PALO VERDE
NUCLEAR GENERATING STATION

I&C Program

Classroom Lesson

I&C Program	**Date: 7/3/2007 2:55:55 PM**
LP Number: NID44C000103	**Rev Author: ROBERT M. PIERCE**
Title: BOP ESFAS	**Technical Review:** Wagner, Robert W(Z96542) Digitally signed by Wagner, Robert W(Z96542) DN: cn=Wagner, Robert W(Z96542) Reason: I have reviewed this document Date: 2011.07.08 11:59:37 -07'00'
Duration : 10 HOURS	
	Teaching Approval: Baker Sr, Lee E(Z07641) Digitally signed by Baker Sr, Lee E(Z07641) DN: cn=Baker Sr, Lee E(Z07641) Date: 2011.07.08 14:46:18 -07'00'

INITIATING DOCUMENTS

Site Maintenance Training Program Description

REQUIRED TOPICS

None

CONTENT REFERENCES

VTM G063-00002: BOP ESFAS Vendor Tech Manual
System Training Manual, Volume 50
36ST-9SA05: FBEVAS, CREFAS, and CRIVAS 18 Month Functional
PVNGS Unit 1 Startup Experience Report, Section III.D
LER 85-084 – Inadvertant CREFAS Initiaion
LER 88-019-00: Inadvertent ESF Actuation While Replacing Relay
VTD-G063-00002 Instructional Manual for BOP ESFAS
LER# 85-010-00; Automatic Actuation of BOP ESFAS Cabinet.
40OP-9SA02, De-energization of BOP ESFAS
Task# 064564 Install-Remove Cross Train B Jumpers
SOER 10-2: Engaged, Thinking Organizations

REVISION COMMENTS

Jul 03, 2007	Ed Blank	Record created Revision 02 - added Prevent Events tools to the lesson plan Revision 03 - added Human Performance Objective

Tasks and Topics Covered

The following tasks are covered in BOP ESFAS:

Task or Topic Number*	**Task Statement**
Lesson:	BOP ESFAS
SA06	Perform "FBEVAS, CREFAS, and CRVIAS 18 Month Functional Test", 36ST-9SA05 or equivalent
SA07	Troubleshoot BOP ESFAS

Total task or topics: 2

TERMINAL OBJECTIVE:

1 Given the applicable reference materials, the I&C Technician will describe the design, operation and maintenance of the Balance of Plant Engineered Safety Features Actuation System. Proficiency will be demonstrated by achievement of at least 80% on a written examination

1.1 State the purpose of the Balance of Plant Engineered Safety Features Actuation System

1.2 Describe the functions performed by the Balance of Plant Engineered Safety Features Actuation System

1.3 Describe the Balance of Plant Engineered Safety Features Actuation System to include major components, location of principal unit and sources of power

1.4 Identify the location, controls, inputs, and outputs of the BOP ESFAS channel power supply

1.5 Describe the operation of the controls located on the key lock switch panel

1.6 Identify the location and function of the isolator assembly

1.7 State the function and describe the construction and operation of the FBEVAS module, to include inputs, outputs, test features, controls, and indications

1.8 State the function and describe the construction and operation of the CPIAS module, to include inputs, outputs, test features, controls, and indications

1.9 State the function and describe the construction and operation of the CREFAS module, to include inputs, outputs, test features, controls, and indications

1.10 State the function and describe the construction and operation of the CRVIAS module, to include inputs, outputs, test features, controls, and indications

1.11 State the function and describe the construction and operation of the LOP/LS module, to include inputs, outputs, test features, controls, and indications

1.12 State the function and describe the construction and operation of the DGSS module, to include inputs, outputs, test features, controls, and indications

1.13 State the function and describe the construction and operation of the LOAD SEQUENCER/AUTO TEST module, to include inputs, outputs, test features, controls, and indications

1.14 Describe the use of Prevent Event Tools and Electrical Safe Work Practices to minimize human performance errors during testing or maintenance of the BOP ESFAS.

1.15 Given examples of BOP ESFAS maintenance problems, determine the fault using applicable BOP ESFAS prints, Tech Manuals, and applicable documents.

Lesson Introduction: BOP ESFAS

The following items are things to consider in your Lesson Introduction. They are not mandatory.

You should develop your own introduction and place that material in the Program Hierarchy in the Lesson Introduction Tab or appropriate Training Unit.

CLASSROOM GUIDELINES

- If applicable, remind students of class guidelines as posted in the classroom.
- Pass the attendance sheet around and have it signed in Dark ink.
- Ensure that student materials needed for the class are available for each student.
- Emphasize student participation and remind them of your philosophy on asking and answering questions, if applicable.

ATTENTION STEP

- Give a brief statement or story to get student concentration focused on the lesson subject matter.

LESSON INTRODUCTION

- Give a brief statement that introduces the specific lesson topic. Should be limited to a single statement.

MOTIVATION

- Focus student's attention on the benefits they derive from the training. At Instructor's discretion. The need for motivation in each succeeding lesson must be analyzed by the Instructor and presented as necessary.
- Instructor should include how the STAR process can be used to improve or enhance Operator Performance, if applicable.
- Read and discuss lesson terminal objective and review lesson enabling objectives, if desired.
- If applicable, briefly preview the lesson topic outline and introduce the major points to be covered. The objective review may have been sufficient.

- REINFORCE the following PVNGS management expectations as opportunities become available:

  Nuclear Safety

  Industrial Safety Practices

  STAR and Self-Checking

  Procedure Compliance

  Communication Standards

  ALARA

  Prevent Events

I.	Self Introduction	Introduce yourself and present your background and experience. Have the Students introduce themselves if desired.
II.	Classroom Guidelines	Identify the CLASS GUIDELINES posted in the classroom. Discuss as necessary
	A. Attendance Sheet	Pass the attendance sheet around and have it signed in black ink.
	B. Materials VTD G063-00002 NID44 Student Handout Prints: (In the following order) J104-66, J104-54, J104-55, J104-57, 01-E-SAF-0004 sh4, J104-23, J104-48, J104-24, J104-39, J104-25, J104-26, J104-12, J104-41, J104-40, J104-44, J104-32, J104-33, J104-15, J104-42, J104-43, J104-34, J104-35, J104-36, J104-14, J104-45, J104-27, J104-28, J104-13, J104-46, J104-47, J104-29, J104-30, J104-31, J104-16	Ensure that the materials needed for the class are available for each student.
	C. Questions and Participation	Discuss the importance of participation.
III.	Attention Step	Get the attention of the students on you rather than outside interests.
IV.	Course Introduction	Briefly introduce the course subject and how this course fits into the qualification program.
V.	Motivation	Focus student attention on ”What’s In It For Me”.

