PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #296, REVISION 1

MEASUREMENT UNCERTAINTY RECAPTURE

CR-3 EXCERPT FROM DRAFT ENGINEERING CALCULATION I-95-0003

ATTACHMENT G

Systems	BS, FW, NI, RC, RP, TB
Calc. Sub-Type	-
Priority Code	4
Quality Class	SR

NUCLEAR GENERATION GROUP

ANALYSIS / CALCULATION

I-95-0003
(Calculation #)

RPS Setpoints and Tolerance Calculations
(Title including structures, systems, components)

☐ BNP UNIT ______

☒ CR3 ☐ HNP ☐ RNP ☐ NES ☐ ALL

APPROVAL

Rev	Prepared By	Reviewed By	Supervisor
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	Name: G.V. Hildebrandt	Name: M. D. Lord	Name: S.Z. Barkofski
	Date: 9/10/03	Date: 9/12/03	Date: 10-5-03

(For Vendor Calculations)

Vendor ______________________ Vendor Document No. ______________

Owners Review By ______________________ Date __________

III. ASSUMPTIONS

1. The calculations presented herein contain data that have been taken to represent an error distribution of 2 sigma. That is to say 95.45% of the random errors will fall within the error bounds. This calculation should be considered 2 sigma in order not to imply a level of confidence not justified.

2. For components where a drift term is not specified, it is assumed that any drift present is bounded by Reference Accuracy of that device. (See DI12 for exception to this assumption for Anticipatory Trip Pressure Switches.)

3. Per Section 6.3.A of the I&C Design Criteria, Reference 7, "Accuracy as identified in a vendor specification is usually assumed to be Reference Accuracy. ...Reference Accuracy includes the combined effects of conformity (linearity), hysteresis, and repeatability." Where conformity (linearity), hysteresis and repeatability values are less than the specified accuracy, the above statement is to be considered true. For conservatism, where conformity (linearity), hysteresis and/or repeatability values(s) are equal to or greater that the specified accurcacy, the the value(s) will be combined via the SRSS method with the specified accuracy term to determine the Reference Accuracy value.

4. Partial Loop "As Left" and "As Found" tolerances are calculated based on the following practice continuing to be implemented at Crystal River Unit 3 with respect to collecting data and calibrating instruments strings. The field devices for strings will be calibrated separately from the rest of the string and the "As Found" and "As Left" data collected. The "As Found" and "As Left" data from the field device calibration is then false loaded into the string at the field connection to the signal processing cabinet. "As Found" and "As Left" data is then collected up to the input of the bistable. For indicating and recording devices, their "As Found" and "As Left" data will be taken at the end of the loop. This "As Found" and "As Left" data represents the Loop data except for the bistable. The bistable will then be checked at the trip point and that "As Found" and "As Left" data also collected. Partial Loop "As Found" and "As Left" will be calculated accordingly.

5. The Uncompensated Ion Chambers and the Linear Amplifiers are calibrated to the secondary heat balance at power by SP113 (Reference 11). The Channel calibration will be changed to start the recording of "As Found" and "As Left" data so as to leave the Linear Amplifier out of the loop by taking readings for the calibration input points of the channel at the output of the Linear Amplifiers. This is justified because the calibration procedure comparison to the secondary heat balance includes the Linear Amplifier. Therefore the "As Left" and "As Found" Tolerances for the trip setpoints associated with those strings will not include the reference, drift or MTE accuracies for the Linear Amplifier. The Uncompensated Ion Chambers accuracies are accounted for in the establishment of the Technical Specifications Allowable Value per Regulatory Guide 1.49 (Reference 26), and the errors associated with those devices are assumed to be a total of ±2.0%.

6. Similar to the Power channel, the RCS Flow channel is calibrated at power so that the flow reading at the output of the Buffer Amplifier Flow at 100% of power is calibrated to be 100% Flow. Because of this calibration and matching the signal out of the Buffer Amplifier Flow module to the power signal, the channel calibration for this channel will also be changed to read the calibration input points at the output of the Buffer Amplifier Flow. Therefore the "As Left" and "As Found" Tolerances for the trip setpoints associated with those strings will not include the reference, drift or MTE accuracies for the Flow Transmitters, the Square Root Extractors and the Buffer Amplifier Flow.

7. Indicating meters on the face of the 880 modules have been recorded and tolerances given in the procedures for the readings. However, these meters are not used for operations and therefore their "As Found" and "As Left" tolerances will not be addressed in this calculation.

8. Tag numbers for the RPS modules are taken from Reference 25 and cross checked to CMIS and the Instrument Data Sheets.

9. The calculated "As Found" and "As Left" tolerances for the Bistables are much larger than the values that historically CR3 has been able to meet. Currently in all cases but one, the "As Left" and "As Found" Tolerances for the Bistables are the same, ±0.0064vdc (References 10 and 11). Systems Engineering and Maintenance have agreed to continue to follow this tolerance for all 880 modules and so this value will be used in calculating the Partial Loop tolerances in Section V.

10. From section 6.1 of "Calculation For Statistical Errors, Crystal River 3 RPS" (reference 19), the Bailey RPS modules have a design temperature range which envelops the assumed Extended Normal temperature range of 60 degrees F to 80 degrees F. The extended low temperature of 60 degrees F was selected to cover minor temperature perturbations during normal operations. The RPS modules are located in EQ Zone 58 and are calibrated between 70 degrees F and 80 degrees F. Therefore, a maximum Extended Normal temperature effect of 20 degrees F will be used.

IV REFERENCES

1. ISA-RP67.04, Part II, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation, Approved September 1994.
2. Crystal River Unit 3 Final Safety Analysis Report. Revision 25.4.
3. SP-112R, Rev 1, Reactor Protection System Reactor Building Pressure Trip Calibration.
4. Calibration Data Sheets RC-4A-TE2, Rev. 4; RC-4A-TE3, Rev. 1; RC-4B-TE2, Rev. 4; and RC-4B-TE3, Rev.3.
5. IDS RC-3A-PT1, Rev. 5; RC-3A-PT2, Rev. 5; RC-3B-PT1, Rev. 5; RC-3B-PT2, Rev. 5
6. BAW-10179P, Safety Criteria and Methodology for Acceptable Cycle Reload Analyses, February 1991
7. I&C Design Criteria for Instrument Loop Uncertainty Calculations. Revision 4.
8. MAR 97-02-12-02, HPI Upgrade, Design Input Record.
9. Analysis Basis Document, Parameter Matrix, Revision 0, dtd 10/30/89.
10. SP-112, Rev 58, Calibration of the Reactor Protection System.
11. SP-113, Rev 73, Power Range Nuclear Instrumentation Calibration
12. Environmental and Seismic Qualification Program Manual, Revision 10, with IC 98-08.
13. CP-146, Measuring and Test Equipment Calibration and Control, Rev. 0.
14. SP906, Rev 5, Calibration of the Reactor Coolant Pump Monitor Watt Transducers.
15. Improved Technical Specifications, Table 3.3.1-1 and Table 3.3.11-1 (Amendment No. 170) and Bases Rev. 19.
16. I95-0005, Revision 2, Measurement & Test Equipment Accuracy.
17. IDS RC-014A-dPT1-4, Rev. 4 and RC-014B-dPT1-4, Rev. 4.
18. IDS BS-59-PS, Rev.2; BS-60-PS, Rev. 2; BS-61-PS, Rev. 2; and BS-62-PS Rev. 2.
19. I83-0001, Rev. 4, Calculation for Statistical Errors, Crystal River 3 RPS.
20. IM 324, Static O Ring, Revision 5.
21. IDS's NI-5-NI, NI-6-NI, NI-7-NI, NI-8-NI, all Rev. 2.

22. IM 539, ASCO Pressure Switches, Revision 1.

23. PEERE 0883, Rev. 1, dtd 8/4/93.

24. IM 409, Instrument Transformer Cubicles, Revision 1.

25. Bailey Drawing E3040962, Analog Logic Drawing, FPC Revision 8.

26. Regulatory Guide 1.49, Power Levels of Nuclear Power Plants, Revision 1, December 1973.

27. GE Apparatus Catalog, Bulletin 7930, dated 7/13/70.

28. GE Apparatus Catalog, Bulletin 7919, dated 2/10/69.

29. IM 0437, Rochester Instrument Systems, Revision 1.

30. IM 1524, Foxboro Instruction Manual, Revision 4.

31. Deleted.

32. MAR 79-10-86, Anticipatory Reactor Trip System.

33. IDS's TB-397,398,399,400,-PS, and FW-320,321,322,323,324,325,326,327-PS all Rev. 2.

34. ASCO Qualification Report AQS-02882 Appendix A (Reel 5162-847, 893)

35. Deleted.

36. SP-110A, Rev. 1, "A Channel RPS Functional Testing" (Typical of All Four (4) RPS Channels)

37. SP-126, Rev. 5, RTD Cross Channel Calibration

38. IM 820, Weston Wattmeter Model 432, Rev. 0.

39. I94-0012, Computer Instrument Accuracy, Rev. 1.

40. IM1400, Bailey Meter Co., Edgewise Indicators, Type RY, Rev. 1.

41. CR3 Work Request 322508 and the Work Instructions, dtd 9/30/94.

42. IDS's for RC-3A&B-PY1-4,both Revision 1.

43. BWNT letter FPC-95-045, addressed to W. W. Nisula from R. L. Black dtd February 23, 1995, Subject: Task 616 - RPS Scaled Difference Amplifier Gain.

Figure 1

ISA-RP67.04		CR3 RPS Application
Safety Limit	________	Accident Analysis Limit
Analytical Limit	________	Analytical Limit (Found in B&W Safety Analysis)
		Process Measurement Error, Design Range Error, Drift, Temperature and Humidity Effects
Allowable Value	________	Tech Specs Allowable Value
Trip Setpoint	________	Trip Setpoint (no Eng Marg)
	________	As Found Tolerance
		Drift & MTE
	________	As Left Tolerance
		Reference Error
	________	Inplant Setpoint (Eng Margin)
	________	As Left Tolerance
	________	As Found Tolerance
Normal Operating Point	________	Operating Point

Note: The difference between the Technical Specification Allowable Value and the Inplant Setpoint less the As Found tolerance is the Engineering Margin, if it exists. Otherwise these are the same.

V DETAILED CALCULATIONS

Each trip string will be addressed one at a time, by section in this part. Each section will calculate for each string the following parameters:
- -Total loop As Left Tolerance (Reference Accuracies)
- -Bistable As Left Tolerance
- -Partial Loop As Left Tolerances
- -Partial Loop As Left Tolerances magnitude check
- -Primary Sensor As Left Tolerance
- -Total loop Drift
- -Total loop MTE
- -Total loop As Found Tolerance
- -Bistable As Found Tolerance
- -Partial Loop As Found Tolerances
- -minimum or maximum trip setpoint
- -Engineering Margin between the trip setpoint and the inplant setpoint
- -Indication and Computer Tolerances.

ANALYSIS/CALCULATION

I95-0003

RPS Setpoints and Tolerances

Revision 4

Excerpt for Nuclear Overpower Setpoints (Section V.4)

V.4 Nuclear Overpower Setpoint Calculation

Per Assumption 5, the error of the Power Range Detectors (Uncompensated Ion Chambers) and the Linear Amplifiers will not be included in this calculation. Therefore:

$e\text{-}FLUX = \pm[\ e\text{-}SUM^2 + e\text{-}BI^2\ ]^{1/2}$

where

e-FLUX is the nuclear power flux string error,

e-SUM is the accuracy for the Summing Amplifier,

e-BI is the accuracy for the Bistable

V.4.1 Nuclear Overpower Loop Total As Left Tolerance

Applying the string error equation and using Reference Accuracy for As Left Tolerances:

$e\text{-}FLUX_{AL} = \pm[\ e_{refSUM}^{\ 2} + e_{refBI}^{\ 2}\ ]^{1/2}$

$e_{refSUM} = \pm 0.200\%$ DI8.10

$e_{refBI} = \pm 0.170\%$ DI8.11

$e\text{-}FLUX_{AL} = \pm[\ 0.2^2 + 0.17^2\ ]^{1/2}$

$e\text{-}FLUX_{AL} = \pm 0.262\%$ of span $= \pm 0.328\%$ Full Power [0.262%x125%FP]

V.4.2 Nuclear Overpower Loop Bistable As Left Tolerance

$e\text{-}BI_{AL} = e_{refBI} = \pm 0.064\%$ of span$= \pm 0.08\%$FP

$e\text{-}BI_{AL} = \pm 0.0064$vdc A9

V.4.3 Partial Loop As Left Tolerances for Nuclear Overpower Trip

$e\text{-}FLUX_{ALPL} = \pm[e\text{-}FLUX_{AL} - e\text{-}BI_{AL}\ ]$

$e\text{-}FLUX_{AL} = \pm 0.262\%$

$e\text{-}BI_{AL} = \pm 0.064\%$

$e\text{-}FLUX_{ALPL} = \pm[0.262-0.064]$

$e\text{-}FLUX_{ALPL} = \pm 0.198\%$ of span$= \pm 0.248\%$FP [0.198%x125%FP]

$e\text{-}FLUX_{ALPL} = \pm 0.0198$vdc

V.4.4 Nuclear Overpower Trip Partial Loop As Left Tolerance Magnitude Check

Since the partial loop for this trip only includes one module, the Summing Amplifier, and since the partial loop accuracy is only 0.002% different from the Summing Amplifier Reference Accuracy, this value is considered to be acceptable.

