APPENDIX VI - HUMAN PERFORMANCE SIMULATORS

Simulator 1: Effective Communication

Activity: What's That You Say?

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

Instruct your lab partner on how to place the colored puzzle pieces into the wooden square according to these instructions. Keep in mind, one mistake—one block in the wrong position or placement in the wooden base—might have catastrophic consequences.

1. Place piece A in the upper, right-hand corner such that A15 is in the corner.

2. Place piece E in the lower, right-hand corner such that E16 is in the corner.

3. Place piece D in the lower, left-hand corner such that D17 is in the corner.

4. Place piece G in the upper, left-hand corner such that G18 is in the corner.

5. Place piece F in the space between pieces A & G such that F9 is next to A1 and F10 is next to G13.

6. Place piece B such that B12 is next to A1.

7. Place piece C such that C6 is next to E8.
Facilitators Key: What’s That You Say?

Give the instructions to the person who is going to be reading them and remind the participants to apply the Human Performance Tools they just learned.

When facilitating this activity, do not stop the team from making a mistake, but rather, ask them what they could have done differently to avoid the mistake. Ask open-ended questions that lead them to understand the benefits of:

- Applying a pre-job briefing (using the S-A-F-E-R Model)
- Having a Questioning Attitude
- Three-way Communication
- Use of the Phonetic Alphabet
Simulator 2: Rigging

**Activity: Is This Thing Rigging?**

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

**OBJECTIVE:**
Suspend loads from hooks on the crane.

**ASSIGNMENT DETAILS:**
Each simulated load weighs 1,000 lbs. You are about to properly and safely suspend a load at each position.

The first position will be a lift using the eye bolts of the load.

The second position will be a lift using a choke on the load.

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**Lift Position 1**

Suspend Load 1 (load with eye-bolts) from the crane hook using proper rigging techniques and rigging hardware. Use the “Crosby User's Guide” Lifting Card to verify your proposed set-up and hardware before the actual lift.

This lift is to be set up with a 60 degree sling angle and the proper lifting hardware.

*Note: “Crosby User's Guide” lifting panels to be used are 2, 3, 4, 9, 11, 12, and 14.*

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**Lift Position 2**

Suspend Load 2 (simulated conduit) at crane hook #2. Use the “Crosby User's Guide” Lifting Card to verify your proposed set-up and hardware before the actual lift.

This lift is to be set up using the choke on the conduit. Maintain a 60 degree sling angle and proper lifting hardware.

*Note: “Crosby User's Guide” lifting panels to be used are 2, 3, 4, 9, 11, 12, and 14.*
Facilitators Key: Is This Thing Rigging?

Setting up the Rigging Simulator Station:
1. Unpack all components.
2. First turn the eyebolts on the load so that you can see through them like a sight on a rifle. This is the wrong position.

To verify, use “Crosby Users’ Guide” Panels
- Basic rigging plan on panel #2 and user responsibility
- Eyebolt information on panel #14
- Shackle information on panel #12
- Web slings on panel #9
- Hardware inspection on panel #3
- Sling inspection on panel #4
- Load calculations on panel #11

Facilitating the Simulator:
To effectively operate this simulator, 2-3 people should work in a group. Refer to the photos below for setup reference.

CORRECT SETUP

Turn the eyebolt 90° for the users
Correct lift position of eyebolts

Proper setup of choke suspension
Simulator 3: Splicing

**Activity: A Splice of Pie#1**

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

**ASSIGNMENT DETAILS:**
Pair each conductor with the appropriate conductor fitting which is dependent on conductor size.

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**Copper Scenario:**

**OBJECTIVE:**

Your assignment is to repair a 2/0 copper conductor that is broken between structures 20 and 21 on the 40kv Sunshine—Moonshine Circuit. You can assume that you have already accepted clearance; tested de energized, and applied personal grounds.

Hold the job briefing to cover the repair on the job. Look over the available materials before you.

Select the correct materials and/or parts to do the job and then explain to the simulator facilitator:

- How you can verify that they are correct
- Why you used them

**Activity: A Splice of Pie#2**

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

**ASSIGNMENT DETAILS:**
Pair each conductor with the appropriate conductor fitting which is dependent on conductor size.

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**AWD Scenario:**

**OBJECTIVE:**

Your crew has been called to a case of trouble. The 69kv circuit between Ronald and Perry stations has locked out. You get to the scene and find the static wire broken and wrapped around the road phase north of structure 11. The circuit has been isolated for clearance of which you have accepted, tested de energized, and applied personal grounds.