VI.	Course Pre-Summary	
	A. General Schedule	Discuss the schedule for the course, i.e. amount of classroom, lab, break frequency, examination type and time
	B. Course Terminal Objective (for first lesson of course only)	Read and/or discuss the course terminal objective. Identify tasks they will be qualified to do upon completion of the course
	C. Questions and answers	Allow time for students to ask questions prior to beginning lesson.
VII.	Lesson Introduction	Introduce the lesson material
	A. Lesson Terminal Objective	Read and/or discuss the lesson objectives
	B. Lesson Enabling Objectives	

TO: 1 **Given the applicable reference materials, the I&C Technician will describe the design, operation and maintenance of the Balance of Plant Engineered Safety Features Actuation System. Proficiency will be demonstrated by achievement of at least 80% on a written examination**

EO: 1.1 **State the purpose of the Balance of Plant Engineered Safety Features Actuation System**	
CONTENT	**METHODS & ACTIVITIES**
1) BOP ESFAS Design	
a)Purpose of BOP ESFAS	
i) Provide continuous monitoring of selected plant variables	VTD page 2-1
ii) Actuate BOP ESF equipment when monitored parameters exceed setpoints	
iii) Provide load sequencing necessary for proper ESF system operation	
b)Minimize the consequences of the following design base accidents	
i) Fuel handling accident	
ii) Fire/smoke – plant vicinity (manual actuation only)	
iii) Loss of power	

EO: 1.2 Describe the functions performed by the Balance of Plant Engineered Safety Features Actuation System	
CONTENT	**METHODS & ACTIVITIES**
1) BOP ESFAS System Functions	VTD Tab 2, PPT Slides
a)Fuel Building Essential Ventilation Actuation Signal (FBEVAS).	
i) Two redundant filter trains actuated by 1 of 2 independent high radiation or airborne signals.	
ii) Maintains negative pressure in fuel building to prevent leakage of unfiltered air to environment after fuel handling accident in fuel building	
b)Containment Purge Isolation Actuation Signal (CPIAS).	
i) Power Access and Refueling Purge stopped and inlets and outlets isolated by 1 of 2 high airborne activity signals	
ii) Minimizes offsite dose in event of a fuel handling accident in Containment	
c)Control Room Essential Filtration Actuation Signal (CREFAS).	
i) Actuated by 1 of 2 C.R. air intake high airborne activity signals, FBEVAS, or CPIAS	
ii) Minimizes dose to Control Room operators by isolating normal ventilation and activating charcoal filter system	
d)Control Room Ventilation Isolation Actuation Signal (CRVIAS).	
i) Actuated manually by Control Room operator upon smoke alarm for outside air intake plenum	
ii) Chlorine detector actuation deleted	

iii) Isolates normal and essential ventilation for control room	
e)Loss of Power/ Load Shed (LOP/LS).	
i) Actuated by 2 of 4 undervoltage relays on 4.16 KV bus	
ii) 1 second Load Shed pulse sheds 4.16 KV and selected 480 V loads and trips 4160 preferred offsite supply breakers	
iii) 60 second off delay LOP actuates forced shutdown loads	
f) Diesel Generator Start signal (DGSS).	
i) Actuated by AFAS-1 or AFAS-2, SIAS/CSAS, or LOP signals	
ii) Starts DG and DG exhaust system	
g)Load Sequencer	
i) Actuated by LOP, SIAS, CSAS, AFAS, DG run, CREFAS, CRVIAS, or FBEVAS to appropriate mode	
ii) Generates sequential timed start and permissive signals to ESF and forced shutdown system fans, pumps, and chillers	
iii) Auto tests each module every 22 seconds when in auto test	

EO: 1.3 Describe the Balance of Plant Engineered Safety Features Actuation System to include major components, location of principal unit and sources of power	
CONTENT	**METHODS & ACTIVITIES**
1) BOP ESFAS General Description	
i) Comparison to NSSS ESFAS	
(1) Single channel input vice 4 channel input for NSSS ESFAS from PPS	
(2) Provides its own interface isolation vice Electronic Isolation System	
(3) Supports NSSS ESFAS by monitoring inputs such as RMS, electrical and HVAC	
ii) Major Components or Sections	Dwg J104-66: Block Diagram
(1) Measurement channels use radiation and voltage sensors	
(2) All inputs are contact action – Open or Closed	
(3) Initiation logic processes trip, test, and bypass inputs	
(4) Actuation logic operates relays to actuate equipment	
(5) Actuated equipment includes components of other systems, such as HPSI pumps	
b)BOP ESFAS Cabinets	
Prevent Events, Electrical Safe Work Practices; *Remind students that I&C personnel do not exclusively deal with low voltage signal processing (less than 50 volts). As a minimum, safety glasses will be worn when working inside BOP-ESFAS cabinets.*	

Maximum voltage encountered in BOP-ESFAS cabinets is vital 120vac, and 125vdc for the power supplies, and some relay decks. Per Electrical Safe Work Practices procedure, 01DP-0IS13, the restricted approach boundary and prohibited approach boundary for qualified employees is 'Avoid Contact'. When voltages greater than 50 volts are encountered, blue low voltage gloves will be worn.	
Prevent Events, FME concerns; *Perform a FME evaluation prior to starting work. Use applicable sections of appendices A, B, C, of 30DP-9MP03 System Cleanliness and FME Controls. Depending on work scope, insulated sheeting and other FME barriers may be needed.*	
Whenever de-terming/removing relays from BOP ESFAS ensure that surrounding area is well insulated to avoid grounding leads/actuating equipment. Either method below is acceptable: *1) Use electrical tape and create an extensive insulation barrier when de-terming, removing, or reinstalling relays.* *2) Use electrical barrier sheeting which is much easier to install/remove and more effective.*	
i) BOP ESFAS cabinet located NW corner of 140' Control Room in front of RMS (SQ) cabinets	VTD pages 2-1 thru 2-8; Dwg J104-54/55: Control Board Assembly
(1) Each Train has dual cabinet assemblies	
(a) One cabinet contains the electronic assemblies	
1. Cabinet layout: A2 to A6, top to bottom and add on A7 on top	
a. A2 – Load Sequencer/Auto Tester	
b. A3 – FBEVAS, CREFAS, CPIAS, LOP/LS, CRVIAS and DGSS modules	
c. A4 – BYPASS switch assembly	BYPASS Switch Assembly
d. A5 – Isolator Network Assembly	
e. A6 – power supply assembly	
f. A7 – fan assembly	

2. All relays in the back and are normally energized with the following exceptions:	
a. K202 and K204 – load shed relays	
b. K231 – charging pump	
c. K234 – spare	
d. K235 – Containment Normal	
Prevent Events; *exercise great caution when working on or around BOP ESFAS relays, particularly the normally de-energized relays.* ***SOER 10-2, Engaged, Thinking Organizations;*** *workers must fully understand and anticipate the effects of their actions. Even momentary grounding of BOP ESFAS relays will cause ESF equipment actuations including DG start.*	
(b) The other cabinet contains the terminal blocks for connections to external equipment	
1. Terminal boards and points numbered sequentially from top to bottom in Train A	
2. Terminal boards and points numbered sequentially from bottom to top in Train B	
ii) Power from 2 class 1E sources for each train, each feeding 28 vdc P/S with auctioneered outputs	
(1) One supply 120 VAC Vital bus, Vital A for A train and Vital B for B train	PNA-D25, PNB-D26
(2) Other supply Class 1E 125 VDC, A for A train, B channel for B train	PKA-D21, PKB-D22