V.4.5 Nuclear Overpower Trip Primary Sensor As Left and As Found Tolerance

Per Assumption 5 this is not applicable.

V.4.6 Nuclear Overpower Loop Total Drift

Applying the string error equation and using Drift error:

$e\text{-}FLUX_d = \pm[\ e_{dSUM}{}^2 + e_{dBI}{}^2\ ]^{1/2}$

$e_{dSUM} = \pm 0.274\%$ DI8.10

$e_{dBI} = \pm 0.164\%$ DI8.11

$e\text{-}FLUX_d = \pm[\ 0.274^2 + 0.164^2\ ]^{1/2}$

$e\text{-}FLUX_d = \pm 0.319\%$ of span $= \pm 0.399\%$ Full Power [0.319%x125%FP]

V.4.7 Nuclear Overpower Loop Total MTE

Per SP113 (Reference 11) the Power Range Test Modules are used to provide 2 false signals to the string and those signals are read at the output of the 2 Linear Amplifiers. The MTE error associated with the reading of those signals is operated on by the Summer which has a gain of 0.5 on each input. As Left and As Found data is taken at the input of the Bistable and then the Bistable is checked separately. Each reading taken in the string uses the Fluke 8522A. Per Reference 16, the MTE for the Fluke in zone 2 is 0.023% of span.

Therefore:

$e\text{-}FLUX_{mte} = \pm[\ 2x(e_{mteSUM}/2)^2 + e_{mteBIIN}{}^2 + e_{mteBI}{}^2\ ]^{1/2}$

$e_{mteSUM} = e_{mteBIIN} = e_{mteBI} = \pm 0.023\%$ DI6.4.2 and 3

$e\text{-}FLUX_{mte} = \pm[\ 2x(0.023/2)^2 + 0.023^2 + 0.023^2\ ]^{1/2}$

$e\text{-}FLUX_{mte} = \pm 0.0364\%$ of span$= \pm 0.0455\%$ Full Power [0.0364% x 125%FP]

V.4.8 Nuclear Overpower Loop Total As Found Tolerance

$e\text{-}FLUX_{AF} = e\text{-}FLUX_{AL} + [e\text{-}FLUX_d{}^2 + e\text{-}FLUX_{mte}{}^2\ ]^{1/2}$

$e\text{-}FLUX_{AF} = \pm 0.262 + [0.319^2 + 0.0364^2\ ]^{1/2}$ V.4.1, V.4.6, V.4.7

$e\text{-}FLUX_{AF} = \pm 0.583\%$ of span $= \pm 0.729\%$ Full Power

V.4.9 Nuclear Overpower Bistable As Found Tolerance

$e\text{-}BI_{AF} = \pm 0.064\%$ of span$= \pm 0.08\%$FP

$e\text{-}BI_{AF} = \pm 0.0064$vdc A9

V.4.10 Nuclear Overpower Trip Partial Loop As Found Tolerances

$e\text{-}FLUX_{AFPL} = \pm[e\text{-}FLUX_{AF} - e\text{-}BI_{AF}\ ]$

$e\text{-}FLUX_{AFPL} = \pm[\ 0.583 - 0.064\ ]$

$e\text{-}FLUX_{AFPL} = \pm 0.519\%$ of span $= 0.649\%$FP [0.519% x 125%FP]

$e\text{-}FLUX_{AFPL} = \pm 0.0519$vdc

V.4.11 Trip Setpoint Nuclear Overpower Loop

There are 5 bistables associated with this loop, the φ/Δφ/flow Bistable, the Overpower High Bistable (2568 MWt and 2609 MWt), the Startup Range (SUR) Rod Withdrawal Inhibit Bypass Bistable, Main Feedpump ART Bypass Bistable, and Turbine ART Bypass Bistable. The φ/Δφ/flow trip will be dealt with in the next section of this calculation. The Overpower High Trip and the SUR Bypass Trip are increasing parameter trips. The 2 ARTs Bypass trips are like increasing parameter trips as they must actuate at a lower power than the power limit identified in DI5. However, these bistables are installed as tripping on decreasing input, and when they are in their tripped state the ARTs are bypassed. Because they are decreasing parameters to trip, their reset points are at a higher input signal than the trip input signal, and therefore closer to the Technical Specifications Specified Condition than their trip points. This can be easily seen by looking at Section 3.1 of Reference 11. Therefore, the difference between the reset point and the Tech Spec Specified Condition is the area of concern.

Since the Nuclear Overpower Trips are an increasing parameter trip,
Overpower Trip Setpoint=Tech Spec Allowable Value/Specified Conditions -(e-$FLUX_{AF}$)

V.4.11.1 Nuclear Overpower Trip High

From DI5, the Tech Spec 2609 MWt Allowable Value is 104.9% Full Power
Overpower High Trip Setpoint=104.9%FP-0.729%FP
Overpower High Trip Setpoint=104.171%FP=8.3337vdc
From DI5, the Tech Spec 2568 MWt Allowable Value is 103.3% Full Power
Overpower High Trip Setoint=103.3%FP-0.729%FP
Overpower High Trip Setpoint=102.571%FP=8.2057vdc
(Note for Modes 2 thru 5, High Setpoint is 5%FP. For that setpoint, From DI5, the Tech Spec Allowable Value is 5.0% Full Power)
Overpower High Trip Setpoint=5.0%FP-0.729%FP
Overpower High Trip Setpoint=4.271%FP=0.3417vdc

V.4.11.2 Nuclear Overpower Startup Range Bypass/EFW Initiation on RCP Status

From DI5, the Tech Spec Specified Condition is ≥10.0% Full Power EFW Initiation must take place on a loss of all RCPs. (Or at <10%FP this initiation may be bypassed.)
Overpower High Trip Setpoint=10.0%FP-0.729%FP
Overpower High Trip Setpoint=9.271%FP=0.7417vdc

V.4.11.3 Main Feedpump ART Bypass Reset

From DI5, the Tech Spec Specified Condition is at ≥20.0% Full Power this Trip (MFP ART) must be armed.
MFP ART Bypass Trip Setpoint=20.0%FP-0.729%FP
MFP ART Bypass Trip Setpoint=19.271%FP=1.5417vdc

V.4.11.4 Turbine ART Bypass Reset

From DI5, the Tech Spec Specified Condition is at ≥45.0% Full Power this Trip (Turbine ART) must be armed.
Turbine ART Bypass Trip Setpoint=45.0%FP-0.729%FP
Turbine ART Bypass Trip Setpoint=44.271%FP=3.5417vdc

V.4.12 Engineering Margin for Nuclear Overpower Loop

Since this is an increasing parameter trip, the inplant setpoint should be ≤ the Trip Setpoint, and the governing equation for Engineering Margin is: Engineering Margin=Trip Setpoint-Inplant Setpoint.

V.4.12.1 Nuclear Overpower High Loop

2609 MWt Trip Setpoint=104.171%FP	V.4.11.1
Inplant Setpoint=8.3200vdc=104.0%FP	DI5
Engineering Margin=104.171%FP-104.0%FP	
Engineering Margin=0.171%FP	

2568 MWt Trip Setpoint=102.571%FP	V.4.11.1
Inplant Setpoint=8.1920vdc=102.4%FP	DI5
Engineering Margin=102.571%FP-102.4%FP	
Engineering Margin=0.171%FP	

For the Mode 2-5 setpoint	
Trip Setpoint=4.271%FP	V.4.11.1
Inplant Setpoint=0.3200vdc=4.0%FP	DI5
Engineering Margin=4.271%FP-4.0%FP	
Engineering Margin=0.271%FP	

V.4.12.2 Nuclear Overpower Startup Range Bypass

Trip Setpoint=9.271%FP	V.4.11.1
Inplant Setpoint=9.0%FP=0.7200vdc	
Engineering Margin=9.271%FP-9.0%FP	
Engineering Margin=0.271%FP	

V.4.12.3 Main Feedpump ART Bypass Reset

Trip Setpoint=19.271%FP	V.4.11.3
Inplant Setpoint=1.5030vdc=18.7875%FP	DI5
Engineering Margin=19.271%FP-18.7875%FP	
Engineering Margin=0.4835%FP	

V.4.12.4 Turbine ART Bypass Reset

Trip Setpoint=44.271%FP	V.4.11.4
Inplant Setpoint=3.4900vdc=43.625%FP	DI5
Engineering Margin=44.271%FP-43.625%FP	
Engineering Margin=.646%FP	

V.4.13 Nuclear Overpower Trip String Indication Tolerances

V.4.13.1 Total Flux Indicator (NI-5-NI, NI-6-NI, NI-7-NI, NI-8-NI) Tolerances

The Total Flux Indicator Tolerance, e-FLUXI, is the SRSS combination of the Partial Loop tolerances with the indicator errors.

$e\text{-}FLUXI_{AL} = \pm[e_{refSUM}{}^2 + e_{refRY}{}^2]^{1/2}$

$e_{refSUM} = \pm 0.200\%$ of span DI8.10

e_{refRY} is the SRSS combination of the accuracies from DI9.13 that fall under the definition of Reference Accurcy.

$e_{refRY} = \pm[(\text{Specified Accuracy})^2 + (\text{Linearity})^2 + (\text{Repeatability})^2 + (\text{Deadband})^2\ ]^{1/2}$ A3

$e_{refRY} = \pm[1.0^2 + 1.0^2 + 0.5^2 + 0.5^2]^{1/2}$

$e_{refRY} = \pm 1.58\%$

$e\text{-}FLUXI_{AL} = \pm[0.200^2 + 1.58^2\ ]^{1/2}$

$e\text{-}FLUXI_{AL} = \pm 1.59\%$ of span =1.99%FP. Rounding up to the nearest 1/2 minor scale division (minor scale divisions are 2%FP), $e\text{-}FLUXI_{AL} = \pm 2.0\%FP$

$e\text{-}FLUXI_{AL} = \pm 1.60\%$ of span=±2.0%FP

$e\text{-}FLUXI_{AF} = \pm e\text{-}FLUXI_{AL} + [e\text{-}FLUXI_{d}{}^2 + e\text{-}FLUXI_{mte}{}^2\ ]^{1/2}$

$e\text{-}FLUXI_{AL} = \pm 1.59\%$ From Above

$e\text{-}FLUXI_{d} = e_{dSUM} = \pm 0.274\%$ DI8.10

(Note: Drift term for the RY indicator is a part of Reference Accuracy, DI9.13)

$e\text{-}FLUXI_{mte} = \pm[2x(e_{mteSUM}\ /2)^2\ ]^{1/2} = \pm[2x(0.023/2)^2]^{1/2} = \pm 0.0163\%$

$e\text{-}FLUXI_{AF} = \pm 1.59 + [0.274^2 + 0.0163^2]^{1/2}$

$e\text{-}FLUXI_{AF} = \pm 1.864\%$ of span=2.33%FP. Rounding up to the nearest 1/2 minor scale division, $e\text{-}FLUXI_{AF} = \pm 3.0$ % FP.

$e\text{-}FLUXI_{AF} = \pm 2.4\%$ of span=±3.0 % FP.

V.4.13.2 Total Flux Computer Points (P-208, 209, 210, and 211) and Recall Points

$e\text{-}FLUXC_{AL} = \pm[e_{refSUM}{}^2 + e\text{-}CP10^2]^{1/2}$ where e-FLUXC is the computer tolerance for both the main computer and the Recall Computer.

