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INTEGRATING THE NON-ELECTRICAL WORKER INTO THE ELECTRICAL SAFETY PROGRAM

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Abstract - The intent of this paper is to demonstrate an electrical safety program that incorporates all workers into the program, not just the electrical workers. It is largely in response to a paper presented at the 2012 ESW by Lanny Floyd entitled "Facilitating Application of Electrical Safety Best Practices to "Other" Workers" which requested all attendees to review their electrical safety program to assure that non-electrical workers were protected as well as electrical workers [1].

The referenced paper indicated that roughly 50% of electrical incidents involve workers whose primary function is not electrical in nature. It also encouraged all to "address electrical safety for all workers and not just workers whose job responsibilities involve working on or near energized electrical circuits." In this paper, a program which includes specific briefings to non-electrical workers as well as to workers who may need to perform their normal activities in proximity to energized electrical conductors is presented. The program uses a targeted approach to specific areas such as welding, excavating, rigging, chart reading, switching, cord and plug equipment and several other general areas to point out hazards that may exist and how to avoid them.

NFPA 70E-2004 was incorporated into the program several years ago and with it the need to include the "other" workers became apparent. The site experience over the years supports the assertion that about half of the electrical incidents involve non-electrical workers and this prompted us to develop specific briefings to enhance the knowledge of the non-electrical worker regarding safe electrical practices. The promotion of "May is Electrical Safety Month" and the development of informative presentations which are delivered to the general site population as well as electrical workers have greatly improved the hazards awareness status of the general worker on site.

Index Terms — Non-Electrical, electrical safety program, training, job safety analysis.

I. INTRODUCTION

At the 2012 IEEE IAS Electrical Safety Workshop, Lanny Floyd exhorted the attendees to consider the non-electrical worker in their electrical safety programs. He cited facts that indicated about half of the electrical incidents involve workers whose main function is not electrical work. The paper he presented was a call for instituting electrical safety programs at the workplace for all workers, not just those who work with electricity on a daily basis [1]. This paper describes what has been implemented over the last several years regarding raising the electrical hazards awareness of all workers at the site.

II. THE ELECTRICAL SAFETY PROGRAM

In 2005, the need to address electrical safety across the site was recognized due, in part, to the number of electrical events that had occurred over the previous 12 months. A program was developed to provide all workers with information on how to recognize and avoid the same mistakes. At that time, the idea that approximately 50% of electrical events involve non-electrical workers was indeed true as well. It was determined that there were several types of workers on site and that they basically fit into three major categories – electrical workers, field workers and administrative workers. Electrical workers, of course, were the qualified electrical workers who routinely dealt with electrical hazards and had the training and skills to work safely while avoiding those hazards. Workers that worked with the electrical workers; worked in the proximity of electrical hazards, or worked where they needed to interface with electrical equipment fit into the field worker grouping. Administrative workers were those whose main day to day routine was in an office environment. Don't think that this category is immune from electrical hazards because they do not work with wiring, junction boxes, disconnect switches and the like. There were a number of events that were cited in electrical safety presentations that showed this category of worker was, in fact, subject to incident or injury as many times as workers in the field.

Based on the premise that these three types of workers were on site, three different but similar safety briefings were developed that would be presented to all site employees during the month of June. (The May Electrical Safety Month idea that was part of the Electrical Safety Foundation International promotion had not yet been recognized). These briefings were titled, "Electrical Hazards Awareness Briefing" and tailored to the electrical worker, the general worker and the administrative worker. The electrical worker briefing delved into the details of the events reviewed and to the specific tasks that electrical workers need to perform to make the work area safe. The general worker briefing addressed some of the same topics, but in a more condensed version easily understood by the non-electrical worker. The administrative worker briefing was even

less detailed, but focused on the specific hazards and events that involved office workers, typically cord and plug devices for the most part. Since there were several cord and plug type events discussed, a specific campaign was initiated to go inspect personal work areas for the types of hazards experienced in the events presented in the briefing.