EO: 1.4 Identify the location, controls, inputs, and outputs of the BOP ESFAS channel power supply	
CONTENT	**METHODS & ACTIVITIES**
1) BOP ESFAS Major Component Description	
i) Power Supply	VTD pages 12-1 thru 12-4; Dwg J-E-SAF-004 sh1 or sh4: Power Supply
(1) Located in A6 assembly at bottom of bay 1.	
(2) Power supply controls and indicators	
(a) Over temperature, over- voltage, and over-current protected.	
(b) 2 ganged 15 amp breakers, one for each power converter	
(c) Red light downstream of each breaker	
(d) Red LED on output of each power supply	
Prevent Events; *Observe Electrical Safe Work Practices procedure, 01DP-0IS13, requirements. Low voltage gloves required on >50volts*	
(3) 120 VAC input to AC/DC converter; 125 VDC into DC/DC converter – local and remote red lamps monitor input power	
(4) Power supply outputs auctioneered 28 VDC	
(a) Local red LED and red lamp on key lock switch panel monitor each output	
(b) Output of AC/DC set slightly higher so 120 VAC will be normal source	
(c) Relays monitor each 28 VDC output and cause High temp/power supply trouble alarm in Control Room if either fails	

(5) Air flow sensor in each P/S monitors internal fan by temp. switch in air flow stream	
(a) Each fan powered by associated P/S	
(b) Each fan status indicated by red lamp on key lock switch panel – lamps may flicker when bay door open due to fan mods	CRDR 2652951 (P/S fan rotation)
(6) Power supply failure in a train	
(a) Loss of one has no effect due to auctioneering	
(b) Loss of both de-energizes cabinet and drops out sequencing and module group actuation relays, causing module actuations and starting loads	

EO: 1.5 Describe the operation of the controls located on the key lock switch panel	
CONTENT	**METHODS & ACTIVITIES**
1) Key Lock Switch Panel	Dwg J104-23 Key Lock Switch Panel; J104-48 System Interconnection Diagram Misc Train A; VTD page 2-4
a)Located in A4 assembly of each BOP ESFAS train	Key Lock Switch Panel
b)Controls and indicators on panel are	
i) LAMP TEST pushbutton/ lamp – lights all module lamps when pushed	
ii) KEYLOCK BYPASS switches for all module inputs except DGSS and Load Sequencer – blocks selected parameter field or test trip inputs	
(a) Interlocked so same parameter cannot be bypassed in both trains at same time	
(b) Keys captured by lock in bypass	
iii) Red POWER lamps indicate 120 VAC, 125 VDC, and 28VDC power for PS1 and PS2	
iv) Red FAN 1 and FAN 2 lamps indicate flow from PS1 and PS2 internal cooling fans	

EO: 1.6 Identify the location and function of the isolator assembly	
CONTENT	**METHODS & ACTIVITIES**
1) Isolator Assembly	VTD pages 13-1 thru 13-7; Dwg J104-24 Isolator Schematic
a)Isolators located behind A5 assembly hinged panel on a single board	
i) 18 isolator channels per card	
ii) inputs on TB1, outputs on TB2	
b)Function is to isolate communication between logic trains A and B	
i) Uses photodiode optically coupled to a phototransistor	
ii) Used in on/off states only	
2) Cabinet Fan Assembly	
a)2 fused 120 VAC fans for cabinet cooling suck air up through cabinet	
b)Thermostat device causes High Temp/Power Supply Trouble alarm if temperature above setpoint	
i) Added on after Sequencer overheated due to a fan failure	PVNGS Unit 1 Startup Experience Report, Section III.D
ii) Located on A7, top panel assembly	

EO: 1.7 State the function and describe the construction and operation of the FBEVAS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) FBEVAS Module	VTD pages 7-1 thru 7-7
a) Function is to monitor FB exhaust duct and Fuel Pool area rad. Levels to reduce radioactive release after fuel handling accident in spent fuel area	
b) Operates FB ventilation on 1 of 2 FB high radiation or airborne trips. i) SQA-RU-31 is an area monitor ii) SQB-RU-145 is a gaseous monitor located in the normal exhaust duct	
c) Inputs to FBEVAS module	Dwg J104-39 FBEVAS Interconnection diagram
i) SQA-RU-31 on east wall of 140 foot Fuel Building overlooking fuel pool – sends a trip to the A train	
ii) SQB-RU-145 on 176’ of W. end FB sends trip to B train	
(a) Time Delay relay added between RU31 contact and the module input	
(b) TD relay prevents spurious output from the monitors from causing an actuation as well as filtering noise	
iii) Manual trip input from spring return switch on B05 (ground to trip).	
iv) Module address and auto test pulse train input from Seq./Auto test module	
v) Lamp test bus input (normally high, ground to test lights).	
vi) Bypass inhibit from cross train FBEVAS	

vii) Keylock bypass switch (signal ground in bypass).	
viii)Cross logic (train) actuation signal	
d)FBEVAS Module Outputs	
i) FBEVAS annunciation relay	
ii) Bypass annunciation relay	
iii) Cross train bypass inhibit via the isolator card	
iv) Test response to Auto Test module	
v) Trip annunciation relay	
vi) Test annunciation relay	
vii) Cross channel trip to FBEVAS via the isolator card	
viii)Essential and non-essential actuation relays – outputs to ERFDADS, QSPDS, SESS	
ix) Trip output signal to load sequencer	
x) Manual actuate computer input relay	
e)Test features	Dwg J104-25 Schematic FBEVAS
i) LAMP TEST will light all module indicators to test for faulty bulbs	
ii) BYPASS blocks field or test trip inputs from reaching actuation logic for that train	
iii) BYPASS INHIBIT isolated signal sent to opposite train so if both in bypass, both drop out	
iv) Local TEST switch/lamp opens ground path to photodiode (same as field trip does); turns photo transistor off – lights Test lamp and gives Test annunciation in Control Room	

f) Controls and indicators	
i) TRIP/RESET switch and 2 section lamp	
(a) TRIP lights solid on field or test trip; dimly on auto test	
(b) RESET lit when field or test trip input clear (after trip only).	
(c) RESET switch resets trip flip flop after reset lit	
ii) TEST switch/lamp lights solid during auto test or when pushed	
(a) Flashes if error during auto test of FBEVAS module	
(b) Causes test trip when pushed	
iii) BYPASS light indicates module bypassed – defeats field and test trips only	
iv) ACTUATE/MAN/RESET switch and 3 section lamp clears manual trip when pushed (all 3 lamps must be lit)	
(a) ACTUATE lit when any trip has initiated	
(b) MAN lit (with ACTUATE) when manually tripped from C.R	
(c) RST lit when MAN trip reset	
v) Manual trip switch on B05 in Control Room	
g)Two interlocks for FBEVAS	Dwg J104-48
i) Missing module interlock causes BOP ESFAS in test alarm (along with door open).	
ii) Jumper on module opens series circuit when module removed	

h)Operation of FBEVAS	Go through prints J104-25, and –26 with class; CPIAS and CREFAS modules are similar, FBEVAS used since it is typical
i) Normal input	
ii) TEST pushbutton input	
iii) Auto test operation	
iv) Field trip input	
v) Bypass condition with any input	
vi) Manual trip	
vii) Cross train trip	
viii)Reset switch ops	

