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Martin Technical™

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FINAL

Electrical Safety Audit Report

For

Port of Los Angeles

San Pedro, CA
January 10, 2013

THE PORT OF LOS ANGELES

Martin Technical

Electrical Safety Audit Report

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SUMMARY, BACKGROUND, AND OVERVIEW

EXECUTIVE SUMMARY

URS in conjunction with Martin Technical and Zoubek Consulting performed an electrical safety audit at the Port of Los Angeles (POLA) on July 25 through July 27, 2012 and August 6 through August 8, 2012 which focused on Division 147 employees. The audit was conducted at the request of POLA management to investigate if complaints and concerns by POLA workers regarding electrical safety were substantiated and if there were other electrical safety or general safety hazards at POLA that should be addressed.

The audit focused on current electrical safety conditions, and selected other safety measures for the Division 147 which includes the Port Electrical Mechanic (PEM) shop in the Construction and Maintenance (C&M) Division. The PEM shop consists of workers from Electrical and Mechanical trades backgrounds that have been cross-trained to handle electrical, mechanical and welding work at the POLA. Note that within this report, all of Division 147 including its management, supervisors, and workers will be referred to as the "Harbor Department"; the Director of Construction and Maintenance and 2nd level Director, will be referred to as "management;" and the 2nd level and 1st level supervisors of Division 147, will be referred to as "supervisors." As a matter of convenience, all front line workers in the PEM shop are referred to collectively as "PEMs", even though some employees in the PEM shop are not classified as PEMs.

The audit consisted of: interviews of all Division 147 employees, observations of employees while working, administration of a safety culture survey; review of training records; review of electrical safety programs; review of safety meeting records; attendance to safety tailgate meetings; and inspection of personal protective equipment (PPE).

The scope of the audit consisted of 19 major areas falling under three categories, as listed below in the following Table 1.1. An overall rating scale was utilized from a scale of 1 to 10, with a rating of 1 corresponding to very poor, a 5 to fair, and a 10 to very good. Two major categories are rated for each area, a Raw Score and an Industry Average. The Division 147 was average score for all 19 major areas was a 5.26.

The raw score captures the auditors scoring of Division 147 in the listed area. The "Industry Average" provides the Port with a means of comparison of how the Port "stands" when compared to other entities the auditors have audited. Industry Average is based upon the auditor's first time audits and inspections with other companies and organizations. As there is not a qualitative measurement for "electrical safety" other than "compliant" or "non-compliant", these measurements are based on subjective observations and information collected by the auditors. It is important to note that being at average or above average does not mean the program is completely in compliance nor that all safe measures are being taken. Refer to

detailed section of the report and Appendix C: Corrective Actions Table for recommended corrective actions.

Table 1.1. Ratings Table

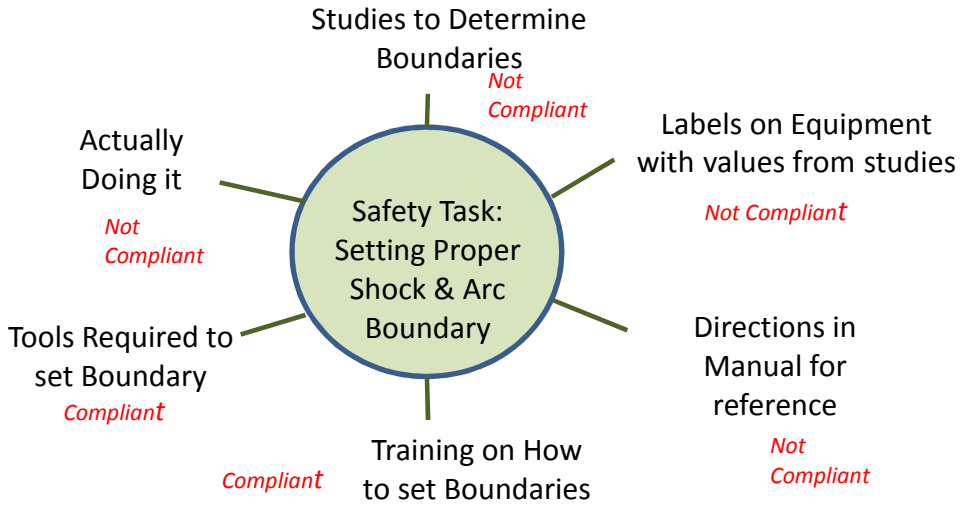
Report Section	Area	Raw Score	Auditor's Average 1st Time Audit	World Class Rating
Part II	Management, Safety Culture, and Injury and Illness Prevention Program (IIPP)	4	7	10
Part III	General Training	7	7	10
Part IV – Section 1.1A	High Voltage Written Program	8	8	10
Part IV – Section 1.1B	Low Voltage Written Program	1	5	10
Part IV – Section 2.1B	Qualified Electrical Worker Program (high voltage)	8	8	10
Part IV Section 2.1A	Qualified Person Program (Low Voltage)	4	6	10
Part IV – Section 2.2 through 2.15	Skills & Safety Training	6	4	10
Part IV – Section 4	Identification & Labeling	4	6	10
Part IV – Section 5	Equipment Installation & Maintenance	3	6	10
Part IV – Section 5	Electrical Preventive Maintenance	3	4	10
Part IV – Section 6 and 7	Reports and Studies	6	5	10
Part IV - Section 8	Electrical Testing	2	4	10
Part IV – Section 9	Electrical Tool & Test Equipment	7	7	10
Part IV - Section 10	Personal Protective Equipment (PPE)	6	5	10
Part IV – Section 11	Electrical Safety Work Practices	6	6	10
Part IV – Section 12	Hazardous Classified Locations	6	6	10
Part IV – Section 13	Engineering Controls	9	7	10
Part IV – Section 14	Planning and Documentation Controls	7	5	12
Part IV – Section 15	Electrical Safety Supervision and Leadership Team	3	7	10
	Average	**5.26**	**5.95**	**10**

Regulatory Applicability

Determination of compliance was based on two regulatory codes that govern electrical safety for the Port of Los Angeles; California Occupational Safety and Health (CalOSHA) Title 8 California Code of Regulations Subchapter 5: Electrical Safety Orders, and the Los Angeles Electrical Code. In addition to these governing codes, two other codes were used as reference sources for compliance; 2012 NFPA 70E, Standard for Electrical Safety in the Workplace and 2008 National Electrical Code (NEC). NFPA 70E is used as the standard for meeting compliance with CalOSHA codes. As it relates to work practices, CalOSHA often provides direction on "what" to do, but not "how" to do it. NFPA 70E provides standards on "how" to comply with particular sections of CalOSHA electrical safety orders. For example, CalOSHA requires electrical workers to "set up" and "clearly mark and protect the limited and arc flash boundaries", but does not provide information on how to determine the limited and arc flash boundary distances. NFPA 70E is therefore referenced to determine how to calculate the boundary distances. As of January 2011, the State of California and the City of Los Angeles adopted the 2008 NEC as their own electrical codes. Due to this, the 2008 NEC is referenced as the original source instead of citing City of Los Angeles Electrical Code.

In addition to compliance, safety was also considered in the audit. Being compliant doesn't always mean working safe, nor does working safe always mean that the process directly follows compliance requirements. Further, compliance in one or more areas does not mean that the worker is compliant overall in the task or necessarily working safe. As depicted in the graphic below, a worker could be compliant with training and tools for a safety task, but still not be compliant as a Qualified Person or working safe. Conversely, the worker could be working safe and setting boundaries, but without proper documentation.

The sample chart below demonstrates how compliance in different areas may work in conjunction to address a particular task. Note: the chart does not depicted actual results.



Overall Findings

As was demonstrated in Table 1.1 Ratings Table, the overall findings in the audit presented mixed results with a rating of 5.26. Some areas were fully compliant and strong, some areas had a program in place, but with some gaps, and some areas were completely lacking. Scores ranged anywhere from a low a 1 to a high of 9. Compliance and safety levels from worker to worker also greatly differed. As a whole, there is a solid structure in place, but the holes in the structure create some specific electrical safety problems as discussed below, most of which is due to lack of proper electrical safety leadership and lack of understanding of some electrical safety requirements and practices.

The C&M management shows genuine concern for the safety of all workers and generally provides a reasonable effort to comply with safety requirements; however gaps are present within Division 147 related to safety communication, safety training, and knowledge on electrical safety requirements.

The management of electrical safety of POLA has improved over the last four years as it relates to documentation, processes and procedures. C&M management has expressed their desire to continually improve workplace safety and to be in full compliance with codes and standards.

Although documentation and compliance has improved over the last four years, the application of electrical safety practices in the field with the PEM workers has digressed due to conflict between PEMs not working together as a team and conflicts with supervisors and PEM employees as well as between fellow employees. The top ten serious electrical safety issues related to compliance requirements are listed starting on page 12 which include: 1) lack of electrical safety technical advisor, 2) lack of low voltage safety program, 3) assignment of job tasks based upon equipment specific skill sets 4) PEM shop not working as a team, 5) implementation of arc flash program, 6) lack of preventive maintenance, 7) task and equipment specific training, 8) proper use and maintenance of electrical equipment, 9) communication of information, and 10) selection of proper use of personal protective equipment and tools. The problems that exist are not due to management's lack of concern for electrical safety, but rather the lack of proper knowledge about electrical systems and electrical safety. Although the majority of the work PEMs perform is electrical in nature, there is no electrical safety lead at POLA, which has greatly contributed to some of the deficiencies found in the audit.

The PEM workforce includes many very experienced and talented workers with deep knowledge of electrical equipment and a high concern for electrical safety. The combined experience and knowledge of the PEM workforce for electrical skills is well above average. The PEM workforce also includes workers that are relatively newer to electrical skills, but have deep mechanical or welding skills background. Combined, the PEM shop team is very talented and capable of handling the tasks assigned, but the electrical skills and knowledge of the more experienced are not being properly leveraged for safety. Electrical safety and electrical

compliance is being directed by supervisors who do not have a deep or broad enough understanding of electrical safety practices and codes for the vast array of electrical distribution equipment, electrical hazards, and challenges found at POLA. There is a need for an electrical safety technical advisor to provide guidance on safe work practices and compliance. In addition, the less electrically experienced workers are held at the same or even higher level of qualification and work than the very experienced workers. Although not a compliance issue, this creates unnecessary safety concerns in addition to conflicts and tension within the PEM shop.

As one would expect, the more seasoned electrical workers have more knowledge and experience about electrical safety and therefore, generally work safer around electricity than their counterparts with less experience. Some of the less experienced electrical workers need continued guidance and on-the-job training to increase their knowledge and safety skills, however there is not a solid process in place to assure that this happens.

Of the 18 general safety training programs reviewed, 14 (or 78%) out of the 18 training topics had workers who were not up-to-date on their required training courses, meaning that either persons had never been trained in the topic or that they had not been trained within the mandatory time frame as required by the associated regulation. Training for electrical safety and basic electrical skills has been conducted for all PEMs, but some of the training lacked proper information and guidance and requires retraining. Specific training for truck boom, national electrical code and equipment specific training was found to be either non-existent or not deep enough.

Overall electrical safety compliance for processes and procedures represented mixed results. The high voltage processes and procedures are mostly compliant and is where most of the focus and effort has been for C&M. Some gaps in proper PPE usage, documentation and safety knowledge exist for high voltage. Low voltage programs are relatively weak and in some areas are non-existent. Maintaining electrical equipment through preventive maintenance and returning equipment to a state that meets safety standards (NEC / Los Angeles Electrical Code) is a very weak point in the electrical safety program. Specifically, existing equipment must be in proper working condition and not be modified in a way that violates the NEC / Los Angeles Electrical Code or left in a condition of disrepair that would present a safety hazard or violate the NEC / Los Angeles Electrical Code. POLA's current understanding and application of the NEC / Los Angeles Electrical Code is only to new installations through engineering. Further, CalOSHA requirements as listed in Title 8 California Code of Regulations Sections 3328 and 2340.1 state that machinery and equipment in service shall be inspected and maintained as recommended by the manufacturer and that equipment must be kept in safe working condition. Related to this misapplication of the NEC / Los Angeles Electrical Code is a lack of knowledge of PEMs on how to properly install or repair some equipment, which is a result of improper knowledge about NEC and improperly assigning personnel to perform the task, which they are not qualified for. PEMs, in general, will not work on energized equipment and PEMS do properly follow steps for de-energization and lockout / tagout, although some individuals were

observed to be deficient on particular equipment or were using equipment or methods not considered as the safest best practice. Specific examples include observation of a PEM who failed to properly lockout a solar activation device on a piece of equipment, PEMs who routinely rely on tick tracers for their sole means of identifying zero energy, and PEMs who stated they had occasionally worked on energized electrical equipment in order to save time.

POLA Engineering has implemented engineering controls, where applicable, to minimize electrical hazards. Engineering is organized and thorough, and specifies the same manufacturer and type of equipment when applicable to reduce electrical accidents due to lack of familiarity with different types of equipment. Engineering should be commended for their detail and proactive approach to electrical safety in these areas. One deficiency in Engineering was lack of implementation of arc flash analysis. Engineering has already implemented an arc flash analysis program for new equipment installations, but has not addressed existing equipment. Another area of deficiency is inconsistent distribution of as-built drawings, one-line drawings, and equipment manuals to Division 147 employees.

Looking forward, the PEM team and its management have the experience, leadership and overall capability of resolving outstanding electrical safety issues and becoming a world-class maintenance organization. Reallocation of human capital and skill sets into the right areas of supervision and management will help close the gaps in electrical safety issues and will help relieve tension within the PEM group. An increased focus on electrical safety leadership and action of the recommended corrective actions in this report will make the PEM team both safer and more efficient. Many of the recommended corrective actions are quick and inexpensive to implement, while a few will require budgeting and extended time to complete. Failure to make changes represents a higher than needed risk of an accident and would leave the POLA C&M team in lack of compliance in many areas.

TOPIC BREAK-DOWNS & RECOMMENDED CORRECTIVE ACTIONS

A break-down of findings and recommended corrective actions by sections and topic are presented below which include: 1) Safety Culture, 2), General Safety, and 3) Electrical Safety. Note that both the findings and recommended corrective actions may overlap from section or subsection to another. Also note that an overall corrective actions table is presented in Appendix C of this report.

Safety Culture. Management and Injury and Illness Prevention Program -Findings & Recommended Corrective Actions

The overall score for "Safety Culture, Management and Injury and Illness Prevention Program (IIPP), was rated a 4.0 on a scale of 1 through 10. This score included a review of the general safety culture, employee interviews, and a review of implementation of the IIPP within Division 147. As part of this review, a written safety culture survey was administered to Division 147 employees. The written safety culture survey included personal opinions related to nine dimension topics as follows 1) management commitment to safety, 2) communication of management to respondent, 3) priority of safety, 4) importance of rules and procedures, 5) supportive environment to safety, 6) personal involvement to safety, 7) personal priority of safety, 8) personal perception of safety risk on the job, and 9) work environment allows for achievement of safety." Note that the safety culture survey has its own independent rating scale due to the nature of the survey. Of the nine dimensional topics, two (or 22%) scored "good," six (or 67%) scored "fair," and one (or 11%) scored "poor." The dimensional topic which scored a "poor" topic was for "Management Communication to Employees." The dimensional topic which bordered on a "poor" rating was for "Management's Commitment to Safety."

In relation to communication, the audit team observed that deficiencies were found with communication and dissemination of information and equipment related to electrical safety at POLA. There is little consistency in the dissemination of information and some PEM workers do not receive the same safety information as other workers. Some PEMs appear to be left out of receiving specific information, access to information, one line drawings, personal protective equipment or tools. Electrical one-line drawings consist in many different forms and revisions. The method for obtaining the proper, controlled electrical one-line drawings is not controlled and the information isn't readily available to all those who need it. Many PEMs are not aware where particular processes or procedures can be accessed.

In regards to employee interviews, the audit team observed a distinct lack of trust between fellow employees, lack of team work, and mistrust in management and supervisors. This influences safety at the Port in that personnel will not speak up about unsafe actions or conditions if observed, nor are they always looking out for the welfare of their fellow employee.

The core conflict in the PEM shop revolves around workers and managers from different backgrounds and varying degrees of knowledge and electrical experience and the jobs they each perform under C&M. In particular, some of those who began as electricians believe some workers who come from a predominantly mechanical background are unfit and unsafe to work on some of the electrical tasks they are given and that supervisors from mechanical backgrounds are unfit to lead electrical maintenance operations. Although the conflict is driven by partisan interests, it is also a legitimate safety concern. The problem is significantly more prevalent in the day shift compared to the night shift.

Some individuals who began as electricians are concerned about their safety when working as an equal to, or under someone they believe doesn't have proper knowledge of the equipment they are working on or the safety procedures involved. They fear that a mistake will be made that could endanger their safety and therefore, do not always trust their co-workers or work as a team. Additionally, some of those who began as electricians are upset that higher-level work or supervision is given to those with less knowledge and experience than themselves. As a result, these individuals take a reserved approach in showing the less experienced workers the correct or safe way to perform work, and instead let the less experienced person potentially struggle with their task as a statement of the inequity they see. This lack of concern is contrary to a good electrical safety system.

On the other hand, some individuals with less electrical experience do not always feel safe working with more experienced individuals because they feel their partner is waiting for them to make a mistake in order to demonstrate the lack of knowledge of the less experienced. As a result, these less experienced individuals tend to work in a more isolated way, and are hesitant to ask for help so that they don't expose any weaknesses that could be used against them.

Both the more experienced and less experienced individuals have valid concerns. These concerns have created a lack of trust and lack of teamwork which is essential for electrical safety.

Specific requirements related to management support are required within by CalOSHA within Title 8 California Code of Regulations 3203. These include requirements for assignment of safety leadership; safety committee meetings; incident reporting requirements; and positive and negative feedback related to safe or lack of safe behaviors. These requirements are not present within Division 147, which reflects poorly on Harbor Department's support and commitment to safety. Full implementation of an Injury and Illness Prevention Program will address this issue.

When employees were asked by the audit team "who was in charge of electrical safety at the Port," employees had no one person they could identify. The supervisors come from mechanical or non-electrical backgrounds, leaving them short of knowledge in some area of electrical safety practices and lack of decisive decision making. One of the managers has an electrical background, but is not in a position to manage daily activities and programs in the field. Lack of deep electrical safety and systems knowledge within the Harbor Department and no electrical safety technical advisor or electrical safety team, has resulted in a program that is only as strong as the supervisors' knowledge of electrical safety, which is lacking in some key areas. Further complicating the issue is the troubleshooting and repair differences between mechanical trades background and electrical trades background. A mechanical philosophy to troubleshooting or repairing equipment can be very different, and more aggressively than the electrical philosophy, and is not always in alignment with electrical safe work practices. This creates a conflict when

management is prescribing work practices that those from an electricians training would view as unorthodox or potentially dangerous.

Within Division 147, there is no formal or regularly scheduled safety committee whereby safety issues can be brought up by managers or employees, discussed, and resolved. As mentioned, a formal reporting procedure or process is not enforced or practiced. In addition, no process exists whereby employees and supervisors are commended or rewarded for safe behaviors nor is there a process for negative feedback for unsafe behaviors.

There are no regularly scheduled field safety audits to identify hazardous conditions and correct them in a timely manner. Without a knowledgeable electrical safety technical advisor to perform field audits and without field audits being conducted, unsafe installations and equipment were observed by the audit team at the Port.

Top cultural issues that concerned the audit team include the following:

1. Mistrust of supervisors and management.
2. Mistrust of PEMs between their peers.
3. Lack of communication on safety procedures, pertinent safety topics, equipment specific concerns, task specific health and safety information
4. Lack of implementation of reporting health and safety issues and lack of procedures to ensure that issues have been corrected.
5. Lack of knowledge on method to anonymously report health and safety concerns
6. Lack of a safety committee or electrical safety committee.
7. Lack of electrical safety technical advisor or point person within supervisor level to address electrical safety concerns, provide guidance, and provide an electrical safety technical advisor and mentor for electrical safety
8. Lack of incident, first aid, accident, and near miss tracking and reporting on lessons learned back to PEMs.

Top cultural safety corrective actions, in order of priority:

1. Establish an overall electrical safety technical advisor who has the ability and desire to be an electrical safety champion.
2. Fully implement Injury and Illness Prevention program
3. Establish a Senior PEM position with extensive electrical knowledge and who has the respect of his peers as a field supervisor for electrical operations and safety. This may or may not be the same person as #1 above.
4. Create a cross-functional electrical safety team consisting of members from various departments within C&M as well as Engineering and Risk Management.
5. Create cross training for teams of employees to leverage the strengths of individual employees

6. Develop a process for tracking and reporting near misses and incidents with feedback to the workers.
7. Establish a process to disseminate as built drawings, equipment drawings, one line drawings, and equipment specific training to PEMs.
8. Establish regular electrical safety meetings
9. Establish regular electrical safety audits
10. Develop and consistently provide PPE and safety equipment to employees

Further information on implementing these recommended corrective actions can be found in the detailed section of the report with a listing of corrective actions presented in Appendix C of this report.

General Safety Training Findings & Recommended Corrective Actions

Health and Safety training includes basic safety training and excludes electrical specific training. In terms of the general safety topics audited, the C&M management has generally provided the proper training and taken diligent steps to provide a safe work environment, although not all PEMs have received the required training. The general safety training was scored with a rating of 7.0 out of 10.0. As already discussed, of the 18 training programs reviewed 14 (or 78%) of the training topics were not compliant, meaning that either persons had never been trained in the topic or that they had not been trained within the mandatory time frame as required by the associated regulation.

Respirator Use, Asbestos Awareness and Lead Awareness training topics were listed by C&M as requirements for the PEM job descriptions. These areas were found to be mostly non-compliant, however, the auditors were uncertain as to the requirement for this training for the tasks that are performed by the PEMs.

The audit team reviewed tailgate meeting records and attended tailgate meetings. From the review, it was determined that tailgate meetings were historically not being done on a regular basis and /or documentation of the meetings were missing. Within the past few months, meetings are now being provided on a regular basis. Tailgate meetings were noted to be generic in nature and not specific to tasks or concerns at hand. Incidents or close calls were not being reviewed in tailgate meetings.

Deficiencies reported in this area and most were the result of the following:

1. Employees not receiving training within the required regulatory time frame
2. Documentation of training – separate training documents were retained by Risk Management and by C&M
3. Employees not receiving training in time frequencies as recommended by C&M policies.
4. Lack of understanding employee populations who require specific types of training
5. Tailgates historically not performed on a regular basis
6. Tailgate topics not pertinent to immediate tasks or work

7. No minutes for tailgate meetings

Top Recommended Safety Training Corrective Actions, in order of priority:

1. Conduct regular tailgate meetings with the content based on immediate tasks, concerns or recent incidents. Present safety issues and incidents, root cause, and corrective actions related to noted issues. Document meetings.
2. Define training populations to understand which employees are authorized and required to take specific training.
3. Generate a list of authorized employees for specific equipment or practices such as but no limited to authorized aerial lift operator, authorized Lockout / Tagout employee; or authorized confined space entrant
4. Generate a training calendar to ensure that employees are receiving training within the required time frame (note – this can be implemented through C&M's current MainStar CMMS software program)
5. Consolidate Risk Management and C&M training records
6. Conduct a Gap Analysis of training requirements to PEMs
7. Provide training to the PEMs based on the gap analysis of training requirements.

Further information on implementing these recommended corrective actions can be found in the detailed section of the report with a listing of corrective actions presented in Appendix C of this report.

Electrical Safety Findings & Recommended Corrective Actions

The primary focus and effort of the audit was directed at electrical safety. Seventeen scores were provided for the electrical safety areas with a high of 9 and a low of 1. The overall average for just the 17 electrical safety areas is 5.24. Being completely in compliance with all electrical safety codes and standards requires a high level of organization, training and effort on the part of the employer management and workers alike. Most national and state codes and standards change on a 3-year basis, and keeping up with changes requires diligence. Properly interpreting the codes and developing programs to implement the safety requirements is a significant challenge for most employers. Very few employers, if any, have all parts of their electrical safety program up to speed at all times. An electrical safety audit will find deficiencies to report, even with the most organized and safety conscientious employers.

Following are the top ten electrical safety concern topics in order of order of priority and recommended corrective actions. There are specific parts within these topics or other topics that may be of higher or lower risk which are identified throughout this report, and the topics listed may contain parts from several different areas and findings.

Further information on implementing these recommended corrective actions can be found in the detailed section of the report with a listing of corrective actions presented in Appendix C of this report.

1. Some lack of deep knowledge and understanding of electrical safety & electrical systems / no electrical safety technical advisor.

   PEM supervisors and managers come from a mechanical or other non-electrical background, with the exception of the Director of C&M, who has little interaction with activities in the field. The lack of a deep electrical safety and systems knowledge within the supervisory staff, and no electrical safety technical advisor, has resulted in a program that is only as strong as the supervisor's knowledge of electrical safety, which is lacking in some key areas.

   Further complicating the issue is the troubleshooting and repair differences between mechanical trades background and electrical trades background. A mechanical philosophy to troubleshooting or repairing equipment can be very different than the electrical philosophy and is not always in alignment with electrical safe work practices.

   Recommended Corrective Actions, in order of priority:

   i. Establish an overall electrical safety technical advisor who has the ability and desire to be an electrical safety champion.
   ii. Establish a PEM with extensive electrical knowledge and who has the respect of his peers as a field supervisor for electrical operations and safety. This may or may not be the same person as #1 above.

2. Low Voltage Safety Concerns & Programs

   There is an intense focus on high voltage work (>600v) at the port because: 1) The high voltage system is the most critical element to the port customers; 2) High voltage accidents have a higher mortality rate than low voltage accidents; and 3) The PEM program requires high voltage work and those who perform this work earn more than who don't.

   Low voltage work (50v – 600v), safety and programs have been relatively ignored. The phrase "it's just low voltage" was heard multiple times and cautions are dropped by many when working on low voltage equipment. Some workers and supervisors actions could lead less experienced workers to believe that low voltage electrical work simply isn't a major hazard or of much concern. While high voltage accidents are more deadly, the reality is that the low voltage equipment is the most likely place that an electrical

accident will happen at the port, and the workforce doesn't recognize this or always take the proper precautions. This is a result of the problem listed in topic number "1" above.

Recommended Corrective Actions, in order of priority:

i. Establish a low voltage, Qualified Person document and program mirroring the current high voltage program.
ii. Re-train work force on electrical safety with emphasis on low voltage safety, shock hazards, low voltage grounding and arc flash hazards.

3. Assignment of jobs for Qualified Persons and Qualified Electrical Worker

Individuals can be assigned to work on equipment they may not be a Qualified Person for, equipment that they should not be working alone on, especially if they have not worked on that piece of equipment in a long time. This is a result of the problems listed in topic numbers "1" and "2" above.

Recommended Corrective Actions, in order of priority:

i. Create a Qualified Person (low voltage) and Qualified Electrical Worker (high voltage) matrix of which workers are qualified to perform what tasks on what equipment. Assign only qualified personnel to lead these jobs and assign unqualified personnel to learn by on-the-job-training.
ii. Identify tasks where only one worker is required and based on information from CalOSHA and the electrical safety team. If the task is not listed as a one-worker task, two workers must be assigned.
iii. It should be noted that these recommendations to improve electrical safety and comply with Cal/OSHA on definitions of "Qualified Persons" may be in conflict with the Civil Servant job descriptions or regulations as it would restrict tasks and jobs that individuals could perform, despite their job classification or job description. In order to implement a proper "Qualified Person" system that identifies individuals to tasks they can perform based on safety and knowledge, it may require changes in the PEM job description and / or changes to the Civil Servant regulations regarding these types of jobs.