Over 1600 less than adequate electrical items were found by all types of workers on site and each was either addressed immediately or work orders generated to have the item repaired or replaced. These items ranged from defective cords to covers missing from junction boxes to improper use of a space heater. They were captured and tracked by a sitewide system for tracking action items until all were completed satisfactorily. This effort made all workers aware of electrical hazards as they participated in making the workplace safer for everyone.

The "Recognize the Hazard" theme was continued for the next two years and additional focus areas were identified and included. In late 2005, a specific electrical worker observation checklist was added to the Behavior Based Safety Observation program. This program promotes all workers to observe their peers and have safety based discussions regarding the observations made with the intent on providing incentive to change any behaviors identified as unsafe. In 2006, a specific training course was developed for the non-electrical worker to make the briefings from the previous year into a course that could be used, and credit given to workers, such that they would be able to recognize, avoid and potentially correct (or have corrected) any electrical hazards discovered. This training course has been a requirement for any worker that will be working near any energized electrical equipment or who must interface with it, such as operating a disconnect switch or using a portable power tool.

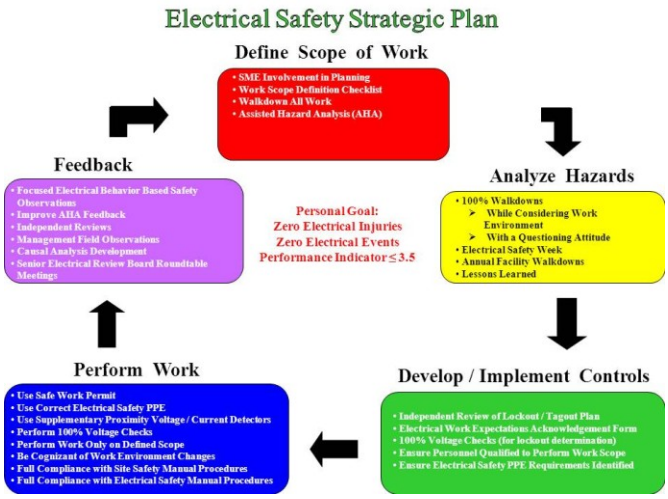

Figure 1 The Electrical Integrated Safety Management System

During the same time frame, the site, as well as the entire DOE Complex, was focused on the "Integrated Safety Management System" or ISMS. Following that same theme, the electrical safety program adopted its own ISMS adaptation and focused on the individual's responsibilities to do the right thing and adhere to the principles of the ISMS. A chart along the same ISMS model was developed and published along with laminated cards to carry with the worker's site access badge as a reminder of the safety principles to use to avoid hazards. Figure 1 represents that chart and in the center is the individual as well as the site focus of:

Personal Goal:
Zero Electrical Injuries
Zero Electrical Events
Performance Indicator ≤ 3.5.

The performance indicator referenced in Figure 1 represents a system established in 1994 to capture a weighted score of the electrical events using a 12-month rolling average and site man-hours worked each month to track as an indicator of the severity of electrical events. Each month the index is reviewed as are any electrical events to determine if there are gaps or areas needing additional focus to assure the right message is getting to the right people at the right times. The focus has been on various worker groups during certain periods of time depending on the specific concerns or events that indicate additional focus is needed.

III. WELDER ELECTRICAL SAFETY

On 7/21/05 two welders were setting up to perform a welding task in a building on site. While connecting the work (ground) lead to the piece of equipment to be welded they received a mild shock, commonly referred to as a "tingle". Subsequently, both welders reported to medical for observation and were released. During inspection of the work area it was noted that there was no earth ground connection to the piece of equipment being welded. The electricians checked for voltage on the welding machine work (ground) lead and found approximately 60VDC and 40VAC to earth ground. Other welding machines in the area were checked and found to have similar readings. The machines were immediately tagged out. The manufacturer was contacted and stated that it was common to find voltage on both leads (Open circuit voltage).

