10	ICC-02-07-10	ICC-03-07-10	FILLER
ICC-01-07-11A	ICC-02-07-11A	ICC-03-07-11A	HPI FLOW 1A
ICC-01-07-11B	ICC-02-07-11B	ICC-03-07-11B	HPI FLOW 1B
ICC-01-07-11C	ICC-02-07-11C	ICC-03-07-11C	HPI FLOW 1C
ICC-01-07-11D	ICC-02-07-11D	ICC-03-07-11D	HPI FLOW 1D
ICC-01-07-12	ICC-02-07-12	ICC-03-07-12	FILLER
ICC-01-07-13	ICC-02-07-13	ICC-03-07-13	TOTAL HPI FLOW
ICC-01-07-14	ICC-02-07-14	ICC-03-07-14	FILLER

CABINET 1	CABINET 2	CABINET 3	
ICC-01-08-01	ICC-02-08-01	ICC-03-08-01	INCORE #1
ICC-01-08-02	ICC-02-08-02	ICC-03-08-02	INCORE #2
ICC-01-08-03	ICC-02-08-03	ICC-03-08-03	INCORE #3
ICC-01-08-04	ICC-02-08-04	ICC-03-08-04	INCORE #4
ICC-01-08-05	ICC-02-08-05	ICC-03-08-05	INCORE #5
ICC-01-08-06	ICC-02-08-06	ICC-03-08-06	INCORE #6
ICC-01-08-07	ICC-02-08-07	ICC-03-08-07	INCORE #7
ICC-01-08-08	ICC-02-08-08	ICC-03-08-08	INCORE #8
ICC-01-08-09	ICC-02-08-09	ICC-03-08-09	FILLER
ICC-01-08-10A	ICC-02-08-10A	ICC-03-08-10A	INCORE #1
ICC-01-08-10B	ICC-02-08-10B	ICC-03-08-10B	INCORE #2
ICC-01-08-10C	ICC-02-08-10C	ICC-03-08-10C	INCORE #3
ICC-01-08-10D	ICC-02-08-10D	ICC-03-08-10D	INCORE #4
ICC-01-08-11	ICC-02-08-11	ICC-03-08-11	FILLER
ICC-01-08-12A	ICC-02-08-12A	ICC-03-08-12A	INCORE #5
ICC-01-08-12B	ICC-02-08-12B	ICC-03-08-12B	INCORE #6
ICC-01-08-12C	ICC-02-08-12C	ICC-03-08-12C	INCORE #7
ICC-01-08-12D	ICC-02-08-12D	ICC-03-08-12D	INCORE #8
ICC-01-08-13	ICC-02-08-13	ICC-03-08-13	FILLER
ICC-01-08-14	ICC-02-08-14	ICC-03-08-14	T-INCORE