$e_{refSUM} = \pm 0.200\%$ of span DI8.10

$e\text{-}CP10 = \pm 0.732\%$ of span DI9.10

$e\text{-}FLUXC_{AL} = \pm[0.200^2 + 0.732^2\ ]^{1/2}$

$e\text{-}FLUXC_{AL} = \pm 0.759\%$ of span=0.949%FP

$e\text{-}FLUXC_{AF} = \pm e\text{-}FLUXC_{AL} + [\ e\text{-}FLUXC_{d}{}^2 + e\text{-}FLUXC_{mte}{}^2\ \ ]^{1/2}$

$e\text{-}FLUXC_{AL} = \pm 0.759\%$

From above

$e\text{-}FLUXC_{d} = e\text{-}FLUXI_{d} = e_{dSUM} = \pm 0.274\%$ V.4.13.1

$e\text{-}FLUXC_{mte} = e\text{-}FLUXI_{mte} = \pm 0.0163\%$ V.4.13.1

$e\text{-}FLUXC_{AF} = \pm 0.759 + [0.274^2 + 0.0163^2\ ]^{1/2}$

$e\text{-}FLUXC_{AF} = \pm 1.033\%$ of span=±1.291%FP

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #296, REVISION 1

MEASUREMENT UNCERTAINTY RECAPTURE

CR-3 PLANT SURVEILLANCE PROCEDURE SP-113A, REVISION 2, "CHANNEL A, POWER RANGE NUCLEAR INSTRUMENTATION CALIBRATION"

ATTACHMENT H

Progress Energy

C
Continuous
Use

PROGRESS ENERGY

CRYSTAL RIVER UNIT 3

PLANT OPERATING MANUAL

SP-113A

CHANNEL A
POWER RANGE NUCLEAR INSTRUMENTATION CALIBRATION

TABLE OF CONTENTS

1.0 PURPOSE

To provide instructions for Quarterly calibration of Channel A Power Range Nuclear Instrumentation Channel, RCS Flow and Axial Power Imbalance Instrumentation Channel and other associated instrumentation.

Changing Flux/Flow/Delta Flux Trip setpoint per applicable ITS Action Statement specified by SSO/CRS.

Equipment tags which are affected by this procedure.

IC-32A-MCS	IC-32B-MCS	NI-5-A14	NI-5-A15	NI-5-A16
NI-5-A19	NI-5-A46	NI-5-A48	NI-5-A49	NI-5-A50
NI-5-A51	NI-5-DNI	NI-5-NI	NI-5-RIR	NI-5-RY-1
RP-A20	RP-A24	RP-A27	RP-A53	RP-A57
NI-6-B50				

2.0 REFERENCES

2.1 Developmental References

2.1.1 Technical Specification References

Applicable References	Surv. Perf. During Modes	LCO/Other Requirement During Modes	Surv. Freq.
3.3.1.5(1)	1 thru 6	1,2	Q
3.3.1.5(8)	1 thru 6	1,2	Q
FPC	1	1	Q

Q-At least once per 92 days

2.1.2 Manual 206, Vol. 1, Bailey Meter Co. NI/RPS Instruction Book

2.1.3 Manual 240, Vol. 2, NI/RPS Instruction Book

2.1.4 PT-120, Controlling Procedure for Power Escalation Testing

2.1.5 SP-113G, Power Range Nuclear Instrumentation Gain Adjustment

2.1.6 PT-138, Hand Axial Power Imbalance Calculations

2.1.7 SOER 90-03, Nuclear Instrument Miscalibration

2.1.8 I95-0003, RPS Setpoints and Tolerances Calculation

2.1.9 NOCS 000947, 022067, 040207, 040241, 040639, 062590, 062634, 062795, 096037, 100092, 100162

3.0 PERSONNEL INDOCTRINATION

3.1 Setpoints

3.1.1 The following setpoints are verified.

SETPOINTS	
BISTABLE	**ACTION/SETPOINT**
HIGH FLUX	TRIP – VARIABLE
	RESET - MANUAL DEADBAND >10 Vdc
FLUX > 10 %	TRIP at 0.7200 Vdc - (9% FP)
	RESET at 0.4000 Vdc - (5% FP)
TURBINE TRIP BYPASS	TRIP at 3.3400 Vdc - (41.75% FP)
	RESET at 3.4900 Vdc - (43.625% FP)
MFP TRIP BYPASS	TRIP at 1.353 Vdc - (16.91% FP)
	RESET at 1.5030 Vdc - (18.7875% FP)
PWR/IMBAL/FLOW	TRIP at 8.5200 Vdc - (106.5% FP with 0% imbalance)
	RESET - MANUAL DEADBAND >10 Vdc

3.1.2 The Pwr/Imbal/Flow variable setpoint is also checked at three different axial imbalance values to ensure proper development of the setpoint.

3.2 Description

This procedure calibrates the Power Range Nuclear Instrumentation System at the required interval, in support of Special Physics Testing or at discretion of SSO/CRS.

Trip setpoints for High Flux and Flux/Flow bistables are checked.

3.3 Definitions

3.3.1 DFAM-Delta Flux Amplifier Module

3.3.2 FCTCM-Flow Channel Test Circuit Module

3.3.3 FGM- Function Generator Module

3.3.4 FP-Full Power

3.3.5 FSC-Full Scale Current (from Ion Chamber)

3.3.6 LAB-Linear Amplifier, Bottom

3.3.7 LAT-Linear Amplifier, Top

3.3.8 PRTM-Power Range Test Module

3.3.9 SDFAM- Scaled Delta Flux Amplifier Module

3.3.10 TFAM- Total Flux Amp Module

3.3.11 TRCFAM- Total RC Flow Amp Module

3.4 Responsibilities

3.4.1 Superintendent Nuclear Electrical/I&C Maintenance is responsible for procedure content.

3.4.2 This procedure is performed by Qualified Maintenance Personnel.

3.5 Limits and Precautions

3.5.1 Only one channel shall be calibrated at a time. Each channel shall be returned to service before starting calibration of the next channel. If calibration is NOT complete, and channel is Operable, channel may be returned to service and another channel calibrated at the discretion of the SSO/CRS.

3.5.2 With a quadrant power tilt present, Nuclear Overpower Trip setpoint and Nuclear Overpower based on RC System Flow and Axial Power Imbalance Trip setpoint must be reduced 2% for each 1% of quadrant power tilt in excess of steady state limit, or as directed by SSO/CRS.

3.5.3 Before and after testing/completion of an RPS channel, Nuclear Operator shall be notified to check each EFIC channel to verify they are NOT in a Half-trip condition.

3.5.4 Due to potential for an inadvertent EFIC initiation, it is NOT normally desirable to perform this procedure in conjunction with any EFIC procedure.
IF performance in conjunction with an EFIC procedure is necessary,
THEN permission shall be obtained from SSO/CRS.

3.5.5 Although plug and jack connections supplying flow signals to NNI are buffered before the flow test module, a low flow spike and lower signal level is sent to NNI when the flow test module is positioned from Test Operate to Cal Out. Since flow signal is used in Tave auto select switch, Feedwater and Reactor should be placed in MANUAL when jack is moved.

3.5.6 Prior to performing work on a flow transmitter or flow buffer, the plug and jack connection supplying flow signal to NNI systems must be patched to Channel B when Channel A is being worked. The Nuclear Operator places plug and jack connection to appropriate location. (plug and jack is located in Cabinet 2 of Channel A.)

3.5.7 Flux >10% FP, Aux. Relay, and Shutdown Bypass bistables will NOT reset while reactor is >10% FP and when NOT in Shutdown Bypass.

3.5.8 Prior to taking any Test module to Operate, permission is obtained from Nuclear Operator.

3.5.9 Prior to taking a Channel from Bypass to Normal, the Supervisor review must be complete and permission obtained from Nuclear Operator.

3.5.10 To reset bistables it may be necessary to turn PRTM Sum and Difference knobs counterclockwise (when PRTM is in Cal-Out).

3.5.11 IF required to "Back-Out" of an RPS channel,
THEN Enclosure 2 is used. The channel is assumed to be in bypass.

3.5.12 IF any Power Range Channel is NOT operable,
THEN Feedwater Demand Loop "A" (ICS 32A-MCS), Feedwater Demand Loop "B" (ICS 32B-MCS) and Diamond Rod Control Station are placed in hand. This prevents a Feedwater run back due to cross limits within ICS because of a false neutron power signal.

3.5.13 Design calculation used to determine setpoints/tolerances specified in this procedure assumed specific test equipment for calibration/functional test. This test equipment must be fully warmed up and set to appropriate range to achieve accuracies assumed in design calculation. (Refer to 3.7.1 for Test Equipment requirements.)

3.5.14 Keithley 2001 Digital Multimeter is used on the 20 Vdc range when taking voltage measurements in RPS. This ensures adequate input impedance and accuracy requirements are met.

3.5.15 Design calculations used to determine setpoints/tolerances specified in this procedure assumes specific temperatures for calibration location which requires recording ambient temperature on page 1 of Enclosure 1. Work Supervisor is contacted if ambient temperature is outside the required range.

3.5.16 Sections 4.1 through 4.8 are first performed to obtain As Found data. Channel is then calibrated if necessary and sections repeated to obtain As Left data.

3.5.17 Substitute test equipment can only be used after authorization from Engineering.

3.5.18 PT-120 provides gain and slope values for this procedure. SP-113A will require revision after plant startup from Refueling to incorporate any new values.

3.6 **Acceptance Criteria**

3.6.1 As Left calibration of each Nuclear Power channel is within tolerance specified.

3.6.2 As Left calibration of each Flux/Flow/Delta Flux channel is within tolerance specified.

3.6.3 Nuclear Overpower trip setpoints have been set consistent with setpoints of this procedure and conservative with respect to Technical Specifications.

3.6.4 Flux/Flow/Delta Flux trip setpoints have been set consistent with setpoints of this procedure and conservative with respect to Technical Specifications. Control of Special Testing may require non-conservative trip setpoints at discretion of SSO/CRS.

3.6.5 Average Flux/Flow/Delta Flux setpoints have been verified to be consistent with tolerances of this procedure by performance of a flow optimization test when plant conditions allow.

3.7 **Prerequisites**

3.7.1 OBTAIN test equipment and RECORD ID# and Cal. Due Date in space provided.

- DMM, Keithley Model 2001 (2 each)
  - 1 hour warm-up required
  - To be used on 20 Vdc Range, when checking Bistable Trip/Reset Points

Test Equipment Number ____________ Cal Due Date_____________

Test Equipment Number ____________ Cal Due Date_____________

- Variable Milliamp/Voltage Source
- Hand Held Thermometer (accurate within ±2°F)

Test Equipment Number ____________ Cal Due Date_____________

- Extender Cards (2 each) (optional)
- 4 Function Calculator

3.7.2 The following keys will be needed:

- RPS Cabinet Door key # 1
- RPS Channel Bypass key # 2

3.7.3 Section 3.0, Personnel Indoctrination has been read and understood.

____/____	____/____	____/____
Initial/Date	Initial/Date	Initial/Date
____/____	____/____	____/____
Initial/Date	Initial/Date	Initial/Date

NOTE

Normal configuration of RPS/NI system is for all 4 channels and associated sensors to be fully operational and NOT tripped or in bypass. Normal testing configuration for this system is for NO channels to be tripped and one channel to be in bypass during period that channel is tested. Any condition which requires a channel to be tripped or in bypass other than as required for this test constitutes an "unusual configuration."

3.7.4 IF RPS/NI system is in an unusual configuration,
THEN PERFORM an evaluation in accordance with AI-550, Infrequently Performed Tests or Evolutions.

3.7.5 The person in charge of performing this activity must ENSURE:

- Work group has reviewed and understands previous sections.
- Prerequisites have been met.
- Pre-job brief has been completed in accordance with AI-607.
- SSO/CRS has been notified.

Completed By:_________________________ Date: ____________

4.0 INSTRUCTIONS

4.1 Setup and Power Supply Check

4.1.1 RECORD ambient temperature for Control Room on Enclosure 1. [NOCS 100092] ☐

4.1.2 REQUEST the Nuclear Operator reset any EFIC channel trips, or ensure EFIC is in an acceptable mode to allow calibration. ☐

> **CAUTION**
>
> With a second Power Range Channel inoperable, a feedwater runback due to cross limits can occur.