In response to the event and others similar in nature, a welding briefing was developed to address the items to do or not to do when welding with electric arc welding machines. As part of that package, an extensive list was compiled to address welding electrical hazards. The conclusion of that briefing reads as follows:

- Welders must always be concerned about the possibility of electrical shock. Wet working conditions must be avoided because water is an excellent conductor and electricity will always follow the path of least resistance. Even a person's perspiration can lower the body's resistance to electrical shock. Standing on a dry rubber mat or, when welding outdoors, standing on a dry board is always advisable.
- Poor connections and bare spots on cables further increase the possibility of electrical shock, so daily, aside from these more obvious shock hazards, equipment operators should routinely inspect for effective ground connections. A proper ground connection is always necessary because it provides a safety connection from a welding machine frame to the earth.
- Connections typically used for grounding an engine-driven welding machine include a cable connected from a ground

stud on the welding machine to a metal stake placed in the ground.

- The work piece being welded and the frame or chassis of all electrically powered machines must be connected to a good electrical ground. This can be accomplished by connecting it to a properly grounded building frame or other appropriate ground. Chains, wire ropes, cranes hoists and elevators must never be used as grounding connectors.
- The work lead is not the grounding lead. The work lead connects the work terminal on the power source to the work piece. A separate lead is required to ground the work piece or power source.
- When arc welding equipment is properly grounded, a voltage may safely exist between the electrode and any conducting object. Examples of conducting objects include buildings, power tools, work benches, welding power source cases and work pieces.
- Never touch the electrode and any metal object unless the welding power source is OFF.
- When installing a welding system, connect the frames of each unit such as welding power source, control, work table and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made electrically hot by stray current may deliver a powerful shock.
- Never ground to an electrical conduit or to a pipe carrying any gas or flammable liquid such as oil or fuel.

Open-Circuit Voltage (OCV) - As the name implies, no current is flowing in the circuit because the circuit is open. The voltage is impressed upon the circuit, however, so that when the circuit is completed, the current will flow immediately. For example, a welding machine that is turned on but not being used for welding at the moment will have an open-circuit voltage applied to the cables attached to the output terminals of the welding machine.

A diagram was also developed to demonstrate the circuit and indicate where the welder must make connections and where to avoid making connections due to current flow paths and is presented in Figure 2. All of this effort did serve to make the overall welding program safer and there have not been any incidents where these guidelines have been followed.

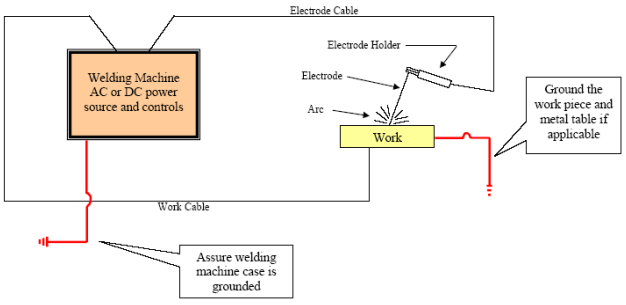

Figure 2 Welder Ground Setup

IV. CORD AND PLUG ISSUES

A constant nemesis seems to be the perennial "cord and plug" connected equipment. Even annual briefings and refreshers of the proper ways to use extension cords, power strips and surge protectors do not seem to be enough to completely eliminate issues with them. Each year, the events over the previous 12 months are presented and reviewed with all site personnel as part of May Electrical Safety Month programs. Invariably, there is at least one cord and plug related event to present and discuss during the electrical safety presentations intended to drive home the message that cords and plugs must be inspected by the user prior to each use. Failure to follow this simple rule has caused several shocks or burn injuries to personnel over the years and this creates a problem for the electrical safety program, since the requirements and recommendations are already put in place to avoid the hazards. Worker noncompliance almost always presents a challenge to those who must implement and monitor the electrical safety program and there is very little that any program can do without management becoming intimately involved in the enforcement of the rules.