4. PEMs working as individuals, not as teams

The core conflict in the PEM shop revolves around some individuals with significantly less time and knowledge in the electrical field being put in positions where they are to lead others with significantly more experience. Although the conflict is in part political, it is also a legitimate safety concern. The problem is significantly more prevalent in the day shift compared to the night shift.

Some individuals with more experience are concerned when working as an equal to or under someone with significantly less experience. They fear that a mistake will be made that could endanger their safety and therefore, do not always trust their counterpart and don't work as a team. Additionally, some individuals feel jaded when working as an equal or under the direction of those with significantly less experience. These individuals take a reserved approach in showing the less experienced people the correct or safe way and instead let the less experienced person potentially struggle with their task as a statement of the inequity they see. This lack of concern is contrary to a good electrical safety system.

Some individuals with less electrical experience do not always feel safe working with more experienced individuals because they feel their partner is waiting for them to make a mistake and are not looking out for their fellow employee's. These individuals tend to work in a more isolated way and are hesitant to ask for help so that they don't expose any weaknesses that could be used against them.

Both the more experienced and less experienced individuals have valid concerns. These concerns have created a lack of trust and lack of teamwork which is essential for electrical safety.

Recommended Corrective Actions, in order of priority:

i. Establish a PEM with extensive electrical knowledge and who has the respect of his peers as a field supervisor for electrical operations and safety. This may or may not be the same person as #1 above.
ii. Create a cross-functional electrical safety team consisting of members from various departments within C&M as well as Engineering and Risk Management.
iii. Create cross training for teams of employees to leverage the strengths of experienced employees
iv. Follow recommended corrective actions for items # i. –iii. above.

5. Arc flash Understanding & Program Implementation

Although arc flash safety training has been conducted, no team member at the port has a strong understanding of arc flash. Arc flash is a relatively new electrical safety requirement, and can be complicated to understand as there is no single document that defines what to do and how to do it, but rather a circular reference between as many as five different standards and codes. The uniform lack of knowledge at the Port is directly related to the quality of the training material presented and is not a lack of effort by the POLA C&M management or PEM workers to understand arc flash.

The Harbor Department associates arc flash hazards in relation to voltages; higher voltages mean more arc flash danger and lower voltages mean less. This over-simplified understanding is incorrect. Some of the most dangerous arc flash hazards and tasks at the port are undoubtedly on the low voltage equipment. The Harbor Department is also generally unaware of what precautions to take to help avoid an arc flash accident and rely too much on personal protective equipment (PPE) to keep them safe. Improper tools are used by some which can lead to an arc flash.

Recommended Corrective Actions, in order of priority:

i. Retrain PEMs on hazards of arc flash with emphasis on low voltage hazards.
ii. Continue implementation of arc flash analysis on new installations.
iii. Implement arc flash analysis on existing equipment with a priority on the equipment that is worked on the most.

6. Proper Preventive Maintenance, Maintenance and Repair

POLA does not have a proper preventive maintenance, and maintenance program for its electrical equipment. POLA does not perform some required testing or maintenance, such as Ground Fault Circuit Interrupter (GFCI) testing or performing maintenance per manufacturer's specifications and as required. Proper maintenance is required by CalOSHA 2340.1 Maintenance.

Repairs are done on an as-needed emergency repair basis and equipment is not repaired or returned to a state that meets electrical safety codes and requirements. All electrical safety programs and processes start with the general assumption that the equipment has been properly maintained and is in good working condition. Equipment that is not properly maintained or is left in a potentially dangerous state is the cause of many electrical incidents and accidents.

The only preventive maintenance done at the port is cleaning of the high voltage switchgear and trenches, which is an annual event and should be done more frequently due to the nature and exposure of the equipment. POLA customers don't like to be shut down for maintenance; however, not performing preventive maintenance becomes a safety issue for both the Port and the customer. Further, the lack of maintenance leads to unplanned shutdowns which are almost always far more costly than planned shutdowns.

Recommended Corrective Actions, in order of priority:

i. Harbor Department's understanding and implementation of financial and safety values of preventive maintenance versus reactive maintenance.
ii. Develop a plan for addressing preventive maintenance. Specific steps can be found in the detailed section of this report.

7. Specific Training Needs & Fulfillment of Cross-Training

   As previously mentioned, POLA does a very good job of making certain that their PEMs receive the base training that they need. What is missing is some specific equipment or task-specific training and the continuation of the cross-training.

   In particular, new equipment is installed at POLA and training on the new equipment is either not provided or is not deep enough. PEMs with electrical backgrounds almost universally stated that this is their number one need.

   Electrical Safety Refresher Training: Some aspects of electrical safety were very weak with the PEMs, including release methods of shock victims. Previous training material had some gaps in it.

   National Electrical Code / Los Angeles City Code training: As related to item number 8 below, PEMs do not have a strong understanding of how the code applies to them.

   Truck Boom and Lift Training: PEMs observed did not have proper knowledge of electrical safety for truck booms and lifts nor is there any record of this type of training.

   Cross-Training: Cross-training initially consisted of a formal classroom training program. The classroom training alone was not sufficient enough to properly cross-train all the PEMs and on-the-job training was to follow. The cross-training program seems to have stalled out in some areas and some individuals are not proficient in all areas as the job description requires and are not receiving additional training.

   Additional training needs are listed in the details of the report.

   Recommended Corrective Actions, in order of priority:

   i. Conduct the following training:
      a. Truck Boom and Lift Training
      b. Electrical Safety re-training
      c. National Electrical Code (NEC) training
      d. Deeper Equipment Specific Training
      e. Cross Training and more on-the-job training for those less experienced in electrical skills

8. Proper Installation, Use and Maintenance of Electrical Equipment

   Major installations at POLA are handled through Engineering and are done to current codes. Small installations, such as installation of new lighting or electrical outlet, are

performed by the PEMs. There are potentially hazardous installations throughout the port that do not meet code because of situations such as lack of proper grounding or bonding, use of unlisted equipment, use of equipment not rated for the environment (e.g. hazardous or wet) or improper use of flexible cords / temporary wiring. Lack of proper installation also reflects on management and supervisors, as it begs the question as to why management and supervisor do not recognize improper installation as a safety issue or if they have the knowledge to recognize improper installations as a safety issue.

Equipment that is worked on or modified needs to be returned to a state that meets code requirements, which is currently a big problem. Missing covers, improper space around equipment, improper wiring methods, improper terminations, and broken equipment are examples of problems identified.

Many PEMs don't have the proper background or knowledge to determine what is correct or incorrect in these small electrical jobs. Those who were trained in this area haven't been updated in years and have gaps in their current knowledge base.

Recommended Corrective Actions, in order of priority:

i. Stop the bleeding. Make sure that new problems aren't continually created going forward due to lack of knowledge. This can be achieved through NEC training and assigning those with the most knowledge to help direct those with less knowledge on the tasks.
ii. Develop a program for addressing existing equipment that is not to code or presents a hazard. Specific steps can be found in the detailed section of this report.

9. Communication & Dissemination of Information & Equipment (as mirrored in Part II Safety Culture)

Deficiencies were found with communication & dissemination of information and equipment related to electrical safety at POLA. There is little consistency in the dissemination of information and some PEM workers receive an almost preferential treatment compared to others. Some PEMs appear to be left out of receiving specific information, access to information or equipment.

Electrical one-line drawings consist in many different forms and revisions. The method for obtaining the proper, controlled electrical one-line drawings is not controlled and the information isn't readily available to all those who need it.

Some PEMs have particular tools, while others do not. Some PEMs have category 4 PPE pants, while others do not. Equipment manuals for new equipment are not always

provided for the PEMs to access. Many PEMs are not aware where particular processes or procedures can be accessed.

Recommended Corrective Actions, in order of priority:

i. Create a streamlined process of electrical one-line dissemination. Specific steps can be found in the detailed section of this report.
ii. Establish electrical safety technical advisor as described in item #1 that will take responsibility for making certain proper information and equipment is obtained and appropriately distributed.
iii. Provide communication to employees regarding lessons learned, root cause, and corrective actions relative to near misses, unsafe condition, and other safety incidents
iv. Conduct regular tailgate meetings with the content based on immediate tasks, concerns or recent incidents. Present safety issues and incidents, root cause, and corrective actions related to noted issues. Document meetings.

10. Selection and Proper Use of Some Protective Equipment & Tools

Many PEMs rely on tick tracers as means of identifying zero voltage in a system. While tick tracers are a fast and easy mean, they are not highly reliable and should only be used in particular applications.

PPE was observed to generally be available to employees but employees were observed to not be wearing appropriate attire in the field or not knowing when to use proper PPE. Employees were observed to not be using sock hoods for Category 2 work, face shields were observed to not be used when required and supervisors were observed to not be using appropriate PPE in field. Some PEMs are resistant to wear all PPE because of heat factors. No insulated gloves were worn while working hot stick. In addition, some employees were not provided with Category 4 pants and some mix Category 2 and Category 4 PPE for Category 4 requirements. Some PEMs do not use rubber insulated gloves where required.

More than half of the PEMs do not have or use insulated tools.

Ladders with conductive sides were found to be in use near electrical equipment.

Recommended Corrective Actions, in order of priority:

i. Require PEMs to use multimeters for verification of de-energization of equipment. Provide additional training on multimeter use for those who need it. Train workers on the limited use and problems with tick tracers.

ii. Provide a basic set of insulated tools for each PEM to keep on their truck. Require PEMs to use the tools unless equipment is already verified as de-energized. Train PEMs on how to properly care for and inspect insulated tools.
iii. Providing re-training on PPE use through electrical safety re-training.
iv. Remove conductive ladders from the PEM department. As new ladders are required throughout C&M, all ladders should have non-conductive sides.
v. As overalls need replacing, consider lighter-weight, more modern materials and / or going from overalls to FR rated shirts and pants, which will not require layering and added heat.

BACKGROUND

The Port of Los Angeles (POLA or the Port) used to have two independent shops that maintained the cranes and the electrical and mechanical infrastructure of the port—the Electrical shop and the Crane Mechanic shop. The Electrical shop consisted of electrical tradesmen, most who went through the IBEW union electrical apprentice program and earned electrical licenses. The Electrical shop was responsible for virtually all electrical work at the port, including the low voltage and high voltage equipment that fed the cranes. The Crane Mechanic shop consisted of tradesmen with a variety of backgrounds and skills necessary to maintain cranes. Backgrounds included mechanics, welders and electricians. The Crane Mechanic shop was responsible for all maintenance aspects of the cranes, including some electrical maintenance.

In 2008, the class of Container Crane Mechanic was changed to Port Electrical Mechanic (PEM) and in 2010 ten Electricians were converted to the PEM classification. The PEM was to be a new class of skilled worker that could be deployed at the port to work on either mechanical or electrical equipment, thereby increasing the efficiency of the workforce and retain the knowledge and skills of the Crane Mechanics. The re-classified Container Crane Mechanic PEMs went through a 400-hour training program which consisted of basic electrical and mechanical classroom training in order to make them multi-craft technicians. The PEM group took over the electrical maintenance operations, including high voltage work. PEM jobs were entitled to a pay increase due to the multiple jobs they could perform.

Division 147 consists of two supervisors (one day and night), 24 PEMS, 2 electrical craft helpers, 1 Senior Electrician, 3 Electricians, and 1 Mechanical Helper. Division 147 reports to a 2nd Level Supervisor who also oversees the plumbing. The 2nd Level Supervisor reports to Operations and Maintenance Manager. The Operations and Maintenance Manager reports to the Director of Port Construction and Maintenance. The 1st Level and 2nd Level Supervisors came from the Crane Mechanic shop and had primarily mechanical trades background, although Crane Mechanics also performed electrical work on the cranes themselves. The placement of primarily mechanical tradesmen from the Crane Mechanic shop to oversee and manage what was mostly electrical work created friction with those who came from the Electrical shop. Today, only the Operations and Maintenance Manager, an outside hire, has a significant knowledge of electrical systems, and he was not directly involved in the day-to-day activities.

Not all members of the Electrical shop were made PEMs, which created an additional conflict. Electricians who had originally had leadership and deep knowledge on the high voltage equipment were not allowed to work on the high voltage equipment while those with significantly less experience were not only working on it, but getting paid a premium for the

work. Those from the Electrical shop that were not made PEMs were originally offered to go through the training, but were unable to or chose not to at that time.

Throughout the course of these changes, some workers from the Electrical shop raised concerns about electrical safety at the port. The particular concerns were 1) managers with mechanical backgrounds leading what was mostly electrical work, and 2) other PEMs with limited or lesser background in the electrical trade taking on work that they were not qualified to perform. 3) Reported near misses or examples of dangerous work that PEMs observed.

Electrical equipment malfunctions, errors, close calls and safety violations have been reported by PEMs in recent years. Specific events that were reported include:
1, An electrical equipment explosion at berth 400
2. Supervisors energizing high voltage equipment without any PPE
3. Supervisors forcing circuit breakers to close
4. Equipment being left in conditions that represents an electrical hazard.
5. Unqualified Persons or Unqaulified Electrical Workers performing work that only Qualified Persons or Qualified Electrical Workers can legally perform.
Cal/OSHA issued a citation on 2/14/2008 for not meeting Qualified Electrical Worker status, substantiating this particular complaint, and the equipment explosion at berth 400 is known as a fact, although the reasons that lead to the problem aren't confirmed.
Concerns by workers were raised that these incidents were bound to happen again with the current structure, making POLA an unsafe place to work.

The series of letters and complaints over the course of time about the potentially electrically unsafe work environment resulted in the need for an electrical safety and general safety audit to help determine if the complaints and concerns were substantiated.

OVERVIEW OF AUDIT METHODOLOGY

PEM NOTE: Throughout this document, the term PEM (Port Electrical Mechanic) is used to refer to all individuals working in the Division 147 Electrical Mechanical shop. Not all workers in Division 147 are PEMs, as they may be an Electrician, Electrical Craft Helper or Maintenance and Construction helper. The term PEM in this document, is used for simplicity sakes in describing the Division 147 Electrical-Mechanical shop workforce.

Objectives

- Determine if the PEM workers are working in an electrically safe work environment.
- Identify any electrical safety work hazards or processes and provide corrective actions for potentially hazardous electrical situations.
- Determine electrical safety compliance with:
    - CalOSHA Title 8, Subchapter 5
    - National Electrical Code / Los Angeles Electrical Code (*Note: The City of Los Angeles adopts the National Electrical Code as their own code. The most current version adopted by the city is 2008 National Electrical Code.*)
    - NFPA 70E
    - NFPA 70B
    - OSHA 1910.331-335
- Identify potential cost savings, efficiencies or other improvements for the electrical safety program.

Scope of Work

The Electrical Safety Audit focused on electrical safe work practices and work conditions at the POLA. This scope of work was limited to the Electrical-Mechanical shop under C&M and did not include other shops or divisions under C&M. The observations were based on compliance and guidelines from the National Electrical Code (NEC) / Los Angeles Electrical Code, CalOSHA Title 8 Subchapter 5, NFPA 70E, NFPA 70B and OSHA 1910.331-335. Observations regarding NEC / Los Angeles Electrical Code were limited to work process, maintenance requirements, and not specific equipment installation or design compliance requirements. Only general observations were made as to the overall compliance with the NEC / Los Angeles Electrical Code.

Further defined, the scope of work was defined by the Construction and Maintenance Division and the International Brotherhood of Electrical Workers (IBEW) as the following:

1. **CalOSHA Safety and Health training requirements (Subchapter 4 & 7, Title 8, CCR -2006)**
    a. Review overall safety & health training program for compliance with CalOSHA subchapter 4 & 7, Title 8, CCR-2006 as applicable to the PEM Division
    b. Review records for staff of 30 employees assigned to PEM Division in regards to safety training received in the last 24 months for compliance with CalOSHA
    c. Review and audit Lockout / Tagout training and compliance with CalOSHA
2. **Qualified Electrical Worker (QEW) Program**
    a. Review and inspect QEW manual (Version 1 dated 01/1/2012) for completeness and compliance with CalOSHA QEW requirements
    b. Review training records for high voltage (above 600 volts)
    c. Verify QEW requirements and PEM staff compliance for all affected employees
    d. Verify re-certification of QEW qualifications (3 years)
3. **Personal Protective Equipment (PPE)**
    a. Verify PPE required by the Port and applicable regulations for PEM staff
    b. Field verify and audit PEM employees to insure knowledge, training and compliance of PPE use, care and safety
    c. Verify and review training records for PPE
4. **High Voltage Electrical Safety Equipment**
    a. Verify inventory of high voltage safety equipment
    b. Verify training received by the PEMS on high voltage safety equipment
    c. Field verify proper usage of high electrical safety equipment
        i. High voltage Hot sticks
        ii. High voltage testers
        iii. Grounding cables
        iv. High voltage test equipment
    d. NFPA 70E, arc flashing equipment, labeling warning signs installation
5. **CalOSHA Required Safety Tailgate meetings (Title 8, CCR CSO Section 1509(e)**
    a. Review representative sample of safety tailgate meeting records for PEM Division
    b. Attend a few safety meetings to verify compliance with CalOSHA standards
6. **Electrical Safety issue reporting procedures**
    a. Verify current process for reporting PEM safety concerns and develop a recommended method for anonymous safety concern reporting
    b. Review informal safety concern reporting structure and effectiveness
7. **Compliance with regulatory agencies required or mandated training required in PEM Division**
    a. Federal Railroad Administration (FRA)
    b. Environmental Protection Agency (EPA)
    c. Coast Guard

d. Air Quality Management District (AQMD)
e. LA Building & Safety
f. Department of Health Services (DHS)
g. Los Angeles Department of Water and Power (LADWP)

8. **PEM Division Safety Culture Survey**
    a. Perform a survey to analyze safety culture in PEM Division front line employees. Include supervisors and managers of PEM Division.
9. **Management Safety Program Support and Ownership**
    a. Interview mid-level and senior managers in Port PEM reporting structure to determine commitment to PEM Division safety program
    b. Review status of ISO-18001 program implementation
    c. Review short term management safety goals (tactical)
    d. Review long term management safety goals (strategic)
10. **Overall PEM staff personal interviews related to safety program**
    a. Interview all PEM staff members with specific questions related to safety. Safety auditor to develop questions, but based on sample questions.

Work Process

Over the course of a month, the audit team members, who have specialized electrical safety and commercial safety work processes experience, interviewed and observed the POLA PEM shop, PEM employees, PEM supervisors, as well as all PEM management and PEM management work processes and safety controls. Hundreds of man-hours were spent observing, interviewing and researching. Several hundred pages of documents were reviewed by the audit team.

The specific steps of the work process included:

Safety Culture Survey:
All PEMs were provided a Safety Culture Survey to complete. The surveys were anonymous and did not include names. The completed surveys are not part of this report or other deliverables to ensure anonymity of the participants. All PEMs willingly participated in the surveys.

Formal Interviews:
All PEMs were interviewed for approximately one hour each in a closed conference room setting and the POLA Construction and Maintenance, Berth 161 building. Only the audit team and the interviewee were present for each interview. The responses to the interview questions were anonymous and the answers to the questions were recorded by transcription by the audit team. The transcriptions of the interviews are not part of this report or other deliverables to ensure anonymity of the participants. PEMs were asked the same core questions, although some questions were eventually removed from the question pool over time as the answers given by the

PEMs were all identical and were supported by documentation. The removal of these questions allowed for deeper questioning and response on other topics where more discovery was required. Follow-up questions for the PEMs varied based on the answers they provided.

All PEMs were provided time to express any concerns they had about their safety or electrical safe work practices at the port. This included the presentation of any documentation or information that they felt was pertinent. PEMs were also provided the personal contact information of the audit team so that they could contact the audit team should they have any follow-up questions or information they would like to share.

All PEMs willingly participated in the interviews. The vast majority of the PEMs spoke frankly and without hesitation.

PEM managers and supervisors were interviewed for approximately one hour in the same closed conference room and setting as the PEMs. PEM manager and supervisor interview questions were specific to their roles and responsibilities, which included, but were not limited to safety controls and management processes. All PEM managers and supervisors willingly participated in the interviews.

The Civil Service Business Representative for IBEW Local Union 11 was interviewed in the same closed conference room and setting. The IBEW Representative was asked questions based on his knowledge and background of the specific training provided for the Union 11 PEM shop, the formation of the Union 11 PEM shop, and as a representative of the Union 11 PEM workers. The IBEW Representative willingly participated in the interview.

The Chief Financial Officer (CFO) of the POLA, was interviewed in his office. The CFO was interviewed regarding the broad scope of operations at the port including budgeting requirements. The CFO willingly participated in the interview.

Work Observations:
The audit team spent more than 80 hours in the field observing the PEMs conduct their daily tasks on both the day and night shifts. Tasks included work on both high voltage and low voltage equipment. The purpose of the work observation was to gain an understanding of the application of safety measures and knowledge in the field to specific equipment and tasks. PEMs were observed from a distance as well as asked questions about what they were doing and why they were doing it. Proper selection and use of PPE, tools, and work processes were observed.

Safety Meeting Observations:
The audit team sat in on PEM safety meetings for both the day and night shifts.

Documentation Discovery:
Documentation was requested and reviewed regarding written compliance. Documentations included, but were not limited to: training and meeting rosters, training outlines and written safety programs and written operation procedures. All documentation requested was provided, if available.

Audit Team

The Port of Los Angeles facilities and work practices was observed by Von Phillips (Martin Technical), Jim Schuster (Martin Technical), Lori Chu (URS) and Paul Zoubek (Zoubek Consulting).

Reporting Notice

The audit team noted multiple code compliance or standard deficiencies in which CalOSHA, OSHA, National Fire Protection Agency (NFPA), NEC or other applicable standards were not met. It is important to point out that these standards and laws can, based on the official making the inspection, be subjective to interpretation and site situation. In addition, you should always check with your local and state authorities on codes or electrical safety that you may have question about.

While the audit team took diligent care and best efforts to inspect and report all concerns, it is possible that not all code violations or electrical safety concerns were identified. Hazard ratings were given to each concern on a scale of 1 to 3 with 1 being the most important concern to be corrected. The ratings are subjective and based on the audit team's knowledge and expertise. The ranking serves as a helpful tool for your maintenance and engineering team to establish a priority list and to understand the biggest and most immediate hazards. It is important to understand that all concerns or code violations are potential electrical safety hazards and that a lower ranking does not mean it is not a hazard, that an accident couldn't immediately happen, or that the severity of an accident is any less than a higher ranking concern. It is recommended that all potential electrical hazards should be addressed and fixed in a timely manner.

Each concern cites national code or standard concerns and has a recommended corrective action. Recommended corrective actions are based on helping meet code and guidelines and are based on the audit team's knowledge, expertise and best practices. Additional code violations and alternative corrective actions not presented here may also be possible.

This inspection and report should be considered a foundation in working toward a safer workplace for your employees and guide for controlling potential electrical safety hazards, but it does not guarantee that by making corrective actions it will eliminate electrical hazards or that

accidents will not happen. Continual training, inspections and following nationally recognized code and guidelines are recommended to help further reduce potentially dangerous electrical hazards.

REGULATORY APPLICABILITY

Regulatory applicability is discussed in detail within the Executive Summary on page 2. Note that the California Occupational Safety and Health (CalOSHA) Title 8 California Code of Regulations Subchapter 5: Electrical Safety Orders, and the Los Angeles Electrical Code are utilized for determination of compliance. The 2010 NFPA 70E and the NEC are used as reference sources for compliance.

OSHA CITATION GENERAL REFERENCE INFORMATION

The top 10 violations typically account for over 50% of all OSHA citations. Of the top 10 violations, three are typically electrically related or connected:

- Control of Hazardous Energy (Lockout / Tagout) 1910.147
- Electrical, wiring methods, components and equipment 1910.305
- Electrical systems design, general requirements 1910.303

The following 5 electrical violations are the top 5 sections of standard city by OSHA for 1910.303:

- 1910.303(b)(2) – Failure to install and use electrical equipment according to manufacturer's instructions
- 1910.303(g)(2) – Failure to guard electrical equipment
- 1910.303(f) – Failure to identify disconnecting means and circuits
- 1910.303(g)(1)(ii) – Failure to keep work spaces clear
- 1910.303(b)(1) – Use of electrical equipment containing recognized hazards.

CALOSHA CITATION REFERENCE

Each year, CalOSHA posts the most cited violations. In 2010, 6 of the top 21 violations are electrically related or connected:

5. Lockout/Tagout (Energy Control)
10. Work about Electrical Equipment
15. Flexible Electrical Cords
16. Installation of Electrical Equipment
19. Proper PPE
21. Electrical Equipment ID of Installation

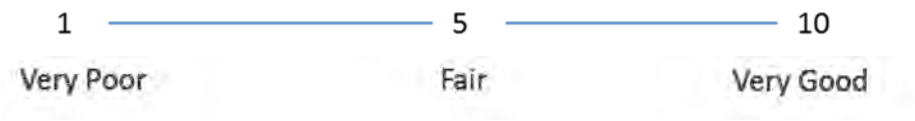
DESCRIPTION OF COMPLIANCE AND RISK RATINGS

Throughout this document, there will be information on rating specific programs and procedures with regulatory compliance and with consensus guidelines. In addition, risk ratings are listed in the document to assist with prioritizing corrective action. Finally a corrective actions table is presented in Appendix C of this report.

Overall Ratings

The scope of the audit consisted of 19 major areas. An overall rating scale was utilized for 19 major areas are rated with a score on a scale of 1 through 10, with a rating of 1 corresponding to very poor, a 5 to fair, and a 10 to very good.

Score:



Two major categories are rated for each area, a Raw Score and an Industry Average. The Division 147 was average score for all 19 major areas was 5.26. Each of the major areas have been provided with an overall rating which is listed at the beginning of each section highlighted in a green table.

The raw score captures the auditors scoring of Division 147 in the listed area. The Industry Average provides the Port with a means of comparison of how the Port "stands" when compared to other entities the auditors have audited. Industry Average is based upon the auditor's first time audits and inspections with other companies and organizations. As there is not a qualitative measurement for "electrical safety" other than "compliant" or "non-compliant", these measurements are based on subjective observations and information collected by the auditors. It is important to note that being at average or above average does not mean the program is completely in compliance nor that all safe measures are being taken. Refer to detailed section of the report for recommended corrective actions.

An example of this table is depicted below.

OVERALL SCORE = 5.26

Compliance Ratings

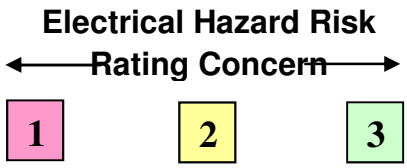
Ratings for compliance are rated as "Yes, No or Needs Improvement." A rating of "Yes" means that the item is in compliance with all regulatory requirements while a rating of "No" means the

item is may be in compliance on some items but not in compliance with the majority of regulatory requirements. The rating of "IMP" means the item needs improvement. Needs improvement means that the item meets the regulatory standard, but can be improved to meet industry best practice or consensus standards. An example of tables which utilized this ranking is provided below:

ITEM	DESCRIPTION	COMPLIANT		
		YES	NO	IMP
1.1A	GENERAL SAFETY TRAINING		X	

Hazard Risk Rating

Ratings for risk are utilized to highlight which items are most important of concern to assist with prioritizing of corrective actions. Hazard ratings were given to each concern on a scale of 1 to 3 with 1 being the most important concern to be corrected. The ratings are subjective and based on the audit team's knowledge and expertise. The ranking serves as a helpful tool for your maintenance and engineering team to establish a priority list and to understand the biggest and most immediate hazards. It is important to understand that all concerns or code violations are potential electrical safety hazards and that just because a concern has a lower ranking, it doesn't mean that it is not a hazard, that an accident couldn't immediately happen or that the severity of an accident is any less than a higher ranking concern. It is recommended that all potential electrical hazards should be addressed and fixed in a timely manner. A full ranking of all items audited is supplied in an Excel spreadsheet so that you can sort and filter the information as needed. Ratings are also colored coded as depicted below.