EO: 1.8 State the function and describe the construction and operation of the CPIAS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) CPIAS Module	
a) Function of CPIAS is to prevent release of radioactivity if fuel handling accident occurs in Containment	
b) Operates containment ventilation system on 1 of 2 high containment purge duct area radiation monitors — combined with CIAS to isolate Containment. isolation valves	
c) Inputs	
i) SQA-RU-37 and SQB-RU-38 in E. electrical penetration room, 140’ Aux Bldg. Between Power Access and Refueling Purge ducts	
ii) Manual trip input from spring return switch on B05 (ground to trip).	
iii) Module address and auto test pulse train input from Seq./Auto test module	
iv) Lamp test bus input (normally high, ground to test lights).	
v) Bypass inhibit from cross train CPIAS	
vi) Keylock bypass switch (signal ground in bypass).	
vii) Cross logic (train) actuation signal	
d) Outputs	
i) CPIAS annunciation relay	

ii) Bypass annunciation relay	
iii) Cross train bypass inhibit	
iv) Test response to Auto Test module	
v) Trip annunciation relay	
vi) Test annunciation relay	
vii) Cross channel trip to CPIAS	
viii) Cross train trip output to isolator	
ix) Subchannel B actuation relays – outputs to ERFDADS, QSPDS, SESS	
x) Manual actuate computer input relay	
e) Test features	
i) LAMP TEST will light all module indicators to test for faulty bulbs	
ii) BYPASS blocks field or test trip inputs from reaching actuation logic for that train	
iii) BYPASS INHIBIT isolated signal sent to opposite train so if both in bypass, both drop out	
iv) Local TEST switch/lamp opens ground path to photodiode (same as field trip does); turns photo transistor off – lights Test lamp and gives Test annunciation in Control Room	
f) Controls and indicators	
i) TRIP/RESET switch and 2 section lamp	
(a) TRIP lights solid on field or test trip; dimly on auto test	

(b) RESET lit when field or test trip input clear (after trip only).	
(c) RESET switch resets trip flip flop after reset lit	
ii) TEST switch/lamp lights solid during auto test or when pushed	
(a) Flashes if error during auto test of CPIAS module	
(b) Causes test trip when pushed	
iii) BYPASS light indicates module bypassed – defeats field and test trips only	
iv) ACTUATE/MAN/RESET switch and 3 section lamp clears manual trip when pushed (all 3 lamps must be lit)	
(a) ACTUATE lit when any trip has initiated	
(b) MAN lit (with ACTUATE) when manually tripped from C.R	
(c) RST lit when MAN trip reset	
v) Manual trip switch on B05 in Control Room	
g) Interlocks	
i) Missing module interlock causes BOP ESFAS in test alarm (along with door open).	
ii) Jumper on module opens series circuit when module removed	

h) Operation of CPIAS	Refer back to FBEVAS schematics if any questions arise. Point out that CPIAS module is identical except for address code switch setting
i) Normal input	
ii) TEST pushbutton input	
iii) Auto test operation	
iv) Field trip input	
v) Bypass condition with any input	
vi) Manual trip	
vii) Cross train trip	
viii) Reset switch ops	

EO: 1.9 State the function and describe the construction and operation of the CREFAS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) CREFAS Module	
a) Function is to minimize exposure of C.R. operators in accident conditions	
b) Operates charcoal filtration system for C.R. on 1 of 2 high airborne activity signals from C.R. air intake monitors	
c) Inputs	
i) SQA-RU-29 and SQB-RU-30, located in smoke ejector fan room, 160' Cable Spreading Room	
ii) Manual trip input from spring return switch on B05 (ground to trip).	
iii) Module address and auto test pulse train input from Seq./Auto test module	
iv) Lamp test bus input (normally high, ground to test lights).	
v) Bypass inhibit from cross train CPIAS	
vi) Keylock bypass switch (signal ground in bypass).	
vii) Cross logic (train) actuation signal	
viii) Cross channel trips from same train CPIAS or FBEVAS	
d) Outputs	
i) CREFAS annunciation relay	
ii) Bypass annunciation relay	
iii) Cross train bypass inhibit	
iv) Test response to Auto Test module	

v) Trip annunciation relay	
vi) Test annunciation relay	
vii) Cross train trip output to isolator	
viii) Sub-channel F and G actuation relays – outputs to ERFDADS, QSPDS, SESS	
ix) Trip output signal to load sequencer	
x) Manual actuate computer input relay	
e)Test features	
i) LAMP TEST will light all module indicators to test for faulty bulbs	
ii) BYPASS blocks field or test trip inputs from reaching actuation logic for that train	
iii)BYPASS INHIBIT isolated signal sent to opposite train so if both in bypass, both drop out	
iv)Local TEST switch/lamp opens ground path to photodiode (same as field trip does); turns photo transistor off – lights Test lamp and gives Test annunciation in Control Room	
f) Controls and indicators	
i) TRIP/RESET switch and 2 section lamp	
(a) TRIP lights solid on field or test trip; dimly on auto test	
(b) RESET lit when field or test trip input clear (after trip only).	
(c) RESET switch resets trip flip flop after reset lit	
ii) TEST switch/lamp lights solid during auto test or when pushed	

(a) Flashes if error during auto test of CPIAS module	
(b) Causes test trip when pushed	
iii) BYPASS light indicates module bypassed – defeats field and test trips only	
iv) ACTUATE/MAN/RESET switch and 3 section lamp clears manual trip when pushed (all 3 lamps must be lit)	
(a) ACTUATE lit when any trip has initiated	
(b) MAN lit (with ACTUATE) when manually tripped from C.R	
(c) RST lit when MAN trip reset	
v) Manual trip switch on B05 in Control Room	
g) Interlocks	
i) Missing module interlock causes BOP ESFAS in test alarm (along with door open).	
ii) Jumper on module opens series circuit when module removed	
h)Operation of CREFAS	Refer back to FBEVAS schematics if any questions arise. Point out that CREFAS module is identical except for address code switch setting
i) Normal input	
ii) TEST pushbutton input	
iii) Auto test operation	

iv) Field trip input	
v) Bypass condition with any input	
vi) Manual trip	
vii) Cross train trip	
viii)Reset switch ops	

