

# PALO VERDE NUCLEAR GENERATING STATION

## Instrumentation & Controls Training

### Classroom Lesson



<b>I&amp;C Program</b>	<b>Date: 5/8/2007</b>
<b>LP Number: NIA02L000201</b>	<b>Rev Author: Christopher A. Mahar</b>
<b>Title: Foxboro SPEC 200 Coding and configuration</b>	<b>Technical Review:</b>
<b>Duration : 5 Hours</b>	
	<b>Teaching Approval:</b>

**INITIATING DOCUMENTS:**

Site Maintenance Training Program Description

**REQUIRED TOPICS**

NONE

**CONTENT REFERENCES**

Foxboro SPEC 200 Technical Manual and Maintenance Instructions

TCS 99-0645 Foxboro card mounting instructions

**Lesson Plan Revision Data**

May 03, 2007 Chris Mahar Record created

Tasks and Topics Covered

The following tasks are covered in Foxboro SPEC 200 Coding and configuration:

Task or Topic Number*	Task Statement
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Lesson: [Foxboro SPEC 200 Coding and configuration](#)

FOX04	Calibrate math/scaler cards
FOX03	Calibrate indicators/recorders
FOX01	Calibrate linear I/O converters
FOX07	Calibrate dynamic compensators
FOX08	Calibrate control cards/stations
FOX05	Calibrate power supplies
FOX06	Calibrate alarm cards
FOX09	Rework Foxboro electronic device
FOX02	Calibrate signal processor cards

Total tasks or topics: 9

**TERMINAL OBJECTIVE:**

- 1.1 Given the necessary tools, equipment, and references,, the I&C Technician will perform maintenance in Foxboro SPEC 200 cabinets. Mastery will be demonstrated by successful completion of all in class exercises, Laboratory Practical Evaluations and scoring 80% or better on an end of course exam.
  - 1.1.1 Identify the on-board fuses on a Foxboro SPEC 200 card
  - 1.1.2 Describe the power distribution in a Foxboro SPEC 200 nest
  - 1.1.3 Remove / Reinstall Foxboro Cards
  - 1.1.4 Given a nest and slot number, locate a card in a Foxboro SPEC 200 cabinet
  - 1.1.5 Given the Foxboro SPEC 200 code for a card, identify the function of the card
  - 1.1.6 Describe the differences between a Control Card module and a Processing Card module

## Lesson Introduction: Foxboro SPEC 200 Coding and configuration

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

[\[Introduction\]](#)

<b>T.Obj 1.1</b>	<b>Given the necessary tools, equipment, and references,, the I&amp;C Technician will perform maintenance in Foxboro SPEC 200 cabinets. Mastery will be demonstrated by successful completion of all in class exercises, Laboratory Practical Evaluations and scoring 80% or better on an end of course exam.</b>
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<b>EO 1.1.1</b>	<b>Identify the on-board fuses on a Foxboro SPEC 200 card</b>
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### 1.1.1.1 Main Idea

A. Foxboro SPEC 200 cards are supplied with □ 15 vdc to power the circuits. As this power comes onto the board, there is a fuse in-line with each of the power supplies mounted on the circuit board.	Methods & Activities: Optional
	<i>Use a Foxboro card to show the students the fuses.</i>

<b>EO 1.1.2</b>	<b>Describe the power distribution in a Foxboro SPEC 200 nest</b>
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**1.1.2.1 Main Idea**

A. The SPEC 200 components require $\pm 15$ vdc to supply the op-amp circuits.	Methods & Activities: Optional
B. Additionally $\pm 15$ vdc may be used to power the transmitters for the loop	
C. 24vac is used to provide power to the chart drive motors on Foxboro recorders	
D. This power is supplied through a Nest Bus	
1. The nest bus is comprised of 6 pin jacks along the bottom of the nest	
2. When a card or card module is installed into the nest, there is a plug that connects to this jack.	
3. The four pins on the top row of these connectors are for the component bus (Circuit Power).	
4. The two pins on the bottom row are for the field bus. The field bus will have +15vdc and -15vdc to provide 30vdc to power transmitters or 24vac for chart drives.	
E. The nest bus is powered from the Rack Power supply through a Power Distribution module or directly from a Single Nest Power Supply.	
F. The single nest power supply will provide the +15vdc and -15 vdc for a single nest.	
G. There are two type of Power distribution modules.	
1. 2AX-DP10 Provides $\pm 15$ vdc for both the component and the field buses.	