An example of a table which utilizes the risk ranking is listed below.

Hazard Risk Rating	Item #	Description of Deficiency
1	1.1	No low voltage written program. High voltage program needs some improvements.

Safety Culture Survey Ranking

A specific methodology was utilized for ranking of safety culture related to the safety survey questionnaire. Therefore this section has a unique ranking system specific to the safety survey methodology that is used only in this section and is described in further detail within Part II. The Safety Culture Survey is based on dimensional scores on a scale of 1 through 10, with 10 being the best and 1 being the worst. A visual depiction of the rankings is provided below.

Dimensional Score	Description
Less than 6	Poor
From 6 to 8	Fair
Greater than 8	Good

PART II

SAFETY CULTURE

SECTION 1 – MANAGEMENT, GENERAL SAFETY CULTURE, INJURY, ILLNESS AND PREVENTION PROGRAM, & REPORTING

OVERALL SCORE = 4.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
III-1.1	SAFETY LEADERSHIP [CALOSHA 3203(a)(1)]			X
III-1.2	SAFETY COMPLIANCE [CALOSHA 3203(a)(2)]		X	
III-1.3	SAFETY COMMUNICATION [CALOSHA 3203(a)(3)]		X	
III-1.4	SAFETY INSPECTIONS [CALOSHA 3203(a)(4)]		X	
III-1.5	ACCIDENT INVESTIGATIONS [CALOSHA 3203(a)(5)]			X
III-1.6	HAZARD CORRECTION [CALOSHA 3203(a)(6)]		X	

IMP= Needs Improvement

Section 1 Overview

Safety cultures consist of shared beliefs, practices, and attitudes that exist at an establishment. Culture is the atmosphere created by those beliefs, attitudes, etc., which shape our behavior. An organization's safety culture is the result of a number of factors such as management and employee norms, assumptions and beliefs; management and employee attitudes; policies and procedures; supervisor accountability, responsibilities and priorities; production pressure versus quality and safety; action to correct unsafe behaviors; employee training and motivation; and employee involvement or "buy-in".

Section 1 Summary

The overall Safety Culture at the Port within Division 147 was rated by the audit team as a score of 4.0 out of 10 due to the lack of implementation of the Injury, Illness and Prevention Program (IIPP). Note that this rating is specific for Division 147 as overall IIPP performance for the entire Port is out of the scope of this audit. Employee perspective from the safety cultural survey rated the culture as "fair" with a dimensional score of 7.0. Serious issues that impact safety at the Port within Division 147 is the PEMs mistrust of management (managers and supervisors) and PEMs mistrust in their fellow peers which is reflected in a score of 6.07 in "management's commitment to safety" which borders on being a "poor" rating, and the perception of personal risk score of 6.26. It is the auditing team's opinion that the Port's management (managers and supervisors) sincerely believes in safety at the workplace and that PEMs themselves want to achieve a safe place to work. However, it is a pervasive sense of mistrust that erodes PEMs confidence in their superiors and PEMs confidence that their peers are looking out for their safety. This mistrust contributes to an unsafe work environment. Mistrust with supervisors and managers was expressed with interviews. Auditors and information obtained from PEMs interviews suggests that supervisors do not always set the proper example towards health and safety and expressed negative comments related to safety and health.

Perception of unfair promotions, distribution of overtime, and the general feeling of a hostile work environment contribute to the creation of an unsafe environment, where personnel focus on these negative issues rather on their work or safety of their work. These issues should be addressed with Human Resources as these are outside of both the scope and the expertise of this audit team.

1.1 SAFETY CULTURE

OVERALL SCORE: 4.0		
Hazard Risk Rating	**Item # in Appendix C**	**Description of Deficiency**
1	II - 1.1 II- 1.2 II – 1.3 II – 1.4 II – 1.5 II - 1.6	Mistrust evident between PEMs and management and between peers; lack of communication; no progression of ISO 14001 implementation; no safety committee; no knowledge on how to report unsafe actions or equipment anonymously; no documentation of corrective actions; lack of communication of lessons learned

1.1 Technical Details

A cultural safety survey was administered to all PEMs employees and excluded managers and supervisors. The survey consisted of 18 statements in which the respondent could respond Strongly Agree, Agree, Neither Agree or Disagree, Disagree, or Strongly Disagree. Respondents were asked to check boxes that corresponded to their response. Responses were tabulated and averaged with Strongly Disagree given a score of 1, Disagree a score of 2, Neither Disagree or Agree a score of 3, Agree a score of 4, and Strongly Agree a score of 5. Sets of two questions were related to each dimensional topic which included perceptions on respondent of:

1. Management commitment to safety;
2. Communication of management to respondent;
3. Priority of safety;
4. Rules and procedures;
5. Supportive environment to safety;
6. Personal involvement to safety;
7. Personal priority of safety;
8. Personal perception of safety risk on the job; and
9. Work environment allows for achievement of safety.

Dimensional scores were calculated by adding the two average scores of the statements which related to the dimensional topic. Note that dimensional scores for negatively worded questions were calculated by reversing the averages, i.e. subtracting the response score by 1 and then averaging. Dimensional scores were then ranked with scores 8 and above noted as good, scores 6 to 8 ranked as being fair, and scores below 6 as poor. See Tables 2.1 and 2.2 on pages 43 and 44 respectively for questions, average scores and dimensional scores.

The Division 147 was evaluated for compliance with CalOSHA 3203 using information gathered during field observations, review of documentation, and employee interviews.

1.2 Results

The audit team has ranked the overall Management, Safety Culture, and Injury and Illness Prevention Program (IIPP), within Division 147 was rated as 4.0 due to the lack of implementation of the IIPP. Note that a written IIPP exists at the POLA, but specific sections were not implemented fully within Division 147. For cultural survey results, which reflect employee viewpoint on safety, only one score fell in the "needs improvement" which was the communication section. Scores which fell in the "fair category" include "supportive environment to safety, priority of safety, work environment allows for achievement of safety, personal perception of risk, and management commitment to safety." Two scores fell in the well instituted category which included "safety is a priority to me and rules and procedures are important." In summary, two (or 22%) scored "good," six (or 67%) scored "fair," and one (or 11%) scored "poor." See Appendix C for a summary of corrective actions.

1.3 Discussion

As an employer in the State of California, the Port is required to implement an IIPP which acts as a foundation and framework to build a strong safety culture within the workplace. A written IIPP is present and documented at the Port however some elements of the IIPP are not implemented within Division 147 as discussed in detail below. Note that lack of implementation of the IIPP, as presently exists within Division 147 is a regulatory violation that is citable by CalOSHA. For information on how to achieve regulatory compliance, refer to "Recommended Corrective Action" section of this document. The IIPP consists of seven major elements as follows:

1. Identifying a person with the authority and responsibility for the safety program;
2. A system for ensuring that employees comply with safe and healthy work practices;
3. A system to communicate health and safety issues with employees;
4. Procedure for identifying and evaluating workplace hazards;
5. Procedure to investigate occupational injury and illness;
6. Procedures for correcting unsafe or unhealthy conditions, work practices and work procedures; and
7. Training.

Item II- 1.1: *Lack of electrical safety lead or point person within supervisor level to address electrical safety concerns, provide guidance, and to provide a leadership and mentor for electrical safety.*

The audit team observed diverse responses to the question, "Who is in charge of electrical safety within Division 147?" Interviewees' response ranged from "Risk Management," "the Director of C&M," "the Director of Port C&M," "C&M Supervisor," to "myself" and "management in general." It is noted that all interviewees took safety very seriously but did not have a designated point person or safety committee to address or to bring forth safety concerns, nor are they always

comfortable bringing forward this information to their immediate supervisors. Without a point person, there is no one present to provide ownership for electrical safety at the Port or to provide leadership qualities for this function. Because a large portion of the Division 147 work is within the realm of electricity and because electrical work is high risk work, it is important to have someone within the manager or supervisor level directly interacting with PEMs to provide guidance and to drive electrical safety at the Port. In addition, an electrical safety point person will allow for a sense of ownership and accountability in electrical safety which should be driven both downstream to Division 147 staff and upstream to Division 147 management. Note: This information is also presented in Part IV Section 15.

Item II - 1.2: *A system for ensuring that employees comply with safe and healthy work practices. Substantial compliance with this item includes recognition of employees who follow safe and healthful work practices, training and retraining programs, disciplinary actions, or any other such means that ensures employee compliance with safe and healthful work practices including supervisors accountable for visibly being involved, setting the proper example, and leading a positive change for safety and health.*

Currently within Division 147 there is no formal process to recognize exemplary health and safety behavior or employees, nor is there any evidence of disciplinary action when safety rules are violated. Because of the lack of trust between PEMs and their peers and between PEMs and supervisors, safety issues are ignored or not reported. Employees feel that peers are "waiting for them to fail," and will not intercede if they see an unsafe condition to prevent an accident.

As part of the audit scope, the audit team was requested to inquire about Port's implementation of Occupational Health and Safety Assessment Series (OHSAS) 18001. OHSAS 18001 is a best management practice and is not regulatory required. OHSAS 18001 provides a framework for an organization to identify and control its health and safety risks, reduce the potential for accidents, comply with legislation and improve operational performance. The Director of Construction and Maintenance indicated that it had not progressed on implementing this program. Implementation of this program would assist with overall compliance with the IIPP and creating a system to ensure that employees comply with safe and healthy work practices.

Behavioral attitudes observed by the audit team in regards supervisors were noted to contribute to overall perception that management (managers and supervisors) does not care about safely. Supervisors also have been observed to not wear PPE when in the field. This negative behavior erodes PEMs confidence and trust in managers and supervisors, the decision making ability of management, and is detrimental into the implementation of a safety culture at the Port. In order for a culture of safety to be instituted at the Port, it is critical that supervisors take a positive attitude towards safety and act as role models for safety.

Item II-1.3: *A system to communicate health and safety issues with employees. Substantial compliance with this item includes provisions designed to encourage employees to inform the employer of hazards at the worksite without fear of reprisal. Substantial compliance with this*

provision includes meetings, training programs, posting, written communications, a system of anonymous notification by employees about hazards, labor/management safety and health committees, or any other means that ensures communication with employees.

The ranking of communication as being poor has been demonstrated with survey results, as well as manager, supervisor and employee interviews. A formal safety committee has not been established; without a safety committee, safety information is not formally discussed by managers and supervisors, or rolled out to PEMs. In addition, there is no clear means to report near misses, incidents, or accidents. Of particular concern is that information regarding findings and preventative actions related to significant incidents and accidents are not communicated to PEMs. In addition, it is uncertain if this information is clearly presented to managers by supervisors. Without formal communication on incidents on safety hazards to PEMs improvements cannot be made to safety procedures or improvements made to unsafe actions or decisions of PEMs and supervisors. During interviews, managers and supervisors acknowledged that improvements can be made within tailgate meetings with institution of meeting minutes and a formal flow down of lessons learned to PEMs. From a review of records, tailgates are being held on a regular basis; however, tailgates can be improved with more job task relevant topics and a review of specific concerns noted by PEMs or brought to the attention of the supervisors. Day shift workers noted that tailgate meetings were not relevant to the concerns of the moment and seemed random.

PEMs have indicated that improvements can be made between communication of activities between night and day shift. Written and oral communication can be improved on what activities have been completed during each shift and what is left to be done. Also updates on safety issues that were noted during each shift can be documented and passed to the next shift.

PEMs have indicated that they would like to see equipment and job specific safety information passed along during safety meetings. Ideally when job assignments are distributed at the beginning of each shift, a brief safety overview can accompany each assignment specific to items to look out for, special safety hazards related to each equipment, specific or special PPE or procedures that need to be followed for each task. PEMs have also indicated that they are interested in obtaining further training from the designer and/or manufacturer of installed equipment. Recommendations for improved communication are detailed in Part IV Section 6.

A lack of communication is also demonstrated in the lack of understanding within PEMs on appropriate confined space procedures. It is noted that the vault at the Waterfront Park is a confined space. PEMs are unsure whether this is a confined space, a non-permitted space, or a permitted space. A clear standard operating procedure should be developed for this space and related training should be passed down to PEMs. PEMs are unsure of procedures to follow or documentation to be filed for entry and work in this space.

PEMs have also indicated frustration with obtaining documentation for equipment specific procedures and one-line drawings for equipment. A lack of communication and procedure is

demonstrated in that personnel are unsure on the correct procedure or process on how to obtain one line drawings or equipment specific procedures. Some persons indicate that they go directly to Engineering, other persons say they have this information stored in their trucks, other persons say they need to go through their supervisor. A clearly defined process on how to obtain this information needs to be established and communicated to all employees. Ideally, a central library or repository can be developed with this information.

Finally during interviews, PEMs voiced concerns that they feel there would be retribution against them for expressing their safety concerns. This emphasizes the need to re-build trust within the Division and also the importance for these persons to be able to report issues anonymously.

Note: This item is also discussed briefly in Part IV Section 15.

Item II - 1.4: *Procedure for identifying and evaluating workplace hazards.*

Substantial compliance with this item includes regular field inspections of work practices to ensure field personnel are working safely. PEMs did indicate that they report safety concerns directly to managers. In addition, there is the ability for personnel to bring concerns forward to the Union which are addressed through the Labor Union committee. Noted issues are sometimes corrected and sometimes not corrected. It is noted that within Division 147, there is no formal documentation of safety issues and no documented follow-up or corrective actions. In addition, no one is assigned responsibility to perform corrective actions. Issues are noted but may not be addressed due to this lack of documentations, oversight and ownership. Because there is no formal documentation process to bring these concerns forward, neither PEMs nor audit team can verify that items when brought forward are being corrected. In addition, due to the lack of documentation, it is uncertain if concerns are being brought to the attention of managers.

Currently, no regularly scheduled inspections are performed or documented. Of particular concern to the audit team is to make sure an electrical safety point person goes out in the field to audit work practices. Within this activity, it is uncertain if PEMs are performing work safely in light of evidence of reported near misses that have occurred related to electrical work and due to observations of the audit team regarding proper PPE use.

Managers, supervisors, and PEMs have indicated that they do not have resources or time to perform preventive maintenance and that preventive maintenance is not regularly performed nor scheduled in MainStar which may result in unsafe equipment being unserviced. MainStar is the Port's computerized maintenance management system used the track and log work orders. Other barriers to preventive maintenance were reported to come from tenants themselves who refuse to allow down time for C&M PEMs to perform maintenance on equipment. Note: Preventive Maintenance is discussed in great detail in Part IV Section 5.

Item II - 1.5 and Item II-1.6: *Procedure to investigate occupational injury and illnesses and procedures for correcting unsafe or unhealthy conditions, work practices and work procedures.*

As already discussed in item 3, there are no formal means to report, track and document incidents and near misses. Because of this lack of documentation, there is a lack of transparency to the PEMs and the perception that managers and supervisors is hiding information from PEMs.

As discussed, managers and supervisors have acknowledged that improvements can be made within tailgate meetings with institution of meeting minutes and a formal flow down of lessons learned to PEMs. Flow down of information can help prevent persons from performing the same unsafe act that resulted in the original incident. As discussed in item 4, corrective actions can be overlooked because there is no documentation to assign an owner for the corrective action or to track the item to closure.

Training.

Training is discussed in Part III and in Part IV Section 2.

References:

CalOSHA 3023
(a) Every employer shall establish, implement and maintain an effective Injury and Illness Prevention Program (Program). The Program shall be in writing and, shall, at a minimum:
(1) Identify the person or persons with authority and responsibility for implementing the Program.
(2) Include a system for ensuring that employees comply with safe and healthy work practices.
(3) Include a system for communicating with employees in a form readily understandable by all affected employees on matters relating to occupational safety and health, including provisions designed to encourage employees to inform the employer of hazards at the worksite without fear of reprisal. Substantial compliance with this provision includes meetings, training programs, posting, written communications, a system of anonymous notification by employees about hazards, labor/management safety and health committees, or any other means that ensures communication with employees.
(4) Include procedures for identifying and evaluating work place hazards including scheduled periodic inspections to identify unsafe conditions and work practices. Inspections shall be made to identify and evaluate hazards.
(5) Include a procedure to investigate occupational injury or occupational illness.
(6) Include methods and/or procedures for correcting unsafe or unhealthy conditions, work practices and work procedures in a timely manner based on the severity of the hazard.
(7) Provide training and instruction on specific hazards that employees encounter at work.

Recommended Corrective Actions:
A discussion of corrective actions is presented in the section below. Note an overall listing of Corrective Actions is presented in Appendix C.

Item II – 1.1: *Lack of electrical safety technical advisor or point person within supervisor level to address electrical safety concerns, provide guidance, and to provide a leadership and mentor for electrical safety.*

The Port should provide an electrical safety point person within supervisor level to address electrical safety concerns, safety oversight, field safety inspections, and provide leadership and mentoring for electrical safety. This item is also discussed in recommended corrective action presented in Part IV Section 15.

Item II - 1.2: *A system for ensuring that employees comply with safe and healthy work practices. Substantial compliance with this provision includes recognition of employees who follow safe and healthful work practices, training and retraining programs, disciplinary actions, or any other such means that ensures employee compliance with safe and healthful work practices.*

The Port should develop incentive programs to employees recognizing their safety work behaviors. The Port should provide rewards, incentives, lunches, and celebrate successes. The Port should reward employees for doing the right things and encourage participation in activities. Safety issues are not being reported such that disciplinary action is not always taken for those who do not follow health and safety procedures, rules and regulations. To address this, an electrical safety technical advisor should perform audits of safety in the field. The Port should implement a process that holds managers and supervisors accountable for visibly being involved, setting the proper example, and leading a positive change for safety and health, and should hold supervisors and managers accountable for being responsive to reported safety issues.

The Port should institute field audits to ensure PEMs are following safe work practices and to provide a mentorship role for PEMs who have questions or require guidance in the field. Supervisors should be accountable for safety, be visibly involved in health and safety, set a proper example, and lead a positive change for safety and health. The Port should institute OHSAS 18001 to create a system for Risk Management, identify legal requirements, set objectives to meet these requirements, and monitor and measure if they are meeting these objectives. Note that currently, there is only one safety engineer at the Port and that increased staffing can assist with the achievement and institution of OHSAS 18001, coordination of safety committee, demonstrate the Port's committee to safety, and provide further leadership and visibility in health and safety at the Port. (This item is also discussed in Part IV Item 15.) OHSAS will also assist with establishing a shared vision of safety and health goals and objectives throughout the Harbor Department and emphasize safety over time pressure to complete work.

Item II – 1.3: *A system to communicate health and safety issues with employees. Substantial compliance with this requirement includes a process or system designed to encourage employees to inform the employer of hazards at the worksite without fear of reprisal. In addition, substantial compliance with this provision includes meetings, training programs, posting, written communications, a system of anonymous notification by employees about hazards, labor/management safety and health committees, or any other means that ensures communication with employees.*

The Port should work to rebuild trust between PEMs members through cross-training and mixing workers while in the field. (See Part IV Section 15 for further discussion on this topic.) The Port should work to rebuild trust between PEMs and managers and supervisors by ensuring supervisors maintain a positive force to health and safety and by having an electrical safety point person within the PEMs.

In conjunction with the designated electrical safety point person, it is highly recommended that a cross functional safety committee be formed to address and take ownership of safety concerns. Due to current mistrust between PEMs and managers and supervisors, it is possible for two committees to be formed, one comprised of PEMs and one comprised of management with the designated electrical safety technical advisor acting as a liaison between the two committees. The management team may consist of management personnel from Risk Management, Operations and Maintenance, Engineering, a PEM representative, an Electrician representative, and Quality. The PEM safety committee may consist of a PEM from each Operating Area, the Maintenance Department, and Quality. Due to heightened concerns and perception on safety within Division 147, precise minutes should be taken detailing items of concern and corrective action. This item is also discussed in Part IV Section 15.

The Port should publicize success to sustaining efforts and keeping everyone motivated. Everyone needs to be updated throughout the process. Progress reports during normal shift meetings allowing time for comments back to the steering committee opens communications, but also allows for input. Everyone needs to have a voice, otherwise they will be reluctant to buy-in. A system can be as simple as using current meetings, a bulletin board, and a comment box.

Item II – 1.4: *Procedure for identifying and evaluating workplace hazards.*

As discussed in Item II – 1.1 of Recommended Corrective Actions, an electrical safety technical advisor should perform field audits to ensure safe work practices are being implemented. Both spot field audits and scheduled audits should be implemented. Inspections should be documented and retained on file. Safety items noted by employees should be able to be brought forward to the safety committee and documented and tracked to corrective action.

In regards to Preventive Maintenance, it is important that management perform risk assessments on aged equipment, create a correction plan, and communicate to employees plans on capital projects and improvements so that staff recognizes that management is not ignoring safety issues related to aged equipment. For further information on Preventive Maintenance, refer to Part IV Sections 3.0 and 5.0.

Item II – 1.5 and Item II – 1.6: *Procedure to investigate occupational injury and illnesses and procedures for correcting unsafe or unhealthy conditions, work practices and work procedures in a timely manner.*

Formal collection of data related to workplace incidents and near misses should be performed by Risk Management. Root cause analyses should be performed and findings should be relayed back to aPEMS, supervisors and managers. Employees at all levels shall be educated on the importance of reporting near miss incidents, first aid and incidents, and accidents, and introduce the concept of the safety pyramid.

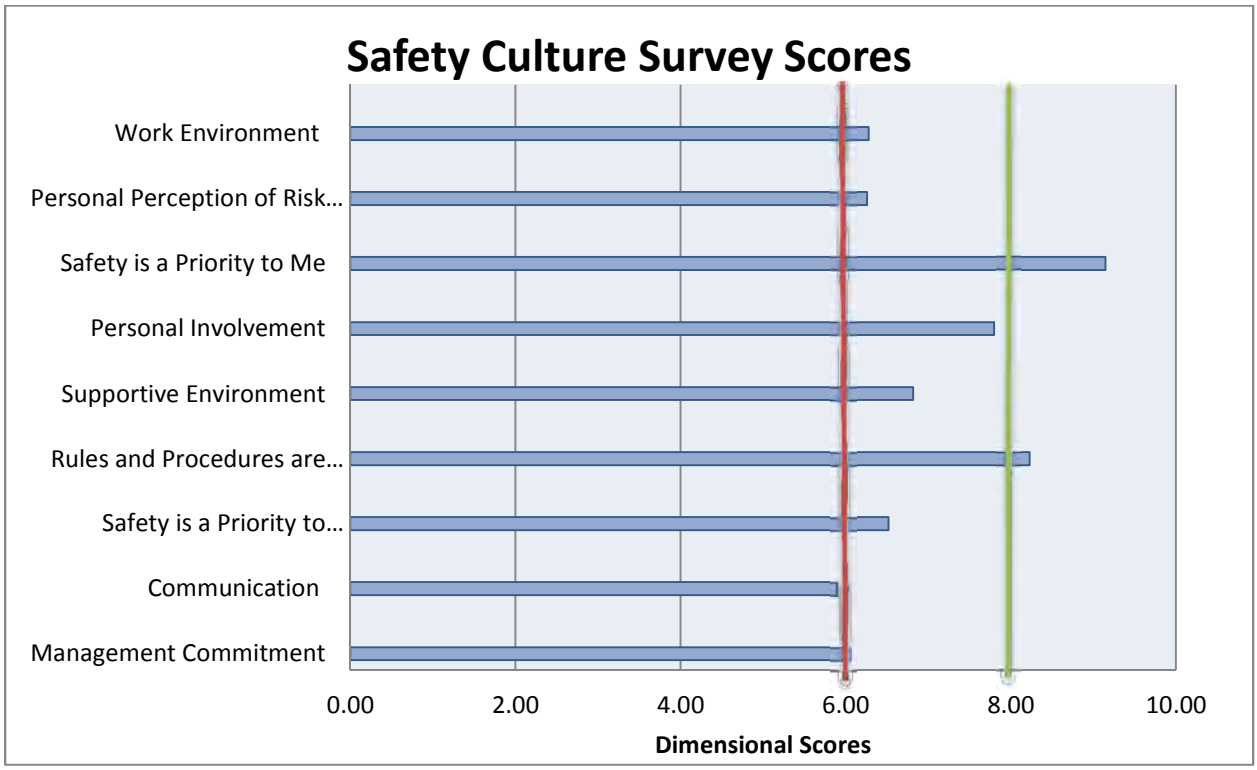
Table 2.1: Safety Culture Survey Questions and Results

Dimensions	Questions	Average Rank (5 is strongly agree 1 is strongly disagree)	Dimensional Score (Rank 1-10)
Safety is a Priority to Me	Safety is the number one priority in my mind when completing a job	4.50	9.15
	It is important that there is a continuing emphasis on safety here at my job	4.65	
Rules and Procedures are Important	Some health and safety rules and procedures do not need to be followed to get the job done safely	1.84	8.23*
	Some health and safety rules are not practical or able to be followed	1.94	
Personal Involvement	I am involved in informing management of important safety issues	3.87	7.80
	I am involved with safety issues at work	3.93	
Supportive Environment	I am strongly encouraged to report unsafe conditions	3.53	6.82
	I can influence, affect, and change health and safety performance here	3.29	
Priority of Safety	Management considers safety as equally important as completing our work assignments	3.13	6.52
	I believe safety issues are assigned a high priority at the Port	3.39	
Work Environment Allows for Achievement of Safety	Our work objectives rarely conflict with safety measures	2.53	6.27
	I am always given enough time to get the job done safely	3.74	
Personal Perception of Risk (high score = perception of low risk)	I am sure it is only a matter of time before I am involved in an accident	2.61	6.26*
	In my workplace, the chances of being involved in an accident are quite high	3.13	
Management Commitment	Management acts decisively, assertive, and with authority when a safety concern has been raised	3.10	6.07
	In my workplace management acts quickly to correct safety problems	2.97	
Communication	Safety information is always brought to my attention to me by my supervisor	2.97	5.90
	There is good communication about safety issues which affect me	2.93	
Overall Average from Dimensional Scores		**FAIR**	**7.00**

Note that dimensional scores for negatively worded questions were calculated by reversing the averages, i.e. subtracting the response score by 1 and then averaging. See asterisks in above table.

Dimensional Score	Description
Less than 6	Poor
From 6 to 8	Fair
Greater than 8	Good

Table 2.2: Safety Culture Dimensional Survey Scores



Dimensional Score	Description
Less than 6	Poor
From 6 to 8	Fair
Greater than 8	Good

PART III

GENERAL SAFETY TRAINING

SECTION 1 – GENERAL SAFETY TRAINING

OVERALL SCORE – 7.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
1.1	GENERAL SAFETY TRAINING		X	

IMP= Needs Improvement

Section 1 Overview

Safety training is an important element in the prevention of work-related injuries, illnesses and death. When properly trained on safety procedures, employees will understand the importance of workplace safety, know how to prevent an incident in the workplace, and will also learn how to respond quickly if presented with an unsafe condition.