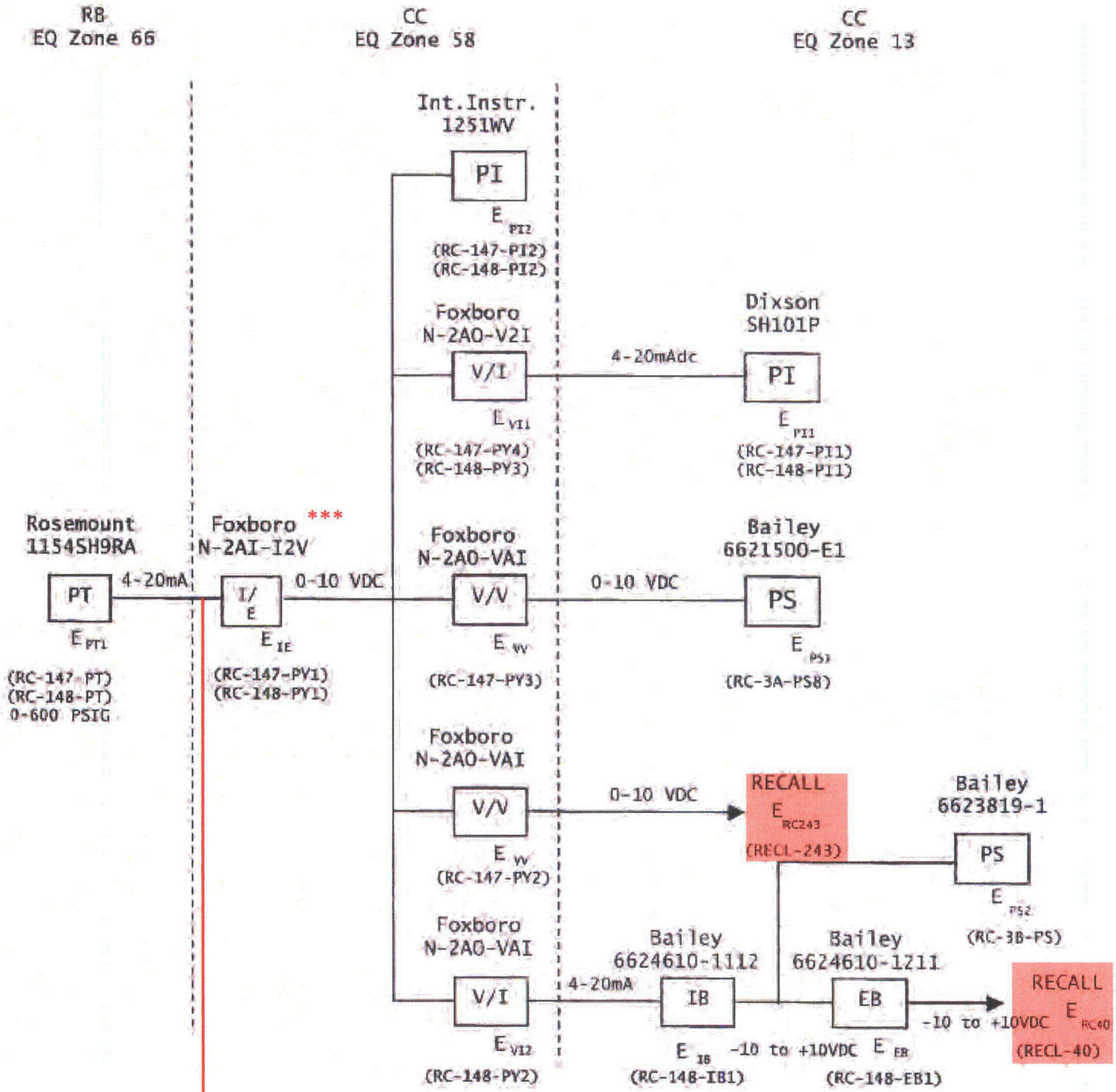
CURTISS WRIGHT Flow Control Company SCIENTECH

PROGRESS ENERGY PO 545831
CRYSTAL RIVER 3 ICCMS

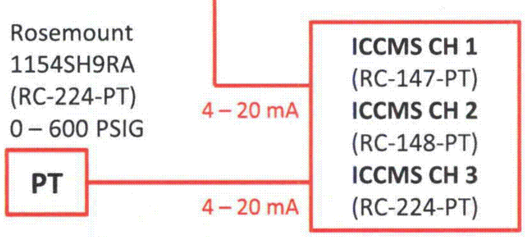
ICCMS BLOCK DIAGRAM
MODULE CROSS REFERENCE

SIZE	CODE IDENT	DRAWING NO.	REV
B	NUS	NUS-A304DB	1
SCALE N/A	RELEASE DATE		SHEET 14 OF 14

Low Range RCS Pressure Instrument Loop
(RC-147-PT / RC-148-PT / RC-244-PT)