EO: 1.10 State the function and describe the construction and operation of the CRVIAS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) CRVIAS Module	
a)Function is to protect C.R. operators in event of contamination of inlet air by other than radioactivity	
b)Operates C.R. ventilation (isolates normal inlet air) when manually actuated by C.R. operator	
i) Operated when smoke detectors in outside air inlet plenum alarm	
ii) Chlorine detectors deleted	
c)Inputs	
i) Field inputs jumpered (2; Chlorine detectors and smoke detectors)	
ii) Manual trip input from spring return switch on B05 (ground to trip).	
iii) Module address and auto test pulse train input from Seq./Auto test module	
iv) Lamp test bus input (normally high, ground to test lights).	
v) Bypass inhibit from 1 and 2 from cross train CRVIAS	
vi) Keylock bypass switch #1 and #2 (signal ground in bypass).	
vii) Cross train isolated CRVIAS 1 and 2 initiation	
d)Outputs	
i) CRVIAS annunciation relay	
ii) Bypass annunciation relay	

iii) Cross train bypass inhibit 1 and 2	
iv) Test response to Auto Test module	
v) Trip annunciation relay	
vi) Test annunciation relay	
vii) Cross train trip output 1 and 2 to isolators	
viii)Subchanel D and E actuation relays – outputs to ERFDADS, QSPDS, SESS	
ix) Trip output signal to load sequencer	
x) Manual actuate computer input relay	
e)Test features	
i) LAMP TEST will light all module indicators to test for faulty bulbs	
ii) BYPASS blocks field or test trip inputs from reaching actuation logic for that train	
iii) BYPASS INHIBIT isolated signal sent to opposite train so if both in bypass, both drop out	
iv) Local TEST switch/lamp opens ground path to photodiode (same as field trip does); turns photo transistor off – lights Test lamp and gives Test annunciation in Control Room	
f) Controls and indicators	
i) TRIP/RESET switch and 2 section lamp lights Trip 1 when Test 1 tripped	
(a) Lights RST lamp when Test 1 pushed again (test trip clear).	
(b) Pushing switch after RST lit clears trip	
ii) TRIP 2/RST same as TRIP 1 except Test 2 trips	

iii) TEST 1/BYPASS 1 switch and 2 section lamp; lights Bypass lamp when Bypass 1 enabled	
(a) Lights TEST 1 lamp when pushed once	
(b) Switch initiates Test 1 trip when pushed once; clears test trip when pushed again	
iv) TEST 2/BYPASS 2 switch same as 1 except channel 2 is operated	
v) ACTUATE 1/ACTUATE 2 lights appropriate Actuate lamp when a channel initiates	
vi) MANUAL/RESET switch and 2 section lamp lights Manual when B05 manual trip actuated	
(a) Reset lit when manual switch in normal	
(b) Pushing switch after Reset lit clears manual trip	
g)Interlocks	
i) Missing module interlock causes BOP ESFAS in test alarm (along with door open).	
ii) Jumper on module opens series circuit when module removed	
h)Operation of CRVIAS	Dwg J104-32 and J104-33 Discuss operation of CRVIAS module
i) Manual trip only by the operator, no cross train trip occurs on manual actuation	
ii) Normal circuitry is in place, but not used	

EO: 1.11 State the function and describe the construction and operation of the LOP/LS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHOD & ACTIVITIES**
1) LOP/LS Module	Dwg J104-42 and J104-43 Interconnection Diagram LOP/LS
a)Function is to strip 4.16 KV and selected 480 VAC loads AND to open the breakers feeding the ESF bus from the SU Xfmr. This allows EDG to load onto dead ESF bus, thus prevents parallel or trip of diesel during LOP conditions	Electrical Power Distribution slide
i) LOP signal energizes two Load Shed (LS) relays and de-energizes two LOP relays	
(a) LS relays open ESF breakers	
(b) LOP relays position dampers, valves, starts motors, close breakers	
ii) Module maintains the LS contact state for one second by requesting a timer to run in the Sequencer	
iii) A 60 second off delay timer prevents BOP ESFAS from acting on a ESF power recovery (clearing the LOP) until ESF loads have been sequenced	
b)Generates LOP and Load Shed signals (with Load Seq. Module) on 2 of 4 UV relay trips on class 1E 4160 VAC bus	
c)Inputs	
i) Field inputs from U/V relays monitoring 4160 VAC bus (4 channels per train).	
(a) S03 for A train; S04 for B	

(b) One U/V relay OR'd with one 35 sec. Delay degraded voltage relay	
ii) Module address and auto test pulse train input from Seq./Auto test module	
iii) Lamp test bus input (normally high, ground to test lights).	
iv) Bypass inhibit 1 through 4 from cross train LOP/LS – four bypasses allow testing and prevent	
(a) Disabling of the Load Shed and LOP signals	
(b) Tripping both diesels	
v) Keylock bypass switch #1 through 4 (signal ground in bypass).	
d)Outputs	
i) Load Shed group 1 and 2	
ii) LOP group 1 and 2 relays	
iii) Loss of Offsite Power annunciator relay	
iv) Manual actuation computer input relay	
v) UV-1 (2,3,4) Trip, TEST, BYPASS annunciator relays (12)	
vi) Isolated bypass inhibits to other train (4)	
vii) Load Seq. LOP signal	
viii)DGSS module LOP signal	
ix) Test return to Load Seq.	
e)Test features	
i) LAMP TEST will light all module indicators to test for faulty bulbs	

ii) BYPASS blocks field or test trip input for channel 1 (2, 3, or 4) – BYPASS INHIBIT isolated signal sent to opposite train so if both channel 1's or 2 or 3 or 4 in bypass, both drop out for that channel	
iii) Local TEST switch/lamp applies ground to photodiode (same as field trip does); turns photo transistor off – lights Test lamp and gives Test annunciation in Control Room	
iv) Auto tested by LS/AT	
f) Controls and indicators	
i) U/V-1 (2,3,4)/TST/BYP switch and 3 section lamps give test trips when pushed	
(a) U/V section lit when trip input exists	
(b) BYP lit when in bypass	
(c) TST lit solid when auto tested or button pushed once; flashes if error on auto test	
ii) ACTUATE/MANUAL switch and 2 section lamp actuates LOP/LS if pushed	
(a) Actuate lit if 2 of 4 trips or manual trip cause actuation	
(b) MANUAL lit when button is pushed, causes trip	
g)Interlocks	
i) Missing module interlock causes BOP ESFAS in test alarm (along with door open) – jumper on module opens series circuit when module removed	
ii) BYPASS interlock prevents U/V-1 (2,3,4) in both trains out of service at same time; both drop out of bypass	

h) Operation	J104-34, J104-35 and J104-36 Schematic LOP/LS; Point out no cross train action on LOP/LS
i) Normal and trip input conditions	
ii) TEST pushbutton input	
iii) Auto test operation	
iv) Bypass condition with any input	
v) Local manual trip	
vi) Trip reset	