Educating employees on workplace safety rules provides them with confidence and knowledge on how to perform work safety which can lead to increased productivity. Effective safety training can result in a reduction in accident and incident rates, which reflects favorably on an organization.

Section 1 Discussion

Records for staff of 31 employees assigned to PEM Division in regards to safety training received for compliance with CalOSHA requirements were reviewed. Completion rates for seventeen training courses were reviewed. The C&M Training and Career Development Officer Manual was utilized to identify assigned training required for PEMs. The division employee list was used to identify PEM Supervisors and PEMs.

Of the 17 training courses reviewed 14 out of the 17 (or 83%) of the training courses have employees who have not received or are out of date with their training. This presents significant regulatory gaps. Appendix C summarizes regulatory findings that correspond to applicable CalOSHA training requirements. Table 3.1 provides percentage of employees who are currently out of compliance with regulatory training requirements. Recommended frequency of training was listed within the C&M Training and Career Development Officer Manual. For Table 3.3, cells highlighted as red indicates a regulatory violative condition that the employee was either 1) was never trained in subject, or 2) that the last training completed was of a longer frequency than required by CalOSHA regulations. Cells highlighted yellow are related to best management practice and indicate that 3) that the last training was completed longer than the frequency as recommended by the Port's C&M internal standards.

Table 3.2 provides the percentage of employees who have not completed training within the recommended frequency as specified by C&M. Note that Table 3.1 and Table 3.2 include records review for thirty-three Division 147 employees. Table 3.3 summarizes employees assigned to the PEM Division and their most recent training date.

In regards to the scope of work related to the review of Port mandated training requirements, discussion with management indicated that the Coast Guard, AQMD, LA Building and Safety, and DHS did not consist of training which Division 147 are required to take. Division 147 is required to take Federal Railroad Administration – Railway Safety and Environmental Protection Agency – Storm Water Pollution Prevention Training. In regards to the LADWP electrical training, it is the audit team's understanding that this is not a required course for PEMs. Courses for electrical safety as required by CalOSHA, including high and low voltage electrical training, has been offered to the PEMs.

Table 3.1 Division 147 Training Regulatory Compliance

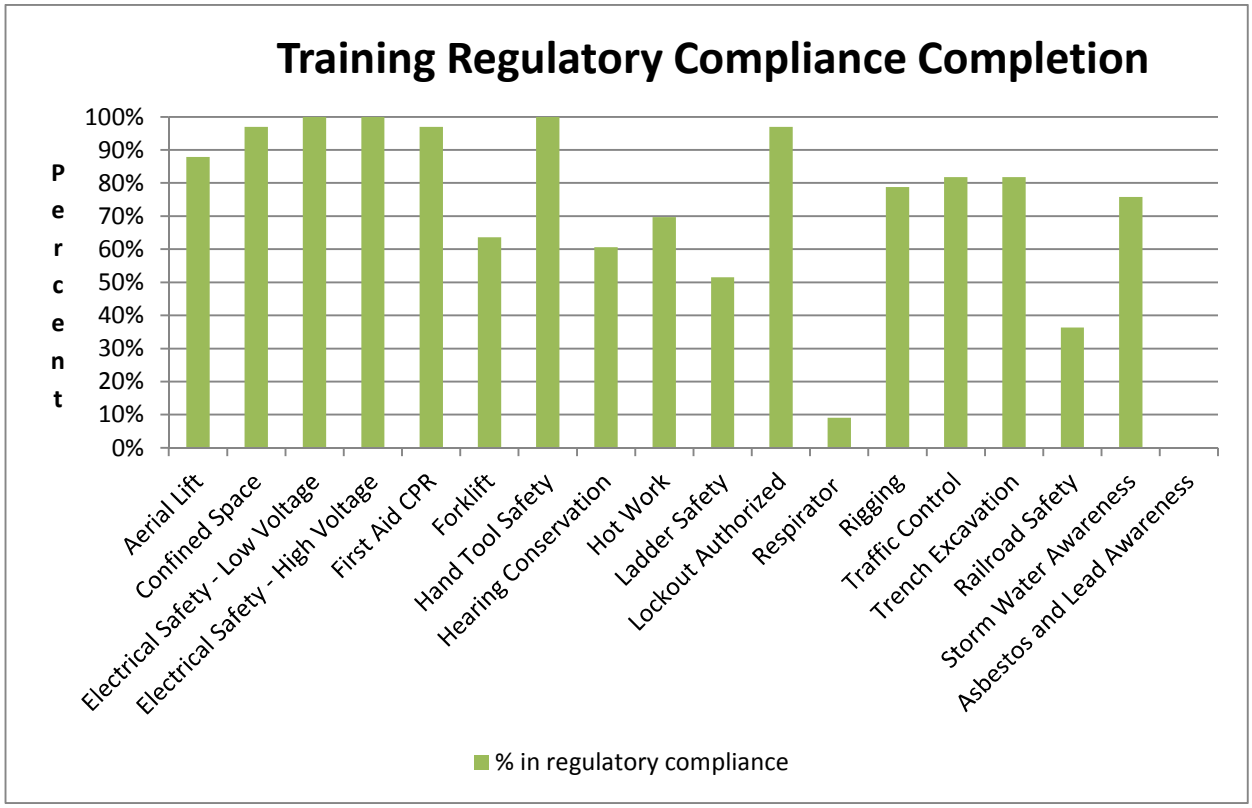


Table 3.2 Division 147 Best Management Training Frequency

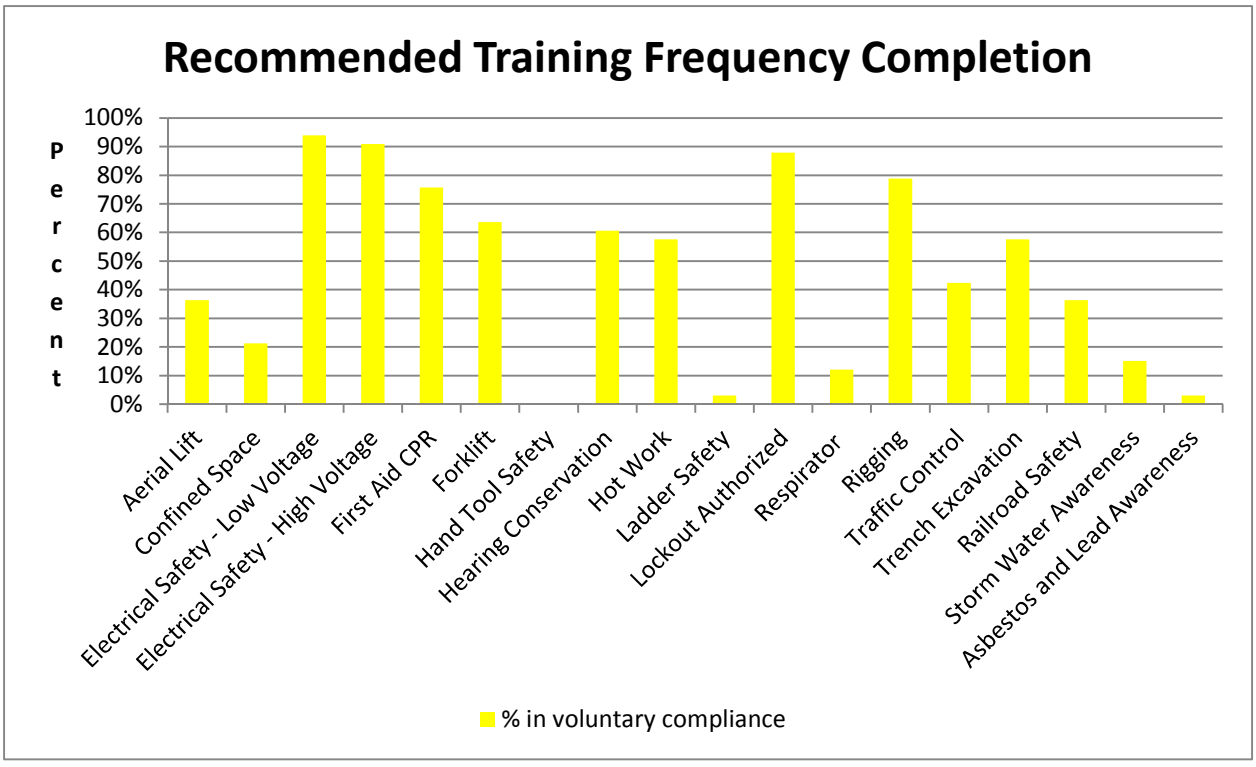


Table 3.3: Division 147 Training Dates

Port Electrical Mechanic																		
Employee	Aerial Lift Operator	Confined Space	Electrical Safety -Low	Electrical Safety-High	First Aid/CPR	Forklift	Hand Power Tool Safety	Hearing Conservation	Hot Work	Ladder Safety	Lockout-Authorized	Respirator (APR)	Rigging	Shop Equipment	Traffic Control	Trenching/Shoring	Railroad Worker Safety	Storm Water Awareness	Asbestos and Lead Awareness
Employee 1	6/15/09	8/24/09			11/17/10	4/21/09	2/3/09	10/1/08			8/11/09 affected	NA			8/5/09	5/27/09	3/28/12	7/24/08	
Employee 2	8/10/10	8/24/09	1/27/11	3/30/11	1/18/12	9/28/11		12/13/11	6/28/10		6/12/12		11/17/09		4/16/09		4/7/11	7/21/2008	
Employee 3	8/10/10	11/19/09	1/27/11	3/30/11	1/17/12	9/15/11		12/6/11	6/28/10		6/12/12	4/13/10	11/17/09		4/16/09	4/18/12	12/8/09		
Employee 4	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12		7/25/06	5/11/10	2/28/06	2/13/06	5/20/10	11/17/09			5/5/12	8/31/11	5/8/2007	
Employee 5	7/7/09	11/19/09	1/27/11	3/30/11	5/5/11	9/28/11		12/14/11	6/28/10		6/12/12	4/13/10	11/17/10		4/16/09	8/20/09	4/16/12	6/14/07	
Employee 6	5/13/09	1/5/11			9/8/11	6/2/2009		12/12/11	6/30/11		7/5/2009	5/20/10				6/1/12	1/6/2009	7/11/2007	7/18/2012
Employee 7		8/11/10	1/27/11	3/30/11	11/17/10	8/8/12		12/14/11		2/22/06	6/12/12				4/16/09	8/20/09	3/28/12	6/19/2007	
Employee 8	8/24/10	8/24/09	1/27/11	3/30/11	9/8/11	10/6/11		12/8/11	9/12/12	8/14/12	6/12/12	2/17/10	4/12/11		4/16/09	6/20/12	4/16/12		
Employee 9	9/20/05	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12		1/25/06	5/11/10	2/22/06	2/13/06	5/20/10	11/17/09			6/1/12	4/6/11		

Table 3.3: Division 147 Training Dates

Port Electrical Mechanic																			
Employee	Aerial Lift Operator	Confined Space	Electrical Safety -Low	Electrical Safety-High	First Aid/CPR	Forklift	Hand Power Tool Safety	Hearing Conservation	Hot Work	Ladder Safety	Lockout-Authorized	Respirator (APR)	Rigging	Shop Equipment	Traffic Control	Trenching/Shoring	Railroad Safety	Storm Water Awareness	Asbestos and Lead Awareness
Employee 10	6/2/10	11/19/09	1/27/11	3/30/11	1/17/12	9/15/11	1/20/09	12/7/11		12/20/08	6/12/06	3/3/11	8/26/10		8/5/09	6/20/12	4/16/12	7/24/08	
Employee 11	3/24/10	12/17/08	1/27/11	3/30/11	1/18/12	2/7/12	2/4/09	10/1/08			6/12/12		8/26/10		6/16/10	5/16/12	4/6/11	4/3/08	
Employee 12	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12		12/13/11	5/11/10		6/12/12	5/20/10	11/17/09		2/9/11	05/3/05	4/6/11	7/12/07	
Employee 13		12/17/08	1/27/11	3/30/11	12/8/10	9/8/11	2/4/09	12/7/11		12/30/08	2/12/09	12/8/10				4/24/12	1/20/11		
Employee 14	8/17/10	1/5/11	1/27/11	2/14/06	1/18/12	8/8/12	2/4/09	7/25/06	05/18/10	12/30/08	6/12/12	95/05/11	4/12/11		4/16/09		4/16/12	8/16/2007	
Employee 15	8/10/10	8/24/09	1/27/11	3/30/11	7/27/10	8/5/09		10/8/08	05/18/10		6/12/12	3/3/11	4/12/11		4/14/10	6/20/12	4/12/11	4/14/08	
Employee 16	6/30/99	12/17/08	1/27/11	3/30/11	4/23/09	08/08/12	2/3/09	12/14/11		2/22/06	6/12/12	5/20/10			6/16/10	5/5/05	1/20/11	6/23/10	
Employee 17	6/25/09	11/19/09	1/27/11	3/30/11	1/17/12	8/5/09		12/8/11	05/14/10		6/12/12		4/12/11		4/16/09	6/20/12	4/12/11	4/18/2008	
Employee 18	6/2/10	11/19/09	1/27/11	3/30/11	5/23/12	8/9/12		12/14/11	09/12/12		6/12/12	1/7/10	4/12/11		4/16/09		4/16/11	6/19/07	

Table 3.3: Division 147 Training Dates

Port Electrical Mechanic																		
Employee	Aerial Lift Operator	Confined Space	Electrical Safety -Low	Electrical Safety-High	First Aid/CPR	Forklift	Hand Power Tool Safety	Hearing Conservation	Hot Work	Ladder Safety	Lockout-Authorized	Respirator (APR)	Rigging	Shop Equipment	Traffic Control	Trenching/Shoring	Railroad Safety	Storm Water Awareness	Asbestos and Lead Awareness
Employee 19	8/16/05	1/5/11	1/27/11	3/30/11	1/18/12	4/21/09				2/22/06	3/12/09	1/5/11	4/12/11		4/16/09	6/1/12	4/16/12	6/19/07	
Employee 20		11/19/09	1/27/11	3/30/11	5/23/12	6/24/09	2/4/09	10/1/08		12/30/08	6/12/12				8/5/09	4/24/12	3/28/12	8/16/2007	
Employee 21	7/7/09		1/27/11	3/30/11	1/18/12	8/5/09		12/14/11	5/11/10		7/5/09	4/13/10	11/17/09		4/16/09	6/1/12	4/30/11		
Employee 22	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12			5/11/10	3/7/06	6/12/12	5/20/10	11/17/09		2/9/11		4/6/11	7/12/07	
Employee 23	6/2/10	11/19/09	1/27/11	3/30/11	5/5/11	8/5/09		10/8/08	05/18/10	2/22/06	6/12/12	2/16/11	4/12/11		4/14/10	6/1/12	4/16/12	8/16/07	
Employee 24	8/17/10	1/5/11	1/27/11	3/30/11	1/18/12	9/8/11		12/14/11	05/18/10	08/14/12	6/12/12	1/5/11	8/26/10		4/16/09	8/20/09	4/7/11		
Employee 25	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12			5/11/10		6/12/12	5/20/10	11/17/09				4/6/11		
Employee 26	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12			5/11/10	2/28/06	6/12/12	5/20/10	11/17/09		2/9/11	4/28/05	4/6/11	7/12/07	

Table 3.3: Division 147 Training Dates

Port Electrical Mechanic																		
Employee	Aerial Lift Operator	Confined Space	Electrical Safety -Low	Electrical Safety-High	First Aid/CPR	Forklift	Hand Power Tool Safety	Hearing Conservation	Hot Work	Ladder Safety	Lockout-Authorized	Respirator (APR)	Rigging	Shop Equipment	Traffic Control	Trenching/Shoring	Railroad Safety	Storm Water Awareness	Asbestos and Lead Awareness
Employee 27		12/17/08	1/27/11	3/30/11	1/17/12	4/21/09	2/4/09	12/8/11	05/18/10	12/30/08	6/12/12	2/16/11	4/12/11		4/16/09	7/8/09	4/12/11	7/24/08	
Employee 28	6/25/09	11/19/09	1/27/11	3/30/11	1/17/12	8/4/09	1/20/09	12/14/11	05/18/10		6/12/12	12/9/09	4/12/11		6/16/10		4/12/11	7/24/08	
Employee 29	7/7/09	11/19/09	1/27/11	3/30/11	9/6/11	08/08/12	2/4/09	10/1/08		12/30/08	6/12/12		4/12/11		8/5/09	6/1/12	4/12/11	6/28/07	
Employee 30	6/25/09	11/19/09	1/27/11	3/30/11	1/18/12	2/7/12			5/11/10	3/7/06	6/12/12	5/20/10	11/17/09		2/9/11		4/6/11	7/12/07	
Employee 31	3/24/10	8/11/10	1/27/11	3/30/11	5/11/10	7/7/10		12/12/11				12/07/10				5/16/12	3/28/12	2/18/10	

Table 3.3: Division 147 Training Dates

Port Electrical Mechanic Supervisor																		
Employee	Aerial Lift Operator	Confined Space	Electrical Safety – Low Voltage	Electrical Safety-High	Forklift	Hand Power Tool Safety	Hearing Conservation	Hot Work	Ladder Safety	Lockout-Authorized	Office Ergo	OSHA Supervisory	Respirator (APR)	Rigging	Shop Equipment	Traffic Control	Railroad Safety	Storm water Awareness	Asbestos and Lead Awareness
Supervisor 1	6/30/99	11/19/09	1/27/11	3/30/11	8/5/09		12/14/11	05/18/10		6/12/12			?	11/17/09		4/16/09	12/16/2008	6/23/10	9/9/2004
Supervisor 2	6/25/09	12/15/08	1/27/11	3/30/11	8/5/09		12/13/11	5/11/10		6/12/12			5/20/10	8/26/10		2/9/11	4/16/11	7/12/07	

PART IV

ELECTRICAL SAFETY

SECTION 1 - WRITTEN ELECTRICAL SAFETY PROGRAM

OVERALL SCORE = 1.0 (LOW VOLTAGE) AND 8.0 (HIGH VOLTAGE)				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
1.1A	LOW VOLTAGE ELECTRICAL SAFETY PROGRAM		X	
1.1B	HIGH VOLTAGE ELECTRICAL SAFETY PROGRAM			X

IMP= Needs Improvement

Section 1 Overview

Development of a formal Electrical Safety Program is considered a key part of keeping workers safe around energized equipment as it provides a clear understanding of processes and procedures in working on and around electrical equipment. Program guidelines should be documented for employees and contractors to follow.

In addition to keeping workers safer, an Electrical Safety Program can help the Maintenance Department work more efficiently.

Section 1 Summary

POLA has a high voltage written electrical safety program in place; however, it does not have a low voltage written electrical safety program in place.

The written high voltage program (identified as Qualified Electrical Worker Manual) meets the basic requirements; however, there are some terms used which are confusing or conflicting in the manual and should be changed. The contents of the Qualified Electrical Worker Manual is not generally well-known or easily accessible by the PEMs. Review of the document should be included in training and easy access to the written program should be made available.

A low voltage written electrical safety program needs to be developed. It is suggested that a third party with expertise in writing electrical safety plans should be hired to develop the document.

1.1 WRITTEN ELECTRICAL SAFETY PROGRAM

OVERALL SCORE = 1.0 (Low Voltage) and 8.0 (High Voltage)		
Hazard Risk Rating	**Item # in Appendix C**	**Description of Deficiency**
1	**1.1A and 1.1B**	No low voltage written program. High voltage program needs some improvements.

1.1 Observation

A high voltage (>600V) written program (QEW) exists that was officially adopted and signed by C&M Management in January 2012. The written program meets requirements; however, needs some minor improvements, as listed in the recommendations section.

A low voltage (50V – 600V) written program does not currently exist. Management stated they are in the early stages of writing a low voltage program.

References:

Note: FPN as listed in NFPA 70E stands for "Fine Print Note"

NFPA 70E 110.3 Electrical Safety Program.
(A) General. The employer shall implement and document an overall electrical safety program that directs activity appropriate for the electrical hazards, voltage, energy level, and circuit conditions.

FPN) No. 1: Safety-related work practices are just one component of an overall electrical safety program.

FPN No. 2: ANSI/AIHA Z10-2005, *American National Standard for Occupational Safety and Health Management Systems*, provides a framework for establishing a comprehensive electrical safety program as a component of an employer's occupational safety and health program.

(B) Awareness and Self-Discipline. The electrical safety program shall be designed to provide an awareness of the potential electrical hazards to employees who work in an environment with the presence of electrical hazards. The program shall be developed to provide the required self-discipline for all employees who must perform work that may involve electrical hazards. The program shall instill safety principles and controls.
(C) Electrical Safety Program Principles. The electrical safety program shall identify the principles upon which it is based.
(D) Electrical Safety Program Controls. An electrical safety program shall identify the controls by which it is measured and monitored.

(E) Electrical Safety Program Procedures. An electrical safety program shall identify the procedures for working within the limited approach boundary and for working within the arc flash boundary before work is started.
(F) Hazard Identification and Risk Assessment Procedure. An electrical safety program shall include a hazard identification and a risk assessment procedure to be used before work is started within the limited approach boundary or within the arc flash boundary of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists. The procedure shall identify the process to be used by the employee before work is started to identify hazards and assess risks, including potential risk mitigation strategies.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. Note that an overall corrective actions table is presented in Appendix C**.**

<u>High Voltage (QEW)</u>

1. Qualified Electrical Worker definition and use of definition – The term "Qualified Electrical Worker" or QEW is used throughout the QEW Manual and multiple definitions used, which are potentially conflicting. "Qualified Electrical Worker" is a legal definition as defined by CalOSHA, Title 8, Subchapter 5, Group 2 and the definition and use of this term should not vary from the legal definition. Those POLA employees that know the legal definition of QEW are confused or skeptical of the POLA definition or application of QEW.

   As correctly noted in the definition of the QEW on page 3 of the QEW Manual, a QEW can be "qualified" to work on some equipment, but not others, and an individual who is going on-the-job training under the supervision of a QEW, and has demonstrated an ability to safely perform the job, is considered a QEW. POLA tends to use QEW as a general "all or nothing" status or title that allows employees to work on all high voltage equipment. See Section 2 of this audit report for more information on further applying a QEW program.

   Section 3 of the QEW Manual – Definitions - Page 3 has the appropriate legal definition, along with some added information by POLA. The information added by POLA should be removed from the middle of the definition. The training requirements should be moved to Section 7 and merged with the other training requirements.

   Section 5.4 of the QEW Manual – page 3. Describes how qualification is made. This doesn't belong in this section.

   Section 7.2, page 2 of the QEW Manual has a partial definition of QEW, which is not necessary. This information should be removed to prevent conflict in definition or

application.

QEW Policy Acknowledgement – page 2 of the QEW Manual. Here a completely different definition of a QEW has been created which the employee and supervisor must sign off on. This definition conflicts with the legal definition that should be used. This should be changed to meet the suggested structure and wording below:

Suggested structure & wording –

a. Change the name of the document from *Qualified Electrical Worker Manual* to something like *High Voltage Worker Manual* or *Port Qualified High Voltage Worker Manual*. QEW is a subset of the overall High Voltage Worker requirements by POLA. This manual contains more than just determining what a QEW is.
b. Define QEW once in the definitions, using the legal definition by CalOSHA. You can add at the end of the definition: "A Qualified Electrical Worker for the Port of Los Angeles has additional requirements as outlined in this manual." From that point on, do not try to redefine QEW.

2. Section 3 – Definitions – page 3of the QEW Manual. Advanced Electrical Safety and Lockout / Tagout Training. It's not certain what was meant by "advanced" here. There is no course reference or training for "advanced" electrical safety.

3. Section 3 – Definitions – page 3 of the QEW Manual – Qualified Person. The definition given here for "Qualified Person" is pulled from the OSHA federal 1926 construction definitions, which isn't in full alignment with OSHA federal 1910 electrical safety definitions nor CalOSHA Title 8, Subchapter 5, group 1 definition of a "Qualified Person".

   Federal definitions of "Qualified Person" applies to workers working on all voltages whereas CalOSHA uses "Qualified Electrical Worker" for high voltage and "Qualified Person" for low voltage. Being that there is a split between the low and high voltage programs and documents, the term "Qualified Person" should probably be removed from the high voltage manual and be reserved for the low voltage manual. If "Qualified Person" is used in this manual, it would be recommended to use the CalOSHA Title 8, Subchapter 5, Group 1 definition, which mirrors both OSHA and NFPA 70E. That definition is as follows:

   Qualified Person. A person, designated by the employer, who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.

NOTES:
1. Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. For example, it is possible for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" with other equipment.
2. An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

4. There is not specific information present outlining emergency response procedures for victims of shock. Add emergency response for shock victims to QEW manual.

5. There is no specific information in Section 5.7 of the QEW Manual of Arc Rated personal protective equipment. PPE information should be specific as to what to wear and when.

Low Voltage (50v – 600v)

A comprehensive Written Electrical Safety Program needs to be developed. A third party with expertise in writing electrical safety plans should be hired to develop the document. This is a relatively low-cost project as most content is boiler plate. Training to the document should be required once completed.

Dissemination of Information & Access

The contents of the high voltage electrical safety program is not well-known by the PEMs. The contents of both the existing high voltage and the forthcoming low voltage program should be included in future training. Employees should have easy access to the written programs.

SECTION 2 - QUALIFIED PERSONS & QUALIFIED ELECTRICAL WORKER

MUTLIPLE OVERALL SCORES = 4.0, 8.0 AND 6.0 AS LISTED IN THIS					
ITEM	**DESCRIPTION**	**SCORE**	**COMPLIANT**		
			YES	NO	IMP
2.1A	QUALIFIED PERSON PROGRAM	4.0		X	
2.1B	QUALIFIED ELECTRICAL WORKER PROGRAM	8.0			X
2.2	ELECTRICAL SAFETY TRAINING	6.0			X
2.3	ELECTRICAL SAFETY RETRAINING		X		
2.4	EMERGENCY FIRST RESPONDER TRAINING				X
2.5	EMERGENCY FIRST RESPONDER RETRAINING			X	
2.6	LOCKOUT / TAGOUT TRAINING				X
2.7	JOB TASK TRAINING				X
2.8	SKILL & KNOWLEDGE OBSERVATION				X
2.9	QUALIFIED PERSON AND WORKER DOCUMENTATION				X
2.10	QUALIFIED PERSON AND WORKERANNUAL INSPECTION			X	
2.11	LIMITED TASK QUALIFIED PERSON TRAINING			X	
2.12	LIMITED TASK DOCUMENTATION			X	
2.13	UNQUALIFIED PERSON TRAINING			X	
2.14	UNQUALIFIED PERSON DOCUMENTATION			X	
2.15	HAZARDOUSE LOCATION TRAINING			X	
2.16	CONTRACTOR & VISITOR PROGRAM		X		

IMP= In Place, but Needs Some Improvement

Section 2 Overview

CalOSHA, OSHA and NFPA 70E requires that only a “Qualified Person” may work on or around exposed energized equipment and defines a “Qualified Person” as “one who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.”

Persons may be Qualified for one task, but not another. Qualified training as well as observation of skills and knowledge should be documented.

CalOSHA Qualified Electrical Worker is a definition specific to the State of California for high voltage workers. CalOSHA defines a Qualified Electrical Work as a qualified person who by reason of a minimum of two years of training and experience with high-voltage circuits and equipment and who has demonstrated by performance familiarity with the work to be performed and the hazards involved.