4.1.3 IF any Power Range Channel is NOT Operable,
THEN REQUEST Nuclear Operator place following Control Stations in HAND/MANUAL to prevent an inadvertent runback: ☐

- STM GEN A FW DEMAND (ICS 32A-MCS)
- STM GEN B FW DEMAND (ICS 32B-MCS)
- Diamond Rod Control Station

4.1.4 REQUEST the Nuclear Operator ensure RC ΔP to NNI Cannon Plug in RPS Channel A is selected to "B" position per OP-501, Reactor Non-Nuclear Instrumentation. ☐

4.1.5 REQUEST the Nuclear Operator ensure Neutron Flux Signal Selector Switch (IC-4112-HS2) in ICS Cabinet 4 is in the "NI 7/8" position. ☐

> **NOTE**
>
> IF the RPS is in Shutdown Bypass,
> THEN all the lamps above the doors may NOT be DIM and the following step may be N/A.

4.1.6 CHECK that the Breaker Trip, Manual Bypass and 4 Amber Protective Sub-System Trip lamps above each channel door are DIM (untripped).

	REQUIRED STATUS	A	B	C	D
BREAKER TRIP	DIM	☐	☐	☐	☐
MANUAL BY-PASS	DIM	☐	☐	☐	☐
4 Amber PROTECTIVE SUB-SYSTEM	DIM	☐	☐	☐	☐

4.1.7 NOTIFY SSO/CRS RPS Channel A is being bypassed and the actions of **ITS 3.3.1, Condition A** are applicable. ☐

4.1.8 COORDINATE with the Nuclear Operator and PLACE RPS Channel A in MANUAL BYPASS. ☐

4.1.9 VERIFY the following:

	REQUIRED STATUS	
MANUAL BYPASS LAMP 2-2-7	BRIGHT	☐
ANN. - RPS CHANNEL BYPASSED J-5-3	ALARM	☐
EVENT POINT 0965 SUB ASMBLY PROTECTION CHANNEL BYPASS	ALARM	☐

> **NOTE**
>
> Measuring circuit divides voltage by 1000.

4.1.10 MEASURE and RECORD As Found Power Range Detector Power Supply voltage, (A1-6-13).

AS FOUND	AS LEFT
______	______
0.600Vdc	
(0.594 to 0.606)	(0.597 TO 0.603)

4.1.11 <u>IF</u> As Found voltage of power supply is within As Left tolerance, <u>THEN</u> PLACE a checkmark in As Left space at 4.1.10. ☐

4.1.12 <u>IF</u> As Found voltage of power supply is <u>NOT</u> within tolerance, <u>THEN</u> ADJUST power supply and RECORD As Left Value at 4.1.10. ☐

NOTE
Sections 4.2 through 4.8 are first performed to obtain As Found data. Channel modules are then calibrated if necessary and sections repeated to obtain As Left data. Placekeeping spaces are provided to the right. If no calibrations are necessary, as left spaces can be N/A'd.

4.2 Linear Amplifier Calibration

4.2.1 COORDINATE with the Nuclear Operator and PLACE PRTM, (A1-6-1), in RANGE and VERIFY the On Test lamp is BRIGHT. ☐ ☐

4.2.2 CONNECT DMM to Output jack on front of LAT, (A1-6-4). ☐ ☐

4.2.3 ADJUST Test Input 1 pot of PRTM, (A1-6-1), to obtain 10.000 Vdc and RECORD voltage. ______ AS FOUND ______ AS LEFT (9.990 TO 10.010)

4.2.4 CONNECT a second DMM to Input 1 jack on front of PRTM, (A1-6-1), and RECORD Test Input 1 voltage. ______ AS FOUND ______ AS LEFT

4.2.5 CONNECT DMM to Output jack on front of LAB, (A1-6-7). ☐ ☐

4.2.6 ADJUST Test Input 2 pot of PRTM to obtain 10.000 Vdc at Output jack of LAB, (A1-6-7). ______ AS FOUND ______ AS LEFT (9.990 TO 10.010)

4.2.7 CONNECT second DMM to Input 2 jack on front of PRTM, (A1-6-1), and RECORD Test Input 2 voltage. ______ AS FOUND ______ AS LEFT

4.2.8 CALCULATE LAT Test Input voltages to an accuracy of four places by multiplying the Test Input 1 voltage recorded in Step 4.2.4 by the percent.

0% = 0 x Test Input 1 Voltage 25% = .25 x Test Input 1 Voltage 50% = .5 x Test Input 1 Voltage 75% = .75 x Test Input 1 Voltage 100% = 1 x Test Input 1 Voltage

	As Found	As Left
0%	______	______
25%	______	______
50%	______	______
75%	______	______
100%	______	______
	______ INITIAL/ DATE	______ INITIAL/DATE
	______ IND. VERIF.	______ IND. VERIF.

4.2.9 COPY calculated test input voltages to input column of LAT Data Table, Enclosure 1, page 1. ☐ ☐

4.2.10 CALCULATE LAB Test Input voltages to an accuracy of four places for LAB by multiplying the Test Input 2 voltage recorded in Step 4.2.7 by the percent.

0%________ ________

25%________ ________

50%________ ________

75%________ ________

100%________ ________

0% = 0 x Test Input 2 Voltage 25% = .25 x Test Input 2 Voltage 50% = .5 x Test Input 2 Voltage 75% = .75 x Test Input 2 Voltage 100% = 1 x Test Input 2 Voltage

INITIAL/ DATE INITIAL/DATE

IND. VERIF. IND. VERIF.

4.2.11 COPY calculated Test Input voltages to Input Column of LAB Data Table, Enclosure 1, page 1. ☐ ☐

4.2.12 OBTAIN data for Linear Amplifier Top and Bottom as follows:

1. PLACE PRTM, (A1-6-1), in ZERO. ☐ ☐
2. CONNECT DMM to Output jack on LAT, (A1-6-4). ☐ ☐
3. RECORD 0% readings on Data Table, Enclosure 1, page 1. ☐ ☐
4. CONNECT DMM to Output jack on LAB, (A1-6-7). ☐ ☐
5. RECORD 0% readings on Data Table, Enclosure 1, page 1. ☐ ☐
6. PLACE PRTM to RANGE. ☐ ☐
7. CONNECT DMM to Input 1 jack on PRTM, (A1-6-1), and SIMULATE Test Inputs using Input 1 pot on PRTM. ☐ ☐
8. RECORD readings on Data Table, Enclosure 1, page 1. ☐ ☐
9. CONNECT DMM to Input 2 jack on PRTM, (A1-6-1), and SIMULATE Test Inputs using Input 2 pot on PRTM. ☐ ☐
10. RECORD readings on Data Table, Enclosure 1, page 1. ☐ ☐

4.3 **Total Flux Amplifier Module (TFAM)**

NOTE
Use of a second DMM is recommended.

4.3.1 OBTAIN data for TFAM as follows:

1. PLACE PRTM, (A1-6-1), in ZERO. ☐ ☐

2. CONNECT DMM to Scaled Output jack on TFAM, (A1-7-1). ☐ ☐

3. RECORD 0% readings on Data Table, Enclosure 1, Page 2. ☐ ☐

4. PLACE PRTM, (A1-6-1), to RANGE. ☐ ☐

5. CONNECT DMM to E1 and E2 jacks on TFAM, (A1-7-1), and SIMULATE Test Inputs using Input 1 and Input 2 pot on PRTM. ☐ ☐

6. CONNECT DMM to Scaled Output jack on TFAM, (A1-7-1). ☐ ☐

7. RECORD readings on Data Table, Enclosure 1, Page 2. ☐ ☐

8. IF Computer Point was over-ranged at the 100% Input Value, THEN APPLY 98.8% Input (123.5% FP) value and RECORD reading for Computer Point. ☐ ☐

4.4 Delta Flux Amplifier Module (DFAM)

4.4.1 ADJUST the DFAM, (A1-7-4), as follows:

1. COORDINATE with the Nuclear Operator and PLACE the PRTM, (A1-6-1), in ZERO. ☐ ☐

2. CONNECT DMM to the E OUT jack on the front of the DFAM, (A1-7-4), and RECORD the E OUT voltage.

   ______ AS FOUND ______ AS LEFT
   -5.0000Vdc
   (-4.9990 to -5.0010)

3. CONNECT DMM to the E3 Input jack on the front of the DFAM, (A1-7-4), and RECORD the E3 Voltage (Bias).

   ______ AS FOUND ______ AS LEFT
   -10.0000Vdc
   (-9.9970 to -10.0030)

4. ADJUST Bias pot on the front of the module to obtain -10.0000 (-9.9990 to –10.0010). ☐ ☐

5. CONNECT DMM to the E OUT Output jack on the front of the DFAM, (A1-7-4). ☐ ☐

6. ADJUST Balance pot on front of the module to obtain -5.0000 Vdc (-4.9990 to -5.0010). ☐ ☐

7. REPEAT steps 2 to 6 until NO further adjustment is necessary and RECORD adjusted values.

   ______ AS FOUND ______ AS LEFT
   E out (-5.0000Vdc)
   (-4.9990 to -5.0010)

   ______ AS FOUND ______ AS LEFT
   E3 bias (-10.0000Vdc)
   (-9.9990 to -10.0010)

4.4.2 COORDINATE with the Nuclear Operator and PLACE the PRTM (A1-6-1) in RANGE. ☐ ☐

4.4.3 CONNECT DMM to Output jack on front of LAT, (A1-6-4). ☐ ☐

4.4.4	ADJUST Test Input 1 pot of PRTM, (A1-6-1), to obtain 3.000 Vdc at Output jack of LAT, (A1-6-4).	______ AS FOUND	______ AS LEFT 3.000Vdc (2.900 to 3.100)
4.4.5	CONNECT DMM to Output jack on front of LAB, (A1-6-7).	☐	☐
4.4.6	ADJUST Test Input 2 pot of PRTM, (A1-6-1), to obtain 1.000 Vdc at Output jack of Linear Amplifier Bottom.	______ AS FOUND	______ AS LEFT 1.000Vdc (.900 to 1.100)
4.4.7	CONNECT DMM to Scaled Output jack on front of SDFAM, (A1-5-1), and RECORD voltage.	______ AS FOUND	______ AS LEFT
4.4.8	CONNECT DMM to E OUT Output jack on front of SDFAM, (A1-5-1), and RECORD voltage.	______ AS FOUND	______ AS LEFT
4.4.9	CALCULATE Gain of SDFAM by dividing Scaled Output, Step 4.4.7 value, by the **absolute value** of E OUT Step 4.4.8. RECORD result.	______ AS FOUND	______ AS LEFT 3.815 (3.765 to 3.865)

SCALED DELTA FLUX GAIN = SCALED OUTPUT / | EOUT |

______ INITIAL/ DATE ______ INITIAL/DATE

______ IND. VERIF. ______ IND. VERIF.

NOTE

E1 input is applied using Input 1 pot on PRTM. E3 input is applied using Input 2 pot on PRTM. These inputs simulate a power imbalance between top and bottom detectors which is then processed by Delta Flux Amplifier circuitry.

SDFAM (output) = 0.5 X GAIN X (E1 - E3)

DFAM (output) = - SDFAM (output) -5.0 vdc.