Recognizing that there are many factors that impact human performance, focusing on some of the key factors does provide some level of confidence that the message will be received and subsequently implemented. Many experts in the field of human performance believe some of those key factors must include:

- Data and information processing
- Resources, tools, and environmental supports
- Consequences
- Incentives
- Rewards
- Skills and knowledge of the individual
- Individual motives

On the specific issue of cord and plug hazards, several of the above factors were considered and specific actions taken to offset any negative impact from them. A specific cord and plug hazards briefing was developed in 2008 which was presented to all workers on site which addressed a number of issues experienced during the previous year. Topics included "Cord and Plug Do's and Don'ts", "Examples of Conditions Found", "Specific Surge Protectors Not Allowed" and "Inspection of Your Work Area" (for any electrical hazards that may be present). Photos of examples were included as part of each segment which indicated the problem and the steps necessary to rectify it and/or avoid it. Figure 3 is one such example.

Figure 3 Example of Cord and Plug Problem

Education of all workers has always been a focus of the electrical safety program, yet it must constantly be made "new and improved" to capture the attention of the individuals and tune in to their individual data processing methods and their specific environmental influences. The consequences of noncompliance (i.e., shock, burn or other injury) need to be reinforced by any presentation to make it very clear to the workers that they share in the responsibility to make the workplace safe.

V. MAY ELECTRICAL SAFETY MONTH CAMPAIGNS

After the first year of having a specific focus on electrical safety in June, 2006, information was obtained from the Electrical Safety Foundation, International (ESFi) and the National Fire Protection Association (NFPA) about the fact that May was considered "Electrical Safety Month." In an effort to follow this theme and capitalize on the materials made available, the site electrical safety program adopted May as electrical safety month.

Each year during the electrical safety month campaign from 2007 to 2011, the materials made available to site personnel included activities that could be addressed each week of the month in addition to the specific monthly safety meeting materials pertaining to electrical safety. These activities ranged from inspecting the immediate employee work space to full scale area inspections with a checklist to complete.

In each case, the briefing packages included events experienced over the previous 12 months and, of course, addressed those involving non-electrical workers. As indicated previously, the cord and plug issues were almost always part of the mix. Examples of the types of events experienced on site and shared during the respective May Electrical Safety Month presentations are included in Table 1.

VI. IMPLEMENTATION OF NFPA 70E

Since the site already had an electrical safety program when NFPA 70E requirements were added to the set of procedures, the task of "melding" the two began. The task team that was set up to make the incorporation painstakingly reviewed page after page of NFPA 70E and the site electrical safety procedures to provide a best fit for the workers in the field. Of course, arc flash was the major topic of discussion as it had not been considered in the past and its implications were far reaching. The hurdles of convincing workers that they now needed to wear significantly more protective equipment to perform the same functions as they "just did last week" were indeed high. [3]

While NFPA 70E implementation was primarily considered to be a major impact to the electrical worker, all workers were educated about the topic. Included in the aforementioned electrical safety briefings was information regarding just what an arc flash was and what it could do. Arc flash testing videos were used rather effectively to drive home the point that there is a real hazard when electrical energy is not properly contained. The videos and discussions after the gasps of the audience when first viewed convinced a lot of non-electrical personnel to leave "that stuff" to the experts. This unintended consequence was actually a good thing, as it tended to dissuade those who might have thought they wanted to operate electrical equipment to reconsider that thought.

Floyd, Aeiker, Liggett and Sullivan state that a "State of the Art Electrical Safety Program" integrates safe work practices, technology, and managing systems such that performance and continuous improvement are sustainable over time [4]. The implementation of NFPA 70E requirements into the existing site electrical safety program did serve to integrate the safe work practices of NFPA 70E, the new technologies that were researched to mitigate or eliminate electrical hazards and the management of information and procedures to better serve the worker on site.

VII. SPECIFIC TASK WORKER DESIGNATION

Along with the implementation of NFPA 70E came the inclusion of a special category of worker designated "Specific Task Worker." This new classification of site worker encompassed workers that needed to perform tasks which either brought them in close proximity to exposed energized conductors or required them to interact with the equipment, such as operating disconnecting means or racking of circuit breakers. This designation was also implemented for those workers that needed to access an electrical cabinet containing exposed energized components for the purpose of taking an instrument reading or observe readouts on devices contained within the enclosure. Specific instructions would be developed for each type of specific task and one classification as Specific Task Worker in one facility did not automatically transfer to different activity in another facility. This designation of worker required training on the basics of electrical hazards awareness as well as the specific task instructions to be qualified as a "Specific Task Worker."