EO: 1.12 State the function and describe the construction and operation of the DGSS module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) DGSS Module	
a) Function is to start diesel on LOP, SIAS/CSAS, AFAS 1 or AFAS 2 to ready the emergency bus for loading	
b) Operates the diesel start, override, and essential air handling unit	
c) Inputs	Dwg J104-45 Interconnection Diagram for DGSS
i) Contact inputs from NSSS ESFAS SIAS/CIAS, AFAS-1, and AFAS-2	
ii) Auto test enable and test pulse train input	
iii) LOP/LS module output on LOP	
d) Outputs	
i) Passes SIAS/CSAS, AFAS 1 and AFAS 2 actuation signals on to Load Seq	
ii) Auto test response	
iii) DGSS essential actuation relay	
iv) Annunciation to SESS	
v) DGSS output relay to plant computer	
vi) Manual actuated output relay to PMS	
e)Test features	
i) LAMP TEST will light all module indicators to test for faulty bulbs	

ii) Test pushbuttons cause initiation and send signal to seq	
f) Controls and indications	
i) LOP/TEST switch and 2 section light gives LOP test trip when pushed	
(a) LOP lit solid indicates LOP or test trip; flashes under auto scan	
(b) TEST lit solid indicates auto test or test trip; flashing means auto test error	
ii) SIAS/CSAS/TEST and AFAS/TEST operate same as LOP/TEST	
iii) DGSS/MANUAL switch and 2 section lamp gives manual actuation when pushed	
(a) DGSS lit on any actuation	
(b) Manual lit when pushed; clears when released	
g) Interlocks – Missing module interlock causes BOP ESFAS in test alarm (along with door open), jumper on module opens series circuit when module removed	Emphasize that there are no bypasses for DGSS
h)Operation	Dwg J104- and J104- Schematic for DGSS; Stress that there is no cross train DG start
i) Normal input conditions	
ii) TEST pushbutton input	
iii) Auto test operation	
iv) Trip input	
v) Manual trip	

EO: 1.13 State the function and describe the construction and operation of the LOAD SEQUENCER/AUTO TEST module, to include inputs, outputs, test features, controls, and indications	
CONTENT	**METHODS & ACTIVITIES**
1) Load Sequencer/Auto Test Module	VTD section 11
a)Two major functions	
i) Monitors LOP and accident signals and initiates 1 of 4 loading sequences upon detection of proper combination	
ii) Automatically tests system and causes alarm on detection of malfunction.	Auto test normally off
b)Load Seq. Provides start signals for ESF equipment needing sequencing	
i) Provides ESF signals in timed manner to meet bus loading and ESF actuation requirements	
ii) Generates LOP and Load Shed pulses for LOP/LS module (1 and 60 second signals)	
iii) Controls most pumps, fans, and chillers (i.e. large loads), but no valves or dampers (i.e. small loads done by NSSS) which are handled by the individual modules	
c) Inputs	J104-46 and J104-47 System Interconnection Diagram Load Sequencer/Tester
i) DG breaker (shut)	
ii) DG running field input	
iii) Module test responses	
iv) Stall test response from other load sequencer	

v) FBEVAS, CREFAS, CRVIAS, CSAS/SIAS, AFAS, LOP field inputs	
vi) Logic test push buttons	
vii) Lamp Test	
d)Outputs	
i) Square wave (stall) signal to other train	
ii) Mode 1 through 4 computer input relays	
iii) Opposite train stalled annunciator relay	
iv) Auto test fail annunciator relay	
v) Auto test on annunciator relay	
vi) Module under test lamp drive (4 for DGSS)	
vii) Module select/test enable bus drive	
viii)14 actuation relays	
ix) Load Shed 1 sec pulse to LOP/LS	
x) LOP 60 sec. Off delay to LOP/LS (output persists for 60 sec. After U/V signal clears).	
xi) Auto test pulse bus drive	
e)Controls and indicators	
i) 9 test switch/3 section lamps simulate all field inputs to load seq	
ii) TST lit on any switch when pushed	
iii) 9 input lights lit when input module actuated or test button pushed	
iv) 15 actuation relay output lights; lit when sequenced.	

v) MANUAL/AUTO switch/2 section lamp shifts test mode when pushed – Light lit for appropriate mode	
vi) START/STOP momentary switch/2 section lamp has no switch function	
(a) Auto starts when placed in auto; START lights	
(b) STOP lit when in manual or auto test stopped.	
vii) Module test light lit when self testing	
viii) STALL OPP TRAIN light lit when no square wave from other sequencer	
ix) CONT NOR, CEDM NOR, CHG P normally lit; permissive relays	
f) Manual testing	
i) Pressing of the TST buttons on load seq. Causes seq. Response as if real input	
(a) If in auto, seq. Will light STOP (AUTO stays lit).	
(b) Pressing again clears trip	
ii) Seq. Always checks for opposite train stall or real input	
g)Auto test features	
i) Self tests by checking top and bottom halves of RAM separately and doing check sum on ROM – error will cause light pattern to flash on seq. And halt all operations to prevent improper actuation	
ii) During module test, lights test lamp on chosen module, trip lights may flicker due to 10 msec. Test pulse	

(a) Error will cause flashing test light on module	
(b) Error may not be in that module	
iii) Removing seq. From auto test while strobe other modules can cause actuation	See Operating Experience below
iv) Actual input blocks test pulse and STOP auto test; test recommences after clear	
v) Modules in bypass will halt auto test and cause error output	
h)Modes of operations	VTD pages 4-30 thru 4-37; pages 11-10 and 11-11, and pages 11-14 and 11-15. Dwg J104-46
i) Mode 0: no inputs or Auto Test	
ii) Mode 1: SIAS or CSAS without LOP	
iii) Mode 2: SIAS or CSAS with LOP and DG breaker shut	
iv) Mode 3: LOP and DG breaker shut and no SIAS or CSAS	
v) Mode 4A: AFAS and no LOP, no SIAS, no CSAS	
vi) Mode 4B: CREFAS or CRVIAS and no LOP, SIAS, or CSAS	
vii) Mode 4C: FBEVAS and no LOP, SIAS, CSAS	
viii)Mode 4D: DG run and no LOP, SIAS, CSAS	
Prevent Events, Operating Event; *Palo Verde Unit-1, LER# 85-010-00; Automatic Actuation of BOP ESFAS Cabinet.*	
1) What happened?	
a) Automatic actuation of the Balance of Plant Engineered Safety Features Actuation System (BOP ESFAS) occurred when transferring the Train "A" sequencer from manual mode to auto mode.	