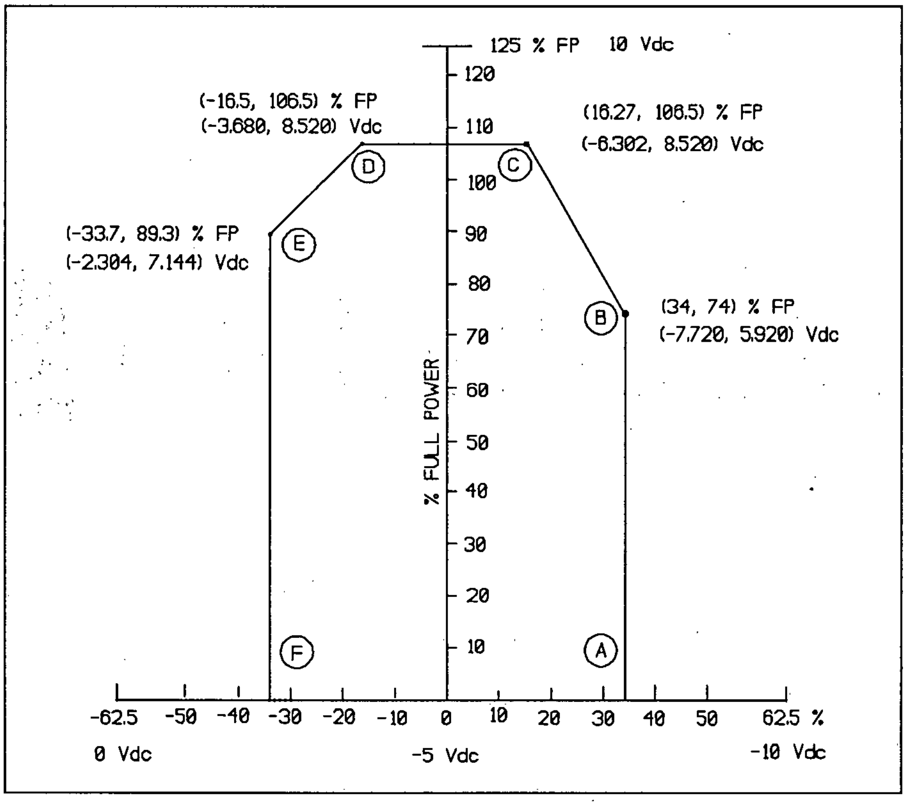
4.4.10 OBTAIN data for DFAM, (A1-7-4) as follows:

1. ENSURE PRTM, (A1-6-1), is in RANGE. ☐ ☐
2. CONNECT DMM to E1 and E3 jacks on SDFAM, (A1-5-1), and SIMULATE Test Inputs using Input 1 and Input 2 pot on PRTM, (A1-6-1). ☐ ☐
3. CONNECT DMM to Scaled Output jack on SDFAM, (A1-5-1), and RECORD reading on Data Table, Enclosure 1, Page 3. ☐ ☐
4. CONNECT DMM to E OUT jack on DFAM, (A1-7-4), and RECORD reading on Data Table, Enclosure 1, Page 3. ☐ ☐
5. RECORD readings for all indicators and computer points listed on Data Table Enclosure 1, Page 3 and 4. ☐ ☐
6. REPEAT Steps 2 through 5 for all Input values listed on Data Table. ☐ ☐

4.5 **Function Generator Module (FGM)**

4.5.1	PLACE the Flow Channel Test Circuit Module, (A1-4-1), in CAL. OUT.	☐	☐
4.5.2	VERIFY the On Test lamp goes BRIGHT.	☐	☐
4.5.3	CONNECT DMM to "K" jack of the FGM, (A1-7-7), and ADJUST voltage with the Calibration Out knob of FCTCM, (A1-4-1), to obtain 8.5200 (8.5170 to 8.5230) Vdc.	☐	☐
4.5.4	PLACE PRTM, (A1-6-1), in CAL. OUT.	☐	☐
4.5.5	CONNECT DMM to E IN jack of FGM, (A1-7-7) and a second DMM to E Out jack of FGM.	☐	☐

FIGURE 1
POWER/IMBALANCE/FLOW TRIP



4.5.6	Using Difference knob of PRTM, (A1-6-1), LOCATE points "A", "B", "C", "D", "E", and "F", and RECORD corresponding voltage readings on Data Table (Enclosure 1, Page 4).	☐	☐
4.5.7	CONNECT DMM to E OUT jack of DFAM, (A1-7-4), and ADJUST Difference Knob of PRTM, (A1-6-1), for -5.000 (-4.970 to -5.030) Vdc.	☐	☐

4.6 **Bistables**

NOTE
Normal unrestricted Full Power setpoint is 104%. Bistable is normally set for 4% when shutdown or for Physics Testing. Other setpoints can be calculated using the guidance at 4.6.2.

4.6.1 DETERMINE from CRS/SSO the required High Flux Bistable Setpoint.

4% (0.320 Vdc) ________ ________

104% (8.320 Vdc) ________ ________

other% ________ ________

________ INITIAL/ DATE ________ INITIAL/DATE

________ CONC. VERIF ________ CONC. VERIF

4.6.2 IF necessary to calculate a Setpoint and Allowable Range, THEN ENTER Setpoint and Allowable Range to the right and in appropriate columns of Data Table Enclosure 1, Page 5.

________ AS FOUND ________ AS LEFT
Setpoint

________ AS FOUND ________ AS LEFT
Allowable Range

To Calculate Other Setpoint specified by SSO/CRS: (Setpoint in %FP) x 0.080 Vdc = ____________ Vdc To Calculate Setpoint Allowable Range in Vdc. (Setpoint in Vdc) ±0.0064

________ INITIAL/ DATE ________ INITIAL/DATE

________ IND. VERIF. ________ IND. VERIF.

4.6.3 OBTAIN data for High Flux Bistable as follows:

1. ENSURE PRTM, (A1-6-1), is in CAL OUT. ☐ ☐
2. CONNECT DMM to Input jack on High Flux Bistable, Enclosure 1, Page 5. ☐ ☐
3. RESET all bistables to ensure Subsystem Trip Lamp on Reactor Trip Module (2-2-7) is DIM. ☐ ☐
4. VARY PRTM, (A1-6-1), Sum Knob as necessary to check: ☐ ☐
   - TRIP point of Bistable
   - Event Point Alarms
   - Subsystem Trip Lamp on Reactor Trip Module (2-2-7) is BRIGHT.
   - RECORD DMM voltage on Data Table, Enclosure 1, Page 5.
5. CONNECT DMM to Deadband jack and RECORD DMM reading. ☐ ☐

6. VARY PRTM, (A1-6-1), Sum knob as necessary to check: ☐ ☐
   - Manual reset of Bistable and memory lamp
   - Event Point return to Normal

4.6.4 OBTAIN data for FLUX >10 % FP, Turbine Trip Bypass and MFP Trip Bypass Bistables as follows:

1. ENSURE PRTM, (A1-6-1), is in CAL. OUT. ☐ ☐

2. CONNECT DMM to Input jack on Bistable to be checked. ☐ ☐

3. VARY PRTM, (A1-6-1), Sum knob as necessary to check Trip and Reset point of each Bistable and RECORD DMM voltage values on Data Table, Enclosure 1, Page 5. ☐ ☐

4.6.5 OBTAIN data for Pwr/Imbal/Flow Bistable as follows:

1. ENSURE FCTCM, (A1-4-1), is in CAL. OUT. ☐ ☐

2. CONNECT DMM to "K" jack of FGM, (A1-7-7), and ADJUST voltage with Cal Output Knob of FCTCM, (A1-4-1), to obtain 8.5200 (8.5170 to 8.5230) Vdc.

   ______ AS FOUND ______ AS LEFT
   8.5200Vdc
   (8.5170 to 8.5230)

3. CONNECT DMM to E OUT jack of DFAM, (A1-7-4), and ADJUST Difference Knob of PRTM, (A1-6-1), for -5.000 (-4.970 to -5.030) Vdc.

   ______ AS FOUND ______ AS LEFT
   -5.000Vdc
   (-4.970 to -5.030)

4. CONNECT DMM to Input jack on Pwr/Imbal/Flow Bistable. Enclosure 1, Page 6. ☐ ☐

5. VARY PRTM, (A1-6-1), Sum knob as necessary to check TRIP point of Bistable and RECORD DMM voltage on Data Table Enclosure 1, Page 6. ☐ ☐

6. CONNECT DMM to Deadband jack and RECORD DMM voltage on Data Table Enclosure 1, Page 6. ☐ ☐

7. VARY PRTM Sum knob as necessary to check: ☐ ☐
   - Manual reset of Bistable and memory lamp.
   - Event Point returns to Normal.

NOTE

The following Steps are performed to ensure Pwr/Imbal/Flow bistable will trip within its required partial loop tolerance in each zone of doghouse curve. Out of tolerance readings indicate SDFAM and/or DFAM and/or Function Generator require calibration.

8. PLACE PRTM, (A1-6-1), in RANGE. ☐ ☐

9. ADJUST Input 1 and Input 2 pots full CCW. ☐ ☐

10. RESET all bistables to Ensure Subsystem Trip Lamp on Reactor Trip Module (2-2-7) is DIM. ☐ ☐

11. CONNECT DMM to E1 and E3 jacks on SDFAM, (A1-5-1), and SIMULATE one set of % IMB. Test Inputs listed in Data Table, Enclosure 1, Page 6, using Input 1 and Input 2 pot on PRTM. ☐ ☐

12. CONNECT DMM to Setpoint and Input jacks on Pwr/Imbal/Flow Bistable and RECORD on Data Table Enclosure 1, Page 6. ☐ ☐

13. REPEAT Steps 11 and 12 for all required Test Input Values. ☐ ☐

NOTE

Unique trip indication will require Pwr/Imbal/Flow Bistable trip below High Flux Bistable setpoint. Pwr/Imbal/Flow Bistable trip due to imbalance with %FP less than 104% (or shutdown High Flux setpoint value).

NOTE

Pwr/Imbal/Flow Bistable Trip Contact is Bypassed when RPS is in Shutdown Bypass.

14. PLACE PRTM, (A1-6-1), to CAL. OUT and ADJUST Sum and Difference knobs to obtain zero flux and zero imbalance indication. ☐ ☐

15. RESET all bistables to ensure Subsystem Trip Lamp on Reactor Trip Module (2-2-7) is DIM. ☐ ☐

16. ADJUST difference knob to trip Pwr/Imbal/Flow Bistable by an imbalance and without increasing flux signal above High Flux Bistable setpoint. ☐ ☐

17. VERIFY Pwr/Imbal/Flow Bistable trip will uniquely change Subsystem Trip Lamp on Reactor Trip Module (2-2-7) from DIM to BRIGHT. ☐ ☐

4.6.6 COORDINATE with the Nuclear Operator and:

- PLACE PRTM, (A1-6-1), in TEST OPERATE. ☐ ☐
- PLACE FCTCM, (A1-4-1), in TEST OPERATE. ☐ ☐

4.6.7 RESET all bistables as required.

4.6.8 COORDINATE with the Nuclear Operator and:

- PLACE PRTM, (A1-6-1), in OPERATE. ☐ ☐
- PLACE FCTCM, (A1-4-1), in OPERATE. ☐ ☐

4.7 Power/Imbalance/Flow Setpoints

NOTE

The following section will measure and adjust, if necessary, Flux/Delta Flux/Flow trip setpoint. Flux/flow trip setpoint is horizontal top of "doghouse" curve (Reference Figure 1, Section 4.5), which is developed by actual flow sensed in RCS hot leg piping and scaled in Total RC Flow Buffer Amplifier. This scaled flow signal is compared to total flux signal to produce flux/flow trip. Maximum/nominal value is 106.5% (8.5200 Vdc). Required setpoint will be calculated for present plant conditions and compared to measured setpoint. Plant conditions may cause the setpoint to be reduced for two reasons:

1. Excessive core imbalance (difference between upper power range detector chamber and lower chamber) is an undesirable condition and setpoint is reduced if imbalance is large.

2. Flow measurements become increasingly inaccurate as reactor power reduces from 100% due to reactor coolant density changes. If actual reactor power is substantially less than 100%, setpoint is reduced. This section should be performed at maximum planned power level (except for physics testing).

4.7.1 VERIFY with SSO/CRS that stability conditions have been met for the past hour.

NO CHANGES IN MEGAWATT DEMAND	☐	☐
RC TAVE STABLE WITHIN 1°F	☐	☐
PRESSURIZER LEVEL WITHIN 3 INCHES	☐	☐
RC PRESSURE STABLE WITHIN 50 PSI	☐	☐
FEEDWATER FLOW REMAINS WITHIN .1 MILLION LBM/HR	☐	☐
MAIN STEAM PRESSURE STABLE WITHIN 25 PSI	☐	☐

4.7.2 VERIFY and RECORD acceptable plant conditions.

Core Thermal Power % FP	______	>15%FP	______
Power Imbalance INCORE	______	<10%	______
Number of RC Pumps "ON"	______	3 or 4	______

4.7.3 IF prerequisites conditions of Step 4.7.1 are met, THEN GO TO 4.7.5 for Setpoint Calculation. ☐ ☐

4.7.4 IF prerequisites conditions of Step 4.7.1 CANNOT be met due to plant instability, AND this section is being performed to reduce Flux/Delta Flux/Flow setpoint to comply with Technical Specifications, THEN prerequisites may be waived with concurrence of Reactor Engineer and SSO/CRS.

SSO/CRS/DATE	SSO/CRS/DATE
REACTOR ENG. Date	REACTOR ENG. Date

4.7.5 **Power/Imbalance/Flow Setpoint Calculation**

NOTE

Maximum/nominal setpoint of Power/Imbalance/Flow trip at zero imbalance is dependent on actual flow and flux-to-flow ratio.