NUS-A304DB Sht. 5 of 14

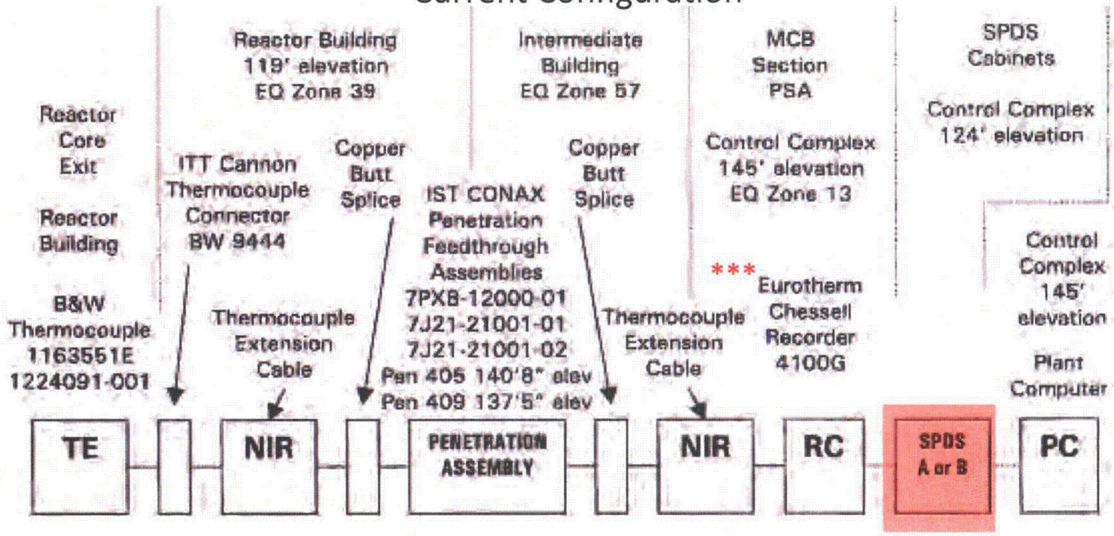


The 4 – 20 mA current loop signal for Low Range RCS Pressure is taken from the instrument loop at the Rosemount transmitter. The block diagram only shows the Channel 1 cabinet. The inputs to SPDS for RC-147-PT and RC-148-PT are RECL-243 and RECL-40 respectively and highlighted in the loop drawing above. RC-224-PT will not be routed to SPDS and will only be used for ICCMS.

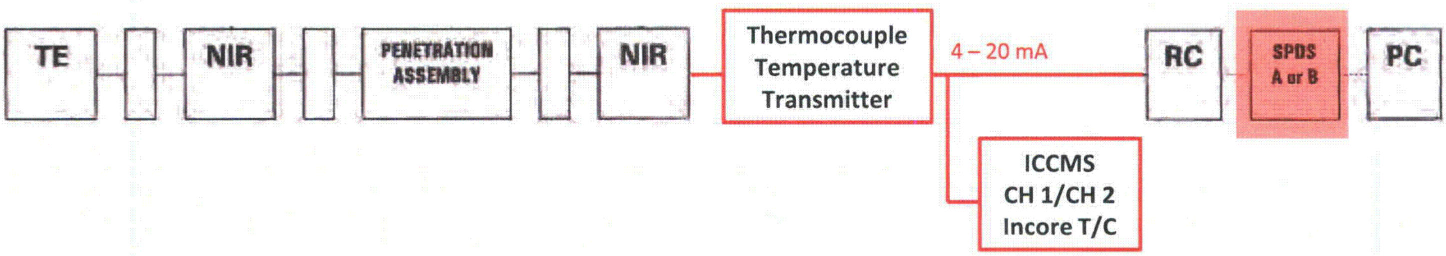
*** Isolation is provided by the Foxboro N-2AI-I2V which is a fully qualified, safety related, current to voltage converter that accepts a 4 to 20 mA input and provides a 0 to 10 VDC isolated output.