Hold the job briefing to cover the repair on the job. The sleeves that are before you (found on the truck) look like they will do for the repair.
Select the correct materials and/or parts to do the job and then explain to the simulator facilitator:

- How you can verify that they are correct
- Why you used them

**Activity: A Splice of Pie#3**

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

**ASSIGNMENT DETAILS:**
Pair each conductor with the appropriate conductor fitting which is dependent on conductor size.

**Hint:** How would you apply your Human Performance Tools to this job? Which tools will you use to perform this task without errors?

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**ACSR Scenario:**

**OBJECTIVE:**

The task of repairing a broken wire on the 138kv circuit between Davidson and Charleston stations has been assigned to your crew. The prints indicate that the conductor is a 159 ACSR. ACSR failure will usually result in damage requiring the installation of conductor and two sleeves.

All appropriate AEP safety procedures are followed in getting clearance and applying personal grounds for the crew to do the work. On the truck you find a variety of splices that might do the repair.

Select the correct materials and/or parts to do the job and then explain to the simulator facilitator:

- How you can verify that they are correct
- Why you used them
Facilitators Key: A Splice of Pie

OBJECTIVE:
Pair each conductor with the appropriate conductor fitting which is dependent on conductor size.

ADDITIONAL INFORMATION:
There is only one appropriate fitting for each of the conductor types: Copper, Alumoweld (AWD) and ACSR (aluminum conductor, steel reinforced). Each kit will have three examples of fittings for each of the above conductor types, of which, only one will be the correct fitting for the conductor sample.

“Best Fit” can accomplish the selection of compression fittings for Copper and AWD in the field with reasonable accuracy. These compression fittings are typically stamped with conductor size, type, stranding, tension or non-tension use and crimp information. This information, along with the snugness of fit, usually assures proper selection.

ACSR two-piece splices can sometimes be fitted with “Best Fit”, but the best practice is to check the fitting against the manufacturer’s catalog number. This is especially true of the inner steel portion. Although the aluminum part is stamped with size and crimp information (the steel sleeve for the inner), steel stranding is typically marked only with the die size and the manufacturer’s catalog number. This is because the steel sleeve may be the appropriate steel for more than one size ACSR conductor, dependant upon the diameter of the steel core section. To assure correct selection, this number should be verified when the part is received from the manufacturer or storeroom.

The conductor kit samples to be provided are:

- 2/0 Stranded Copper
- 7#10 Alumoweld (AWD)
- 159.0 ACSR
2/0 Copper Fitting Selection

Scenario #1

Given a choice between 2/0, 3/0 and 4/0 full tension splices, training and experience should lead to the determination of the following:

- Only the 2/0 sleeve offers the correct snugness on the conductor
- The die index is marked on the sleeve
- Full tension copper splices are compressed with a hydraulic tool
- The crimp pattern is marked on the sleeve

Copper Fitting Selection

Typically in the field, copper conductors and fittings can be accurately identified by utilizing experience and a fitting or splice as a determining tool. Calipers or a wire gauge can be utilized, but are not usually necessary if the proper sized fitting is available.

Copper Splices

The “best fit” is the 2/0 Stranded Copper Splice – Die 166

Tools Required

Usually, Transmission Drawings, Maps and Data Sheets are used to determine conductor type, size and fittings during job planning. However, if a determination must be made in the field, the following tools are useful:

- Calipers or a Wire Gauge
- Conductor Data Sheets
- Appropriate sized fittings
- Manufacturer Specifications
7#10 AWD Fitting Selection

Scenario #2

Given a choice between 7#10 AWD, 7#8 AWD and 3/8" Steel/EHS full tension splices, training and experience should lead to the determination of the following:

- Only the 7#10 sleeve offers the correct snugness on the conductor
- One of the offered sleeves is for 3/8" Extra High Strength Steel not AWD
- The die index is marked on the sleeve
- Full tension AWD splices are compressed with a hydraulic tool
- The crimp pattern is marked on the sleeve

AWD Fitting Selection

Typically in the field, AWD conductors and fittings can usually be accurately identified

Alumoweld Splices

The “best fit” is the Burndy YDSM10T 7#10 and 3#7 AWD Splice – Die 676 by utilizing experience and a fitting or splice as a determining tool. Calipers or a wire gauge and a conductor data sheet can be helpful in some cases.