The Specific Task Worker is not allowed in any case to "work on" any energized electrical component, only "work near" to use an old term now dropped from NFPA 70E [5]. The "working on" activities are reserved for only the qualified electrical workers, who, by demonstration of the knowledge, skills and experience are deemed qualified to work on energized components when it becomes necessary to do so. By designating certain individuals as "Specific Task Workers" many tasks can be

performed that might possibly have required a qualified electrical worker to accomplish them. Making this designation took a great deal of effort and discussion among the electrical safety program owners and sponsors to assure that there would be no unnecessary exposure to any "unqualified" worker to energized components. By implementing the training requirements and designating the individual work groups as the owner of the specific task training requirements, the acceptance of the new worker type was assured.

VIII. CONCLUSIONS

To adequately address electrical hazards awareness in the workplace, the responsible parties for the electrical safety program must be diligent about continuously bringing the issues to the forefront. Briefings, special safety messages, May Electrical Safety Month campaigns and electrical event information dissemination are all part of that effort to make the general worker aware that electrical energy demands respect and that there are simple ways to avoid the hazards. Electrical Safety programs cannot afford to be silent about the everyday exposure to all workers to electrical hazards during the normal course of the workday. We all are users of electrical energy and need to put into practice the basic rules we have learned both from past experience and from the experiences of others.

It is apparent that an electrical safety program that adopts the following philosophy will continue to serve both the employer and the employees [6]:

- All electrical injuries are preventable
- Adherence to safe work practices is a condition of employment
- All unsafe conditions shall be corrected.
- It is the responsibility of every person to identify unsafe conditions/acts and avoid or correct them within their limits

IX. ACKNOWLEDGEMENTS

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XI. VITA

T. David Mills, P.E. (M'77–SM'00) received the B.S.E.E. degree from Virginia Tech, Blacksburg, in 1978.

He has been an Electrical Engineer with Burlington Industries, Columbia Nitrogen Corporation, Cleveland Electric Company, E. I. DuPont de Nemours, Inc., Bechtel Savannah River, Inc., and currently, Savannah River Nuclear Solutions, LLC, Aiken, SC. His experience covers several industries, including textiles, chemical, nuclear power plant construction, industrial construction, nuclear materials facilities, commercial buildings and diesel driven systems.

Mr. Mills is currently an IEEE Standards Association member and participates in several standards making committees including Co-Chair of IEEE Std. 3000 (Recommended Practice for Engineering of Industrial and Commercial Power Systems) Working Group, Secretary of the Power Systems Design Subcommittee, member of the Forensics Working Group, member of the Standards Coordinating Committee 18 (SCC 18) as an IEEE primary representative to Code Panel 3 of the National Electrical Code®, and is Chair of the Industry Applications Society (IAS) Industrial and Commercial Power Systems Department (I&CPS). He serves on the Advisory Committee for the Electrical and Computer Engineering Technology Program at Augusta Technical College. He has been a program evaluator for the Accreditation Board of Engineering and Technology's (ABET) Technology Accreditation Commission (TAC), which is responsible for evaluation of collegiate engineering technology programs and has been the IAS Standards Department Chair.

He is a Registered Professional Engineer in the States of Georgia and South Carolina.

John H. McAlhaney, Jr., P.E., (M'78-SM'07) received the B. S. degree in electrical engineering with honors from Clemson University in 1978.

He started his career with the E. I. DuPont Company at the Savannah River Plant in Aiken South Carolina as an electrical project engineer in 1978 where he was primarily engaged in the design and start-up of industrial electrical systems for chemical processing and infrastructure support facilities. In his 35 years of service at this site, he has held several assignments in the electrical functional area including engineering supervisor for electrical projects and project manager for capital improvement projects. He is currently a Principle Technical Advisor with the Savannah River Nuclear Solutions, LLC, at the Savannah River Site and responsible for providing leadership and oversight of the electrical safety program and electrical infrastructure system.