Core Exit Thermocouple Instrument Loops

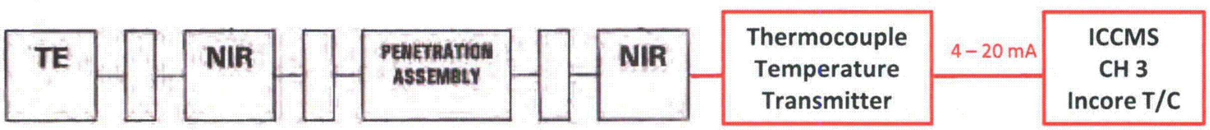
Current Configuration



New Configuration for ICCMS Channels 1 and 2



New Configuration for ICCMS Channel 3

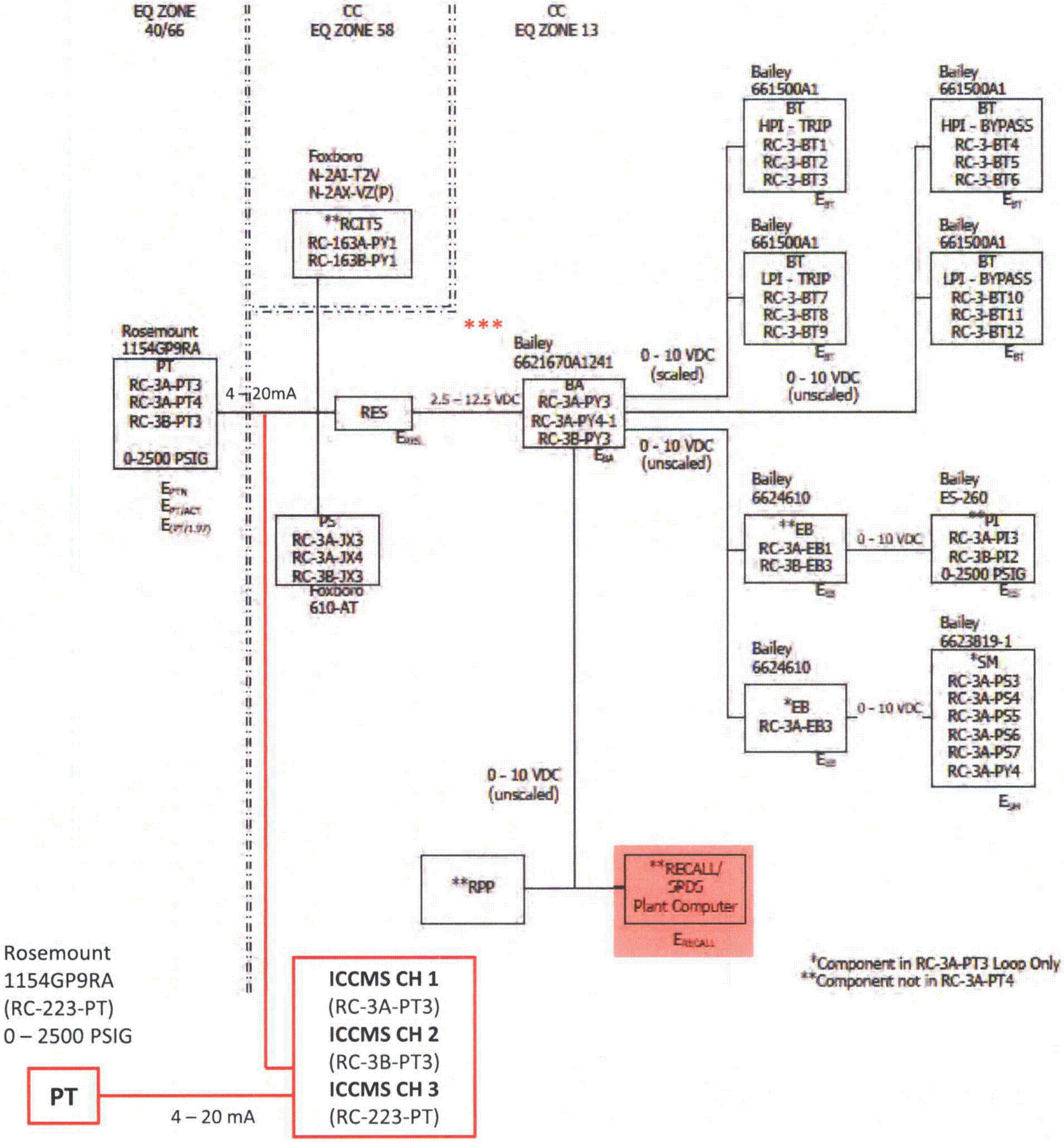


NUS-A304DB Sht. 4 of 14

The core exit thermocouples are currently routed to the ***Eurotherm Chessell Recorder 4100G in the PSA section of the Main Control Board. The eight core exit thermocouples that are designated for ICCMS channel 1 are currently routed to one recorder (Train A) and eight core exit thermocouples that are designated for ICCMS channel 2 are routed to the other recorder (Train B). The Eurotherm Chessell Recorder 4100G are fully qualified, safety related recorders with each recorder providing outputs to SPDS.

The eight core exit thermocouples that will be used for channel 3 that are not currently qualified are not routed to SPDS but they are sent to the plant process computer system. These eight core exit thermocouple signals will be routed to the plant process computer system via the non-safety related online monitor portion of ICCMS.

Wide Range RCS Pressure Instrument Loops
(RC-3A-PT3 / RC-3A-PT3 / RC-223-PT)