2) Why did it happen?
a) Investigation showed that digital circuit flip-flop U-14 at MC 6676 is set for a short period while the FBEVAS module is being tested by the sequencer diagnostic software program. *i) If a transfer from auto to manual is completed at the proper instant, flip-flop U-14 can be left in the set condition with no means for it to reset:* *ii) This results in a valid trip condition, thereby causing the sequencer in Train "A" to actuate the appropriate equipment and also to cross-trip Train "B" causing the same sequencing.* *iii) This timing situation was verified by the equipment vendor.*
3) Can it happen again?
a) T*o prevent a recurrence of this type of trip, it is required that the BOP ESFAS only be transferred from auto to manual when the sequencer is in module test (the test lamp lit on the sequencer).* i) *Both Train "A" and "B" have functioned as per design since being reset during the sequence module test portion of the auto testing sequence.*
ii) ***Procedure adherence;*** *applicable procedures were revised to prevent a re-occurrence.* ***Place keepers*** *should always be used to ensure proper sequence of step performance.*

EO: 1.14 Describe the use of Prevent Event Tools and Electrical Safe Work Practices to minimize human performance errors during testing or maintenance of the BOP ESFAS.	
Prevent Events, Electrical Safe Work Practices; *Remind students that I&C personnel do not exclusively deal with low voltage signal processing (less than 50 volts). As a minimum safety glasses will be worn when working on BOP-ESFAS systems.*	
Two Minute Drill: *Troubleshooting boundaries may change. Power supplies, fuses, etc, located in the BOP ESFAS cabinets often carry voltages greater than 50 volts. Appropriate measures should then be observed when checking these components i.e. use of low voltage gloves, etc.*	
Maximum voltage encountered in BOP ESFAS cabinets is 120vac/125vdc. Per Electrical Safe Work Practices procedure, 01DP-0IS13, the restricted approach boundary and prohibited approach boundary for qualified employees is 'Avoid Contact'. Insulated sheeting and low voltage gloves will be used when necessary.	
Demonstrate care when removing/installing power supplies and relays to avoid pinched wires and other problems.	
*Refer to **30DP-9MP01 Conduct of Maintenance** for proper lead and jumper control*	See 3.3.10.4 Control of Electrical Leads & Jumpers

1) Maintenance	
i) Troubleshooting Precautions and Limitations	
(1) FBEVAS and CPIAS cross channel trip CREFAS	
(2) Must reset CPIAS and FBEVAS to reset CREFAS	
(3) CRVIAS manually initiated only	
(4) Only one BOP ESFAS channel bypassed at a time for given function; placing both in bypass drops both out	
(a) In bypass, only field and local test trips blocked; manual, cross channel, and cross train trips still function	

(5) RMS computer or RIC checked before removing CREFAS, CPIAS, or FBEVAS from bypass	
(6) Module test button not pushed when flashing or unlit unless trip desired	
(a) Flashing test button on module indicates auto test failure	
(b) Failure not necessarily in that module	
(7) Seq. Manual-auto button placed in manual only when in self test to prevent trip	
(a) Occurs for 5 sec. every 22 sec in auto test	
(b) Seq. MODULE TEST light lit	
(8) Avoid pushing switch when changing bulbs	
(9) When troubleshooting the system, remember that all relays (with the 5 exception) are energized	
Operating Event; LER 88-019-00; *Palo Verde Unit 1, Mode 5; Inadvertent Engineered Safety Feature Actuation while replacing Relay*	
1) *What happened?*	
a) A Loss of Power (LOP) was received for the "B" train class 1E 4.16 kV bus 1E-PBB-S04. Emergency Diesel Generator (EDG) "B" automatically started and supplied power to 1E-PBB-SOR.	
b) Train "B" Fuel Building Essential Ventilation Actuation Signal (FBEVAS) was received and cross-tripped the train "B" Control Room Essential Filtration Actuation Signal (CREFAS) as per design.	
c) The train "B" FBEVAS and CREFAS cross-tripped the train "A" FBEVAS and CREFAS respectively as designed.	
2) Why did it happen?	
a) The cause of the event was the physical layout of the work area which contributed to a personnel error.	

b) Since the relay was inside, on the side of the cabinet, on the underside of the relay, with terminals not perpendicular to the chassis, access was difficult. No clear direct route of installing the wiring was available
c) Technician had replaced a relay in order for the original unit to be examined by engineering.
d) While re-terminating the leads on the new relay, the screw, with the power lead and the screwdriver attached, slipped off the terminal to which it was to be attached. The screw momentarily touched the relay chassis and grounded the power lead.
e) This momentary dip in the power supply initiated the LOP and caused the BOP-ESFAS relays to change state and initiate the ESF actuations.
3) Can it happen again?
a) Momentary loss of focus, or inadequate prep of work site can, and has allowed similar occurrences while working in BOP-ESFAS
i) Even momentary grounding neutral lead on normally de-energized relays will cause these relays to energize.
b) ***Prevent Events;***
i) ***Pre-Job Brief*** *should contain detail on how to avoid grounding relay/ relay leads.*
(1) Type of tools to be used – insulated, reliable, good working order
(2) Type of insulating sheeting/tape and where it should be placed.
(3) ***Expertise;*** *ask questions get input from other technicians who have record of performing similar work successfully*
(4) ***Two Minute Dril;*** *Take time to evaluate job site prior to work commencement to address problems overlooked in Pre-Job Brief*
PREVENT EVENTS, Operating experience tool; *40OP-9SA02, De-energization of BOP-ESFAS.*
Performed almost every outage
a)De-terming normally de-energized Relays K202-K204:
i) During outages the class power is de-energized one train at a time

(1) It's necessary to determ the power leads to the load shed relays prior to down power.	
ii) During the re-power a voltage spike caused the load shed relays to pick up	
(1) Being in cooldown mode the load shed tripped the LPSI or CS pump	
(2) Critical to restore Shutdown Cooling before boiling occurs	
iii) Operating Experience and Pre-job Brief Tools	
(1) All relay are energized by applying a signal ground	
(2) When de-terming normally de-energized relays (load shed relays) it's imperative that lead control is maintained	
(3) If lead control is lost and the wire touches the cabinet it just found the ground it needs to energize	
iv) Operating experience provides the knowledge:	
(1) *Of the importance of using tools in good working condition – good holding screwdrivers*	
(2) *Of the importance of using insulated tools*	
(3) *Of the importance of insulating the area around the relay*	
*(4) A good **pre-job brief** that covers all of the above learned experiences*	Ask the participants what other Prevent Event Tools or Maintenance Standards could be used to ensure proper performance or the task
b) Repetitive Tasks are issued to direct I&C's roll in performance of 40OP-9SA02.	CRDR 2381569
i) Cover Repetitive Task# 064564 'Installation and Removal of Cross Train B Trip Jumpers, in Support of 40OP-9SA02'	
Removing/Reinstalling BOP-ESFAS Modules:	
1) Wire wrap pins can short on side of case if module sides are bowed in or pressed on	

