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Title: Learning Team Review 2016-0001 Installing Outlets for Programmatic Equipment

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Learning Team Review 2016-0001
Installing Outlets for Programmatic Equipment

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Introduction:

The purpose of a Learning Team is to transfer and communicate the information into operational feedback and improvement. We want to pay attention to the small things that go wrong because they are often early warning signals and may provide insight into the health of the whole system.

Brief Description of Event:

An ESR was placed in the October of 2015 to move/install a number of 120V and 208V outlets in 455-104B to support programmatic furnace needs. Electrical design review was completed for ESR 22217 on February 22, 2016 and a Design Change Form completed describing the modification needed as: demolish 1 existing receptacle and circuit leaving conduit and jbox for use to install new receptacle and 5 new receptacles/circuits are required and one existing receptacle is to be relocated, listed under FSR 149229. The FSR scope of work was written:: Please have the Electricians come out to perform demolition (1ea.), installation (6ea.)& relocation (1ea.) of receptacles / circuits. ESR 22217 & DCF-16-35-0455-1281 is in place for this work. Coordinate final receptacle locations with Laboratory Resident. Contact John Dunwoody or O-MC for this information. WO# 545580-01 was signed on April 20, 2016.: Electricians to perform demolition, installation, & relocation of receptacles / circuits PER attached DCF-16-0455-1281-SK-1.

The walkdown with MST-7 and two electricians was May 16 and May 17. MST-7 said the same two electricians participating in the walkdown performed the subject work. When the two electricians arrived to perform the work, they asked MST-7 if they wanted the units wired. MST-7 said that was the work that was needed. The plugs were technically purchased by MST-7 when ordered through the FSR, but not purchased independently. The electrician brought the plugs with them when they started. The plug was installed on the furnace on May 19. After completing the wiring, the electricians asked if MST-7 wanted the furnace tested. MST-7 said no because they could not vouch for state of furnace because they were not sure of background on the furnace and because the ESO had not completed an inspection.

The ESO made his first inspection. He made sure the two conductors were independently wired and did not connect to any part of the case or ground. He then made sure the ground was well grounded. He left the instrument with the back panel off and knew it would not be turned on.

When the owner's manual was reviewed it was learned that a 3 meter cord was recommended and MST-7 had provided the electricians a 17 feet long cord. MST-7 installed a shorter cord

based on the owner's manual instructions cutting the cord to a shorter length from the furnace side.

The ESO was called a second time for an inspection after MST-7 had installed a shorter cord during the week of May 23rd. The ESO checked each of the conductors to make sure they were not touching any of the grounds. For high power instruments, an ESO reviewing 50 amps, will just make sure all conductors connected to power to ensure it will have power in the future. The work looked professional and net and the ESO may not have looked at it as closely. A sticker placed on the furnace as LANL Electrical Safety Approved. Later that week, MST-7 staff plugged the furnace into the outlet to begin initial testing. Furnace controls did not power on. Staff called the ESO

The ESO inspected the furnace again and opened up the furnace cabinet and the cord cap that had been sealed by electricians. At this point it was discovered that the wiring had been performed incorrectly. The cord cap and wire included a dead leg not necessary for single phase operation. However, it appears that the electricians had mislabeled or lost track of which wires were connected to the cord cap; one phase of the wiring was wired incorrectly left dead and capped inside the furnace cabinet. The conductor was not touching anything, it was not a safety issue but a functional issue. The ESO wired the plug correctly and MST-7 replaced a fuse.

On June 16, 2016, the ESO and MST-7 checked the new receptacles and welder plug caps. On June 23, 2016, a work package change notice was signed for installing cord caps on a group furnished cord, also install 3 cord caps on existing cords for welding machines per group request.

Fact Finding Results:

As a result of the incident described above, the learning team has been tasked with determining the following:

1. What's important for us to know? How did this event happen?

The following existing conditions were (may have been) contributing factors to the incident:

- Usually, programmatic staff install plugs on equipment. However, in this incident when the electricians asked MST-7 if they wanted the wiring done as well, MST-7 said yes. Electricians do not normally do work on plugs for programmatic equipment.

2. How was the organization managing the hazard?

- MST-7 and the electricians walked down the job before it occurred.
- When the electricians finished the work, they asked MST-7 if they wanted the equipment tested. MST-7 declined the offer to review the owner's manual for startup testing.
- MST-7 staff engaged the ESO several times.