<p>2. 2AX-DP10E Provides <math>\pm 15</math> vdc to the component bus only. There is a separate connection on the front of the module to allow 24vac to be connected to supply to the field bus for chart recorder drive motors.</p>	
<p>H. The other type of modules that distribute power are signal distribution modules. These modules distribute power and signals to other locations through a 30 pin connector.</p>	
<p>1. 2AX-DIO This module will distribute four signal pairs, <math>\pm 15</math> vdc from the component bus, and there is no connection to the field bus. 24vac can be connected to terminals 3<math>\pm</math> to provide power to the chart drive motors.</p>	
<p>2. 2AX-DSP This module will distribute four signal pairs, <math>\pm 15</math> vdc from the component bus, and 24vac from the field bus to provide power to the chart drive motors. This would be used in conjunction with a 2AX-DP10E connecting 24vac to the field bus.</p>	
<p>3. 2AX-DS1 This module will distribute 12 signal pairs. There is no power distribution with this module.</p>	



<b>EO 1.1.3</b>	<b>Remove / Reinstall Foxboro Cards</b>
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### 1.1.3.1 Main Idea

Foxboro cards and card-modules have two screws, one on top and one on the bottom.

Methods & Activities: Optional

TCS 99-0645

The bottom screw is associated with the pins/socket connection with the nest.

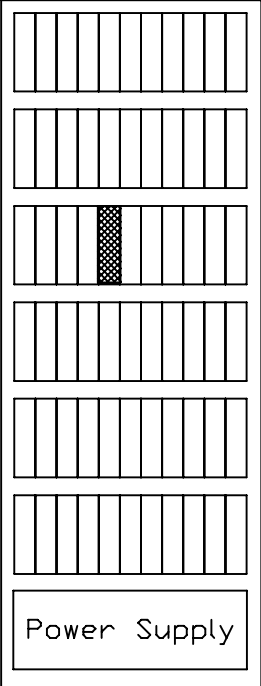
When installing a card, start with the bottom screw. Fully insert the bottom screw making sure the connection with the nest is properly aligned and inserts smoothly. Then tighten the top screw.

When removing a card, start by completely loosening the top screw, then back out the bottom screw to unplug the card from the nest. This will prevent bending the pins.

As you unscrew the bottom screw, it is actually jacking the pins out of the sockets on the nest.

<b>EO 1.1.4</b>	<b>Given a nest and slot number, locate a card in a Foxboro SPEC 200 cabinet</b>
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**1.1.4.1 Main Idea**

<p>A drawing of a Foxboro SPEC 200 cabinet is shown. Each cabinet has space for a Rack Power Supply and six nests. The nests are numbered from top to bottom 1-6. Each nest has 11 slots numbered from left to right 1-11. Slot 11 in each nest is where the power distribution module is located that provides power to the nest from the Rack Power Supply. If a single nest power supply is used, it takes up two slots (10 &amp; 11).</p>	<p>Methods &amp; Activities: Optional</p>
<p>When determining the location of a particular card, for example nest 3 slot 5 (N3S5), start at the top and count down to the 3rd nest, and count from the right over to the 5th slot. The shaded area indicates the location for N3S5.</p>	 <p>The diagram shows a vertical cabinet layout. At the bottom is a box labeled 'Power Supply'. Above it are six horizontal rows, each representing a nest. Each nest contains 11 vertical slots. The third nest from the top (the second nest from the power supply) has its fifth slot from the right shaded with a stippled pattern. This shaded slot represents the location of card N3S5.</p>

<b>EO 1.1.5</b>	<b>Given the Foxboro SPEC 200 code for a card, identify the function of the card</b>
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**1.1.5.1 Main Idea**