Mr. McAlhaney is currently a working group member for IEEE Standard 1584 (Guide for Performing Arc Flash Hazard Calculations), IEEE Std. P1683 (Standard for Motor Control Centers Rated up to and Including 600 VAC or 1000 VDC with Requirements Intended to Reduce Electrical Hazards), IEEE Std. P1814 (Recommended Practice for Electrical Safety Design Techniques to Improve Electrical Safety) and IEEE Std.

1242 (Guide for Specifying and Selecting Power, Control and Special Purpose Cable for Petroleum and Chemical Plants). He is also a working group member for the EPRI Cable Users Group. Mr. McAlhaney currently chairs the Department of Energy (DOE) Facility Contractors Organization (EFCOG) Electrical Safety Subgroup and chairs the workshop committee for the annual DOE/EFCOG Electrical Safety Workshop. Mr. McAlhaney also participates on the NFPA 70E-2015 Articles 105 and 110 Task Group.

Mr. McAlhaney has served on the Aiken Technical College Electromechanical Advisory Board and is a Registered Professional Engineer in the State of South Carolina.

Table 1 Accumulated Electrical Events 2005 – 2012

Event Description	Event Details	Type of Event	Worker Type
Worker drilled into energized cable	During installation of metal flashing, worker drilled into energized 270V insulated electrical cable.	Electrical Intrusion	Non-Electrical
Energized wire cut	During deactivation of a facility, workers cut into conduit containing an energized line.	Electrical Intrusion	Electrical
Cable penetrated by screw	Carpenter drilled into armored cable while attaching medicine cabinet to a sheet rock wall.	Electrical Intrusion	Non-Electrical
Energized wire cut	Electricians isolating a facility cut through a live 110-volt wire.	Electrical Intrusion	Electrical
Power tool cord cut	Worker cut cord to his power tool while cutting cables in a cable tray with lineman pliers	Electrical Intrusion	Electrical
Energized wiring cut	Worker cut into conduit containing energized 120VAC circuit while air gapping conduit to a motor starter rack.	Electrical Intrusion	Electrical
Wire shorted to power strip housing	Incident where a factory design flaw allowed an auxiliary receptacle to be dislodged from the unit causing an energized conductor to contact the metal case.	Electrical Fault	Non-Electrical
Worker shocked by contour probe	Shock Incident involving a Parker Contour Probe, Model B300 Moisture discovered inside the sealed unit around the switch (rubber boot failure) was probable cause of shock. Shock was limited to what the GFCI allowed prior to clearing the fault.	Electrical Shock	Non-Electrical
Loose wire in plug cap causes damage	Twist-lock plug failure where one of the hot legs had a loose connection (screw type fastener), that resulted in some conductor damage and insulation discoloration.	Electrical Fault	Non-Electrical
Missing ground pin causes cord damage	Extension cord found with no ground pin in the male end and apparent overheating at the female end where devices were connected.	Electrical Fault	Non-Electrical
Arc Flash Event	Mechanics were troubleshooting a 480V circuit breaker when an arc-flash event occurred.	Arc Flash with Injury	Electrical
Arc Flash Event	An arc flash event occurred during performance of the preventive maintenance activities as a mechanic was placing a disconnect switch in the closed (on) position (door closed). A flash occurred internal to the equipment and it is believed that a foreign material initiated the subsequent arc-flash event.	Arc Flash with No Injury	Electrical
Receptacle with a cord plug	While replacing a metal receptacle cover on a	Electrical Fault	Electrical