Section 2 Summary

Implementing a Qualified Person and / or Qualified Electrical Worker program is a confusing task for most employers. OSHA and CalOSHA tell you "what" to do, but not "how" to do it. Implementing a Qualified Person / Qualified Electrical Worker program is up to each employer and there is no specific way to accomplish this. Because corporations and organizations have a difficult time translating what OSHA or CalOSHA is stating, and because there are no specific written guidelines, few corporations or organizations have proper Qualified Person / Qualified Electrical Worker programs in place. POLA is strong in some parts of this area, which only minor adjustments to be made. Other parts of this area are completely lacking by POLA at this time, but getting up to speed should be relatively easy as the core structures are already in place.

POLA C&M has implemented a Qualified Electrical Worker program for high voltage. The high voltage program meets nearly all points and only needs minor improvements.

While there is a high voltage program in place, there is no low voltage "Qualified Person" program in place.

One problem that POLA has is the improper use of the term "Qualified Electrical Worker", which is misapplied and leads to confusion for those that are most familiar with electrical safety requirements. POLA has used "Qualified Electrical Worker" as a status for someone who can demonstrate knowledge on high voltage switchgear and therefore, can work on all electrical equipment. Because POLA uses QEW as a status term, Qualified Person and low voltage programs have been comparatively ignored.

The phrase "it's just low voltage" was heard multiple times, and cautions are dropped by many when working on low voltage equipment. Some PEMs and supervisors expressed that low voltage electrical work simply isn't a big hazard or much to be too concerned about. While high voltage accidents are more deadly, the reality is that the low voltage equipment is the most likely place that an electrical accident will happen at the port, and the workforce doesn't recognize this or always take the proper precautions.

Also as a result of a focus on high voltage and QEW as a general status term, individuals can be assigned to work on equipment they may not actually be a Qualified Person for, or that they should not be working alone. Some QEWs may have experience with high voltage switching on particular equipment, but may have no knowledge on working with Variable Frequency Drives (VFDs) or Programmable Logic Controllers (PLCs). Qualified Person and Qualified Electrical Worker programs need to be specific to equipment and tasks. Not all PEMs have been thoroughly cross-trained on all electrical equipment.

POLA does a very good job of making certain that their PEMs receive the base training that they need. What is missing is some specific equipment or task specific training and the continuation of the cross-training. In particular, new equipment is installed at POLA and training on the new equipment is either not provided or is not deep enough. PEMs with electrical backgrounds almost universally stated that this is their number one need.

PEMs as a whole had the following gaps in their training:

- Not enough / deep enough equipment specific training.
- Emergency release methods and proper understanding of arc flash in electrical safety training.
- Boom Truck electrical safety training and Lift Truck electrical safety training.
- NEC / Los Angeles Electrical Code for maintenance technicians.
- Application of grounding and bonding on low voltage systems.
- Training on Hazardous Locations.
- Cross-Training is incomplete for some PEMs.

In addition to the Qualified Person and Qualified Electrical Worker programs for the PEMs, the C&M division needs to implement a program for Limited Task Qualified Persons and Unqualified Persons. HVAC technicians, janitors, gardeners, security guards and other similar personnel work on or around electrical equipment and need to either be a Qualified Person for the specific task they perform (i.e. closing breakers) or they need to be considered an Unqualified person that is trained on how to recognized electrical hazards, but isn't allowed to go within the limited approach boundary or arc flash hazard boundary to perform any work.

2.1 A QUALIFIED PERSON PROGRAM

OVERALL SCORE = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**2.1A**	A QEW program only exists for high voltage; no Qualified Person procedures have been developed

2.1A Observation

The QEW program that C&M has implemented is specific only to high voltage and ignores low voltage >50v to 600v. There is no process in place to assure or document that workers are Qualified Persons when it comes to low voltage equipment. Without documentation, there is no evidence to indicate whether or not PEMS are Qualified Persons for particular pieces of low voltage equipment or for particular tasks concerning low voltage equipment.

References:

CalOSHA 2300

CalOSHA defines a Qualified Person as "a person, designated by the employer, who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved".

These persons have experience related to the construction and operational elements of electrical equipment/systems and routinely receive training on the specific hazards and precautions necessary to work safely on and around energized electrical equipment. Qualified Persons are intended to be only those who are well acquainted with and thoroughly conversant in operation and maintenance of electrical equipment/systems and the hazards associated with related work.

OSHA 1910.399, NFPA 70E 110.6

A "Qualified Person" is "one who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved."

Summary:
In general, a Qualified Person program will consists of:

- Electrical Safety Training, conducted live at least once every 3 years
- CPR & First Responder Training every year
- Lockout / Tagout Training every year
- Observation & Testing of a workers skills and knowledge
- Documentation of who is qualified for what tasks and equipment

Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment.

Recommended Corrective Actions:
A Qualified Person Program should be implemented that determines what worker is a Qualified Person to perform what tasks on what equipment (low voltage as it is applied to the POLA program).

It should be noted that these recommendations to improve electrical safety and comply with Cal/OSHA on definitions of “Qualified Persons” may be in conflict with the Civil Servant job descriptions or regulations as it would restrict tasks and jobs that individuals could perform, despite their job classification or job description. In order to implement a proper “Qualified Person” system that identifies individuals to tasks they can perform based on safety and knowledge, it may require changes in the PEM job description and / or changes to the Civil Servant regulations regarding these types of jobs.

REFER TO APPENDIX D– QUALIFIED PERSON PROGRAM for suggestions on implementing a Qualified Person Program.

2.1 B QUALIFIED ELECTRICAL WORKER PROGRAM

OVERALL SCORE = 8.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**2.1B**	Equipment Specific documentation needs improvement

2.1A Observation

A QEW program for high voltage is in place. The following areas need improvement:

1. Definition of "Qualified Electrical Worker" in the program and how it's used. Workers, by law, can be considered "Qualified Electrical Workers" by meeting the standards set by the state and it is highly likely that the Port has QEWs for some equipment, but not necessarily all equipment. The Port is using the terms as a broad status for all electrical work, which is an inappropriate application.
2. There is no documentation of the time of training and experience an individual has spent with the high voltage circuits.
3. There is nothing specific about the equipment and / or tasks that the individual has gained QEW status for. Whether an employee is considered to be a "Qualified Electrical Worker" will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" with other equipment.

References:

CalOSHA 2700

Qualified Electrical Worker: A qualified person who by reason of a minimum of two years of training and experience with high-voltage circuits and equipment and who has demonstrated by performance familiarity with the work to be performed and the hazards involved.

Recommended Corrective Actions:

1. Please refer to recommended corrective actions in section 1.1 for proper use and application of the legal term of "Qualified Electrical Worker".
2. The start date and / or time spent on specific high voltage equipment should be added to the Qualified Electrical Worker checklist and sign-off sheet.
3. The specific equipment or tasks that the individual can perform should be added to the Qualified Electrical Worker checklist and sign-off sheet.

REFER TO APPENDIX D – QUALIFIED PERSON PROGRAM for suggestions on implementing a Qualified Person Program.

2.2 QUALIFIED PERSON AND QUALIFIED WORKER ELECTRICAL SAFETY TRAINING

OVERALL SCORE = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**2.2**	Electrical Safety Training needs improvement

2.2 Observation

Qualified Workers are being trained on general electrical safety at least once every three years. Workers have some of the main points on electrical safety, but are missing others. Due to the common responses from the PEMs, it appears that some topics have not been properly covered in previous trainings.

In particular, the following deficiencies were found with a significant population of those that were interviewed:

- Lack of understanding of arc flash, especially with low voltages.
- Lack of understanding of insulated tool use. Many don't use insulated tools or understand when to use them.
- Lack of understanding of the role of PPE. Many thought they were working safe simply because they applied the proper PPE. There was a lack of understanding of PPE as a last line of defense and that in the event of an arc flash, serious injury or even death may still occur if wearing the proper PPE.
- Lack of understanding and / or application of boundaries.
- Lack of understanding flexible cord use. Flexible cords were found misapplied throughout the port in a variety of situations.
- Lack of understanding of release methods of shock victims

High voltage training that has been provided was described as lacking quality by some individuals. The trainer did not have a strong enough background in the subject to be training. 1 out of 31 PEMs had not received High Voltage Electrical Safety Training in past three years. Training records were missing from 2 (or 6%) of these employees.

Electrical safety for boom and lift trucks has not been completed. PEMs observed did not have a safe working knowledge of safety principles of working with boom and lift trucks and there was no record of this type of training ever being conducted. Workers were observed using truck booms and / or lifts without using proper electrical safety precautions. Lack of grounding, exposed metal through insulated barriers and lack of protection from those on the ground were noted.

<u>References:</u>

CalOSHA 2300, OSHA 1910.332, NFPA 70E 110.2

A "Qualified Person" as is "one who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved."

A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

Training shall be classroom or on-the-job type, or a combination of the two. The degree of the training provided shall be determined by the risk to the employee.

CalOSHA/OSHA - Practices addressed in this standard. Employees shall be trained in and familiar with the safety-related work practices required by CalOSHA 3203 and OSHA 1910.331 through 1910.335 that pertain to their respective job assignments.

Recommended Corrective Actions:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

1. The content of the general electrical safety training needs to be adjusted with emphasis on areas where the workers are deficient; specifically:
   - Release methods of shock victims
   - Arc flash protection at low voltages / understanding arc flash
   - Insulated tool use
   - How to properly determine boundaries and when boundaries need to be used
   - Role of PPE in electrical safety
   - Flexible cord use
2. High voltage training needs to be conducted by an individual with expert knowledge of the topic. Training should be conducted every 3 years.
3. Conduct electrical safety training for boom trucks and lifts.

2.3 QUALIFIED PERSON AND QUALIFIED WORKER ELECTRICAL SAFETY RETRAINING

Hazard Risk Rating	Item #	Description of Deficiency
NA	2.3	In compliance; however retraining due again soon.

2.3 Observation

Electrical safety training is being done once every three years as required. Training is due again soon.

References:

Note: NFPA 70E 110.2. NFPA 70E 110.2(D)(3) as listed below encompasses electrical safety training with requirements over a page long. This section is all encompassing of electrical safety training needs which includes safety training, emergency procedures, qualified person training, and unqualified person training, each as their own written section in NFPA 70E.

Port Requirement, NFPA 70E 110.2 (D)(3) Retraining.
Retraining shall be performed at intervals not to exceed 3 years.

An employee shall receive additional training (or retraining) under any of the following conditions:
(1) If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices.
(2) If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.
(3) If he or she must employ safety-related work practices that are not normally used during his or her regular job duties.

OSHA 1910.269(a)(2)(iii) - Power Generation, Transmission & Distribution Facilities ONLY – Same as NFPA 70E above.

Recommended Corrective Actions:
Training is due again soon. Make sure retraining includes targeting the areas where the most deficiencies are found in this report.

2.4 QUALIFIED PERSON EMERGENCY RESPONSE TRAINING

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**2.4**	Supervisors not receiving electrical safety training

2.4 Observation

Qualified persons are being properly trained for emergency response, however PEM supervisors are not being trained. PEMs and Supervisors are also uncertain on emergency procedures related to shock. For example, multiple employees did not know to release on employee who is being shocked.

References:

NFPA 70E 110.2 (C) Emergency Procedures. Employees exposed to shock hazards and those employees responsible for taking action shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Employees shall be regularly instructed in methods of first aid and emergency procedures, such as approved methods of resuscitation, if their duties warrant such training. Training of employees in approved methods of resuscitation, including cardiopulmonary resuscitation and automatic external defibrillator, shall be certified by the employer annually.

CalOSHA 3400(a), CalOSHA 2940.10, OSHA 1910.151(a) The employer shall ensure the ready availability of medical personnel for advice and consultation on matters of plant health.

CalOSHA 3400(b), OSHA 1910.151(b) In the absence of an infirmary, clinic, or hospital in near proximity to the workplace which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. Adequate first aid supplies shall be readily available.

OSHA 1910.269 (b) Power Generation, Transmission & Distribution Facilities ONLY - "Cardiopulmonary resuscitation and first aid training." When employees are performing work on or associated with exposed lines or equipment energized at 50 volts or more, persons trained in first aid including cardiopulmonary resuscitation (CPR) shall be available as follows:
1910.269(b)(1)(i) For field work involving two or more employees at a work location, at least two trained persons shall be available. However, only one trained person need be available if all new employees are trained in first aid, including CPR, within 3 months of their hiring dates.
1910.269(b)(1)(ii) For fixed work locations such as generating stations, the number of trained persons available shall be sufficient to ensure that each employee exposed to electric shock can be reached within 4 minutes by a trained person. However, where the existing number of employees is insufficient to meet this requirement (at a remote substation, for example), all employees at the work location shall be trained. NOTE: The adequacy of employee training

can become an issue in contested cases where the affirmative defense of unpreventable employee misconduct is raised. Under case law well-established in the Commission and the courts, an employer may successfully defend against an otherwise valid citation by demonstrating that all feasible steps were taken to avoid the occurrence of the hazard, and that actions of the employee involved in the violation were a departure from a uniformly and effectively enforced work rule of which the employee had either actual or constructive knowledge.

Recommended Corrective Actions:

A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Policy should be changed to require PEMs and supervisors to be First Aid, automated external defibrillator (AED) and CPR trained. Re-training should be to render emergency aid to persons who have been shocked and education on how to save a person who is being shocked.

2.5 QUALIFIED PERSON EMERGENCY RESPONSE RETRAINING

Hazard Risk Rating	Item #	Description of Deficiency
NA	2.5	None

2.5 Observation

First Aid, automated external defibrillator (AED), and CPR training is being completed every 2 years per American Heart Association guidelines and per Los Angeles Fire Department mandate for all Los Angeles City Workers There are conflicting requirements between NFPA 70E (annually) and the Los Angeles Fire Department (every 2 years). While NFPA 70E states annually, conducting the training every 2 years meets legal requirements and is sufficient according to industry experts.

References:

NFPA 70E 110.2 (C) Emergency Procedures. Employees exposed to shock hazards and those employees responsible for taking action shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Employees shall be regularly instructed in methods of first aid and emergency procedures, such as approved methods of resuscitation, if their duties warrant such training. Training of employees in approved methods of resuscitation, including cardiopulmonary resuscitation and automatic external defibrillator, **shall be certified by the employer annually.**

Recommended Corrective Actions:
None.

2.6 LOCKOUT / TAGOUT TRAINING

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**2.6**	Lockout / Tagout annual periodic inspections and retraining is not being done frequently enough

2.6 Observation

Lockout / Tagout training is performed at POLA, but appears to be on a 3-year schedule Lockout / Tagout training should be done annually.

Lockout / Tagout training needs to be specific to equipment. A PEM was observed working on a piece of electrical equipment that included a photovoltaic cell. The PEM shut off the main power grid supply, but did not know to shut off the photovoltaic power source as well.

References:

CalOSHA 3314(h), OSHA 1910.147 (C)(7) Periodic inspection review shall been performed annually with each authorized employee. In addition, retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedures. Additional retraining shall also be conducted whenever a periodic inspection under paragraph (c)(6) of this section reveals, or whenever the employer has reason to believe that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures. The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary. The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

NFPA 70E 120.2 (B) (2) All persons who could be exposed shall be trained to understand the established procedure to control the energy and their responsibility in executing the procedure. New (or reassigned) employees shall be trained (or retrained) to understand the lockout/tagout procedure as it relates to their new assignment. Retraining shall be required as the established procedure is revised.

Recommended Corrective Actions:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Lockout tagout training should be done as follows:

- Annually;
- For all authorized and affected employees whenever there is a change in job assignments, change in machines, equipment or processes that present a new hazard, or when there is a change in energy control procedures;
- With periodic inspection of equipment for lockout tagout, this is to be done annually; Whenever the employer has reason to believe that there are deviations or inadequacies.

2.7 QUALIFIED PERSON JOB TASK TRAINING

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**2.7**	Some specific training lacking

2.7 Observation

A significant amount of classroom training as well has some equipment specific training has been provided to the PEMs. Part of this training included a 400 classroom hour program, approximately half of which of which is electrical. For those with significant electrical backgrounds, this training was review. For those crosstraining from mechanical fields, the training was essential.

In addition to classroom training, PEMs have a training and education budget that they can use for further education on their own time. Few PEMs take advantage of this as they don't want to take vacation time for learning skills and information that they believe are directly related to their job and should be done on company time.

Many PEMs learn new skills through on-the-job training, by watching others with more knowledge. Some PEMs teach themselves on new equipment by doing research online and reading equipment manuals.

Through the learning methods above, most PEMs have most of the the basic skills and theory to perform their jobs safely and properly, but there are some training and knowledge gaps throughout the shop that need to be filled.

Through interviews and observations, the following was identified:

1. **Equipment Specific Training:** Almost universally, those PEMs with deep electrical backgrounds identified that more equipment specific training is required. From an electrical background, being a "Qualified Person" and working safely requires intimate knowledge of the equipment including not only what to do, but how things are designed to operate. PEMs stated that they often get quick training overviews of the operation of the equipment, but no training or real knowledge on how the equipment was designed to operate, which leaves a knowledge gap for them. At other times, no training is provided or no Original Equipment Manufacturer (OEM) manuals are provided for new equipment. Some PEMs have taken upon themselves to download OEM manuals off of the internet or even contact the manufacturer directly for information.

Equipment specific training typically comes from the manufacturer of the equipment. There were several possible reasons stated as to why this training was not being provided, including that the C&M and Engineering divisions couldn't agree on who should pay for it or that Engineering does not want the PEMs to know about the equipment so that they don't try and work on it. It is the opinion of Martin Technical that the real reason for the lack of deeper equipment specific training is lack of recognition by management for the need of this type of training or understanding as to why some PEMs want it.

Contrary to the PEMs with deep electrical backgrounds, those that came from mechanical backgrounds almost universally said that they knew everything they needed to know and that they couldn't identify any training needs, which simply reinforced their lack of deep electrical understanding compared to their electrically-based counterparts.

2. **NEC Training Specific to Maintenance Technicians:** Most workers who came from the mechanical or machinist background acknowledged they didn't know much about the codes and / or have not received any training on the codes. Some others, including those with an electrical background, had a very limited knowledge of the codes. In general the knowledge of the NEC and how it applied was found to be deficient.

   Many employees stated or argued that these codes were not applicable to their jobs and were only for design engineers and new installations. These statements reinforce these individuals' lack of knowledge of the NEC. NEC includes examination, identification, installation and use (operation) of electrical equipment, not just new installations. (2008 NEC 110 I).

   - Any time a piece of electrical equipment is worked on or modified, the NEC must be followed, which includes returning the equipment to a state that meets the NEC. Workers are not consistently returning the equipment to a state that meets NEC (see Section 3.0 for examples)
   - Workers are daily working on installations, such as the addition of lighting, rewiring, or fixing motors which are subject to NEC requirements. Included in the NEC are topics that affect the daily work of the workers, e.g. mechanical execution of work, proper wiring methods, methods of grounding and bonding, temporary wiring and flexible cords, spaces about electrical equipment, equipment to be used in outdoor locations or locations with hazardous atmosphere, equipment in fountain areas, and lighting and power around railway conductors, among others. Many of these codes are not being followed.

   Many PEMs and supervisors said they had a basic knowledge of the code, but stated they hadn't seen any or only a few small violations of the code on the job site. The Port has

hundreds of pieces of electrical equipment that have obvious violations to the NEC which are not being noticed or overlooked. See Part IV – Section 3.0 for further detail. A Qualified Person or Qualified Electrical Worker should be able to identify when equipment is in a condition considered hazardous by NEC.

The NEC prohibits using non-listed equipment to repair or replace electrical equipment. Non-listed equipment was found, and is evidence that the NEC is not known and / or being followed by some.

3. **Title 46, Code of Federal Regulations, Subchapter J, Parts 110-113:** Title 46 is the portion of the Code of Federal Regulations that governs shipping within the United States and includes Subchapter J, which covers electrical installations on ships. Rewiring of a hybrid ship is currently being done at the port, all of which is subject to Title 46 CFR. Although NEC does not cover installations in ships, portions of the NEC as well as other safety and design codes are incorporated by reference into Title 46, Code of Federal Regulations, Parts 110-113.

4. **Specialty Training:** Electrical equipment is becoming more solid state and controlled by computers. Training such as PLC (Programmable Logic Controllers) is required to keep up with modern electrical systems. Other specialty training such as VFDs or Motor Controls may be required for specific equipment.

5. **Truck Boom and Lift Electrical Safety:** PEMs were observed using truck booms and / or lifts without using proper electrical safety precautions. Lack of grounding, exposed metal through insulated barriers and lack of protection from those on the ground were noted. PEMs did not report any electrical safety training for this topic nor was any training documented.

6. **Grounding & Bonding – Field Application:** The PEMs have a working knowledge of grounding and bonding as it applies to their tasks on high voltage; however, some PEMs showed a lack of deeper understanding of the application and many did not apply grounding and bonding to their low voltage applications. Note that grounding and bonding class room training has been provided to PEMS however, hands-on field training has not been provided. This course should be focused on the practical applications in the field and can be completed in 2 days.

7. **Frequency of Training:** PEMs reported that they may not work on a piece of equipment for an extended period (i.e. over 1 year), and then be called to work on it. The time lapse between working on the equipment can create a safety hazard. If a PEM is to be the lead

on a piece of equipment they have not worked on recently, they may require on-the-job refresher training first.

References:

CalOSHA 2300, OSHA 1910.332 & NFPA 70E 110.6 Summary: Qualified Persons need to be sufficiently skilled in tasks and operations to perform their job safely, including the skills to install, maintain and troubleshoot equipment in a safe manner. A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

The degree of training provided shall be determined by the risk to the employee and determined by the employer.

NOTE: The adequacy of employee training can become an issue in contested cases where the affirmative defense of unpreventable employee misconduct is raised. Under case law well-established in the Commission and the courts, an employer may successfully defend against an otherwise valid citation by demonstrating that all feasible steps were taken to avoid the occurrence of the hazard, and that actions of the employee involved in the violation were a departure from a uniformly and effectively enforced work rule of which the employee had either actual or constructive knowledge.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

1) Provide in-depth OEM training when new equipment is brought on line.
2) Conduct NEC training for all journey level employees that will be installing or repairing electrical equipment. The training should focus on:
   a. How to use the NEC to find what they are looking for.
   b. The most common NEC standards that affect the POLA workforce based on the equipment and conditions at the port as well as addressing the most often violated standards that were found at the report through the audit.
3) One or more individuals should be assigned to learn the required codes for equipment that would fall outside of normal conditions, such as fountains and pools, battery installations, and marine vessel installations. These individuals should be consulted when work is conducted on equipment in these areas if replacement parts will be required or if new wiring is required.
4) Provide PLC training to those that need it. Identify other specialty training needs based on equipment being worked on.
5) Provide Truck Boom and Lift electrical safety training.
6) Provide Grounding and Bonding field training with emphasis on understanding the application and requirements for low voltage systems.

7) If a worker does not feel highly comfortable with a piece of equipment, or has not worked on a piece of equipment for an extended period that would make memory recall difficult, the worker should be retrained.

2.8 QUALIFIED PERSON SKILL & KNOWLEDGE

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**2.8**	No low voltage program. High voltage needs minor improvements.

2.8 Observation

Demonstration of skill and knowledge for QEW (high voltage) is being done, but demonstration of skill and knowledge for Qualified Person (low voltage) is not being done.

High voltage switching procedures were initially watched by supervisors. This is acceptable by legal terms as the supervisors are considered QEWs themselves; however, because they do not regularly work on the equipment, nor are they the most proficient regarding electrical safety, there are other QEWs that would be more suited to the observation.

References:

OSHA 1910.399 A "Qualified Person" as is "one who has received training in and **has demonstrated skills and knowledge** in the construction and operation of electric equipment and installations and the hazards involved."

Demonstration of skill and knowledge must be observed by another Qualified Person.

CalOSHA 2700 A Qualified Electrical Worker requires two years on the job being observed by another QEW for his/her demonstration of skills and knowledge.

NFPA 70E Article 100 Same as OSHA 1910.399.

NFPA 70E 110.2(D)(1)(f) The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this standard.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

1. Implement a Qualified Person program for low voltage. See Appendix D for details.
2. Consider choosing individuals with the highest level of knowledge of electrical safety and knowledge of the equipment to perform the observations of future Qualified Person and Qualified Electrical Worker status on an annual basis.

3. Perform regular supervision of work per NFPA 70E to make certain that each employee is complying with the safety-related work practices. This is best done through having a QEW assigned to work with other individuals and report back.
4. It should be noted that these recommendations to improve electrical safety and comply with Cal/OSHA on definitions of "Qualified Persons" may be in conflict with the Civil Servant job descriptions or regulations as it would restrict tasks and jobs that individuals could perform, despite their job classification or job description. In order to implement a proper "Qualified Person" system that identifies individuals to tasks they can perform based on safety and knowledge, it may require changes in the PEM job description and / or changes to the Civil Servant regulations regarding these types of jobs.

2.9 QUALIFIED PERSON DOCUMENTATION

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.9**	Some documentation should be improved.

2.9 Observation

Some documentation is being done, but needs improvement, including:

- QEW documentation to specific tasks and equipment
- Qualified Person documentation

References:

NFPA 70E 110.2 (E) Training Documentation. The employer shall document that each employee has received the training required by paragraph 110.6 (D). This documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of the training, each employee's name, and dates of training.
FPN: Employment records that indicate that an employee has received training are an acceptable means of meeting this requirement.

NFPA 70E 110.2(D)(1)(f). The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this standard.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Adopt the following documentation:

- QEW documentation by supervisor for specific skills and tasks
- Documentation of Qualified Persons for specific skills and tasks
- See Appendix D for implementing Qualified Person programs

2.10 QUALIFIED PERSON ANNUAL INSPECTION

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.10**	Qualified Person Annual Inspections process and procedure not formalized

2.10 Observation

Supervisors and other QEWs are observing, but there is no formal program or documentation in place or way to determine that regular supervision is being done. It is uncertain who is being observed and whether or not all employees are being observed on an annual basis.

References:

CalOSHA 2700: QEW shall demonstrate by performance familiarity with the work to be performed and the hazards involved.

NFPA 70E 110.2(D)(1)(f) The employer shall determine, through regular supervision or thorugh inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this standard.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Establish a formal process of observing or inspecting employee safety-related work practices on at least an annual basis. This is best done through having a QEW and / or Qualified Person assigned to work with other individuals and report back.

2.11 LIMITED TASK QUALIFIED PERSON TRAINING & QUALIFICATION

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**2.11**	Non-electrical employees are potentially performing tasks for which they have not been qualified

2.11 Observation

Non-electrical employees are potentially performing tasks for which they have not been qualified. PEMs reportedly are the only workers authorized to work on electrical equipment. However, workers outside of the PEM group were observed and found to be using electrical equipment or working on or around electrical equipment. Security guards use breaker switches for turning lights on and off. Gardeners and tree trimmers use electrical equipment and tools near electrical equipment, some of which have exposed parts (for example, lighting fixtures in the Ports O'Call Village and HAB garden area). Building technicians perform electrical tasks and use electrical tools and equipment.

All of these workers need to be properly trained for their tasks and equipment and need to be part of the "Qualified Person" program. Although a full audit of workers outside of the PEM group was not done, documentation on training requirements and training completed did not include electrical safety as part of their training, and therefore, they are currently "Unqualified" workers working on electrical equipment.