3. What failed? What worked? What tools would have helped prevent this event?

What Failed?

- The electrician did not have a copy of the owner's manual.
- The owner's manual stated a 3 meter long cord was needed.
- The electrician installed a 17 feet long cord as provided by MST-7.
- A four conductor cable was supplied for a single phase.
- The cord cap did not match the machine end wiring. The cord has four conductors; the instrument requires three. This is not a failure, but worth mentioning.
- Configuration was on the plug cap side, the red, black and green were wired. On the furnace, red, white wire taped blue were wired. Red and blue went to instrument for phase and green went to ground. .
- The opportunity to follow the wires end to end was missed.

What Worked?

- The ESO was involved in the work throughout the process.
- When the power did not work, staff called the ESO to evaluate the situation.

What was surprising?

- The control fuse to the furnace was blown and we do not know when that happened or why.
- Even though the wiring was incorrect, it was never unsafe.
- The cord cap wiring did not match the machine end wiring.

4. Error Precursors:

1) Task Demands; 2) Work Environment; 3) Individual Capabilities; 4) Human Nature

Comments:

- Task Demands
  - Interpretation Requirements – The electricians did not know a 3 meter cord was needed.
  - Unclear goals, roles, and responsibilities – There is confusion if programmatic staff or craft install plugs on equipment.
  - For elecricians, this type of work is repetitive.
  - The electricians attempted to match the facility phasing/wiring color code.
- Work Environment
  - Confusing Displays or Controls – When the ESO inspected the equipment the first time, it was not obvious two of the four wires were not connected. .
  - Confusing Displays or Controls – A four conductor cable was supplied for a single phase. The cord cap did not match the machine end wiring. The cord has four conductors; the instrument requires three.

- Human Nature
  - Assumptions – ElThe work package stated the electricians were to perform demolition, installation, & relocation of receptacles / circuits. As noted in the work package change notice, the work also included installinig cord caps on a group furnished cord.

Pose the Following Question to Affected Employee:

"What would you do differently in the future to prevent this from happening again"?

- All wiring of cords will be checked to ensure end to end continuity for each conductor.

Organizational/System Issues:

- A walkdown of the work occurred, but MST-7 and the two electricians were not clear on what was included in the scope of work. The scope was clear.
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Summary/Conclusion:

The direct cause of the event was the wiring was incorrect. When MST-7 turned on the power, the furnace did not turn on. The root cause is that the wires were not followed end to end to determine if the circuit were complete prior to powering the furnace. The contributing causes were the scope of work at the task level was not understood by all workers as far as installation of the plug, the electricians did not have a copy of the owner's manual, taping of the wires was confusing, the walkdown was not effective in addressing the scope of the work, and the cord cap did not match the machine end wiring.

Recommended Improvement Corrective Actions?

1. When programmatic staff and crafts are involved with electrical work, an ESO and electrician should perform a two man check for wiring continuity.
2. For the wiring for the three welders, crafts and programmatic staff will walk down the equipment before it is started. COMPLETE
3. A cord cap that matches the vendor's instructions should always be used.
4. MST-7 and ESO walk down the new receptacles and welder plug caps . COMPLETE
5. MSS-STO, Electrical Crafts Supervisor) will review the scope of work for the work plan and talk about the situation with the electricians assigned to this task .COMPLETE
6. MST-7 and ESO will check voltage configurations of the affected power receptacles as well as verify manufacturer's wiring requirements on the three welder plugs installed by the electricians.