Nominal Setpoint = 1.065 (100% flow) $\left(\frac{10\ \text{Vdc}}{125\%\ \text{FP}}\right)$ = 8.5200 Vdc
with four pumps

Nominal Setpoint = 1.065 (75% flow) $\left(\frac{10\ \text{Vdc}}{125\%\ \text{FP}}\right)$ = 6.3900 Vdc
with three pumps

This nominal setpoint voltage is reduced by two different means as described below.

Nominal setpoint is reduced by a factor which is dependent on Quadrant Power Tilt when actual tilt exceeds steady state tilt limit. Tilt Correction Factor is calculated by using difference between actual Quadrant Power Tilt and Steady State Limit for Power Range Channels listed in Quadrant Power Tilt Limits for Thermal Power >60% Rated Thermal Power table in Core Operating Limits Report.

Nominal setpoint is corrected to account for reactor coolant density which is dependent on core power. For this correction, core power level is determined by heat balance and present RC flow is determined by RC pump count.

1. DETERMINE from SSO/CRS if a correction is required due to Actual Tilt exceeding Steady State Limits specified in Core Operating Limits Report. ☐ ☐

2. IF NO correction is required,
THEN ENTER 0 as Tilt Correction Factor in Step 3 and GO TO Step 4 to determine density correction factor. ☐ ☐

3. CALCULATE Tilt Correction Factor as follows:

   a. OBTAIN fresh "Group 59" data from plant computer. ☐ ☐

NOTE

Incore Sym Det Tilt should be used if Incore Detector system is operational, otherwise use Outcore NI Det. Tilt.

   b. From "Group 59" data, DETERMINE most conservative (highest positive reading) value of tilt of four quadrants and RECORD as Actual Tilt. ☐ ☐

c. DETERMINE from SSO/CRS (Reference COLR) Steady State Limit to be used and RECORD as Tilt Limit. ☐ ☐

d. CALCULATE Tilt Correction Factor using formula below and RECORD value. ☐ ☐

TILT CORRECTION FACTOR

$$= (\text{ACTUAL TILT} - \text{TILT LIMIT}) \times 2 \times \frac{10\text{Vdc}}{125\%\text{FP}}$$

Actual Tilt	______	______
Tilt Limit	______	______
Tilt Correction Factor	______	______
	INITIAL/ DATE	INITIAL/DATE
	IND. VERIF.	IND. VERIF.

4. CALCULATE Density Correction Factor as follows:

a. OBTAIN "Group 59" data, or use data obtained in Step 3.

b. RECORD AULD Instantaneous Core Power.

c. RECORD number of RC Pumps running.

d. IF AULD Instantaneous Core Power is ≥100%FP,
THEN ENTER 1.000 for Correction Factor.
(No calculation required)

e. CALCULATE Density Correction Factor for appropriate number of RC Pumps running using formula below.

Core Power	______	______
#RCP's Running	______	______
Density Correction Factor	______	______
	INITIAL/ DATE	INITIAL/DATE
	IND. VERIF.	IND. VERIF.

For 4 RC Pumps,

$$\text{DENSITY CORRECTION FACTOR} = [0.0600 \times \frac{(\text{CORE POWER in \% FP})}{100\ \%\ \text{FP}}] + 0.940$$

For 3 RC Pumps,

$$\text{DENSITY CORRECTION FACTOR} = [0.070911 \times \frac{(\text{CORE POWER in \% FP})}{100\%\text{FP}}] + 0.9468$$

5. CALCULATE required setpoint as follows:

	AS FOUND	AS LEFT
a. RECORD nominal setpoint for number of RC Pumps running. — Nominal Setpoint 4 RCP=8.5200Vdc 3 RCP=6.3900Vdc	______	______
b. RECORD Tilt Correction Factor from Step 3. — Tilt Correction Factor	______	______
c. RECORD Density Correction Factor from Step 4. — Density Correction Factor	______	______
d. CALCULATE required setpoint. — Required Setpoint (NOT TO EXCEED 8.5200Vdc)	______	______
	INITIAL/ DATE	INITIAL/DATE
	IND. VERIF.	IND. VERIF.

REQUIRED SETPOINT = (NOMINAL SETPOINT - TCF) x DCF

4.7.6 Power/Imbalance/Flow Setpoint Adjustment

1. OBTAIN Total RC Flow Amplifier Scaled Output Data as follows:

   a. CONNECT DMM to Scaled Output jack on Total RC Flow amplifier. (A1-5-10)

   b. RECORD 10 readings at 1 minute intervals.

   c. CALCULATE average of readings.

   d. RECORD Required Setpoint from 4.7.5 5(d).

   e. COMPARE avg. reading calculated above to Required Setpoint and RECORD difference.

1	______	______
2	______	______
3	______	______
4	______	______
5	______	______
6	______	______
7	______	______
8	______	______
9	______	______
10	______	______
AVERAGE	______	______
REQUIRED SETPOINT	______	______
AVERAGE - SETPOINT	< 0.050 Vdc	<0.050 Vdc
	INITIAL/ DATE	INITIAL/DATE
	IND. VERIF.	IND. VERIF.

NOTE

A Nuclear Condition Report is NOT normally required if SP-113A is being performed during plant startup/power ascension, and RC flow is found out-of-spec. in conservative direction.

Step	Action	AS FOUND	AS LEFT
2.	IF difference between Average Reading and Required Setpoint is NOT within required tolerance, AND this procedure is being used to change system setpoint, THEN GO TO Step 6.	☐	☐
3.	IF difference between Average Reading and Required Setpoint is NOT within required tolerance, AND this procedure is NOT being used to change system setpoints, THEN REFER TO Section 5.2.	☐	☐
4.	IF difference between Average Reading and Required Setpoint is within tolerance of Step 16, THEN PLACE checkmarks in data at Step 16 and GO TO Step 18.	☐	☐
5.	IF difference between Average Reading and Required Setpoint is NOT within tolerance of Step 16, THEN PROCEED with Step 6.	☐	☐
6.	PLACE PRTM (A1-6-1) in CAL. OUT.	☐	☐
7.	CONNECT DMM to EOUT Output jack on Delta Flux Amplifier Module, (A1-7-4).	☐	☐
8.	ADJUST Difference Knob on PRTM, (A1-6-1), to obtain -5.000 Vdc (Zero Imbalance) on DMM and RECORD voltage.	______ AS FOUND	______ AS LEFT
9.	PLACE Flow Channel Test Circuit Module, (A1-4-1), in CAL. OUT.	☐	☐
10.	CONNECT DMM to Scaled Output jack on Total RC Flow Amplifier, (A1-5-10).	☐	☐

NOTE
To obtain access to gain adjustment, the module will have to be withdrawn, it is recommended that two extender cards be used to keep module energized for adjustment. Removing module while in by-pass will not trip channel.

11. ADJUST Total RC Flow Amplifier Gain as follows:

a. RECORD Required Setpoint and average reading from Step 1.	REQUIRED SETPOINT	______	______
b. ADJUST Calibration Output Knob on FTM to obtain average reading (±0.050 Vdc) on DMM.	AVERAGE	______	______
c. CONNECT DMM to X1 Output jack on Total RC Flow Amplifier, (A1-5-10), and RECORD reading.	X1 OUTPUT	______	______
d. CONNECT DMM to Scaled Output jack on Total RC Flow Amplifier, (A1-5-10).	SCALED OUTPUT	______	______
e. ADJUST Gain (pot R7.2 on PC-2) of Total RC Flow Amplifier Module, (A1-5-10), for Required Setpoint (± 0.0020) Vdc and RECORD Scaled Output reading.		SETPOINT ± 0.0020 Vdc	
		INITIAL/ DATE	INITIAL/DATE
		IND. VERIF.	IND. VERIF.

12. PLACE PRTM, (A1-6-1), in TEST/OPERATE. ☐ ☐

13. PLACE FCTCM, (A1-4-1), in TEST/OPERATE. ☐ ☐

14. RESET all bistables that will reset. (Flux >10% will NOT reset if power is >10%) ☐ ☐

15. COORDINATE with Nuclear Operator and:
    - PLACE PRTM, (A1-6-1), in OPERATE. ☐ ☐
    - PLACE FCTCM, (A1-4-1), in OPERATE. ☐ ☐

16. OBTAIN Total RC Flow Amplifier Scaled Output Data as follows:

   a. CONNECT DMM to Scaled Output jack on Total RC Flow amplifier, (A1-5-10).

   b. RECORD 10 readings at 1 minute intervals.

   c. CALCULATE average of readings.

   d. RECORD Required Setpoint from Step 1.

   e. COMPARE average reading calculated above to Required Setpoint and RECORD difference.

	AS FOUND	AS LEFT
1	______	______
2	______	______
3	______	______
4	______	______
5	______	______
6	______	______
7	______	______
8	______	______
9	______	______
10	______	______
AVERAGE	______	______
REQUIRED SETPOINT	______	______
AVERAGE - SETPOINT	______ < 0.025 Vdc	______ <0.025 Vdc
	______ INITIAL/ DATE	______ INITIAL/DATE
	______ IND. VERIF.	______ IND. VERIF.

17. IF values are NOT within tolerance specified, THEN REFER immediately to Section 5.2. ☐ ☐

	AS FOUND	AS LEFT
18. CONNECT DMM to X1 Output jack on Total RC Flow Amplifier (A1-5-10), and RECORD reading.	______	______
19. DISCONNECT DMM from Total RC Flow Amplifier, (A1-5-10).	☐	☐
20. RESET bistables and memory lamps that will reset. (Flux >10% will NOT reset if power is >10%).	☐	☐

4.8 NI-5 Input to Auctioneer NI-6-B50

> **NOTE**
>
> Failure of auctioneer module to meet As Found acceptance criteria should NOT require declaring associated RPS channel inoperable.
>
> **NOTE**
>
> This section must be performed while reactor power is >15% FP and held constant ± 0.5% FP.

4.8.1 COORDINATE with Nuclear Operator and PLACE Channel A PRTM (A1-6-1), in TEST/OPERATE. ☐ ☐

4.8.2 VERIFY Auctioneer is selecting NI-6 signal as follows:

1. CONNECT DMM to E IN 2 jack on Auctioneer, (B1-6-10), and RECORD voltage. ______ E IN 2 (NI-6) Vdc ______
2. CONNECT DMM to E OUT jack on front of Auctioneer, (B1-6-10), and RECORD voltage. ______ E OUT Vdc ______
3. VERIFY E OUT voltage is within 0.020 Vdc of E IN 2 voltage. ______ Difference ______ Tolerance ± 0.020 Vdc

______ INITIAL/ DATE ______ INITIAL/DATE

4.8.3 COORDINATE with Nuclear Operator and PLACE Channel A PRTM, (A1-6-1), in OPERATE. ☐ ☐

4.9 Module Calibration Data Evaluation

4.9.1 REVIEW As Found data and COMPARE to As Found/As Left Acceptable Ranges/Tolerances listed. ☐

4.9.2 IF As Found data is within As Left Acceptable Ranges/Tolerances specified
AND NO adjustments are desired,
THEN PLACE checkmarks in As Left columns at appropriate Step and/or Data Tables and GO TO Section 4.10 for Channel restoration. ☐

4.9.3 IF any As Found data is NOT within As Found Tolerances specified, THEN PERFORM following: ☐

- CIRCLE Out of Tolerance Reading in Red
- COMPLETE Out-Of-Tolerance Log Sheet (Enclosure 3)
- INITIATE a Nuclear Condition Report, if required
- GO TO Step 4.9.4 for Calibration.

4.9.4 DETERMINE which individual component(s) (module, indicator, etc.) require calibration. ☐

4.9.5 OBTAIN Cal Data Sheets from Document Control, if available, for those components requiring calibration. ☐

4.9.6 CALIBRATE components as required using appropriate instructions in Nuclear Instrumentation and Reactor Protection System Manual #206. ☐

4.9.7 IF a component CANNOT be calibrated to required tolerances, THEN NOTIFY SSO/CRS and Work Supervisor and INITIATE a WR for repair/replacement. ☐

4.9.8 WHEN any needed calibrations have been completed, THEN REPEAT Sections 4.2 through 4.6 as necessary to obtain As Left data. ☐

4.9.9 IF any As Left values are NOT within tolerance specified, THEN REFER TO Section 5.2. ☐

4.10 RPS Channel Restoration

4.10.1 SUBMIT results of RPS Channel's Calibration to Supervisor to ensure Channel's calibration is complete. [NOCS 40639]

____
INIT/DATE

____
SUPVR.

NOTE

SP-113G is used to perform checks and adjustments if necessary.