References:

CalOSHA 2300, OSHA 1910.399, OSHA 1910.332 & NFPA 70E 110.6 and Artcile 100
Summary - Training and Qualified Persons – It is important to note here anyone working on electrical equipment above 50v must be a Qualified Person in order to do their task, which is not just limited to electricians and maintenance technicians repairing or maintaining electrical systems. "Qualified Person" status is only specific to tasks and equipment and someone like a line operator throwing breakers must be a Qualified Person to throw that breaker, which includes the proper training and demonstration of skills and knowledge about the operation of the equipment.

The following are common occupations that require some level of electrical safety training in order to do the tasks they perform:

- Industrial Machine **Line** Operators
- Mechanics & Repairers
- Riggers & Roustabouts
- HVAC Technicians
- Janitors
- Material Handling Equipment Operators
- Painters
- Stationary Engineers
- Welders
- Tree trimmers

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C

- Task-qualified status for maintenance technicians should be established with proper training and documentation. Operating a breaker, troubleshooting an AC unit, or working around water features in a garden all require different levels of electrical safety. Training does not have to be as deep as what a PEM would receive, but rather just enough to do their job safely. This training can be conducted internally by a PEM who is a Qualified Person for those tasks.
- Add this training to the training requirement lists for each job.
- The understanding and clear authorization on who can do what is a little fuzzy amongst management and workers outside of the PEM group, and should be clarified.
- Those that aren't considered to be a "Qualified Person" for a limited task need to be classified as an Unqualified Person and not permitted to perform any work inside the limited approach boundary or arc flash boundary of equipment.

2.12 LIMITED TASK QUALIFIED PERSON DOCUMENTATION

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.12**	No documentation for limited task qualified persons

2.12 Observation

Qualified Tasks / Equipment for the worker not being documented (demonstration of skills and knowledge).

References:

CalOSHA 3203(b): Training documentation shall be retained for at least one year and shall include employee name or other identifier, training dates, type(s) of training, and training providers.

NFPA 70E 110.2 (E) Training Documentation. The employer shall document that each employee has received the training required by paragraph 110.6 (D). This documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of the training, each employee's name and dates of training.
FPN: Employment records that indicate that an employee has received training are an acceptable means of meeting this requirement.

NFPA 70E 110.2(D)(1)(f) The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this standard.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

The Port should document all training as well as observation / compliance of qualified tasks. In addition, the Port should keep records on file for each individual person.

2.13 UNQUALIFIED PERSON ELECTRICAL SAFETY TRAINING

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.13**	**Electrical safety awareness training is lacking**

2.13 Observation

Electrical Safety Awareness training is being provided for all affected employees in C&M, but awareness training should apply to all employees.

References:

OSHA 1910.332 (b) (2) Additional requirements for unqualified persons. Employees who are covered by paragraph (a) of this section but are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed by 1910.331 through 1910.335 but which are necessary for their safety.

NFPA 70E 110.2 (D) (2) Unqualified Persons. Unqualified persons shall be trained in and be familiar with any of the electrical safety-related practices that might not be addressed specifically by Chapter 1 but are necessary for their safety.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Provide all employees electrical safety awareness training, which should be part of their OSHA training program. This training focuses on the dangers of electricity and keeping Unqualified Persons away from electrically hazardous situations including recognition of signs and alerting techniques.

This “awareness” training is short and can be conducted successfully internally, online, through videos or from outside services. Office personnel need to be taught about proper use of extension cords, which is a common violation and hazard that leads to fires.

Unlike training for Qualified Persons, this training does not need to be conducted live.

2.14 UNQUALIFIED PERSON DOCUMENTATION

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.14**	No training documentation for unqualified persons

2.14 Observation

Electrical Safety Awareness Training not being done or documented for Unqualified Persons.

References:

CalOSHA 3203(b): Training documentation shall be retained for at least one year and shall include employee name or other identifier, training dates, type(s) of training, and training providers.

NFPA 70E 110.2 (E) Training Documentation. The employer shall document that each employee has received the training required by paragraph 110.6 (D). This documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of the training, each employee's name and dates of training.
FPN: Employment records that indicate that an employee has received training are an acceptable means of meeting this requirement.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Document electrical safety awareness training for unqualified persons. Keep records on file for each individual person.

2.15 HAZARDOUS LOCATIONS & SPECIAL EQUIPMENT TRAINING

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**2.15**	No training being done for hazardous locations

2.15 Observation

The Port has battery stations and a new battery room area with a hybrid boat. PEMs were not aware of any special handling of batteries and have not received any training on batteries and battery rooms.

The Port has several potentially explosive atmospheres, including the police station firing range and petroleum areas. PEMs have not received any training on working in these potentially explosive atmospheres.

Although not technically classified as a hazardous location, the Port is surrounded by water, has water features and maintains outdoor electrical equipment in a wet environment. Special considerations need to be made when working in wet environments including using equipment rated and designed for the location.

The Port may have other hazardous areas that were not identified.

References:

CalOSHA 2535.1 Provisions shall be made for sufficient diffusion and ventilation of gases from storage batteries to prevent the accumulation of explosive mixtures.

CalOSHA 2540.2 (a) Documentation. All areas designated as hazardous (classified) locations under the Class and Zone system and areas designated under the Class and Division system established after May 5, 2008 shall be properly documented. This documentation shall be available to those authorized to design, install, inspect, maintain, or operate electric equipment at the location

OSHA 1910.332 OSHA description for Qualified Person includes training and knowledge of all work practices regarding the hazards.

NFPA 70E 300.2 Responsibility. The employer shall provide safety related work practices and employee training. The employee shall follow those work practices.

NFPA 70E 310.4 Employee Training. (A) Qualified Persons. (1) Training. Describes the training requirements for work practices regarding Electrolytic Cells.

NFPA 70E 340.7 Specific Measures for Personnel Safety (A) Employer Responsibility (1) Proper Training. Describes the training requirements for work practices regarding Power Electronic Equipment.

Recommended Corrective Action:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Identify Classified Hazardous Locations and conduct training specific to Hazardous Locations & Special Equipment per NFPA 70E and NEC requirements for all personnel working on the electrical equipment in those areas. This training is relatively short and simple and focuses primarily on the additional hazards of working in these locations, additional PPE that may be required, specific equipment that may be required for repairs or minor installations, additional signage that may be required, and barricading access to unqualified persons. Specific hazardous location training should include:

- Battery and battery rooms
- Fuel Docks
- Sewage Stations
- Potentially explosive areas
- Wet areas and water features
- Other hazardous area identified by the Port.

2.16 CONTRACTOR & VISITOR PROGRAM

OVERALL SCORE (COMBINED WITH 2.2 THROUGH 2.16) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**2.16**	No sign off. Contract program never reviewed – inconclusive.

2.16 Observation

A contractor program is in place, but documentation of contractors signing off on program has not been provided.

References:

NFPA 70E 110.1 (A) Relationship with Contractors (Outside Service Personnel, etc.) Summary - the host employer must let contractors know of hazards related to the work and the contractor must ensure that their employees is instructed on dealing with the hazards, has basic training and that the employees will follow the work practices required by the host employer.

NFPA 70E 110.1 (C) Documentation. There shall be a documented meeting between the host employer and the contract employer.

Recommended Corrective Actions:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

A contractor program helps inform contractors of the hazards that exist and specific procedures required at the location. The program also helps protect the employer / customer from a legal perspective. The program should be written by or reviewed by legal counsel or someone familiar with contract law. The contractor program should include, among other things, information that requires them to follow POLA electrical safety requirements, and that they are Qualified Persons and QEWs and are experienced and knowledgeable with electrical safe work practices on the equipment they will be working on. If they are not a Qualified Person or QEW for any piece of equipment, they shall not be permitted to work on the equipment and shall notify POLA immediately. The program should also reference the POLA lockout tagout process which the contractor must be familiar with and list any special hazardous locations that the contractor should be aware of. Engineering needs to implement this for their contractors also.

Contractors should sign off on an electrical safety agreement with the document kept on file at POLA.

SECTION 3 - DESIGN & INSTALLATION (NEC)

OVERALL SCORE – 3.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
3.0	EQUIPMENT IN SAFE CONDITIONS		X	

Section 3 Overview

The National Electrical Code (NEC) provides provisions that are considered necessary for electrical safety installations and safeguards persons and property from hazards arising from the use of electricity. The NEC covers the installation of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways for public and private buildings.

Following NEC is not just for new construction projects, but also applies to repairs, modifications and small installations of any electrical equipment. Equipment that is modified or repaired shall be returned to a state which meets current codes and standards and does not present a safety hazard.

Section 3 Summary

All electrical safety programs and processes start with the general assumption that the equipment has been properly maintained, and is in good working condition. Equipment that is not properly maintained or is left in a potentially dangerous state is the cause of many electrical incidents and accidents.

Given the scale of POLA and its aging infrastructure, it was fully anticipated that many deficiencies would be found in this area during the course of the audit. The purpose of this audit was not to evaluate equipment at the facility, and therefore only a general overview and not a detailed breakdown of the status of the equipment is provided.

Major installations at POLA, such as new mobile amping stations or new electrical distribution switchgear, are handled through Engineering and are done to current codes. Small installations, such as installation of new lighting or electrical outlets, are performed by the PEMs. There are potentially hazardous installations throughout the Port that do not meet code because of situations such as lack of proper grounding or bonding, use of unlisted equipment, use of equipment not rated for the environment (e.g. hazardous or wet) or improper use of flexible cords / temporary wiring.

A large part of the problem is that there is no direction, responsibility or accountability for any individual to properly maintain the equipment to the proper state. Direction is not given by supervisors to correct the equipment and individuals do not feel that it is their responsibility or that they have the authority to correct the equipment. Further, many PEMs don't have the proper background or knowledge to determine what is correct or incorrect in these small electrical jobs. Those who were trained in this area haven't been updated in years and have gaps in their current knowledge base.

There is uncertainty within the Harbor Department and POLA management on the value to repair or replace this equipment. Some pieces of equipment are in locations where the ownership of the equipment is questioned or unknown. Some pieces of equipment are in locations that may be slated for demolition / rebuilding. There is also the question of the expected large capital requirement and manpower commitment to bring all electrical equipment to the proper and safe state.

There is also a misunderstanding and misapplication of the NEC / Los Angeles Electrical Code at POLA. Specifically, existing equipment must be in proper working condition and not be modified in a way that violates the NEC / Los Angeles Electrical Code or left in a condition of disrepair that would present a safety hazard or violate the NEC / Los Angeles Electrical Code. POLA's current application and understanding of the NEC / Los Angeles Electrical Code is only to new installations through engineering. Further, CalOSHA 3328 and 2340.1 state that

machinery and equipment in service shall be inspected and maintained as recommended by the manufacturer and that equipment must be kept in safe working condition, which also has not been properly applied at POLA.

There is no process for employees to report equipment deficiencies or safety issues if observed. There is no tracking to see that problems are resolved. There is no clear procedure to categorize and identify risk related to aging equipment and to prioritize required repairs to equipment by risk.

The majority of the code violations are coming from:

- Returning equipment that has been repaired or modified to code standard.
- Small installations by the C&M group that do not go through engineering design.
- Old equipment that may have been in code at the time of design, but is now left in a potentially dangerous state.
- Vandalism.

The most common deficiencies observed are listed below. The letters correspond to sample photos taken at POLA.

A. Live parts not guarded or covered
B. Damaged electrical equipment left in state of disrepair
C. Lack of workmanship
D. Improper termination of abandoned / discontinued equipment
E. Unused openings not covered
F. Improper support of metal conduit and liquid tight flexible metal conduit (LFMC)
G. Flexible electrical cords being used where permanent wiring should be installed
   Flexible electrical cords running through fences, walls and other barriers
H. Flexible cords damaged
I. Grounding and bonding connections broke / missing (including broken welds on trench covers)
J. Minimum work space around electrical equipment
K. Equipment not listed or rated for the environment being used
L. Improper protection from damp or wet locations / lack of GFCI where required
M. Equipment not clean and clear of debris

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K. & L.

M.

Recommended Corrective Actions:
A general discussion of corrective actions is presented below. An overall listing of corrective actions is presented in Appendix C.

Correcting and maintaining all electrical equipment at the Port is a significant task and is not something that can be corrected quickly. Improving the state of the equipment will take planning and time.

The following steps are suggested:

1. Stop the Bleeding
   The first step is to make sure that going forward, new problems aren't created. As part of the work order close-out process, individuals should be assigned to make certain that their repair or modification meets safe standards. Supervisors or other assigned personnel with appropriate knowledge should be assigned to review the work.

2. Break Existing Equipment Down into Sections for Management
   Looking at the Port as a whole is overwhelming. The Port should be broken down into manageable sections. Take on just one section at time.

3. Confirm with Management immediate plans of the Buildings and Equipment
   As there is some confusion about the status of buildings and equipment, POLA management and C&M management should have a meeting to clearly determine what the short term plans are for the facilities and who is responsible for the maintenance of the equipment. Any facility or equipment that is planned to be part of the Port in the short term needs to be considered for bringing up to current standards. Long term plans often change and it might be 5 – 10 years before they come to fruition, which is too long to have potentially hazardous equipment on site with no action.

4. Identify Most Hazardous / Important Equipment
   Identify the equipment that represents the biggest hazards in each section by using the following criteria. Identification can be done internally at the Port or through a third party. Assign the most value to the following equipment:
   a. Equipment that exposes a potential hazard to Unqualified Persons and/or public.
   b. Hazards that have a high potential for an accident to occur.
   c. Equipment that is worked on the most frequently.
   d. Equipment that is most essential for operations.
   e. Equipment that is old and susceptible.
   f. All other equipment.

5. Budget for Repair or Replacement
   Once equipment is identified and prioritized, budgets and personnel can be assigned. Fix the highest priorities immediately. Budget the remaining repairs and

fixes with given resources. Old equipment should be analyzed to determine if upgrade or replacement is more cost effective.

As an estimate based on the work rate of the current PEM work force, it would take approximately 12 men 9 months to 1 year (20,000 – 25,000 man hours) and $350K in parts and equipment to repair equipment that is currently in disrepair.

6. Assign Leadership and / or Responsibility

   Leadership and / or responsibility must be given to ensure that equipment is brought up to speed. The leadership and responsibility must be given to individuals in the field knowledgeable about electrical safety and the NEC. These individuals must have the skill set to properly identify common deficiencies found in electrical equipment. Leaders can manage sections and be in charge of reviewing completed projects as part of the work order completion and / or providing direction on how things should be repaired properly.

   As an example: A person familiar with explosion proof equipment should be assigned as a leader or person of responsibility to ensure that equipment in potentially explosive environments (i.e. gun range) meets code. Or, a person that frequently works in a particular area (i.e. underground vault in park water feature), should be in charge of that area.

   Once leadership is assigned and ownership is taken, individuals will apply more effort in doing things the right way the first time.

7. Repair

   Repair and replace equipment.

8. Create Reporting Structure across all of C&M

   PEMs are only one part of the solution. Other skilled workers, such as HVAC technicians, gardeners, and janitors need to be trained on how to identify basic deficiencies in systems, how to avoid them, and have a process of reporting them when they are found.

   Skilled workers outside of PEMs are more likely to see many of the deficiencies if they are in areas where the PEMs do not spend a large amount of time (gardens, rooftops). This also gives some responsibility and accountability to all members of C&M to help keep a safe work environment. The responsibility should not fall solely on the PEM team members.

SECTION 4 - IDENTIFICATION & LABELING

OVERALL SCORE = 4.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
4.1	EQUIPMENT NAME ID LABELS			X
4.2	VOLTAGE / SHOCK HAZARD ID LABELS			X
4.3	EQUIPMENT FEED ID LABELS			X
4.4	ARC FLASH LABELS		X	
4.5	ARC FLASH LABEL APPLICATION		X	
4.6	ARC FLASH LABEL CONTENT		X	
4.7	HIGH VOLTAGE WARNING LABELS			X
4.8	ELECTRICAL ROOM WARNING LABELS	X		
4.9	HAZARDOUS AREA WARNING LABELS			X
4.10	DISCONNECT IDENTIFICATION			X
4.11	AVAILABLE SHORT CIRCUIT CURRENT & SCCR			X

IMP= In Place, but Needs Some Improvement

Section 4 Overview

Labeled equipment provides critical safety information to both Qualified Persons who work on the energized equipment as well as the authority having jurisdiction for inspection. Labels also provide information to keep out or warn unqualified persons.

As defined by NEC and NFPA: Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Section 4 Summary

Compliance is mixed between older equipment and equipment installed within the past few years.

Most equipment installed has some form of marking and identification number, but sometimes this is the only marking on the panel and conflicting information may be found on the panels. Missing information from older panels typically includes one or more of the following:

- Equipment name ID (required)
- Voltage / Shock Hazard ID labels (required)
- Arc Flash labels (required)
- Disconnect ID label (required)
- Equipment feed ID (best practice)

New installations are being installed with the correct information, with exception of Arc Flash labels which is a relatively new specification and one that Engineering has already implemented for future installations.

Going forward, all new installations should be 100% compliant and the Engineering team is well organized on this. The challenge is the massive infrastructure that exists that is not in compliance.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Correcting and maintaining all electrical equipment at the Port is a significant task and is not something that can be corrected quickly. Getting the correct labels on the equipment will take some time, although it will not be a capital intensive project.

The following steps are suggested:

1. Coordinate with Engineering to make certain that proper names on ID labels are used and that both Engineering and C&M have the same information.
2. Break existing equipment down into sections for ease of management.
   Looking at the Port as a whole is overwhelming. The Port should be broken down into manageable sections. Take on just one section or building at time.
3. Combine task with other projects.
   Completing the labeling of the equipment should be done in conjunction with one of the other projects in order to save time and energy: updating equipment to safe status, updating one line drawings, or arc flash analysis.
4. Labels can be printed or etched plastic. (note – mobile printers are available so that labels can be printed in the field as needed).

4.1 EQUIPMENT NAME IDENTIFICATION LABELS

OVERALL SCORE (AS COMBINED WITH 4.1 – 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
3	**4.1**	Equipment ID labels missing on panels

4.1 Observation

Panels throughout the Port are missing equipment ID labels or ID is not clear. New equipment installed has been done properly, but some older equipment have no markings at all, especially disconnects.

References:

CalOSHA 2340.21(a) Identification of Manufacturer and Ratings.
Electric equipment shall not be used unless the following markings have been placed on the equipment:
(1) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; and
(2) Other markings giving voltage, current, wattage, or other ratings.

CalOSHA 2340.22(c) Services, Feeders, and Branch Circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

NFPA 70E 205.10. Identification of Components. Identification of components, where required, and safety-related instructions (operating or maintenance), if posted, shall be securely attached and maintained in legible condition.

NEC 110.21 Marking. The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified shall be placed on all electrical equipment. Other markings that indicate voltage, current, wattage, or other ratings shall be provide as specified elsewhere in this Code. The marking shall be of sufficient durability to withstand the environment involved.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Each electrical panel should be given a unique identification number with that number affixed to the panel. This allows positive identification and tracking for work orders, Lockout / Tagout procedures and other safety matters where identification of the proper panel(s) is required.

Label electrical panels room by room until completed. This will be necessary prior to getting one-line drawings completed or in conjunction with getting the one-lines completed. These equipment labels should be independent of any other labels.

Example of a panel with one type of a proper ID label on it.

As equipment is replaced or added, updating the labels should be part of the work order close-out process.

SEE APPENDIX E FOR EQUIPMENT LABELING IMPLEMENTATION.

4.2 VOLTAGE / SHOCK HAZARD IDENTIFICATION LABELS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**4.2**	Voltage Rating / Shock hazard labels missing

4.2 Observation

Panels are required to have voltage ratings and / or shock hazard information on them so that a required shock hazard analysis can be done prior to working on the equipment.

Panels throughout the facility are missing voltage rating / shock hazard labels.

Example of electrical panel at POLA with no shock hazard ID labels on it.

References:

CalOSHA 2340.21
Identification of Manufacturer and Ratings.
Electric equipment shall not be used unless the following markings have been placed on the equipment:
(1) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; and
(2) Other markings giving voltage, current, wattage, or other ratings.
(b) Durability. The marking shall be of sufficient durability to withstand the environment involved.

OSHA 1910.303(e)(1) Marking. Electrical equipment may not be used unless the following markings have been placed on the equipment: 1910.303(e)(1)(ii) Other markings giving voltage, current, wattage, or other ratings as necessary.

OSHA 29 CFR 1910.335(b)(1) Safety signs and tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by 1910.145.

NEC 110.21 Marking. The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified shall be placed on all electrical equipment. **Other markings that indicate voltage, current, wattage**, or other ratings shall be provide as specified elsewhere in this Code. The marking shall be of sufficient durability to withstand the environment involved.

NFPA 70E 130.5 (C) Electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:
(1) At least one of the following: a. Available incident energy and the corresponding working distance b. Minimum arc rating of clothing c. Required level of PPE d. Highest Hazard/Risk Category (HRC) for the equipment
(2) Nominal system voltage
(3) Arc flash boundary

NFPA 70E 205.12 Identification of Circuits. Circuit or voltage identification shall be securely affixed and maintained in updated and legible condition.

NFPA 70E 205.11 Warning Signs. Warning signs, where required, shall be visible, securely attached, and maintained in updated and legible condition.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

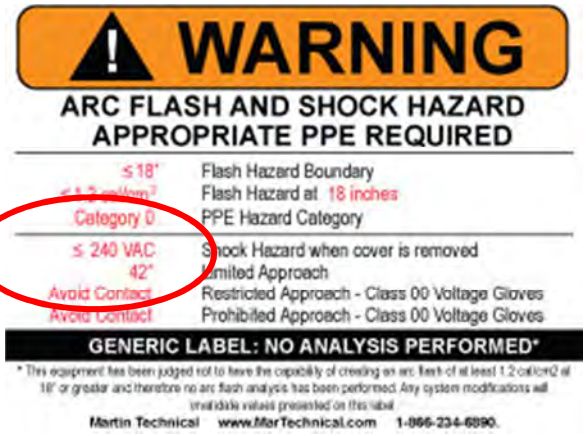
Makes sure that voltage is identified on all panels through one of the following means: Apply either a) generic shock hazard & arc flash labels, b) voltage ID labels, or c) manufacturer labels with voltage ID. Take one room at a time to accomplish.

Voltage ID label

Voltage ID on OEM label

Generic Arc Flash & Shock Hazard Label

Voltage Identification



As equipment is replaced or added, updating the labels should be part of the work order close-out process.

SEE APPENDIX E FOR EQUIPMENT LABELING IMPLEMENTATION.

4.3 EQUIPMENT FEED IDENTIFICATION LABELS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**4.3**	Equipment Feed ID labels missing

4.3 Observation

Panels throughout the facility are missing equipment feed ID labels. The most recent panels have feed ID information on them, but older ones do not.

Example of electrical panel at POLA with no equipment ID labels on it.

References:

NOTE: There is no specific code that requires identifying the feed source of the equipment, but is rather a best practice in electrical safety management.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

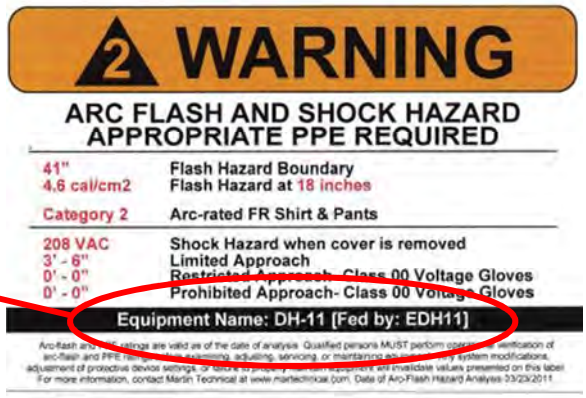
Label panels with what equipment is feeding them. This should be done in conjunction with updating the one-line drawings. An update of the arc flash analysis and new arc flash labels can include equipment feed information as well, but will be limited to equipment in the scope of the study. As equipment is replaced or added, updating the labels should be part of the work order close-out process.

SEE APPENDIX E FOR EQUIPMENT LABELING IMPLEMENTATION.

Feed Identification Label

Example only.

Arc Flash Label with Equipment Feed ID



Example only.

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4.4 ARC FLASH HAZARD LABELS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
1	**4.4**	Arc Flash labels missing

4.4 Observation

No arc flash labels are present on equipment at POLA. No arc flash analysis completed. Arc flash labels are planned for new, future installations by direction of Engineering.

References:

NFPA 70E 130.5 (C) Electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

(1) At least one of the following:
   a. Available incident energy and the corresponding working distance
   b. Minimum arc rating of clothing
   c. Required level of PPE
d. Highest Hazard/Risk Category (HRC) for the equipment
(2) Nominal system voltage
(3) Arc flash boundary

NEC 110.16 Arc Flash Hazard Warning
Electrical equipment, such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. FPN No. 2 ANSI Z535.4 provides guidelines for the design of safety signs and labels.

CalOSHA 3340, OSHA 1910.335(b)(1)
Safety signs and tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by 1910.145.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Arc flash labels should be applied to all equipment so proper arc flash boundaries and PPE can be determined. Labels subject to the scope of an arc flash analysis should be updated when updating the next arc flash analysis. Labels should be applied in a manner where it is easy to see and clear what hazard belongs with what panel. Generic arc flash labels can be applied to equipment not subject to the scope of the arc flash analysis.

Sample Arc Flash Label from Arc Flash Analysis

SEE APPENDIX F FOR ARC FLASH LABELS & LABEL APPLICATION.

4.5 ARC FLASH LABEL APPLICATION

Hazard Risk Rating	Item #	Description of Deficiency
NA	4.5	No arc flash labels to audit; proper "label application" can not be addressed at this time.

4.5 Observation

Not applicable because there are no labels to audit. Because no arc flash labels are present, the audit team can't determine if label application is correct.

References:

NEC 110.16 Arc-Flash Hazard Warning. Electrical equipment, such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. **The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment**.
Informational Note FPN No. 2 ANSI Z535.4 provides guidelines for the design of safety signs and labels.

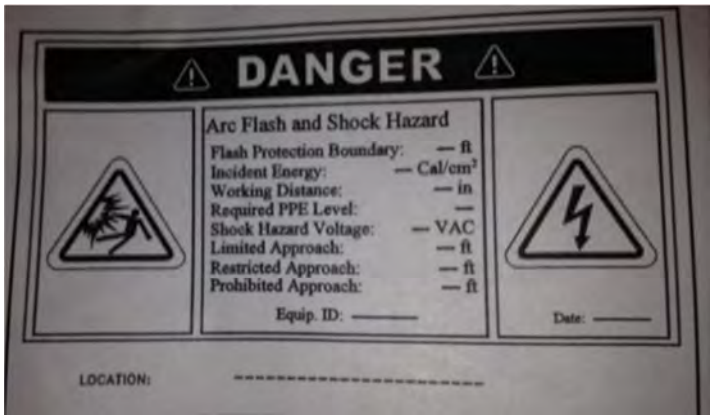
Recommended Corrective Actions:
SEE APPENDIX F FOR ARC FLASH LABELS & LABEL APPLICATION.

4.6 ARC FLASH LABEL CONTENT

Hazard Risk Rating	Item #	Description of Deficiency
NA	4.6	No arc flash labels

4.6 Observation

The arc flash label below is what is specified at POLA for future jobs. Required content is on the label, but improvements can be made. The only thing that is incorrect on this is "Flash Protection Boundary". That term has been replaced with "Arc Flash Hazard Boundary".