<p>A. The arrangement of Foxboro Technical Instruction (TI) and Maintenance Instructions (MI) for the SPEC 200 System is straight forward with few exceptions. It is arranged by the code designations assigned to the components.</p>	<p>Methods &amp; Activities: Optional Refer to Powerpoint presentation</p>
<p>B. The number code consists of a 3 digit alpha-numeric code designating the equipment category.</p>	
<p>C. It is followed by a 3 digit alpha-number code describing the component</p>	
<p>D. Recorders, display units and control station all use a 3 digit number between 200 and 299 followed by a 3 digit number to identify the type of unit and model covered by the instruction.</p>	
<p>E. All other units used in the SPEC 200 System use a 2 followed by 2 letters to identify the function of the device. The 3 digit number that follows is unique for each model. Below lists the letter combinations and their meaning for the 3 digit equipment code.</p>	
<p>1. SPEC 200 2</p>	
<p>2. Analog A Digital D</p>	
<p>3. Control C Input I Nest N Output O Processing P Rack R Test T Auxiliary X</p>	
<p>4. Below we see examples of the component codes that could be found with the different equipment codes.</p>	
<p>a. INPUT (from field) 2AI-</p>	

<p>1) A Pneumatic (3-15 PSI)          B BCD          C Contact ON-OFF          F Frequency          H 10-50 ma          I 4-20 ma          T TC or mv          N Nickel RTD          P Platinum RTD</p>	
<p>2) 2 Isolated          3 Non-Isolated</p>	
<p>3) V Voltage 0-10</p>	
<p><i>Example 2AI-I2V Spec 200 Analog Input Card - 4-20 ma (I) 2 isolated to 0-10 Volts</i></p>	
<p>b. OUTPUT (to field) 2AO-</p>	
<p>1) I Integrator          L Logic          V Voltage</p>	
<p>2) 2 Isolated          3 Non-Isolated          PD Power Driver</p>	
<p>3) H 10-50 ma          I 4-20 ma          R Relay          S Solid State</p>	
<p><i>Example</i>  <b>2AO-V3I Spec 200 Analog Output Card - Volts 3 non-isolated to I 4-20 ma</b>  <b>2AO-L2CR Spec 200 Analog Output Card - Logic 2 isolated to Contact Relay</b>  <b>2AO-IPDS Spec 200 Analog Output Card - Integrator Power Driver Solid State</b></p>	
<p>c. PROCESS (within Spec 200) 2AP-</p>	
<p><i>All 2AP designated components indicate both module and card.</i></p>	

1) ALM-A Nest Alarm Absolute SUM Summer SSL Signal Selector DSL Dual Scaler MUL Multiplier / Divider SQE Square Root Unit SGC Signal Characterizer AVS Voltage Source	
d. CONTROL (within Spec 200) 2AC	
1) A2 Proportional Control Card A3 Proportional + Derivative (P+D) A4 P+I A5 P+I+D N4 Non-Linear P+I N5 Non-Linear P+I+D T5 Remote Tuning P+I+D	
e. POWER SUPPLIES	
1) 2 SPEC 200 A Analog R Rack PS Power Supply	
<i>2ARPS9 powers 9 slots</i>	
f. AUXILIARY 2AX	
1) SUM Summer Card only (NO module) DSP Distribution Signal Power	

EO 1.1.6	Describe the differences between a Control Card module and a Processing Card module
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### 1.1.6.1 Main Idea

<p>A. Input and output cards are mounted directly into the nest with mounting screws and make up with the nest bus power connectors when installed.</p>	<p>Methods &amp; Activities: Optional Refer to Powerpoint presentation</p>
<p><i>Note: When installing cards in the nest, tighten the lower screw first to ensure good connection to the nest power connection.</i></p>	
<p>B. Control cards and processing cards are mounted in modules that are installed into the nest with mounting screws.</p>	
<p>C. The processing or control card then slides into its appropriate module and makes up with the electrical connections using a connector on the back of the module.</p>	
<p>D. There are two different types of card modules, one for processing cards and one for control cards..</p>	
<p>E. The control card module has extra wiring to a 30 pin connector that will exchange signals with the control station associated with the controller</p>	
<p>F. Additionally, there are two fuses on the top of a control module that provides protection for the <math>\pm 15\text{vdc}</math> power going to the control station..</p>	
<p>G. Caution must be exercised when replacing a module to ensure the correct type is installed since control cards will not work when installed into a processing card module.</p>	

## 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.