PALO VERDE
NUCLEAR GENERATING STATION

I&C Program

Classroom Lesson

I&C Program	**Date: 8/17/2010 8:19:03 AM**
LP Number: NID26P000102	**Rev Author: ROBERT M. PIERCE**
Title: Reactor Power Cutback System	**Technical Review:** Jones, Warren H(Z54741) Digitally signed by Jones, Warren H(Z54741) DN: cn=Jones, Warren H(Z54741) Reason: I have reviewed this document Date: 2010.08.31 16:45:04 -07'00'
Duration : 10 HOURS	
	Teaching Approval: Meredith, Robin T(Z00799) Digitally signed by Meredith, Robin T(Z00799) DN: cn=Meredith, Robin T(Z00799) Reason: I am approving this document Date: 2010.09.06 14:36:49 -07'00'

INITIATING DOCUMENTS

Site Maintenance Training Program Description

REQUIRED TOPICS

None

CONTENT REFERENCES

01-J-SFE-067 Instrument Loop Wiring Diagram Reactor Control System

WSL 245516 Functional Test RPCS

VTM-C490-0022 Reactor Power Cutback System

LESSON PLAN REVISION DATA

Aug 17, 2010	Rob Pierce	Record created
		Revision 02: Updated content due to RPCS modification: 1) MCRAS, System Trouble Alarm inputs changed due to circuit card changes; 2) Operations Procedure changed from 41OP-XS04 to 40OP-9SF04; 3) Calibration and Testing Procedures changed to a single procedure, MI#1SF00002.

Tasks and Topics Covered

The following tasks are covered in Reactor Power Cutback System :

Task or Topic Number*	Task Statement
Lesson:	Reactor Power Cutback System
SF02	Troubleshoot reactor power cutback system

Total task or topics: 1

TERMINAL OBJECTIVE:

1 Given the appropriate reference material, , the participant will describe the operation and maintenance of the Reactor Power Cutback System (RPCS) Mastery will be demonstrated by satisfactory completion of a Lab Practical Evaluation

1.1 State the purpose of the RPCS

1.2 Describe the input/output signals for RPCS, including their origin/destination

1.3 Given a block diagram for reference, , describe the operation of the RPCS on event of a Loss of Feedpump (LFP)

1.4 Given a block diagram for reference, , describe the operation of the RPCS on event of a Large Load Reject (LLR)

1.5 Given a Corrective Maintenance Work Order describing a fault in the RPCS, , troubleshoot the system in accordance with the applicable work order to determine the nature of the fault

I.	Subject Introduction	
II.	Attendance Sheet	
III.	Qualification	III. Discuss the two tasks involved and their link to qualification.
IV.	Introductions	
V.	Course Materials	V. Describe HO, LP, Prints, Tech Manual, etc.
VI.	Questioning Technique	VI. Directed or Open Forum
VII.	Course Objectives	
VIII.	JPM Description	

TO: 1 Given the appropriate reference material, , the participant will describe the operation and maintenance of the Reactor Power Cutback System (RPCS) Mastery will be demonstrated by satisfactory completion of a Lab Practical Evaluation

EO: 1.1 State the purpose of the RPCS

Main Idea	**Methods & Activities**
I. RPCS Overview	
A. Purpose	PPT slide
1. The purpose of the Reactor Power Cutback System is to, in conjunction with the Reactor Regulating System (RRS) and the Steam Bypass Control System (SBCS), prevent a reactor trip and the subsequent delay in returning to power generation by reducing reactor power rapidly to:	
a. Match NSSS thermal output to a reduced secondary capacity in the event of a Large Load Rejection (LLR).	a. i.e. turbine trip detected via 51% mismatch bistables in SBCS; QO generates secondary load of 8 x 6.9% = ≈56% (actually 8 x 10% = ≈ 80%)
b. Match NSSS thermal output to within the capability of one main feedwater pump turbine in the event of a Loss of Feedpump (LFP).	b. Feedpump's capacity ≈60%; subsequent setback of turbine load ≈60%; rx power cutback ≈60%