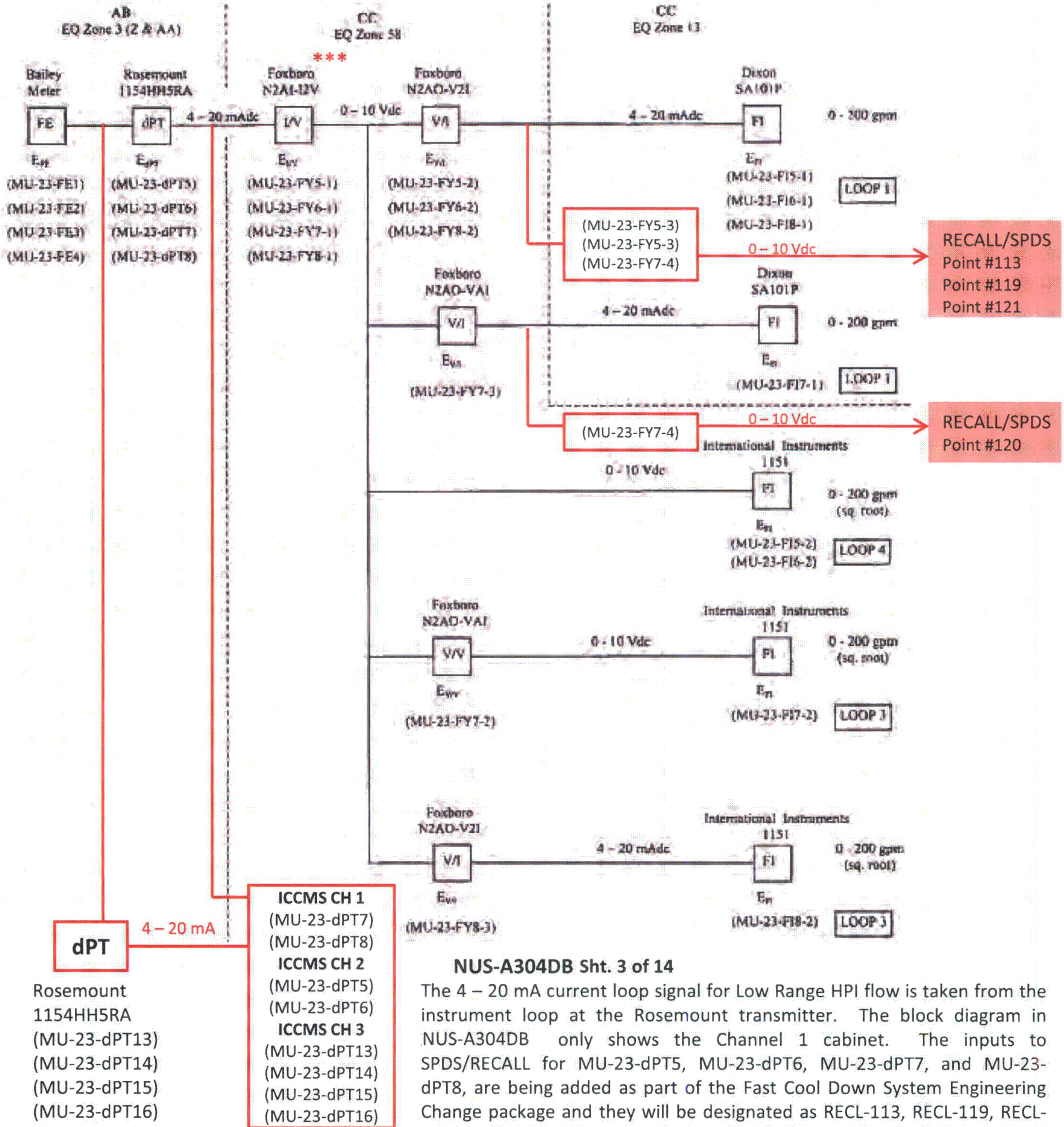


NUS-A304DB Sht. 5 of 14

The 4 – 20 mA current loop signal for Wide Range RCS Pressure is taken from the instrument loop at the Rosemount transmitter. The block diagram in NUS-A304DB only shows the Channel 1 cabinet. The inputs to SPDS for RC-3A-PT3 and RC-3B-PT3 are RECL-4 and RECL-5 respectively and are highlighted in the loop drawing above. RC-223-PT will not be routed to SPDS and will only be used for ICCMS.

*** Isolation is provided by the Bailey Buffer Amplifiers RC-3A-PY3 and RC-3B-PY3 for Trains 'A' and 'B' respectively. The Bailey 6621670A1241 is a fully qualified, safety related, voltage buffer.

Low Range HPI Flow Instrument Loops
(MU-23-dPT5 / MU-23-dPT6 / MU-23-dPT7 / MU-23-dPT8)
(MU-23-dPT13 / MU-23-dPT14 / MU-23-dPT15 / MU-23-dPT16)