Tools Required

Usually, Transmission Drawings, Maps and Data Sheets are used to determine conductor type, size and fittings during job planning. However, if a determination must be made in the field, the following tools are useful:

- Calipers or a Wire Gauge
- Conductor Data Sheets
- Appropriate sized fittings
- Manufacturer Specifications
Simulator 4: Switching

**Activity: A Flip of a Switch**

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

**OBJECTIVE:**
To de-energize test, and ground three line sections so that adjustments to the switches located at Pole #321 can be completed.

**EQUIPMENT IN OPERATION:**

Switch Person: ____________________________
Dispatcher: ____________________________
Date: ________________  Time: ________________

1. Open Rogue CB-123.

2. Open CB-123 LD.

3. At Pole #321, open Rogue AB-321.

4. Check that the Rogue line potential is out.

*Note: Dispatcher issues clearance to test, and apply protective grounds on the Rogue Line section between the open CB-123 LD and the open Rogue AB-321.*

5. To test the Rogue line de-energized attach one end of a red lead to the test probe (lower right side of panel) and the other end to the test probe between Rogue AB-321 and the Rogue CB-123. If de-energized the light will not light and the alarm will not sound.

6. To ground attach one end of a probe lead to the ground probes and connect the other end to the Rogue line test point.


8. Open CB-132 LD.


10. Check that the Ridge line potential is out.
Note: Dispatcher issues clearance to test, and apply protective grounds on the Ridge line section between the open CB-132 LD and the open Ridge AB-321.

11. To test the Ridge line section is de-energized attach one end of a red lead to the test probe (lower right side of panel) and the other end to the test probe between Ridge AB-321 and the Ridge CB-132. If de-energized the light will not light and the alarm will not sound.

12. Attach one end of a probe lead to the ground probes and connect the other end to the Ridge line section test point.


14. Open CB-312 LD.

15. At Pole #321, open River AB-321

16. Check that the River line potential is out.

Note: Dispatcher issues clearance to test, and apply protective grounds on the River line section between the open CB-312 LD and the open River AB-321.

17. To test the River line section is de-energized attach one end of a red lead to the test probe (lower right side of the panel) and the other end to the test probe between River AB-321 and the River CB-312. If de-energized the light will not light and the alarm will not sound.

18. Attach one end of a probe lead to the ground probes and connect the other end to the River line section test point.
Picture of the Simulator: A Flip of a Switch
Facilitators Key: A Flip of a Switch

A Flip of a Switch

Contents:

1. Switching simulator cabinet
2. 120 v/12v Power Supply
4. jumpers
1. information package
1. carrying case

Setting up the Simulator Station:

3. Unpack all components.
4. Check that all jumpers have been removed from the “test” probes.
5. Locate 120v/12v power supply and connect to the power supply jack located on the left side (when facing the front) of the simulator unit and plug the power transformer into any 120v receptacle.
6. Set all switches to the closed position. (All line pot LEDs will be illuminated.)
7. Attach one end of the red lead to the test probe at the lower, right side of the panel and touch the other end to all other test points. The alarm will sound and the indicating red light will illuminate. This indicates that all components of the simulator are in working order.

Facilitating the Simulator:

To effectively operate this simulator, a minimum of 2 people should perform the activity. One person will act as the switch person (operating the switching on the cabinet) and the other person will act as the dispatcher.
Simulator 5: Wiring

Activity: Making the Connection

Please approach this task as you would every job (every day, every time) using the Human Performance Tools for Excellence.

ASSIGNMENT DETAILS:

Troubleshooting non-operation of the breaker

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Odem switch 1009 to Sinton Sub, 69kv line clearance for the Transmission Line Crew

Transmission Dispatch had opened CB 2545 at Sinton station via SCADA control for planned insulator replacement between line disconnect switch 2546 and Odem switch. Before the line could be isolated for clearance, severe weather moved into the area. The TDC decided to cancel the outage and return the CB to service. Attempts to close the CB via SCADA failed. The TDC has dispatched you to Sinton station to repair and close the breaker.