Should Improvement/Corrective Actions be tracked and entered into PFITS? Yes/No

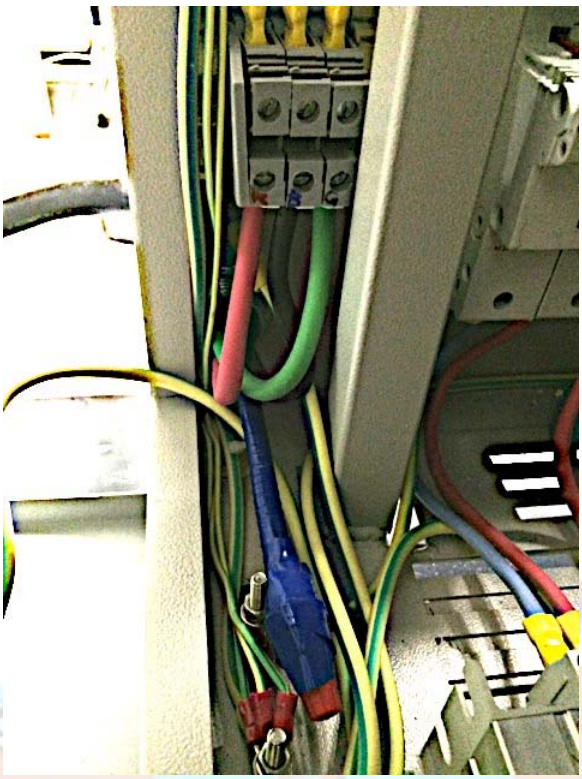
No.

Should a Lessons Learned/Best Practice be developed? Yes/No

No. The Learning Team Review will be submitted to the institutional Lessons Learned program for posting on the internet.

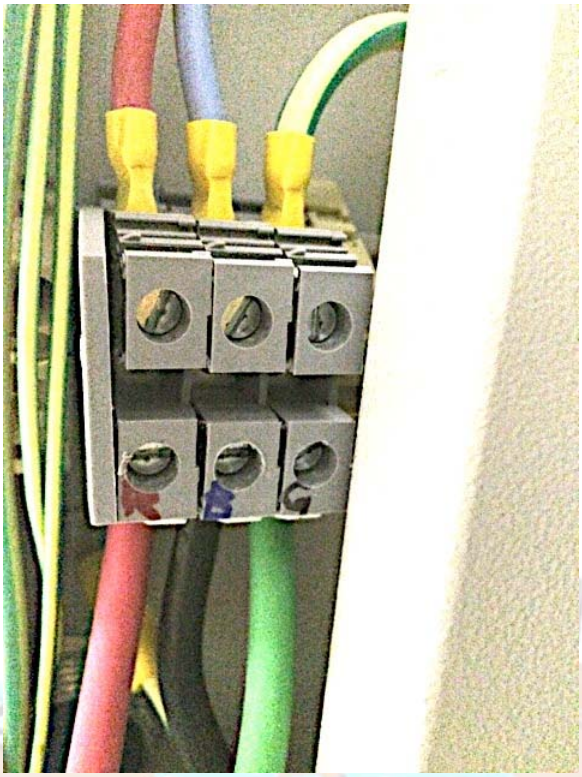
Pictures:

Excess cord remnant with original taping



Current configuration:

Note: Red “R”, Blue “B”, Black “G” marked prior to disconnecting original wiring to document original wiring. Blue “B” was intentional to differentiate from Black, which was capped and left loose. Did not have green marker available for “G.” This shows how things are currently configured. There is now a white wire taped blue. This wire was connected in the original configuration to the Blue



Current configuration:

Note: Dead leg is a white conductor wrapped in blue tape. Was originally placed in center hot terminal to recreate original wiring.

Original Plug

ADDENDUM

HPI Error Precursors

- o Time pressure (in a hurry)
- o High workload (high memory requirements)
- o Simultaneous, multiple tasks
- o Repetitive actions / Monotony
- o Irrecoverable acts
- o Interpretation requirements
- o Unclear goals, roles, & responsibilities
- o Lack of or unclear standards

2) Work Environment

- o Distractions/Interruptions
- o Changes/Departure from routine
- o Confusing displays/controls
- o Work-arounds/OOS instrumentation
- o Hidden system response
- o Unexpected equipment condition
- o Lack of alternative indication
- o Personality conflict

3) Individual Capabilities

- o Unfamiliarity w/ task / First time
- o Lack of knowledge
- o New technique
- o Imprecise communication habits
- o Lack of proficiency/Inexperience
- o Indistinct problem-solving skills
- o "Unsafe" attitude for critical tasks
- o Illness/Fatigue

4) Human Nature

- o Stress
- o Habit patterns
- o Assumptions
- o Complacency/Overconfidence
- o Mind-set
- o Inaccurate risk perception
- o Mental shortcuts
- o Limited short-term memory

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☐ ISM five-step process

1) Define Scope of Work
2) Analyze Hazards
3) Develop and Implement Controls
4) Perform Work
5) Ensure Performance / Feedback