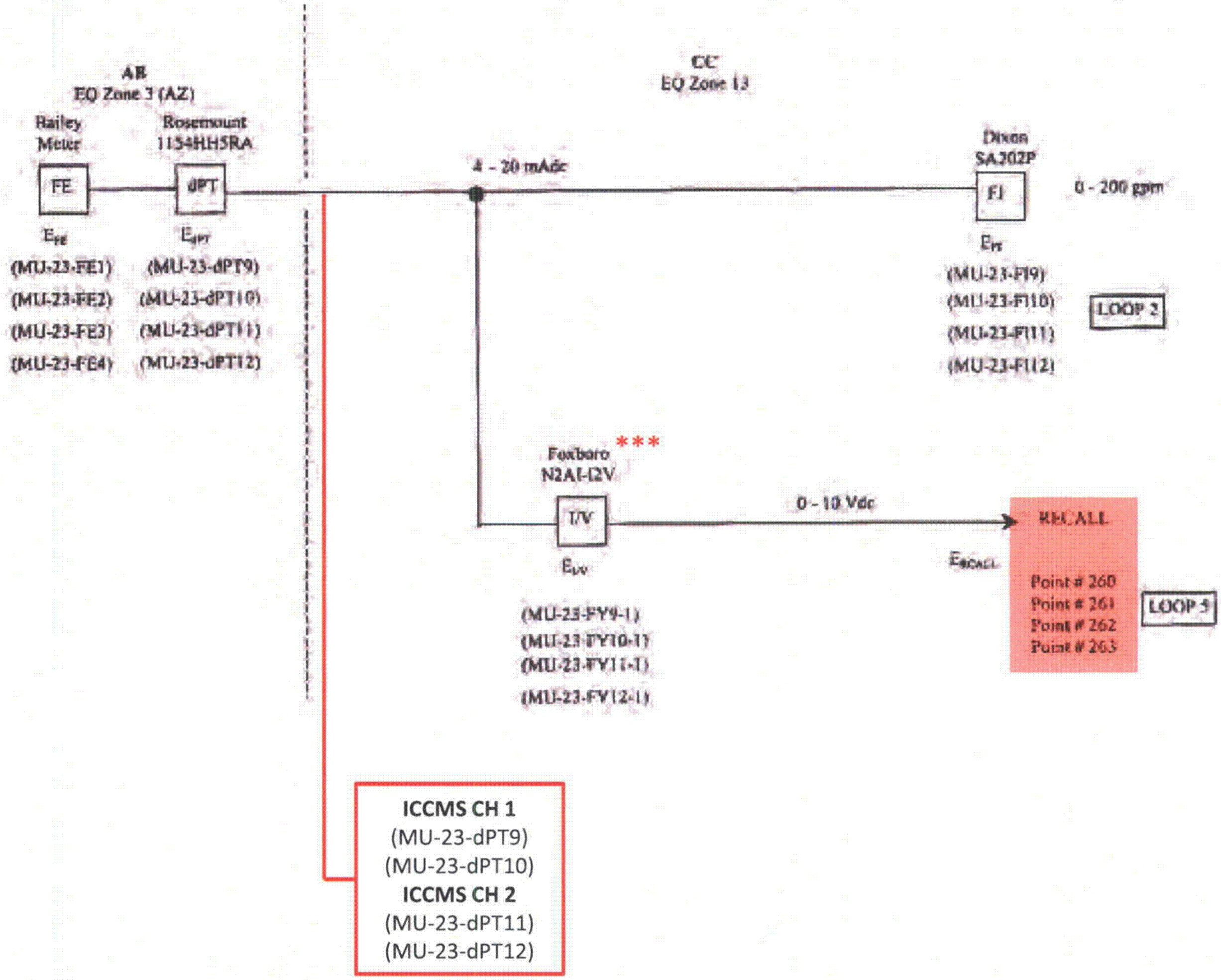


NUS-A304DB Sht. 3 of 14

The 4 – 20 mA current loop signal for Low Range HPI flow is taken from the instrument loop at the Rosemount transmitter. The block diagram in NUS-A304DB only shows the Channel 1 cabinet. The inputs to SPDS/RECALL for MU-23-dPT5, MU-23-dPT6, MU-23-dPT7, and MU-23-dPT8, are being added as part of the Fast Cool Down System Engineering Change package and they will be designated as RECL-113, RECL-119, RECL-120, and RECL-121 respectively. MU-23-dPT13, MU-23-dPT14, MU-23-dPT15 , and MU-23-dPT16 will not be routed to RECALL/SPDS and will only be used for ICCMS initiation channel 3.

*** Isolation is provided by the Foxboro N-2AI-I2V which is a fully qualified, safety related, current to voltage converter that accepts a 4 to 20 mA input and provides a 0 to 10 VDC isolated output.

Low Range HPI Flow Instrument Loops
(MU-23-dPT9 / MU-23-dPT10 / MU-23-dPT11 / MU-23-dPT12)



NUS-A304DB Sht. 3 of 14

The 4 – 20 mA current loop signal for Low Range HPI flow is taken from the instrument loop at the Rosemount transmitter. The block diagram in NUS-A304DB only shows the Channel 1 cabinet. The inputs to SPDS/RECALL for MU-23-dPT9, MU-23-dPT10, MU-23-dPT11 , and MU-23-dPT12 are designated as RECL-260, RECL-261, RECL-262, and RECL-263 respectively.

*** Isolation is provided by the Foxboro N-2AI-I2V which is a fully qualified, safety related, current to voltage converter that accepts a 4 to 20 mA input and provides a 0 to 10 VDC isolated output. The Dixson SA202P flow indicators MU-23-FI9, MU-23-FI10, MU-23-FI11, and MU-23-FI12 are classified as safety related 1E instrumentation and they do not need to be isolated from ICCMS.