4.10.2 NOTIFY SSO/CRS that channel calibration is complete. ☐

4.10.3 REQUEST Operations perform a channel check to ensure channel is working properly. ☐

4.10.4 OBTAIN permission from Nuclear Operator to return RPS channel to NORMAL. ☐

4.10.5 Using keyswitch on Reactor Trip Module, PLACE selected RPS Channel in NORMAL and VERIFY following. ☐

	REQUIRED STATUS	
MANUAL BYPASS LAMP 2-2-7	DIM	☐
ANN. - RPS CHANNEL BYPASSED J-5-3	NORMAL	☐
EVENT POINT 0965 SUB ASMBLY PROTECTION CHANNEL BYPASS	NORMAL	☐

4.10.6 REQUEST Nuclear Operator reset any EFIC trips that may exist or place EFIC in an acceptable mode. ☐

4.11 Flux Recorder NI-5-RIR [NOCS 022067]

NOTE

Failure of recorder modules to meet As Found acceptance criteria should NOT require declaring associated RPS channel inoperable.

4.11.1 NOTIFY SSO/CRS and Nuclear Operator that NI-5-RIR will be taken out of service for calibration. ☐

4.11.2 LIFT following wires at Main Control Board Recorder Nest Rack-Nest 4, Slot 3.

TERM 8 (+)

wiremarkTB56-6 ☐

TERM. 8 (-)

wiremark TB56-7 ☐

4.11.3 CONNECT a variable voltage source with DMM in parallel to NI-005-RY1 8(+) and 8(-). ☐

4.11.4 Using variable voltage source APPLY inputs listed and RECORD As Found recorder values.

INPUT		MCB RECORDER - NI-5-RIR				
%	VDC	DESIRED OUTPUT%	AS FOUND %	AS FOUND TOLERANCE	AS LEFT %	AS LEFT TOLERANCE
0	0.00	0.00		-2.5 to +2.5		-2.5 to +2.5
24	2.400	30.0		27.5 to 32.5		27.5 to 32.5
48	4.800	60.0		57.5 to 62.5		57.5 to 62.5
72	7.200	90.0		87.5 to 92.5		87.5 to 92.5
100	10.000	125.00		122.5 to 127.5		122.5 to 127.5

4.11.5 IF As Found data is NOT within Acceptable Range, THEN REFER TO Section 5.2, Contingencies. ☐

4.11.6 IF all As Found data meets As-Left tolerances AND adjustments are NOT desired, THEN PLACE a checkmark in As Left column and GO TO Step 4.11.10. ☐

4.11.7 CALIBRATE recorder as required and RECORD As Left data in Step 4.11.4. ☐

4.11.8 IF recorder CANNOT be calibrated to required tolerances, THEN NOTIFY SSO/CRS and Work Supervisor and INITIATE a WR for repair/replacement. ☐

4.11.9 IF any As Left values are NOT within tolerance specified, THEN REFER TO Section 5.2, Contingencies. ☐

4.11.10 DISCONNECT all test equipment. ☐

4.11.11 CONNECT wires that were disconnected for recorder calibration and DOCUMENT in Step 4.11.2.

TERM. 8 (+) ☐

wiremark TB56-6

TERM. 8 (-) ☐

wiremark TB56-7

INITIAL/DATE

CONC.VERIF.

4.11.12 VERIFY that NI-5-RIR reads within 5% of higher reading of pair of NI channels selected by Neutron Flux Signal Selector Switch (IC-4112-HS2) as follows: ☐

1. DETERMINE position of IC-4112-HS2 (ICS Cabinet 4). ☐
2. RECORD readings of MCB indicators for Channels to which IC-4112-HS2 is selected. ☐
3. RECORD reading from NI-5-RIR. ☐
4. VERIFY recorder reading is within 5% of Highest reading recorded in Step 2.

INDICATION	READING	ACCEPTABLE RANGE (HIGHER READING x 0.95 to HIGHER READING x 1.05)
NI-5-NI		-----
NI-6-NI		-----
NI-7-NI		-----
NI-8-NI		-----
NI-5-RIR		
HIGHEST AGREE INITIAL/DATE		-----

5.0 FOLLOW-UP ACTIONS

5.1 Restoration Instructions

NOTE
SP-113G is used to perform checks and adjustments if necessary.

5.1.1 NOTIFY SSO/CRS that channels requiring calibration are complete and REQUEST Operations perform a channel check to ensure channels are working properly. ☐

5.1.2 VERIFY that all RPS channels are in their normal operating mode and NOTIFY SSO/CRS. ☐

5.1.3 RETURN keys to CRS/SSO. ☐

5.1.4 RETURN test equipment to Calibration Lab. ☐

5.2 Contingencies

5.2.1 IF any As Found calibration is NOT within As Found tolerance, THEN GENERATE a Nuclear Condition Report, as determined by SSO/CRS and COMPLETE Enclosure 3 for instrument that is out-of-tolerance.

5.2.2 IF any As Left reading is NOT within As Left tolerance, perform following:

- NOTIFY SSO/CRS that equipment or channel is INOPERABLE.
- GENERATE a W/R to repair equipment.
- Upon completion of work, PERFORM failed section again.

5.2.3 IF any module parts must be replaced or module must be removed and bench calibrated,
THEN GENERATE a W/R and upon completion of work, PERFORM failed section again.

5.2.4 IF acceptance criteria of Section 3.6 CANNOT be met,
THEN REQUEST SSO/CRS refer immediately to Action Statement of Technical Specifications Section **3.1.8, 3.3.1**.

5.2.5 IF a channel is placed in tripped condition to comply with Technical Specifications,
THEN applicable restoration steps for that channel should be marked N/A.

5.3 Reports and Documentation

5.3.1 REVIEW 4.0 and ENSURE all out-of-tolerance readings are listed on Enclosure 3. ☐

5.3.2 SIGN and DATE Enclosure 3 when complete as necessary. ☐

5.3.3 FORWARD a copy of Enclosure 3 to Supervisor, Systems Engineering (I&C) as necessary. ☐

RPS Channel "A" NI-5 Linear Amplifier

NOTE
Linear Amplifier meter readings rounded off to nearest whole number for readability of indicator. Actual 100 % input = 62.5 %.

TOP

INPUT			LINEAR AMPLIFIER - OUTPUT Vdc (1-6-4) [NI-5-A16]					LINEAR AMPLIFIER Meter (1-6-4) [NI-5-A16]				
%	As Found CALCULATED Vdc	As Left CALCULATED Vdc	DESIRED OUTPUT Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
0			0.000		-0.03 to 0.03		-0.024 to 0.024	0.00		-2.0 to +2.0		-2.0 to +2.0
25			2.500		2.470 to 2.530		2.476 to 2.524	16.0		14.0 to 18.0		14.0 to 18.0
50			5.000		4.970 to 5.030		4.976 to 5.024	31.0		29.0 to 33.0		29.0 to 33.0
75			7.500		7.470 to 7.530		7.476 to 7.524	47.0		45.0 to 49.0		45.0 to 49.0
100			10.000		9.970 to 10.030		9.976 to 10.024	63.0		61.0 to 64.0		61.0 to 64.0

BOTTOM

INPUT			LINEAR AMPLIFIER - OUTPUT Vdc (1-6-7) [NI-5-A46]					LINEAR AMPLIFIER Meter (1-6-7) [NI-5-A46]				
%	As Found CALCULATED Vdc	As Left CALCULATED Vdc	DESIRED OUTPUT Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
0			0.000		-0.03 to 0.03		-0.024 to 0.024	0.00		-2.0 to +2.0		-2.0 to +2.0
25			2.500		2.470 to 2.530		2.476 to 2.524	16.0		14.0 to 18.0		14.0 to 18.0
50			5.000		4.970 to 5.030		4.976 to 5.024	31.0		29.0 to 33.0		29.0 to 33.0
75			7.500		7.470 to 7.530		7.476 to 7.524	47.0		45.0 to 49.0		45.0 to 49.0
100			10.000		9.970 to 10.030		9.976 to 10.024	63.0		61.0 to 64.0		61.0 to 64.0

AMBIENT TEMPERATURE °F		
CALIBRATION LOCATION	REQUIRED	ACTUAL
CONTROL ROOM	70 TO 80	

Calibration Completed by:______________________ Date:____________ Data Reviewed by:______________ Date:____________

RPS Channel "A" NI-5 Total Flux Amplifier

INPUT		TFAM - Meter (1-7-1) [NI-5-A48]					TFAM - SCALED OUTPUT (1-7-1) [NI-5-A48]				
%	E1 & E2 Vdc	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %	DESIRED OUTPUT Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc
0	0.00	0.00		-2.5 to +2.5		-2.5 to +2.5	0.000		-0.0519 to 0.0519		-0.0198 to 0.0198
28	2.80	35.0		32.5 to 37.5		32.5 to 37.5	2.800		2.7481 to 2.8519		2.7802 to 2.8198
52	5.20	65.0		62.5 to 67.5		62.5 to 67.5	5.200		5.1481 to 5.2519		5.1802 to 5.2198
76	7.60	95.0		92.5 to 97.5		92.5 to 97.5	7.600		7.5481 to 7.6519		7.5802 to 7.6198
100	10.00	125.00		122.5 to 127.5		122.5 to 127.5	10.000		9.9481 to 10.0519		9.9802 to 10.0198

INPUT		NI-5-NI (MCB)					Computer Point P-208				
%	E1 & E2 Vdc	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
0	0.00	0.00		-3.0 to +3.0		-2.0 to +2.0	0.00		-1.291 to 1.291		-0.949 to 0.949
28	2.80	35.0		32.0 to 38.0		33.0 to 37.0	35.00		33.709 to 36.291		34.051 to 35.949
52	5.20	65.0		62.0 to 68.0		63.0 to 67.0	65.00		63.709 to 66.291		64.051 to 65.949
76	7.60	95.0		92.0 to 98.0		93.0 to 97.0	95.00		93.709 to 96.291		94.051 to 95.949
100	10.00	125.00		122.00 to 128.00		123.00 to 127.00	125.00		123.709 to 126.291		124.051 to 125.949
*98.8	9.88						123.50		122.209 to 124.791		122.551 to 124.449

NOTE
***98.8 % INPUT only required for Computer Point if 100% point is off scale.**

INPUT	Recall Computer Point RECL-0				
%	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
0	0.00		-1.291 to 1.291		-0.949 to 0.949
28	35.00		33.709 to 36.291		34.051 to 35.949
52	65.00		63.709 to 66.291		64.051 to 65.949
76	95.00		93.709 to 96.291		94.051 to 95.949
100	125.00		123.709 to 126.291		124.051 to 125.949

Calibration Completed by:______________________ Date:____________ Data Reviewed by:______________ Date:____________

RPS Channel "A" NI-5 Delta Flux Amplifier

NOTE
E1 & E3 Input Values are based on SDFAM Gain of 3.815. If SDFAM Gain is being changed then E1 & E3 Input values need to be recalculated.

INPUT			SDFAM – SCALED OUTPUT (1-5-1) [NI-5-A51]					DFAM - E OUT OUTPUT (1-7-4) [NI-5-A49]				
%	E1 Vdc	E3 Vdc	DESIRED OUTPUT Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc	DESIRED OUTPUT Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc
+62.50	4.000	1.379	+5.000		+4.983 to +5.017		+4.983 to +5.017	-10.000		-9.975 to -10.025		-9.977 to -10.023
+60.00	4.000	1.484	+4.800		+4.783 to +4.817		+4.783 to +4.817	-9.800		-9.775 to -9.825		-9.777 to -9.823
+30.00	4.000	2.742	+2.400		+2.383 to +2.417		+2.383 to +2.417	-7.400		-7.375 to -7.425		-7.377 to -7.423
0.00	4.000	4.000	0.000		-0.017 to +0.017		-0.017 to +0.017	-5.000		-4.975 to -5.025		-4.977 to -5.023
-30.00	2.742	4.000	-2.400		-2.383 to -2.417		-2.383 to -2.417	-2.600		-2.575 to -2.625		-2.577 to -2.623
-60.00	1.484	4.000	-4.800		-4.783 to -4.817		-4.783 to -4.817	-0.200		-0.175 to -0.225		-0.177 to -0.223
-62.50	1.379	4.000	-5.000		-4.983 to -5.017		-4.983 to -5.017	0.000		+0.025 to -0.025		+0.023 to -0.023

DFAM - Meter (1-7-4) [NI-5-A49]					NI-5-DNI (MCB Meter)				
DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
+62.50		+60.0 to +65.0		+60.0 to +65.0					
+60.00		+57.5 to +62.5		+57.5 to +62.5	+60.00		+57.0 to +63.0		+58.0 to +62.0
+30.00		+27.5 to +32.5		+27.5 to +32.5	+30.00		+27.0 to +33.0		+28.0 to +32.0
0.00		-2.5 to +2.5		-2.5 to +2.5	0.00		-3.0 to +3.0		-2.0 to +2.0
-30.00		-27.5 to -32.5		-27.5 to -32.5	-30.00		-27.0 to -33.0		-28.0 to -32.0
-60.00		-57.5 to -62.5		-57.5 to -62.5	-60.00		-57.0 to -63.0		-58.0 to -62.0
-62.50		-60.0 to -65.0		-60.0 to -65.0					

Calibration Completed by:__________ Date:________ Data Reviewed by:__________ Date:________

* Additional RPS Channel A "NI-5" Delta Flux Components on next page.