Main Idea	Methods & Activities
c. Permits the reactor plant to remain on-line	c. Has saved Rx trip several times at PVNGS
d. Significantly reduces the requirements for steam dump and bypass capacity and feedwater pump capacity.	d. Provision of 100% capacity Bypass Valves, Condenser, and Feedwater pumps would be prohibitive in cost and inefficient to operate.
2. This rapid power cutback is accomplished by causing the Control System to drop preselected rods. At the same time, the Turbine Control System is caused to reduce turbine power.	2. Review definitions of Cutback, Setback, and Runback:
	CB-Onetime adjustemnt of Reactor Power to ≈60% by dropping selected CEAs
B. Design Basis	
1. Automatically initiate, in response to signals generated in the Main FPCS, rapid reductions in Rx power to levels which assure continued NSSS operation without requiring action of safety equipment on loss of one of two operating FWP.	SB-Onetime adjustment of Turbine load to ≈60% by driving back EHC load set motors
	RB-Continuing adjustment of Turbine load until parameters monitored are in spec

2. Produce, in response to signals generated by the SBCS, rapid reductions in Rx power to power levels which assure continued NSSS operation without requiring action of safety equipment following large turbine load rejections including turbine trips from full power.	2. Safety parameters possibly challenged: High Pressurizer Pressure
3. Ensure that the Rx power reduction, commanded by the RPCS, is to a steady state level of between 20% and 75% of rated power.	PPT Slide
4. Provide an operator interface to inform the control room operator of automatic RPCS actions, and to allow the operator to intervene and manually initiate a power reduction.	
5. Avoid initiating spurious power reductions which might be caused by equipment failure.	

EO: 1.2 Describe the input/output signals for RPCS, including their origin/destination

Main Idea	Methods & Activities
II. Inputs\Outputs	PPT Slide. Refer to HO
A. System Equipment	
1. Reactor Power Cutback Control Panel (RPCCP)	1. Cabinet number SQN-C02
2. Reactor Power Cutback Module	
B. The RPCM receives inputs from:	
1. Main Feedpumps	a. RPCM actuates on two of two coincidence from either feedpump
a. Four oil pressure switch outputs (digital)	
b. Two from each feedpump	
c. Actuate at 75 psig decreasing	
2. RPCCP	PPT Slide
a. Allows CEA drop programming on event of LLR or LFP	
b. Allows manual CEA drops	
c. Provides indication of system status	

3. Steam Bypass Control System (SBCS) — PPT Slide

   a. Detects LLR if TLI or steam flow (secondary side demand) is incompatible with pressurizer pressure (primary side power).
      - a. Requires a 51% mismatch LLR signal from both SBCS panels, i.e. two of two ckts coincidence.

   b. Generates runback demand if secondary side load (TLI) is too high for primary plant power (T avg/P stm)
      - b. Drives EHC loadset motors back at rapid rate to decrease load.

4. Plant Monitoring Computer — PPT Slide

   a. <u>COULD</u> be used to automatically program the CEAs to be dropped by calculating the negative reactivity needed at any time.
      - a. Not used at PVNGS, manually programmed by operator

C. The RPCM sends output signals to:

1. Main Turbine Control System (TCS)
   - a. Onetime loadset motor adjustment to 60% at 480%/min

   a. <u>Setback</u> reduces turbine load to 60%

   b. <u>Turbine Load Increase Inhibit (TLII)</u> prevents turbine from picking load back up after a setback.
      - c. Monitors TLI for achievement of 60% setback; if not, runback at 120%/min. SBCS monitors Tavg/Pstm to detect TRPD for NSSS overcooling event (i.e. LFP with cutback)

   c. <u>Runback</u> may be generated by RPCS if SBCS detects that a mismatch of secondary load and primary power exists.