References:

NFPA 70E 130.5 (C) Electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

(1) At least one of the following:
   a. Available incident energy and the corresponding working distance
   b. Minimum arc rating of clothing
   c. Required level of PPE
   d. Highest Hazard/Risk Category (HRC) for the equipment

(2) Nominal system voltage

(3) Arc flash boundary

ANSI Z535.4 - Summary as applied to arc flash labels: Orange "Warning" for category 0,1,2,3 and 4; Red "Danger" for above category 4 (imminent injury or death).

Recommended Corrective Actions:
We recommend adding the following to the label specification.

- Orange “Warning” for category 0-4
- Red “Danger” for category >4
- Available short circuit current
- Add “Equipment fed by”
- Change wording to Arc Flash Hazard Boundary instead of “protection”

SEE APPENDIX F FOR ARC FLASH LABELS & LABEL APPLICATION.

4.7 HIGH VOLTAGE WARNING SIGNS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
NA	**4.7**	No deficiencies noted.

4.7 Observation

No deficiencies noted.

References:

CalOSHA 2810(a), OSHA 1910.303(h)(5)(iii)(A) & B The entrances shall be kept locked unless they are under the observation of a qualified person at all times; and **1910.303(h)(5)(iii)(B)** Permanent and conspicuous warning signs shall be provided, reading substantially as follows**:"DANGER -- HIGH VOLTAGE -- KEEP OUT."**

OSHA 1910.303(g)(2)(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

NEC 110.34 (C) Locked Rooms or Enclosures. The entrance to all buildings, vaults, rooms, or enclosures containing exposed volts, nominal, shall be kept locked unless such entrances are under the observation of a qualified person at all times. Where the voltage exceeds 600 volts, nominal, permanent and conspicuous warning signs shall be provided, reading as follows: **Danger - High Voltage - Keep Out**.

NEC 490.35 (A) High-Voltage Equipment. Doors that would provide unqualified persons access to high-voltage energized parts shall be locked.

Generic Recommended Corrective Actions:

In general, place the appropriate DANGER – HIGH VOLTAGE – KEEP OUT warning signs on entrances and barriers of high voltage areas. No specific deficiencies were noted at the Port during the audit.

4.8 ELECTRICAL ROOM WARNING SIGNS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) =4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**4.8**	Electrical room warning signs missing

4.8 Observation

Electrical room warning signs are missing. The word "electrical room" is on many doors or locations, but warning signs are not present.

References:

CalOSHA 2811, OSHA 1910.303(g)(2)(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

NEC 110.27 (C) Warning Signs. Entrances to rooms and other guarded locations that contain exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Place warning signs on the exterior of electrical rooms.

4.9 HAZARDOUS AREA WARNING SIGNS

OVERALL SCORE (AS COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**4.9**	Hazardous area warning signs were not present

4.9 Observation

Hazardous areas such as battery terminals stations were missing warning signs.

References:

Electrolytic Cells
NFPA 70E Article 310.5(B) Permanent signs shall clearly designate electrolytic cell areas.

Batteries & Battery Rooms
NFPA 70E 320.3(A)(4) Warning Signs. The following warning signs or labels shall be posted in appropriate locations: (1) Electrical hazard warnings indicating the shock hazard due to the battery voltage and the arc hazard due to the prospective short-circuit current (2) Chemical hazard warnings, applicable to the worst case when multiple battery types are installed in the same space,….. (3) Notice for personnel to use and wear protective equipment and apparel appropriate to the hazard for the battery (4) Notice prohibiting access to unauthorized personnel.

NOTE: OSHA and NEC have various warning sign requirements dependent on the area that are too numerous to list here. See NEC Hazardous (Classified) Locations Section.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Place warning signs on the exterior of electrical rooms or areas that contain hazards.

4.10 DISCONNECT IDENTIFICATION

OVERALL SCORE (COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**4.10**	Circuit breaker & disconnect labels missing or not proper

4.10 Observation

Circuit breaker and disconnect labels missing where required in some locations. In other locations, information is not workmanlike and potentially confusing.

Electrical Panel B-126

References:

CalOSHA 2340.22
(a) Motors and Appliances.
Each disconnecting means required by this Safety Order for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.
(b) Services, Feeders, and Branch Circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.
(c) Each service disconnecting means shall plainly indicate whether it is in the open or closed position.
(d) Durability of Markings. The markings shall be of sufficient durability to withstand the environment involved.

OSHA 1910.303(f) Disconnecting means and circuits
1910.303(f)(1) Motors and appliances. Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. 1910.303(f)(2) Services, feeders, and branch circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

NEC 110.22 Identification of Disconnecting Means
(A) General. Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall be of sufficient durability to withstand the environment involved.

NEC 408.4 Circuit Directory or Circuit Identification
Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use. Identification shall include sufficient detail to allow each circuit to be distinguished from all others. Spare positions that contain unused over current devices or switches shall be described accordingly. The identification shall be included in a circuit directory that is located on the face or inside of the panel door in the case of a panelboard, and located at each switch on a switchboard. No circuit shall be described in a manner that depends on transient conditions of occupancy.

NFPA 70E 205.12 Identification of Circuits. Circuit or voltage identification shall be securely affixed and maintained in updated and legible condition.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Install all missing labels. Circuit breaker identification cards inside panels should be kept current. Labels and cards / charts can be found at most companies that supply safety labels. Individual breakers / disconnects should be labeled as to their purpose.

Examples only.

4.11 AVAILABLE SHORT CIRCUIT CURRENT & SCCR LABELS

OVERALL SCORE (COMBINED WITH 4.1 THROUGH 4.11) = 4.0		
Hazard Rating	**Item #**	**Description of Deficiency**
3	**4.11**	Engineering to add specifications to require SCCR label on outside of all newly installed industrial control panels.

4.11 Observation

No industrial control panels requiring short-circuit current ratings (SCCR) were found, although complete investigation of the port was not completed.

References:

NEC 409.110 Marking. An industrial control panel shall be marked with the following information that is plainly visible after installation:

(1) Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified.

(2) Supply voltage, number of phases, frequency, and fullload current for each incoming supply circuit.

(3) Industrial control panels supplied by more than one power source such that more than one disconnecting means is required to disconnect all power within the control panel shall be marked to indicate that more than one disconnecting means is required to de-energize the equipment.

(4) Short-circuit current rating (SCCR) of the industrial control panel based on one of the following: a. Short-circuit current rating of a listed and labeled assembly

b. Short-circuit current rating established utilizing an approved method

Additional NEC codes covering available short circuit current & SCCR markings:

- Industrial control panels [409.110]
- Industrial machinery electrical panels [670.3(A)]
- Multimotor and Combination Load Equipment [440.3(B)]
- HVAC equipment [440.4(B)]
- Meter disconnect switches [230.82(3)]
- Motor controllers [430.8]

NEC 110.24 Available Fault Current. (A) Field Marking. Service equipment in other than dwelling units shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.

(B) Modifications. When modifications to the electrical installation occur that affect the maximum available fault current at the service, the maximum available fault current shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of maximum available fault current. Exception: The field marking requirements in 110.24(A) and 110.24(B) shall not be

required in industrial installations where conditions of maintenance and supervision ensure that only qualified persons service the equipment.

NOTE on OSHA & NFPA 70E: The facility is also responsible for complying with OSHA regulations concerning safety for the life of the equipment. OSHA Code of Federal Regulations for General Industry Subpart S, 1910.303(b)(5) prohibits extensive damage caused by this improper overcurrent protection. If the facility had an injury resulting from inadequate SCCR, it would be an OSHA violation.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

General recommendations include the SCCR of the panel. The SCCR is often found on the OEM label, but not always. If you need to determine the available short circuit current or SCCR of an industrial control panel, do this when you update your arc flash analysis as the information for conducting an arc flash analysis is the same as for the available short circuit current. Finding the SCCR for an industrial panel that is not marked can also be done at the same time as an arc flash analysis. As built electrical designs can also be used to determine the SCCR if all the information is available.

General recommendation includes ensuring that SCCR is provided on the panel as part of the specification when ordering installing new industrial control panels.

SECTION 5 - ELECTRICAL MAINTENANCE & PM

OVERALL SCORE = 3.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
5.1	ELECTRICAL PREVENTIVE MAINTENANCE PROGRAM		X	

Section 5 Overview

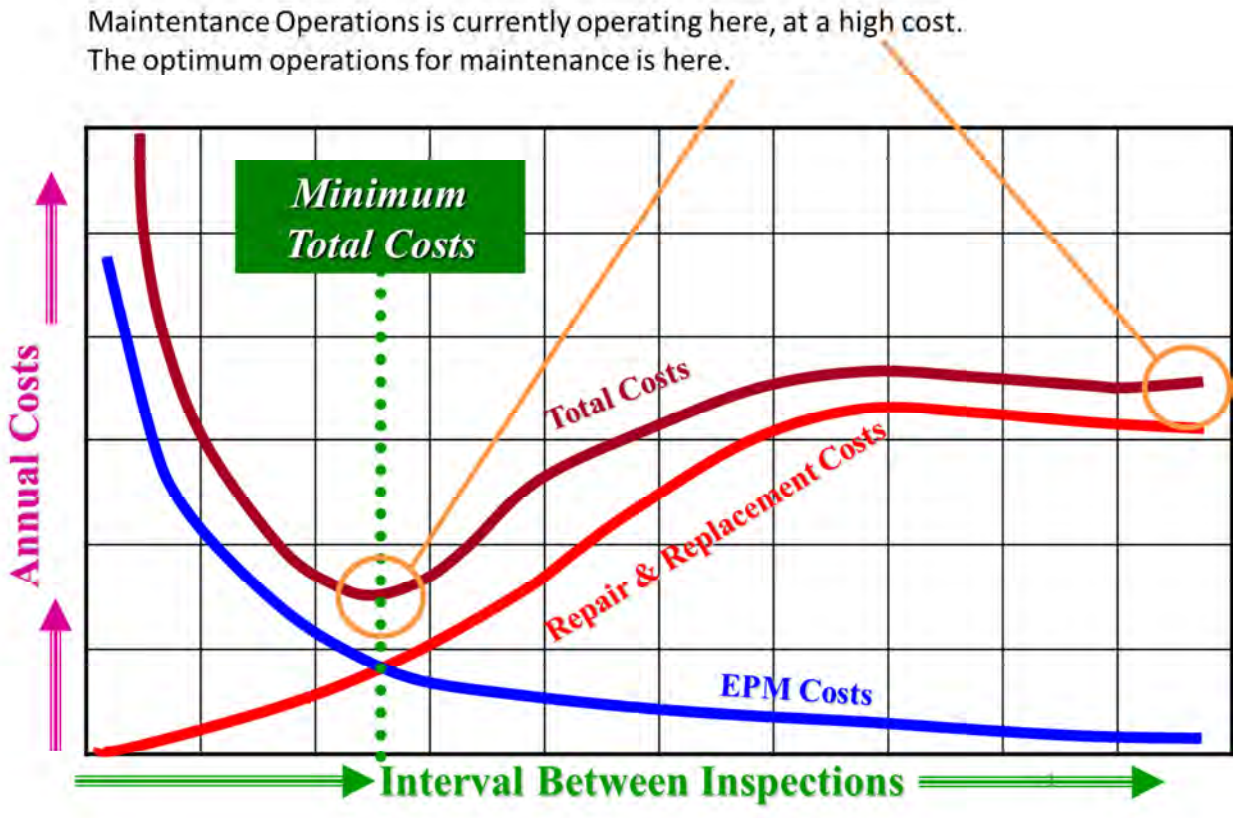
Although OSHA does not mandate that a formal electrical preventive maintenance program be developed and followed, equipment is required to be kept in a safe working condition per CalOSHA 2340.1 and OSHA 1910.303 (b)(2), which typically requires preventive maintenance and implies that a preventive maintenance program be instituted.

Implementing a proper preventive and predictive maintenance program can help decrease accidents by identifying and resolving small issues before they become big ones. This is especially true for electrical systems where loose connections, hot spots and other deficiencies that can be dangerous can be identified before an accident happens. In addition to preventing accidents, a preventive and predictive maintenance program reduces maintenance costs and increase uptime of equipment.

Section 5 Summary

The only electrical preventive maintenance (PM) program at POLA is annual cleaning for selected high voltage equipment specific to customer crane operations. POLA C&M operates almost exclusively on an emergency repair basis which is both expensive and potentially hazardous. Operating on an emergency repair basis only is not unique to POLA and is rather an epidemic in the United States that is leading to a crumbling infrastructure. What is unique about POLA is its role in both the California and the U.S. economy as a major port for transportation of goods. Downtime in the Port may cost millions of dollars directly and tens of millions of dollars indirectly. Maintaining Port operations which directly service the ships, trains and trucks should be of the highest concern of POLA, and a proper PM program is critical.

Proper preventive maintenance increases the lifespan of a product, reduces downtime, decreases the amount of emergency repair calls, and decreases overall maintenance costs. While scheduling PM initially takes away some resources for emergency repairs, POLA must look at long-term strategies and not just short-term.



The assumption for electrical equipment and electrical safety is that the equipment has been maintained properly and is in good working condition. If the equipment has not been

maintained properly, equipment may malfunction. Many electrical accidents happen each year because equipment is not operating properly due to lack of preventive maintenance.

References:

CalOSHA 3328 Machinery and equipment in service shall be inspected and maintained as recommended by the manufacturer where such recommendations are available

CalOSHA 2340.1 and OSHA 1910.303 (b)(2) states that equipment must be kept in safe working condition. Keeping equipment in safe working condition commonly requires that the equipment be maintained in accordance with manufacturer recommendations. **In the event of an accident, one aspect that will be researched is whether or not equipment was properly maintained and in good working condition.** If poor equipment maintenance caused the accident or was a contributing factor, the employer will most likely have to assume some liability, which could have various outcomes with insurance underwriters and third party lawyers. Note that this item was discussed briefly in Part II.

POLA management stated that they are striving to build a world-class maintenance program. All world-class maintenance programs have strong PM programs.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

General Equipment

1. POLA C&M management, CFO, and the Harbor Department must clearly understand the value of PM vs. emergency repairs.

   The best analogy is relating the PM of port electrical equipment to the PM of a car. If you never change the oil or fluids in your car, emergency repairs will come sooner, the repairs will be more costly than if the PM had been done and ultimately, the overall value of the car is decreased as it won't last as long. Essentially, you just run a car into the ground. Further, when a car is not operable due to an emergency repair, plans and resources have to be changed, which takes time, energy and money. When planned maintenance can occur, time and resources can more easily be managed, which is less costly.

   A meeting should be held with vested parties and a general budget set. A third party with knowledge in maintenance management operations and costs of operations may be a consideration for the meeting if it is perceived that there is not enough alignment among vested parties.

2. Break Existing Equipment Down into Sections for Management

   Looking at the Port as a whole is overwhelming. The Port should be broken down into manageable sections. Take on just one section at time.

3. Identify Most Important Equipment
   Identify the equipment that is the most important to Port operations and make that a priority.

4. Implement into CMMS (Computerized Maintenance Management System)
   POLA has a current CMMS, although it is heavily underutilized at this time. Inputting equipment and PM into the CMMS is time consuming activity. As mentioned, the input should be broken down into small, manageable chunks with a priority on the most important equipment for operations.
   a. Refer to OEM manuals for maintenance requirements
   b. Include infrared inspection and other manual inspections in addition to OEM recommendations. Infrared inspections typically cost about $1.5K per day with an outside vendor, but save $10,000 for each deficiency found before it becomes a major problem or emergency repair. Typically one or more deficiencies are found each day.
   c. Schedule events and time into CMMS.
   d. Include all tools required and replacement parts to make the PM efficient.
   e. PM directions should also include safety requirements / directions.

High Voltage Switchgear and Bus Bar

The high voltage switchgear and bus bar are perhaps the most critical electrical operations for POLA. Currently, an annual outage (July 5) is scheduled for the PM. Port customers do not want their equipment down at any time due to lost productivity. Some equipment related to customer operations may require more than annual maintenance. From the experience on site, it was clear that equipment critical for berths needed emergency attention on a regular basis, which costs the customers and POLA unplanned downtime and money for repairs. The case should be made to Port customers that the unplanned downtime is far more costly than planned downtime for preventive maintenance. Statistical analysis of Port downtime and customer downtime versus planned downtime should be provided.

SECTION 6 - ELECTRICAL DRAWINGS

OVERALL RATING = 6.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
6.1	ELECTRICAL ONE-LINE DRAWINGS			X
6.2	ELECTRICAL DRAWING ACCESS			X
6.3	ELECTRICAL DRAWING MANAGEMENT PROCESS			X

IMP= In Place, but Needs Some Improvement

Section 6 Overview

Maintaining electrical one-line drawings allows for Qualified Persons to fully understand the energy distributions system. Drawing should be kept up-to-date and in a location where Qualified Persons can easily access them for reference.

Section 6 Summary

For newer equipment, one-line drawings are kept and generally well-managed by engineering. One-line drawings are available in both electronic and hard copy formats. Older equipment that preceded the current employees may only have very dated hard copy one-lines or no one-lines at all.

Access to and management of the electrical one-line drawings needs significant improvement.

Some PEMs take it upon their own initiative to develop their own one-line drawings. It is unknown whether this information ever makes it back to Engineering for official updates. Some PEMs have accumulated their own libraries of one-line drawings which they keep as personal archives on their service trucks. In all, there may be multiple versions of a single one-line floating throughout the organization, which can create a safety hazard if there are discrepancies or one is simply outdated. The management of one-lines needs to be streamlined and organized so that everyone is working off of the same drawings.

Obtaining one-line drawings is not organized. Some PEMs go direct to Engineering, some go through their boss and some do their own program if response time is too slow. There must be a more effective and controlled process for obtaining one-lines.

Access to one-lines is not always convenient. Some one-lines are available via computer, but only a portion of the PEMs are aware that this exists. Some one-lines are available in hard copy form in the maintenance shop. The night shift does not have access to Engineering if one lines are needed, leaving them at a disadvantage. If a PEM gets a call to a location and doesn't have the one-lines available, it may require 45 minutes in travel time alone to go to the call, realize one-lines are needed, go back to the shop, then return to the field with the drawings. This is a tremendous waste of time and can be a safety problem. Instead of spending the 15 minutes or 45 minutes to go back to the shop for centralized prints or to download them from the computer, PEMs will cut corners to save time and will risk potentially not having the correct information.

See following sections for recommended corrective actions. An overall listing of corrective actions is presented in Appendix C.

6.1 – 6.3 ELECTRICAL ONE LINE DRAWINGS

OVERALL SCORE (AS COMBINED WITH 6.1 THROUGH 6.3) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
3	**6.1**	Updated and available one-line drawing access

Item 6.1 – 6.3 Observation

Electrical drawings are available from Engineering, and there is an internal engineering process in place to track changes. This a strong area of the current electrical safety program.

While electrical one-line drawings are available from Engineering, there are many different versions in use in the field and access to drawings is not always good. PEMs make their own one-line drawings and keep older one-line drawings on their trucks. There may be 12 or more copies of the same one-line in use, several of which may be different versions.

A centralized location of the drawings makes it easy for workers to justify cutting corners and not looking at drawings prior to starting work. Most workers often won't walk across a large facility to get prints from a centralized location. Due to the physical size of the POLA, it may take a 45 minute round trip to retrieve one-lines from a centralized location, which will deter workers from obtaining the prints.

References:

FPA 70E 205.2 Single Line Diagram. A single line diagram, where provided for the electrical system, shall be maintained in legible condition and shall be kept current.

NFPA 70E 120.1 Process of Achieving an Electrically Safe Work Condition. An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process: (A) Determine all possible sources of electrical supply to the specific equipment. **Check up-to-date drawings**, diagrams, and identification tags….

NFPA 70E 120.2 (F) (1) (a) Procedures. The employer shall maintain a copy of the procedures required by this section and shall make the procedures available to all employees. **(1) (a)** Locating Sources. Up-to-date single-line drawings shall be considered a primary reference source for such information. When up-to-date drawings are not available, the employer shall be responsible for ensuring that an equally effective means of locating all sources of energy is employed.

CalOSHA & OSHA - OSHA expects employers to know their workplaces. If an employer cannot provide a written description or drawing of the circuit or equipment, then the compliance officer may assume that the employer has not assessed the facility for electrical hazards.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

1. Bring one-line drawings to the field where needed.
   One and/or both of the following methods are suggested to bring relevant one-line drawings to the field:
   a. Place one-line drawing hard copies in the field where they will be easily accessed by PEMs. It is common to place electrical one-line drawings in electrical rooms, switchgear areas, motor control centers (MCCs) and substations, and near major equipment for easy reference. One-lines can be protected by plastic and mounted on walls or folded into plastic covers placed in 3-ring binders. The binders can be attached to walls or other nearby structures. The advantage of this method is that the official one-line is always accessible to every person, day or night shift, and everyone is working off of the same reference drawing. Managing updates is easier as only one copy needs to be changed outside of the engineering offices.
   b. Mobile Tablets. Mobile technology has become very advanced and very inexpensive. Tablets are an ideal tool for accessing up-to-date one-line drawings that are managed by engineering. In addition to using the tablets for one-lines, OEM manuals, work orders and safety procedures can be found using the tablets. Given the size of the port, this would be a very effective method. Just 2 to 3 trips of going back to a centralized location for information would pay for the cost of the tablet itself.

2. Streamline the updating process.
   While Engineering has an internal process for updating the one-lines that is robust, there is a disconnect between what the field finds and what Engineering has. A process must be put in place for the PEMs to submit updates for one-lines.

3. Hire a Drafter.
   A drafter may only be needed part-time and would be a good liaison between Engineering and the PEMs. The drafter could be responsible for updating one-lines for information provided by both Engineering and the PEMs. The drafter would be responsible for overall management of all one-line drawings, including electronic and hard copy deployment. This can be a low-level position and may not require full time work or might be a temporary position until the one-lines are in reasonable order.

   The drafter would be best managed by Engineering, but would need to be intimately involved with the PEMs and easily accessible by the PEMs.

4. Incorporate PEM drawings into Engineering library.
   Some PEMs have created their own drawings. These drawings should be given to Engineering for inclusion in their library. If the drawings are in a CAD format, Engineering can easily adopt them to their software programs. If the drawings are not in CAD format, Engineering can easily recreate the drawings using the appropriate software.

5. Update/create one-lines where needed.

   Creating and updating the one-lines as a standalone task could be daunting, but easily managed if combined with other projects.

   a. Updating with an arc flash analysis is the most logical synergy. One-line drawings are required for doing an arc flash analysis. Arc flash one-lines typically don't cover all equipment required for one-lines, but all equipment for a one-line can be requested for an additional fee. Make certain that if a third party conducts the arc flash analysis that drawings are provided in .dwg format or something similar that can be edited by POLA Engineering.
   b. Update one-lines as part of one of the other suggested projects, such as labeling panels or PM activities.

SECTION 7 - STUDIES & REPORTS

OVERALL RATING = 6.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
7.1	ARC FLASH ANALYSIS		X	
7.2	ARC FLASH REPORT ACCESS		X	
7.3	ARC FLASH UPDATING		X	
7.4	TEMPORARY ARC FLASH PROGRAM			X
7.5	SHORT CIRCUIT STUDY		X	
7.6	SHORT CIRCUIT CURRENT RATING STUDY			NA
7.7	PROTECTIVE DEVICE COORDINATION STUDY	X		
7.8	ELECTRICAL SAFETY AUDIT	X		

IMP= In Place, but Needs Some Improvement

Section 7 Overview

Electrical Studies and Reports cover equipment and systems to ensure that the electrical distributions system is designed to operate safely and to identify known hazards. Making certain that equipment is properly rated and coordinated for use is required by OSHA as is identifying known hazards. In addition to verifying safety and known hazards, the corrective actions to these studies can help your system operate more efficiently.

Section 7 Summary

Engineering is strong in this area with the exception of arc flash analysis and SCCR. Arc flash was only introduced in 2002 and was not mainstream or widely practiced until about 2004. The current City of Los Angeles Electrical Code is the adoption of the 2008 NEC, which did not include SCCR requirements. If history is an indicator of the future, the City of Los Angeles will adopt the 2011 NEC in 2014. The 2011 NEC includes the SCCR requirements, so it would be best to incorporate SCCR where needed at this time and get ahead of the curve.

Engineering has already begun to implement arc flash analysis for future installations, so they are on the right track in this regard. Existing equipment must also be considered. There is a general misunderstanding at the Port, both with Engineering and C&M, about what equipment creates a hazardous arc flash and how to implement the program. What the Port currently has is a good stop-gap measure until an arc flash analysis is completed, but it is in no way a complete and compliant program.

The biggest problem is that the Harbor Department looks at arc flash hazards in relation to voltage: the higher the voltage, the higher the hazard. This overly simplistic outlook can be very dangerous as undoubtedly some of the most hazardous arc flash situations at POLA are with low voltage equipment. Fault clearing time (the time it takes for protective devices to clear a fault) is a significant contributor to the amount of energy seen in an arc flash. Many low voltage devices have slow fault clearing times for a variety of reasons.

For arc flash, POLA currently used an over-simplified “risk based” method that is based loosely on NFPA 70E tables. The risk based method using the tables is acceptable provided that the parameters of the tables are met, however, POLA is not meeting the parameters. In particular, the available short circuit current and fault clearing time must be known and fit under the parameters of the table. If either the available short circuit current or fault clearing time falls outside the parameters of the table, the table can’t be used and the “hazard based” method of conducting an arc flash analysis must be done. POLA has not tried to apply the parameters to the tables, and therefore it is unknown what equipment works with the charts and what doesn’t. Even with proper application of the tables, the NFPA 70E tables have several shortcomings and the tables are rarely used as a complete program.

What POLA has is a temporary, stop-gap, program, but is by no means a comprehensive program designed to properly protect employees. POLA needs to conduct an arc flash analysis for all applicable electrical equipment.

7.1 ARC FLASH ANALYSIS

OVERALL SCORE (AS COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**7.1**	Arc flash analysis has not been completed

7.1 Observation

Arc flash analysis has not been completed. Engineering has recently started specifying that an arc flash analysis be completed on new installations. For new equipment, a good program is being put in place, but there is no analysis or plan for the existing equipment which represents the majority of the existing hazards.

References:

CalOSHA 3380
(f) Hazard assessment and equipment selection.
(1) The employer shall assess the workplace to
(A) Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;
(B) Communicate selection decisions to each affected employee; and
(C) Select PPE that properly fits each affected employee.

OSHA 29-CFR 1910.333, 1910.335 (a) (1)(i), 1910.132(d)(1) Standard number 1910.333 specifically addresses Standards for Work Practices and references NFPA 70E. OSHA 29CFR 1910.335 (a) (1)(i) requires the use of protective equipment when working where a potential electrical hazard exists and 29CFR 1910.132(d)(1) which requires the employer assess the workplace for hazards and the need for personal protective equipment **AND that the PPE must match the hazard**. **OSHA Interpretive letter from Nov 2006 directly addresses that the incident energy from an arc flash must be used to determine proper PPE levels.**

OSHA 29 CFR 1910.335(b)(1) Safety signs and tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by 1910.145.

IEEE 1584 Describes the scope of an arc flash analysis and the calculations.

NFPA 70E 130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use.

The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis.