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OBJECTIVE:

By using the electrical diagram/schematic and materials, locate, repair and operate the circuit breaker. Perform a close operation and an open operation of the circuit breaker to verify the circuit breaker is operating correctly.

This is the given scenario for this simulator:

You and your co-worker arrive at the station and report to the dispatcher you are there to investigate and correct the problem on breaker 2545 at Sinton Station.
Referring to the schematic you know that the breaker failed to close when tried by SCADA. So as a team, you decide to test out the close circuit (scheme) for proper operation and eliminate the possibility of electrical problems.

Assume that you have already taken the following steps:

*** Refer to the Schematic/Elementary Diagram ***

1) First, you pushed the 101 Close button and the breaker did not close. Next, you conducted some testing on the circuit.

2) The team decided to connect the multimeter from Neg. to J2 and push the 101 Close button. Then you read the 25 VDC battery voltage. The circuit (scheme) was good to there.

3) You then moved your lead to J3 and pushed the 101 Close button again. Now you got a 0 VDC reading. Was that what you expected to happen? At this point, what would you think the problem is? – see below

** The field installed jumper note on the schematic between the front panel terminals of J2 and J3 seems to be missing. What happens if you place a temporary jumper between these two points?
Facilitators Key: Making the Connection

FACILITATOR ONLY  You must provide the 24 volt dc power

SIMULATOR SET UP INFORMATION: Prior to the demonstration

1) Open the knife switch on the front.
2) Install the relays, which are in the bag.
3) Lay the other jumpers in front of the board for student's usage.
4) Connect 24 volts DC to the clip jumpers on the back.
   Depending on the voltage type of battery used be sure to series them properly to get a 24 volt output.
5) Install a temporary jumper between "J2" and "J3" terminals on the front panel.
6) Do a quick test of the board to verify proper operation.
7) Remove the jumper you just installed for the test and Open the knife switch.
8) YOU are ready for this simulator to be used by the students.

Making the Connection

SIMULATOR INFORMATION for reference only:

By using a 24 volt D.C. battery, these circuits are designed to energize the X-relay (front of circuit board) which closes the normally open X contacts that seal in or keep the X-Relay energized. This turns on the Red Light and sounds the audible signal together. The normally closed X contact will open and turn off the Green Light.

To accomplish this:
   1. Close the Knife Switch
   2. Press and release the 101 Close button

To turn off or de-energize the X-Relay:
   1. Turn off the Red Light and the audible signal sound (Press the 101 Open button.)
   2. This will energize or turn on the Y-Relay which will open the normally closed Y contacts.
   3. This will de-energize the X-Relay, which then opens the X contacts. This will turn off the Red Light, the audible signal sound and also close an X contact that will turn on the Green Light.

NOTE: These electrical circuits represent the operation of a Circuit Breaker's close and open operations.
INSTRUCTIONS:

2. First close the knife switch. You will notice that Green Light will light up. (This also verifies battery power.)**
3. Press and release 101 Switch Close button. This energizes X-Relay
a. With X-Relay energized, the normally open X-contacts, X1, X2, X3 will close and the normally closed X4 contact will open
b. X1 contact closes keeping the X-Relay energized.
c. X2 contact closes and turns on the red light.
d. X3 contact closes and sounds the audible signal (64-80)dBs
e. X4 contact opens and turns off the green light

4. After pressing and releasing the 101 Close button, the X-Relay is energized, Red Light is on, the audible signal should be heard.

To turn off or de-energize the X-Relay, Red Light and the audible signal and then to turn on Green Light:

1. Press and release the 101 Open button
   a. This will energize the Y-Relay
   b. The energized Y-Relay will open the normally closed Y1 and Y2 contacts
   c. With Y1 and Y2 contacts open, the energized X-Relay will turn off or become de-energized.
   d. This opens the X1(seal in contact for X-Relay), X2 and X3 contacts, which in turn will turn off Red Light and the audible signal
   e. The X4 contact closes and turns on Green Light

** Install or connect a jumper from Terminal J2 to J3 on front side of circuit board.
FRONT PANEL VIEW
Circuit Breaker Trip and Close Circuits