2. Main Control Room Annunciator System (MCRAS) — PPT Slide

   a. Reactor Power Cutback

   b. Reactor Power System Trouble

      (1) System Failure

      (2) Loss of a signal (LOFP or LLR) to the RPCS

      (3) Only one of two coincidence signals received

3. Steam Bypass Control System (SBCS) — PPT Slide

   a. Quick Open Block generated on loss of feedpump

   a. Prevents increasing secondary heat sink unnecessarily since SBCS has adequate capacity to support:

      1 feedpump @ ≈60%

      1 setback turbine @ ≈60%

      1 cutback reactor @ ≈60%

4. Control Elements Drive Mechanisms Control System (CEDMCS) PPT Slide

    a. RPCS generates two signals

        (1) Drop 1 (ARM)

        (2) Drop 2 (DROP)

    b. Both signals required by CEDMCS to cutback

    c. Subgroups 4, 5, 22 only ones wired in.

EO: 1.3 Given a block diagram for reference, , describe the operation of the RPCS on event of a Loss of Feedpump (LFP)

Main Idea	Methods & Activities
III. RPCS Operation	PPT Slide

A. Plant configurations to be considered are:

1. Rx Pwr = 0 - 69%
2. Rx Pwr = 70 - 74%
3. Rx Pwr = > 74%

B. Events to be considered are: PPT Slide

1. Loss of one Main Feedpump
2. Large Load Rejection

C. 40OP-9SF04, "Operation of the RPCS" states:

1. 0-69% RX power = RPCS not used at all

2. 70-74% RX power = No CEA selections made, but RPCS enabled to execute setback/runback

3. > 74% RX power = CEA subgroups 4, 5 and 22 (based on Core Data Book information) are selected for cutback, regardless of core load or core life

C. Rationale for these actions will be provided next.

D. 0-69% Reactor Power

1. LFP

a. No need for action

D. RPCS deenergized

a. Single feedpump has adequate capacity to provide heat sink

E. 70-74% Reactor Power — PPT Slide

1. LFP

a. No CEAs programmed

b. Secondary load reduced

(1) Setback to 60%

(2) Runback if needed

(3) TLII developed to prevent picking load back up

(4) LFP signal sent to SBCS for QOB, since a large secondary heat sink increase is not needed

(4) Meanwhile, RRS is reducing primary power based on Tave/Tref mismatch.

F. >74% Reactor Power — PPT Slide

1. LFP

a. CEA Subgroups 4, 5 and 22 dropped to bring RX power down to a level that a single operating feedpump can support

a. Drop command is maintained by RPCS for 10 seconds to prevent inadvertent CEDM re-latch while CEAs are dropping

b. Secondary load reduced

(1) Setback to 60%

(2) Runback if needed

(3) TLII developed to prevent picking load back up

(4) LFP signal sent to SBCS for QOB, since a large secondary heat sink increase is not needed

(4) Meanwhile, RRS is reducing primary power based on Tave/Tref mismatch.

EO: 1.4 Given a block diagram for reference, , describe the operation of the RPCS on event of a Large Load Reject (LLR)

Main Idea	Methods & Activities
III. RPCS Operation	PPT Slide

A. Plant configurations to be considered are:

1. Rx Pwr = 0 - 69%
2. Rx Pwr = 70 - 74%
3. Rx Pwr = >74%

B. Events to be considered are: PPT Slide

1. Loss of one Main Feedpump
2. Large Load Rejection

C. 40OP-9SF04, "Operation of the RPCS" states:	C. Rationales for these actions will be provided next
1. 0-69% RX power = RPCS not used at all	
2. 70-74% RX power = No CEA selections made, but RPCS enabled to execute setback/runback	
3. >74% RX power = CEA subgroups 4, 5 and 22 are selected for cutback, regardless of core load or core life	
D. 0-69% Reactor Power	D. RPCS deenergized
2. LLR	
a. No need for action	a. SBCS can accommodate a rejection from this RX power level
E. 70-74% Reactor Power	PPT Slide
2. LLR	
a. No need for action	a. SBCS can accommodate a rejection from this RX power level since other house steam loads (i.e. feedpump turbines) are still being fed.