a)Module removal, disassembly, and replacement	
i) Module removal tool used to remove module after screws released	
ii) Address code switch setting necessary for FBEVAS, CPIAS, and CREFAS modules since identical; Table 6-1 of T/M	
iii) Power must be removed to pull any module to prevent module damage or transients	
iv) Removal of power from train causes all actuations except load shed	
(1) In process of forming modification to remove power from module vice train	
Testing 36ST-9SA05; FBEVAS, CREFAS, CRVIAS, 18 month Functional Test	
1) The intent is to verify the proper operation of FBEVAS, CREFAS and CRIVAS	
a)Automatic, cross channel, cross train and manual actuation are verified	
b)The end devices are place in their un-actuated position and verifying it repositions upon the actuation	
2) The DGSS, LOP/LS and the Sequencer are tested during the Integrated Safeguards ST	
3) The automatic test of the CREFAS module is performed by actuating the radiation monitor	Step 8.3.5 of the ST
a)Module trip cannot be reset until trip input is clear or removed	Step 8.3.11 through step 8.3.15
b)Chemistry technician resets the radiation monitor	Step 8.3.11
i) Changes the setpoint back to original value	
ii) Signs off that it has been done	Step 8.3.12

c) Ops verifies that the RESET on the TRIP/RESET push-button is illuminated	
i) Resets the CREFAS Module by pushing the TRIP/RESET push-button.	
d) Ask the participants what Prevent Event tools or Maintenance Standards can be applied to ensure the task is done correctly, i.e. the RESET is not illuminated	
i) Discuss ***Procedure Use and Adherence and Placekeepers***	
Prevent Events, Operating Event; *Palo Verde mode1; LER# 85-084 Inadvertent CREFAS Initiation*	
1) What happened?	
a) RU-30 left in trip condition after calibration by I&C and caused CREFAS when removed from bypass	
2) Why did it happen?	
a) RO failed to check status of trip input before un-bypassing CREFAS	
3) Can it happen again?	
a) ***Pre-Job Brief*** *needs to cover critical steps in work evolution.*	
b) Maintain ***Procedural Adherence, Use Place Keepers;***	
i) Procedure 36ST- 9SA05 has RMS reset the radiation monitor	*Step 8.3.11*
ii) Changes the setpoint back to original value	
iii) RMS signs off that it has been done	*Step 8.3.12*
a) Use ***Two Minute Drill*** *prior to performing a critical step.*	
iv) Performer verifies that RESET on the TRIP/RESET push-button is illuminated.	
v) Performer resets the BOP ESFAS Trip by pushing the TRIP/RESET push- button.	

vi) Ask the students what Prevent Event tools or Maintenance Standards can be applied to ensure the task is done correctly, i.e. the RESET is not illuminated
4) *Almost identical event was reported in LER# 86-040-00. If time permits quickly go over this event also.*

EO: 1.15 Given examples of BOP ESFAS maintenance problems, determine the fault using applicable BOP ESFAS prints, Tech Manuals, and applicable documents.
Prevent Events, Procedural Use and Adherence; *Always perform thorough review of any procedure or work instructions before performing work. Special considerations or unusual work conditions should be thoroughly covered during the* ***Pre-Job Brief****.*
Perform a Two Minute Drill, *prior to beginning work, or after any type of interruption of focus to reset to task being performed.*
Any work should always be performed with an active ***questioning attitude.*** *If a question arises or an unexpected situation is encountered,* ***Stop when unsure,*** *and get help. Notify your supervisor.*

1) Troubleshooting Aids	
a) Drawings 13-J-SAS-003 and 004 contain extensive useful information	
i) Relays and contacts associated with each function	
ii) Relay output terminal numbers	
iii) Reference drawing numbers	
iv) Name and tag number of actuated component	
v) Relay function associated with component, i.e. stop or start	
b) 40OP-9SA01, BOP ESFAS MODULES OPERATION contains useful information	
i) Precautions for operation	Cover examples from applicable sections
ii) Guidelines for determining cause of trips	
iii) Guidelines for trip resetting	
iv) Sequencer mode operability test	
v) Placing modules in and out of bypass	
vi) Placing Load Seq in and out of auto test	

vii) Lists of actuated equipment	
c) 36ST-9SA05, FBEVAS, CREFAS, and CRVIAS 18 Month Functional	Optional; Cover examples from applicable sections
i) Tech Spec Requirements are listed	6.4.4 Equipment Verification (steps 3 & 5)
ii) Design Basis are listed	
iii) FBEVAS, CREFAS, CRVIAS Trips and resets	
d) 36MT-9SA02, BOP ESFAS Load Sequencer Module Functional Test	Optional; Cover examples from applicable sections
i) Covers Simulator Cabinet setup	
ii) Covers AstroMed Dash 10 setup for use with procedure/simulator	
iii) Information on MODE sequence timing	
1) Maintenance & Troubleshooting Practices:	
a) **Paper Troubleshoot**: I&C is supporting Operations BOP ESFAS testing of procedure 36ST-9SA05	Use copies of applicable sections of 36ST- 9SA05
(1) Ops notices that M-HJA-F04 CR ESS AHU Fan is supposed to start but does not.	
ii) Ask what components could be at fault?	
(1) Which relay is being tested?	36ST-9SA05 identifies it as K127
(2) Are any other components affected?	
(a) If the M-HJA-F04 CR ESS AHU Fan is the only component affected then it is most likely the K127 relay is the problem	(If all components were affected, it could still be the relay but it also could be a problem in the testing circuit.)
iii) What document would be used?	13-J-SAS-003
(1) Have class use 13-J-SAS-003 Listing	

(a) Demonstrate use of Index and applicable sheets.	K127 is energized by the Load Sequencer
(i) Since the Sequencer tests the signal path to the relay, If testing the Sequencer does not detect a fault, it reinforces that K127 may be the problem	
(b) Have students identify cabinet relay is in.	J-SAA-C02A
(i) Point out that the elementary reference dwg. 13-E-HJB-0002 is inactive. However the Unit specific print i.e. 01-E-HJB-0002 can be used to further verify	01-E-HJB-0002 only lists the deck terminals
(c) Have students identify relay deck and relay terminals that affect M-HJA-F04 CR ESS AHU Fan	Deck 1, B and C
(d) Have students identify type of contact, NC or NO	NC
(i) Which state would the contact be in during normal operation (energized)?	Open
(ii) Which state would the contact be in if in actuation?	Closed
(e) Will checking the contacts for voltage be intrusive?	Do not use a 702 or 743 (36ST-9SA05, step 4.2.1)
(f) Have students identify TB and terminals related to this contact inside the applicable cabinet	TB77, Terminal 3 and 4
(i) Ask students what precautions should be taken when reading voltages in the Aux Relay Cabinets	
1. Ensure Elec Safe Work Practices and FME concerns are addressed.	
(g) Have students use procedure sections and 13-J-SAS-003 listings to determine Aux Relay outputs, deck terminals, and TB's and term pts. on other Aux relays.	

Optional: If time permits	
2) Have students pair up and create trouble shooting scenarios. a) Emphasize that scenarios will have indications and proper system response b) Scenarios need to address proper use of Prevent Event tools and Electrical Safe Work Practices associated with replacement or repair.	
c) After 30 minutes have students present troubleshooting scenarios for class to solve. i) Ensure that the use of Prevent Event tools and Electrical Safe Work Practices is addressed. ii) Have class vote on best scenario, best solution.	

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 student's 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.