RPS Channel "A" NI-5 Delta Flux Amplifier

NOTE
E1 & E3 Input Values are based on SDFAM Gain of 3.815. If SDFAM Gain is being changed then E1 & E3 Input values need to be recalculated.

INPUT			COMPUTER POINT P-214					RECALL COMPUTER POINT RECL-58				
%	E1 Vdc	E3 Vdc	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %	DESIRED OUTPUT %	As Found %	As Found ACCEPTABLE RANGE %	As Left %	As Left ACCEPTABLE RANGE %
+62.50	4.000	1.379	+62.50		+60.78 to +64.22		+61.55 to +63.45	+62.50		+60.78 to +64.22		+61.55 to +63.45
+60.00	4.000	1.484	+60.00		+58.28 to +61.72		+59.05 to +60.95	+60.00		+58.28 to +61.72		+59.05 to +60.95
+30.00	4.000	2.742	+30.00		+28.28 to +31.72		+29.05 to +30.95	+30.00		+28.28 to +31.72		+29.05 to +30.95
0.00	4.000	4.000	0.00		-1.72 to +1.72		-0.95 to +0.95	0.00		-1.72 to +1.72		-0.95 to +0.95
-30.00	2.742	4.000	-30.00		-28.28 to -31.72		-29.05 to -30.95	-30.00		-28.28 to -31.72		-29.05 to -30.95
-60.00	1.484	4.000	-60.00		-58.28 to -61.72		-59.05 to -60.95	-60.00		-58.28 to -61.72		-59.05 to -60.95
-62.50	1.379	4.000	-62.50		-60.78 to -64.22		-61.55 to -63.45	-62.50		-60.78 to -64.22		-61.55 to -63.45

RPS Channel "A" NI-5 Function Generator

POINT I.D.	E IN JACK FUNCTION GENERATOR (1-7-7) [NI-5-A50]					E OUT JACK FUNCTION GENERATOR (1-7-7) [NI-5-A50]				
	DESIRED Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc	DESIRED Vdc	As Found Vdc	As Found ACCEPTABLE RANGE Vdc	As Left Vdc	As Left ACCEPTABLE RANGE Vdc
A	-7.720		-7.700 to -7.740		-7.700 to -7.740	≤ 0.00		≤ 0.00		≤ 0.00
B	-7.720		-7.700 to -7.740		-7.700 to -7.740	5.920		5.870 to 5.970		5.870 to 5.970
C	-6.302		-6.282 to -6.322		-6.282 to -6.322	8.520		8.470 to 8.570		8.470 to 8.570
D	-3.680		-3.660 to -3.700		-3.660 to -3.700	8.520		8.470 to 8.570		8.470 to 8.570
E	-2.304		-2.284 to -2.324		-2.284 to -2.324	7.144		7.094 to 7.194		7.094 to 7.194
F	-2.304		-2.284 to -2.324		-2.284 to -2.324	≤ 0.00		≤0.00		≤ 0.00

Calibration Completed by:______________________ Date:______________ Data Reviewed by:______________ Date:______________

RPS Channel "A" % FP Bistables

BISTABLE	ACTION/SETPOINT	As Found	As Found ACCEPTABLE RANGE Vdc	AS LEFT	As Left ACCEPTABLE RANGE Vdc	ALARMS
FLUX > 10 % FP NI-5 1-7-12 (NI-5-A19)	TRIP at 0.7200 Vdc - (9% FP)		0.7136 to 0.7264		0.7136 to 0.7264	FLUX > 10 % FP AUX RELAY 1-7-14 [NI-5-A18] All 3 Lamps "BRIGHT" ☐ FLUX > 10 % TRIP TO EFIC AUX RELAY 1-3-9 (RP-A-60) "BRIGHT" ☐
MFP TRIP BYPASS 1-8-5 (RP-A57	RESET at 1.5030 Vdc - (18.7875% FP)		1.4966 to 1.5094		1.4966 to 1.5094	
TURBINE TRIP BYPASS 1-8-12 (RP-A53)	RESET at 3.4900 Vdc - (43.625% FP)		3.4836 to 3.4964		3.4836 to 3.4964	
HIGH FLUX NI-5 1-7-10 (RP-A20)	TRIP at 8.3200 Vdc - (104% FP) or TRIP at 0.3200 Vdc - (4% FP) or ____________		8.3136 to 8.3264 or 0.3136 to 0.3264 or to		8.3136 to 8.3264 or 0.3136 to 0.3264 or to	EVENT POINT 969 "ALARM" ☐
HIGH FLUX NI-5 1-7-10 (RP-A20)	MANUAL RESET @ < TRIP SETPOINT DEADBAND > 10.000 Vdc		> 10.000		> 10.000	EVENT POINT 969 NORMAL ☐
TURBINE TRIP BYPASS 1-8-12 (RP-A53)	TRIP at 3.3400 Vdc - (41.75% FP)		3.3336 to 3.3464		3.3336 to 3.3464	
MFP TRIP BYPASS 1-8-5 (RP-A57)	TRIP at 1.353 Vdc - (16.91% FP)		1.3466 to 1.3594		1.3466 to 1.3594	
FLUX > 10 % FP NI-5 1-7-12 (NI-5-A19)	RESET at 0.4000 Vdc - (5% FP)		0.3936 to 0.4064		0.3936 to 0.4064	FLUX > 10 % FP AUX RELAY 1-7-14 [NI-5-A18] All 3 Lamps "DIM" ☐ FLUX > 10 % TRIP TO EFIC AUX RELAY 1-3-9 (RP-A-60) "DIM" ☐

Calibration Completed by:____________ Date:________ Data Reviewed by:____________ Date:________

*Additional RPS Channel "A" NI-5 components next page.

RPS Channel "A" Pwr/Imbal/Flow Bistable

BISTABLE	ACTION/SETPOINT	As Found	As Found ACCEPTABLE RANGE Vdc	AS LEFT	As Left ACCEPTABLE RANGE Vdc	ALARMS
PWR/IMBAL/FLOW BISTABLE 1-4-10 (RP-A20)	TRIP at 8.5200 Vdc - (106.5% FP) with 0% Imb.		8.5136 to 8.5264		8.5136 to 8.5264	EVENT POINT 970 "ALARM" ☐
	MANUAL RESET @ < TRIP SETPOINT DEADBAND > 10.000 Vdc		>10.000		>10.000	EVENT POINT 970 NORMAL ☐

NOTE
E1 & E3 Input Values are based on SDFAM Gain of 3.815. If SDFAM Gain is being changed then E1 & E3 Input values need to be recalculated.

INPUT			PWR/IMBAL/FLOW BISTABLE - SETPOINT to INPUT Δ Vdc (1-4-10) [RP-A27]				PWR/IMBAL/FLOW BISTABLE - SETPOINT to INPUT Δ Vdc (1-4-10) [RP-A27]			
% IMB / % FP	E1 Vdc	E3 Vdc	As Found SETPOINT Vdc	As Found INPUT Vdc	Δ Vdc SETPOINT - INPUT = Δ Vdc	As Found Δ Vdc ACCEPTABLE RANGE	As Left SETPOINT Vdc	As Left INPUT Vdc	Δ Vdc SETPOINT - INPUT = Δ Vdc	As Left Δ Vdc ACCEPTABLE RANGE
+25 / 90.5	7.764	6.716				-0.0700 to 0.0700				-0.0512 to 0.0512
0 / 106.5	8.520	8.520				-0.0325 to 0.0325				-0.0199 to 0.0199
-25 / 98.0	7.316	8.364				-0.0900 to 0.0900				-0.0419 to 0.0419

As Found Δ Vdc - Calculated By:______________________ Date:__________ Independent Verification By:__________________ Date:__________

As Left Δ Vdc - Calculated By:______________________ Date:__________ Independent Verification By:__________________ Date:__________

Calibration Completed by:______________________ Date:__________ Data Reviewed by:__________________ Date:__________

BACKING OUT OF RPS CHANNEL TESTING

NOTE

It is assumed that Channel is in BYPASS.

1. RETURN Test Module(s) to TEST/OPERATE position as necessary.

NOTE

FLUX > 10% and Shutdown Bypass bistables will NOT reset at > 10% Power. Low Pressure Bistable will NOT Reset at <1928 PSIG. Main Feedwater Pump Trip Bistables will NOT reset when their associated Main Feedwater Pump is tripped. Turbine Trip Bistable will NOT reset if Turbine is NOT latched.

2. RESET all Bistables (Output State and Output Memory lamps) that can be reset (as necessary).

3. COORDINATE with Nuclear Operator and PLACE Test Module(s) to OPERATE.

4. RESET all Bistables (Output State and Output Memory lamps) that can be reset (as necessary).

NOTE

IF RPS is in Shutdown Bypass,
THEN all lamps above doors may NOT be DIM.

5. CHECK Breaker Trip lamp, and four (4) protective subsystem lights above each channel door are DIM (untripped state).

6. VERIFY Subsystem Trip and Test Trip lamps are DIM on Reactor Trip Module (2-2-7).

7. Have Nuclear Operator check each EFIC channel and reset any that is in a HALF TRIP condition.

8. OBTAIN permission from Nuclear Operator, to return RPS Channel's Manual By-pass keyswitch to Normal.

9. On Reactor Trip Module, PLACE Manual Bypass keyswitch in NORMAL position and remove key.

10. VERIFY the following:

LOCATION	INDICATION	REQUIRED STATUS
REACTOR TRIP MODULE (2-2-7)	MANUAL BY-PASS LAMP	DIM
MCB Annunciator	J-5-3	NORMAL
MCB Event Point	0965 RPS CHANNEL BYPASSED	NORMAL

Progress Energy

INTEROFFICE CORRESPONDENCE

FROM: Superintendent Nuclear E/I&C
Office

TO: Supervisor, Systems Engineering (I&C) DATE:__________

SUBJECT: Out-of-Tolerance Log Sheet

Tag #	Step/Enclosure #	Page #	Max Error	NCR y/n	NCR#	Date	Comments	Print Name

Additional Comments/Observations:______________________________

____

____

____

Completed by:______________________________ Date: ______________

REVISION SUMMARY

The following changes were made in this revision:

Throughout	Added module locations to steps. AR 221012 Replaced lines with boxes for placekeepers. AR 212023
4.2.12	Relocated steps to minimize Control Room alarms. AR 212023
4.4.10	Changed to say "ensure" PRTM is in range. AR 221012
4.5.1, 4.5.2	Revised to be two steps vice one. AR 212023
4.6.5	Added steps to check reset of alarm and module. AR 212023
4.6.6, 4.6.8	Broke steps into separate bullets. AR 212023.
4.7.5.4	Clarified that AULD Instantaneous Core Power is the power to be used. AR 221180
4.7.6.11	Aligned data spaces with steps. AR 212023
4.9.8	Changed to just reperform 4.2 to 4.6 as necessary. AR 212023
Enclosure 1	Rearranged data tables for ease of use. AR 212023

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #296, REVISION 1

MEASUREMENT UNCERTAINTY RECAPTURE

ISOMETRIC DRAWINGS OF APPLICABLE SECTIONS OF CR-3 FEEDWATER PIPING

ATTACHMENT I

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"Isometric Drawings of Applicable Sections of CR-3 Feedwater Piping" Drawing Number P1-305-831

WITHIN THIS PACKAGE... OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-01

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"Isometric Drawings of Applicable Sections of CR-3 Feedwater Piping" Drawing Number P1-305-832"

WITHIN THIS PACKAGE... OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-02