F. >74% Reactor Power	PPT Slide
2. LLR	
a. CEA subgroups 4,5 and 22 are dropped to bring the steaming rate to within the capacity of the SBCS.	a. Simultaneously, SBCS develops a quick open demand to provide a secondary heat sink to the condenser.
G. Manual actuation	
1. Operator selects subgroup(s) at RPCCP.	1. Refer students to HO.
2. Must depress event select switch and Drop Subgroups switch simultaneously to cause cutback.	2. Demonstration will be held in lab on simulator later.
IV. Calibration and Testing	PPT Slide
A. Periodically a RPCS calibration test must be performed (MI#1SF00002).	
1. Power supplies PS-1 and PS-2 are checked	1. 24VDC +/- 0.20 V < 20 mV RMS ripple or < 100 mV peak-peak ripple
2. Timer Delay Modules Z1A and Z2A.	
a. Calibrated for 10 seconds. Uses a stop watch for a standard.	

B. Following the power supply checks, a functional test performed at the RPCCP and is used to verify operation of the RPCS.

B. Explain to the class that all subgroup select switches are tested even though only 4, 5 and 22 are used.

EO: 1.5 Given a Corrective Maintenance Work Order describing a fault in the RPCS, , troubleshoot the system in accordance with the applicable work order to determine the nature of the fault

Main Idea

V. Troubleshooting

1. Use system documentation

a. Tech Manual	
b. Functional Diagrams	b. Refer students to HO.
c. Wiring Diagrams	c. Display 01-J-SFE-067 (Loop Wiring Diagram). Using large copy, trace signal path and demonstrate logic if needed.
d. Procedures	d. MI or OP procedures provide RPCCP operation direction and predicted system responses

PRACTICE SESSION

FOLLOWING THE COMPLETION OF THIS CLASSROOM PRESENTATION, THE STUDENT WILL BE ALLOWED TO COMPLETE THE KNOWLEDGE QUESTIONS IN THE CLASSROOM.

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IN THE LAB THE STUDENT WILL BE GIVEN THE OPPORTUNITY TO FAMILIARIZE HIMSELF WITH THE RPCS MODULE, AND PRACTICE TROUBLESHOOTING PRIOR TO THE EVALUATION STEP. DURING THIS PRACTICE SESSION, DIRECTION MAY BE GIVEN TO THE STUDENT.

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ENSURE EACH STUDENT HAS ALL THE PROPER RESOURCES TO PERFORM THE LPE.

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MONITOR STUDENT'S PERFORMANCE OF THE LPE, TO ENSURE SAFE, CORRECT PERFORMANCE.

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PROVIDE ASSISTANCE AS NEEDED, TO ENABLE STUDENT MASTERY OF THE OBJECTIVES.

PERFORMANCE EVALUATION

FOLLOWING THE COMPLETION OF THIS PRACTICE SESSION, THE STUDENT WILL BE ALLOWED TO COMPLETE THE PERFORMANCE EVALUATION.

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IN THE LAB THE STUDENT WILL BE GIVEN THE LPE. DURING THIS EVALUATION, DIRECTION MAY NOT BE GIVEN TO THE STUDENT.

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ENSURE EACH STUDENT HAS ALL THE PROPER RESOURCES TO PERFORM THE LPE.

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MONITOR STUDENT'S PERFORMANCE OF THE LPE, TO ENSURE SAFE, CORRECT PERFORMANCE.

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SUMMARY OF MAIN PRINCIPLES

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.

Objectives Review

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

Questions and Answers

Oral questioning

Ask questions that implement the objectives. Discuss students' answers as needed to ensure the objectives are being met.

Problem Areas

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

Concluding Statement

If not done in the previous step, review the motivational points that apply this lesson to students needs. If applicable, end with a statement leading to the next lesson.

You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.