Event Description	Event Details	Type of Event	Worker Type
power prong broken off causes short circuit	110 volt outlet, a spark occurred when a mechanic made inadvertent contact with an energized cord plug power prong which had broken off in the receptacle.		
Worker drilled into energized conductor	An electrician inadvertently penetrated an electrical conduit that contained live 120 V conductors while drilling a series of 1 1/2" holes through a wall.	Electrical Intrusion	Electrical
480 Volt Cord and Plug Shock	Worker failed to control both ends of the cord while changing out the plug and another worker unintentionally plugged in the cord. The first electrician received a 480V shock and second degree burns.	Electrical Shock with Burn Injury	Electrical
Conduit Cut in Slab Penetration	2 unknown electrical conduits were discovered after the concrete was cut. Rebar in concrete "masked" seeing the conduit on subsurface survey and conduit was not identified on any engineering drawing.	Electrical Intrusion	Non-Electrical
Work on Energized Conductor by Unqualified Worker	An unqualified worker entered an electrical cabinet to unplug a cooling fan that was believed about to fail and become a potential fire hazard.	Shock Protection Boundary Violation	Non-Electrical
Dump Truck Violates Safe Approach Boundary and Breaks Static Line	Dump truck driver failed to lower dump body after emptying load and drove under an energized overhead 13.8kV. The static line was broken by dump body which came within 3 feet of energized 13.8kV line.	Shock Protection Boundary Violation	Non-Electrical
Worker Shocked by 480 Volt Cable Thought to be Non-hazardous	While troubleshooting low voltage (less than 50 volts) cathodic protection system between areas, the underground cable that had to be excavated to complete testing and repairs, which included breaching the cable. Electricians used proximity voltage testers (two different models) as a last check before breaching the cable. Worker felt a shock when breaching the cable and it was determined to be 480V.	Electrical Shock	Electrical
Parking Lot Lighting Excavation near energized 480V cable	Troubleshooting the repair of the 208V parking lot lighting system in an area required engineering drawing reviews, Ground Penetrating Radar (GPR), and electrical testing, all of which was believed to be performed. Two underground interferences were identified and 208V system locked out. Hand digging was required to locate underground interferences, but backhoe was used.	Electrical Intrusion	Non-Electrical
Shock From Floor Buffer toggle switch	Floor Cleaning Service subcontract employee received a shock to his left hand while operating a floor buffer. He reached down with his left hand to decrease the speed using a metal toggle switch and he felt a shock.	Electrical Shock	Non-Electrical
Voltage found in HVAC control panel	A subcontract electrician discovered uncontrolled voltage while performing a preliminary absence of voltage check in a HVAC control panel.	Inadequate Lockout	Electrical

Event Description	Event Details	Type of Event	Worker Type
Slight burn/shock from power supply cord	An electrical short in the power (110V) cable for a three step battery charger resulted in a severed power cable and a minor burn.	Electrical Shock with Burn Injury	Non-Electrical
Jacket for temporary cord cut by scissor lift	A subcontractor weld inspector operating a scissor lift was in the process of moving/lowering the lift when the lift caught a temporary 480v power cable.	Electrical Intrusion	Non-Electrical
Slight Shock at E85 Fuel Tank	A subcontractor employee touched a scaffold and felt a slight tingle. The scaffold was erected at the 715-2A E-85 alternate fuel tank, in preparation to perform cleaning and painting of the tank.	Electrical Shock with No Injury	Non-Electrical
Unexpected Contact with Electrical Energy Source	A worker touched a handrail to a skid shack and received a mild shock. The source of the voltage was due to an unconnected neutral conductor at the power panel supplying power to the shack. The return current sought the path back to the source through the equipment ground and the building ground.	Electrical Shock with No Injury	Non-Electrical
Incorrectly Installed L/T	Subcontract electrical workers were installing electrical service to a building using a Single Point Lockout/Tagout (SPLT) to isolate electrically a portion of this work. A manager was observing the work area and found the disconnect switch had 2 tags installed with no locks/hasps.	Lockout/Tagout Violation	Electrical
L/T Removed Prior to Authorization	A lockout to isolate power to a jib crane prior to performing painting was removed by two workers prior to obtaining the authorization to remove.	Lockout/Tagout Violation	Non-Electrical
Slight Shock from Electrical Calibrator	A worker was calibrating a voltage/current meter using a calibrator when he placed it in standby mode. He immediately began to remove the test lead from the unit under test with his right and felt a mild shock to his right hand.	Electrical Shock with No Injury	Non-Electrical