The arc flash hazard analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

NFPA 70E 130.5 (C) Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

(1) At least one of the following:
   a. Available incident energy and the corresponding working distance
   b. Minimum arc rating of clothing
   c. Required level of PPE
   d. Highest Hazard/Risk Category (HRC) for the equipment
(2) Nominal system voltage
(3) Arc flash boundary

NEC 110.16 Arc-Flash Hazard Warning. Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. Informational Note FPN No. 2 ANSI Z535.4 provides guidelines for the design of safety signs and labels.

ANSI Z535.4 - Summary as applied to arc flash labels: Orange "Warning" for category 0,1,2,3 and 4; Red "Danger" for above category 4.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Conduct or update arc flash analysis. Make certain that the study is done to current IEEE 1584 and NFPA 70E codes and standards.

If the short circuit studies and protective device studies are up-to-date, this information can be used to conduct the studies. Further consultation should be had on this, and a comparative study of what is in the field compared to one-lines should be done before relying on this information.

The arc flash analysis should include at a minimum:
a) Data and tables of arc flash analysis results
b) Recommended corrections for mitigating arc flash hazards

An arc flash analysis should be updated whenever major changes in equipment occur or at a minimum of every 5 years to account for changes in the system.

When conducting the analysis, it is also a good time to update all other labeling, drawings, and study needs that might be needed for the facility. The data collection work for arc flash analysis will collect everything needed to be compliant for labeling as well as the short circuit and protective device studies.

7.2 ARC FLASH ANALYSIS REPORT ACCESS

OVERALL SCORE (COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
3	**7.2**	No arc flash completed - NA

7.2 Observation

Not applicable because no arc flash analysis was completed and therefore no report can be generated This section is dependent upon completion of 7.1.

References:

NFPA 70E 130.5 (C) Arc Flash Hazard Analysis. The method of calculating and data to support the information for the label shall be documented.

IEEE 1584 Describes the scope of an arc flash analysis and the calculations.

NOTE:
In the event of an arc flash accident, the investigation will focus on the report and methods of calculations, not just the label. If a label is not backed up by methods of calculations for the system at the time of the analysis, it will be very difficult to prove that the information on the label was accurate.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Once the arc flash analysis is completed, it should be kept on file where it can easily be referenced.

7.3 ARC FLASH UPDATING

OVERALL SCORE (COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**7.3**	Arc flash analysis not completed

7.3 Observation

As the arc flash analysis program is new, there has not been a process put in place to manage the changes, which should be discussed.

References:

NFPA 70E 130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use.

CalOSHA 3203(a): Include procedures for identifying and evaluating work place hazards including scheduled periodic inspections to identify unsafe conditions and work practices. Inspections shall be made to identify and evaluate hazards. Retraining shall be provided when new substances, processes, procedures or introduced into the work environment; as new equipment is regularly introduced into the worksite, retraining shall occur as new equipment comes online.

The arc flash hazard analysis **shall be updated when a major modification or renovation takes place**. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis. The arc flash hazard analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

NOTE: These standards are set into place to help assure that when modifications are made to an electrical system, the assessment of the hazards that go along with those changes are reasonably made. It is the responsibility of the employer to update the hazards as the electrical system changes.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Because a thorough arc flash analysis has not been completed, there are no updates to complete. In general, update your arc flash analysis any time there are major modifications or renovations to electrical distribution equipment. The best way to accomplish this is to have a process for tracking the changes to your system that would impact the results of the arc flash analysis**.**

Without a program in place to identify the changes to your electrical system that would impact your arc flash analysis, you would have the following problems:

1. Potentially false PPE recommendations that could lead to unnecessary injury. A change in a system may change an existing panel from category 2 to a category 4.
2. Updating your arc flash analysis at the 5-year mark means re-doing the entire analysis since you don't know what has changed and what hasn't. If you keep track what has changed, you can do the analysis on those sections only, saving both time and money in the future.

7.4 TEMPORARTY ARC FLASH PROGRAM

OVERALL SCORE (COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
NA	**7.4**	NA

7.4 Observation

The arc flash program that POLA has currently in place is considered a temporary, stop-gap program.

References:

CalOSHA 2320.2 (a) Work shall not be performed on exposed energized parts of equipment or systems until the following conditions are met:(1) Responsible supervision has determined that the work is to be performed while the equipment or systems are energized. (2) Involved personnel have received instructions on the work techniques and hazards involved in working on energized equipment. (3) Suitable personal protective equipment and safeguards (i.e., approved insulated gloves or insulated tools) are provided and used.

OSHA 29-CFR 1910.333, 1910.335 (a) (1)(i), 1910.132(d)(1) Standard number 1910.333 specifically addresses Standards for Work Practices and references NFPA 70E. OSHA 29 CFR 1910.335 (a) (1)(i) requires the use of protective equipment when working where a potential electrical hazard exists and 29CFR 1910.132(d)(1) which requires the employer assess the workplace for hazards and the need for personal protective equipment AND that the PPE must match the hazard. OSHA Interpretive letter from Nov 2006 directly addresses that the incident energy from an arc flash must be used to determine proper PPE levels.

NFPA 70E 130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use. ***Exception*: The requirements of 130.7(C)(15) and130.7(C)(16) shall be permitted to be used in lieu of determining the incident energy at the working distance.**

NFPA 70E – General Summary: Employers are required to provide their best effort in identifying hazards and providing the proper PPE and training to employers in order to protect themselves from known hazards.

Recommended Corrective Actions:
Even though an arc flash analysis has not been completed, steps can be taken to reasonably alert workers and protect them from arc flash hazards until an analysis is completed. This includes using the NFPA 70E Tables 130.7(C)(15) and130.7(C)(16), even though not all the criteria to properly use the tables is met.

Training should be conducted to cover this so that PEMs understand how the charts are being used and the shortcomings of the using the charts in a temporary program. Training should also be conducted on better understanding arc flash as recommended in the Qualified Person section.

7.5 SHORT CIRCUIT STUDY

OVERALL SCORE (COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**7.5**	Missing on older equipment

7.5 Observation

Engineering uses a third party to conduct short circuit studies of the electrical systems. Older equipment does not have studies completed.

References:

CalOSHA 2340.9, OSHA 1910.303(b)(4) Interrupting rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

OSHA 1910.303(b)(5) Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

OSHA 1910.304(f)(2)(iii) The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions.

NEC 110.9 Interrupting Rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating not less than the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage not less than the current that must be interrupted.

NFPA 70E 130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use.

The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis.

The arc flash hazard analysis **shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance**.

NFPA 70E 210.3 Conductors. Current-carrying conductors (buses, switches, disconnects, joints, and terminations) and bracing shall be maintained to 1) Conduct rated current without overheating 2) Withstand available fault current

NFPA 70B 8.4.3 An up-to-date short-circuit and coordination study is essential for the safety of personnel and equipment. The momentary and interrupting rating requirements of the protective devices should be analyzed, that is, will the circuit breaker or fuse safely interrupt the fault or explode in attempting to perform this function?

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Update when conducting the arc flash analysis. It is cost prohibitive to do this update separate from the arc flash since the same data collection and system modeling is required.

7.6 SHORT CIRCUIT CURRENT RATING (SCCR) STUDY

Hazard Rating	Item #	Description of Deficiency
NA	**7.6**	NA

7.6 Observation

No specific panels were identified that required SCCR; however, a full investigation of all equipment was not conducted. SCCR was introduced in the 2011 NEC. The Los Angeles Electrical Code is currently on the 2008 version, but it is anticipated that the city will adopt the 2011 NEC in 2014. It would be best to get ahead of the curve on this code.

References:

NEC 409.110 Marking. An industrial control panel shall be marked with the following information that is plainly visible after installation:

(1) Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified.

(2) Supply voltage, number of phases, frequency, and fullload current for each incoming supply circuit.

(3) Industrial control panels supplied by more than one power source such that more than one disconnecting means is required to disconnect all power within the control panel shall be marked to indicate that more than one disconnecting means is required to de-energize the equipment.

(4) Short-circuit current rating (SCCR) of the industrial control panel based on one of the following: a. Short-circuit current rating of a listed and labeled assembly

b. Short-circuit current rating established utilizing an approved method

Additional NEC codes covering available short circuit current & SCCR markings:

- Industrial control panels [409.110]
- Industrial machinery electrical panels [670.3(A)]
- Multimotor and Combination Load Equipment [440.3(B)]
- HVAC equipment [440.4(B)]
- Meter disconnect switches [230.82(3)]
- Motor controllers [430.8]

NEC 110.24 Available Fault Current. (A) Field Marking. Service equipment in other than dwelling units shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.

(B) Modifications. When modifications to the electrical installation occur that affect the maximum available fault current at the service, the maximum available fault current shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of maximum available fault current. Exception: The field marking requirements in 110.24(A) and 110.24(B) shall not be

required in industrial installations where conditions of maintenance and supervision ensure that only qualified persons service the equipment.

CalOSHA 2340.9, OSHA 1910.303(b)(4). Interrupting rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

OSHA 1910.303(b)(5). Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

OSHA 1910.304(f)(2)(iii) The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions.

NEC 110.9 Interrupting Rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating not less than the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage not less than the current that must be interrupted.

NOTE on OSHA & NFPA 70E: The facility is also responsible for complying with OSHA regulations concerning safety for the life of the equipment. OSHA Code of Federal Regulations for General Industry Subpart S, 1910.303(b)(5) prohibits extensive damage caused by this improper overcurrent protection. If the facility had an injury resulting from inadequate SCCR, it would be an OSHA violation.

Recommended Corrective Actions:
Start making sure that Engineering includes SCCR ratings on industrial control panels for new equipment installations.

7.7 PROTECTIVE DEVICE COORDINATION STUDY

OVERALL SCORE (COMBINED WITH 7.1 THROUGH 7.8) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**7.7**	Older equipment missing study on protective devices

7.7 Observation

Engineering uses a third party to conduct protective device studies of the electrical systems. Older equipment does not have the study completed.

References:

CalOSHA 2340.9, OSHA 1910.303(b)(5) Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

CalOSHA 2340.10, OSHA 1910.304(f)(2)(iii) The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions;

NFPA 70E 130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use.

The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis. The arc flash hazard analysis **shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance**.

NFPA 70B 8.4.3 An up-to-date short-circuit and coordination study is essential for the safety of personnel and equipment. The momentary and interrupting rating requirements of the protective devices should be analyzed, that is, will the circuit breaker or fuse safely interrupt the fault or explode in attempting to perform this function?

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Update when conducting the arc flash analysis. It is cost prohibitive to do this update separate from the arc flash since the same data collection and system modeling is required.

7.8 ELECTRICAL SAFETY AUDIT

Hazard Rating	**Item #**	**Description of Deficiency**
2	**7.8**	Recently completed, but no previous records found

7.8 Observation

An electrical safety audit was recently completed, but there are no records of any previous audits.

References:

NFPA 70E 110.4 (H) Electrical Safety Auditing.

(1) Electrical Safety Program. The electrical safety program shall be audited to verify the principles and procedures of the electrical safety program are in compliance with this standard. The frequency of the audit shall not exceed 3 years.

(2) Field Work. Field work shall be audited to verify the requirements contained in the procedures of the electrical safety program are being followed. When the auditing determines that the principles and procedures of the electrical safety program are not being followed, the appropriate revisions to the training program or revisions to the procedures shall be made.

(3) Documentation. The audit shall be documented.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Conduct an electrical safety audit at least once every three (3) years. Keep records of the audit on file until the next audit is performed.

Given the events and situation of POLA, we would suggest an audit sooner than 3 years. The audit should focus on resolving the deficiencies found and would be a significantly shorter and less expensive audit. A 3-day audit should cover the next round, unless all equipment is to be examined for safety compliance.

SECTION 8 - TESTING

OVERALL RATING = 2.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
8.1	INFRARED / THERMOGRAPHY INSPECTION		X	
8.2	CIRCUIT BREAKER TESTING		X	
8.3	RELAY TESTING		X	
8.4	TRANSFORMER OIL ANALYSIS		X	
8.5	GFCI TESTING		X	

Section 8 Overview

Electrical Testing covers equipment and systems to ensure that the electrical distribution system is designed to operate safely and to identify known hazards. The condition of electrical protective devices such as fuses, circuit breakers, protective devices, and relays should be checked. These devices are the safety valves of an electrical system, and their proper operating condition ensures the safety of personnel, protection of equipment, and reduction of economic loss.

The reports defining the hazards of a system are based on proper functioning of these devices, so it is imperative that these be functioning properly.

Making certain that equipment is functioning and maintained to manufacturer's standards is required by CalOSHA 2340.2(b) OSHA 1910.303 (b)(2) in which listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling (listing of electrical equipment includes maintenance instructions).

In addition to verifying safety, maintenance of these components will help your system operate more efficiently.

Section 8 Summary

No preventive maintenance or testing is being conducted on electrical equipment at POLA.

Making certain that equipment is functioning and maintained to manufacturer's standards is required by CalOSHA 2340.2(b) and OSHA 1910.303 (b)(2) in which listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling (listing of electrical equipment includes maintenance instructions).

In addition to verifying safety, maintenance of these components will help your system operate more efficiently.

8.1 INFRARED (IR) INSPECTION

OVERALL SCORE (AS COMBINED WITH 8.1 THROUGH 8.5) = 2.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**8.1**	Infrared inspection has not been done

8.1 Observation

Infrared (IR) inspections are not done. C&M management has discussed adding this to PM program, but hasn't implemented it yet.

References:

NFPA 70B 21.17 Describes Infrared Inspection guidelines. This is a best practice and not a legal code.

NOTE: A typical electrical infrared survey can in a net a savings from $10,000 to $20,000, depending on the number and category of anomalies found. In addition to the direct financial savings, valuable time is saved by incorporating an annual infrared electrical survey into your PM program. Providing accurate information regarding the integrity of your electrical system's components cuts down on maintenance time, prevents costly replacements and can eliminate unforeseen outages, downtime, and can help prevent an accident before it happens.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

It is recommended that infrared inspections should take place annually to help identify potential problems before they become major hazards or safety risks. This process is a great preventive maintenance tool that finds potential problems before equipment damage, loss of production or harm to people can happen.

With the size of the POLA, it would almost require a full-time job for a worker. By the time everything was looked at, it would be time to start over.

At the bare minimum, the Port should have a camera on hand for looking at the most volatile or expensive equipment or have a third part resource available to conduct inspections as needed.

8.2 CIRCUIT BREAKER TESTING

OVERALL SCORE (COMBINED WITH 8.1 THROUGH 8.5) = 2.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**8.2**	Circuit breaker testing has not been completed / not documented

8.2 Observation

Circuit breaker testing has not been completed. C&M management thought they were outsourcing this to Square D and that Engineering would have the reports.

References:

OSHA 1910.303 (b)(2) Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling *(listing of electrical equipment includes maintenance instructions).*

NFPA 70E 205.3 General Maintenance Requirements. Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

NFPA 70E 205.4 Overcurrent Protective Devices. Overcurrent protective devices shall be maintained in accordance with the manufacturers' instructions or industry consensus standards. Maintenance, tests, and inspections shall be documented.

NFPA 70E 225.3 Circuit Breaker Testing After A Fault. Circuit breakers that interrupt faults approaching their interrupting ratings shall be inspected and tested in accordance with the manufacturer's instructions.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Perform circuit breaker testing to manufacturer's recommendations. This task is often best performed when outsourced.

When conducting the next circuit breaker test, be certain to keep record of the testing for a period of five (5) years.

Circuit breaker testing should be driven by the CMMS and part of C&M, not necessarily Engineering.

8.3 RELAY TESTING

OVERALL SCORE (COMBINED WITH 8.1 THROUGH 8.5) = 2.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**8.3**	Relay testing has not been completed / not documented

8.3 Observation

Relay testing has not been completed. C&M management thought they were outsourcing this to Square D and that engineering would have the reports.

References:

CalOSHA 2340.2(b) and OSHA 1910.303 (b)(2) Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling *(listing of electrical equipment includes maintenance instructions).*

NFPA 70B 8.9.7.2 Since protective relays play such an important part in the prevention of hazard to personnel and plant equipment, they should be given first line maintenance attention. Furthermore, since the only time they operate is during an abnormal electric power system condition, the only way to assure correct operation is by a comprehensive inspection, maintenance and testing program.

NFPA 70B 21.10.3 Describes Relay Testing guidelines.

NFPA 70E 205.3 General Maintenance Requirements. Electrical equipment shall be maintained in accordance with manufacturer's instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Perform relay testing to manufacturer's recommendations. This task is often best performed when outsourced.

When conducting the next relay test, be certain to keep record of the testing for a period of five (5) years.

Circuit breaker testing should be driven by the CMMS and part of C&M, not necessarily Engineering.

8.4 TRANSFORMER OIL ANALYSIS

OVERALL SCORE (COMBINED WITH 8.1 THROUGH 8.5) = 2.0		
Hazard Rating	**Item #**	**Description of Deficiency**
3	**8.4**	Transformer oil analysis has not been completed / not documented

8.4 Observation

This facility owns and is responsible for maintaining many transformers feeding the facilities. Transformer oil analysis has not been completed.

References:

CalOSHA 2340.2(b) and OSHA 1910.303 (b)(2) Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling *(listing of electrical equipment includes maintenance instructions).*

NFPA 70E 205.3 General Maintenance Requirements. Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

NFPA 70B 10.2.2 Describes General Inspections of Transformers, **NFPA 70B 10.2.8** Liquid Maintenance and Analysis describes transformer oil analysis.

NOTE: This analysis should only be done on transformers supplying electricity to buildings and that are owned by the facility.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Perform transformer oil analysis to manufacturer's recommendations. This is best performed by an outside vendor. Transformer oil is rarely a problem, so a focus on older equipment would be best suited and frequent testing is not required.

When conducting the relay test, be certain to keep record of the testing for a period of five (5) years.

8.5 GFCI TESTING

OVERALL SCORE (COMBINED WITH 8.1 THROUGH 8.5) = 2.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**8.5**	GFCI testing is not being done or being done routinely

8.5 Observation

Ground fault circuit interrupter (GFCI) testing is not being done.

References:

CalOSHA 2340.2(b) and OSHA 1910.303 (b)(2) Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling *(listing of electrical equipment includes maintenance instructions).*

The UL standard for GFCI includes the listing and labeling for GFCIs with instructions that they be tested monthly. OSHA 1910.303 (b)(2) is the most common electrical safety violation cited by OSHA.

NFPA 70E 205.3 General Maintenance Requirements. Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

NFPA 110.4 (D) Ground-Fault Circuit-Interrupter Devises GFCI protection devices shall be tested in accordance with the manufacturer's instructions. (*A UL listed device will have instructions for testing monthly*)

STATE OSHA – some states have specific GFCI required testing laws. Please refer to your particular state code.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listin
is presented in Appendix C.

GFCI Tester

Example only

Conduct GFCI testing per manufacturer's instructions
or on the following schedule:

- Before first use
- Before use after repair
- Before use after any event that could cause damage
- Once every month.

Be certain to keep record of the testing for a period of five (5) years.

SECTION 9 - EQUIPMENT & TOOLS

OVERALL RATING = 7.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
9.1	TEST INSTRUMENTS & EQUIPMENT	X		
9.2	TEST INST. OPERATION VERIFICATION			X
9.3	PORTABLE ELECTRICAL EQUIPMENT	X		
9.4	PORTABLE LADDERS		X	

IMP= In Place, but Needs Some Improvement

Section 9 Overview

Test instruments, equipment, and their accessories shall be rated for the circuits to which they will be connected and designed for the environment they will be used in. Proper inspection and operation verification are key components in working safely with test instruments and equipment.

Section 9 Summary

POLA employees are provided with test equipment and tools. In general terms, the equipment is properly used and cared for. Portable electrical equipment is rarely used in favor of battery operated equipment, which eliminates some concerns.

Many PEMs rely on Tick Tracers for verification of zero energy in systems. While most PEMs properly operate the Tick Tracers, using a Tick Tracer is not a recommended tool for most applications and a multimeter should be used instead. Many employers forbid the use of Tick Tracers due to their unreliability and false readings. Because of the heavy use of Tick Tracers, it is unknown if all PEMs know how to properly operate a multimeter.

Portable ladders with conductive sides were found near electrical work, which is not up to CalOSHA, OSHA or NFPA codes.

9.1 TEST INSTRUMENTS & EQUIPMENT OPERATION

OVERALL SCORE (COMBINED WITH 9.1 THROUGH 9.4) = 7.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**9.1**	Test instrument & equipment are not properly rated or are damaged.

9.1 Observation

Tick Tracers are prevelant, but are being used properly. Tick Tracers are fine for some limited applications, but multimeters should be used to verify zero voltage. Many employers forbid the use of Tick Tracers due to their unreliability and false readings.

Due to the heavy use of Tick Tracers, it is unknown if all PEMs know how to properly inspect, operate and care for multimeters.

References:

CalOSHA 3328 Machinery and equipment in service shall be inspected and maintained as recommended by the manufacturer where such recommendations are available.

OSHA 1910.334(c)(2) Visual inspection. Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

NFPA 70E 110.4 (A)(1) – (3)
(1) Testing. Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists.
(2) Rating. Test instruments, equipment, and their accessories shall be rated for circuits and equipment to which they will be connected.
Informational Note: See ANSI/ISA-61010-1 (82.02.01)/ UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.
(3) Design. Test instruments, equipment, and their accessories shall be designed for the environment to which they will be exposed and for the manner in which they will be used.

NFPA 70E 110.4 (A)(4) Visual Inspection. Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before each use. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no

employee shall use it until repairs and tests necessary to render the equipment safe have been made.

NFPA 70E 110.4 (A) (5) Operation Verification. When test instruments are used for the testing for the absence of voltage on conductors or circuit parts operating at 50v or more, the operation of the test instrument shall be verified before and after an absence of voltage test is performed.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Limit the use of Tick Tracers to quick and initial ID of voltage. Enforce that multimeters should be used for zero voltage verification.

Include multimeter operation, inspection and care as part of your next electrical safety training program.

9.2 TEST INSTRUMENTS OPERATION VERIFICATION

Hazard Rating	Item #	Description of Deficiency
NA	9.2	NA

9.2 Observation

No observations made.

References:

NFPA 70E 110.4 (A) (5) Operation Verification. When test instruments are used for the testing for the absence of voltage on conductors or circuit parts operating at 50v or more, the operation of the test instrument shall be verified before and after an absence of voltage test is performed.

Recommended Corrective Actions:
Not applicable.

9.3 PORTABLE ELECTRICAL EQUIPMENT

Hazard Rating	Item #	Description of Deficiency
NA	9.3	No specific deficiencies found

9.3 Observation

No specific deficiencies were found; however, not all equipment was inspected.

PEMs rely more on battery operated tools than corded tools, which eliminates many hazards.

References:

OSHA 1910.334 Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.

OSHA 1910.334(a)(2)(ii) If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

OSHA 1910.334(a)(3)(i) A flexible cord used with grounding type equipment shall contain an equipment grounding conductor.

OSHA 1910.334(a)(3)(ii) Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.

NFPA 70E 110.4 (B)
(1) Handling. Portable equipment shall be handled in a manner that will not cause damage. Flexible electric cords connected to equipment shall not be used for raising or lowering the equipment. Flexible cords shall not be fastened with staples or hung in such a fashion as could damage the outer jacket or insulation.
(2) Grounding-Type Equipment. (a) A flexible cord used with grounding-type utilization equipment shall contain an equipment grounding conductor. (b) Attachment plugs and receptacles shall not be connected or altered in a manner that would interrupt continuity of the equipment grounding conductor. Additionally, these devices shall not be altered in order to allow use in a manner that was not intended by the manufacturer. (c) Adapters that interrupt the continuity of the equipment grounding conductor shall not be used.

Recommended Corrective Actions:
In general, examine all portable plug-in equipment and dispose of equipment that appears to be damaged or is not grounded properly.

Replace corded tools with battery operated tools if available.

9.4 PORTABLE LADDERS

OVERALL SCORE (COMBINED WITH 9.1 THROUGH 9.5 = 7.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**9.4**	Portable ladders being used have conductive sidings.

9.4 Observation

Portable ladders with conductive sides were found near electrical work. Ladders sometimes are interchanged between divisions within C&M.

References:

CalOSHA 3276(e)(18) and OSHA 1910.333 (c) (7) "Portable ladders." Portable ladders shall have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

NFPA 70E 130.7 (D) (1) (e) Portable Ladders. Portable ladders shall have non-conductive side rails if they are used where the employee or ladder could contact exposed energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists. Nonconductive ladders shall meet the requirement of ANSI standards for ladders listed in Table 130.7 (F).

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Remove ladders with conductive sides from areas where they could come into contact with exposed energized parts. Tag or color ladders with conductive sides so that it is clear they are not to be used for work near energized equipment. Purchase non-conductive ladders for all C&M divisions in the future.

Example of ladder with non-conductive sides.

SECTION 10 - PPE PROTECTIVE EQUIPMENT

OVERALL RATING = 6.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
10.1	CONDUCTIVE APPARREL			X
10.2	PPE CLOTHING			X
10.3	PPE CLOTHING STORAGE & CARE	X		
10.4	GLOVE & INSULATED RUBBER TESTING			X
10.5	CONFINED SPACE PPE USE			NA
10.6	INSULATED TOOLS		X	
10.7	INSULATED TOOLS STORAGE & CARE			X

IMP= In Place, but Needs Some Improvement

Section 10 Overview

PPE (Personal Protective Equipment) includes clothing, tools and other materials designed to protect workers from serious injuries. Electrical safety PPE helps protect workers from shock hazards as well as arc flash and arc blast hazards.

Choosing the correct PPE, properly using the PPE, caring for the PPE, and testing the PPE are all parts of a successful electrical safety program.

Section 10 Summary

POLA C&M is providing the workers with Category 2 and Category 4 arc flash clothing and insulated gloves and other insulated materials for protection. Despite some complaints by PEMs about wearing coveralls, the practice of Category 2 FR rated clothing for everyday wear by PEMs is a very strong practice A change to a newer, cooler material and / or a change to FR shirts and pants can reduce the heat PEMs are complaining about.There are some gaps in the PPE program that can be attributed to a simple lack of knowledge and understanding.

Not all PEMs have Category 4 pants. The distribution of this equipment seems to be limited and even unknown for some. Category 4 pants are rarely worn by the PEMs.

When and how PPE is used is not always consistent. PEMs often ditch the PPE for lower voltage systems due to a misunderstanding about the dangers. PEMs were also found not using PPE when they should, or mixing PPE Category 2 equipment in with Category 4 needs. Some PEMs were found with PPE, such as gloves, in packaging that had never been opened.

Gloves are being tested on a regular basis, but how the PEMs are notified about this is something to be desired. Some PEMs seem to not be getting the information to turn in their gloves for testing. Further, gloves should be marked as to whom they belong to. Gloves are mixed together after testing and PEMs may pick up a pair that someone else had been using. Although the gloves have been tested, this makes some PEMs uncomfortable as they don't know how the other PEM may have used the gloves.

Insulated tool knowledge and use is limited with the PEMs. Some PEMs have no concept of when to use insulated tools or why they would need them. There are insulated tools in the maintenance office; however, not all PEMs are aware they are there and access to the tools is not convenient. A PEM will not drive across the Port to check out an insulated tool and instead will cut corners by not using them. PEMs that have insulated tools on their truck purchased their own tools.

10.1 CONDUCTIVE APPAREL

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**10.1**	Conductive apparel being worn.

10.1 Observation

Generally, employees working on electrical equipment do not wear conductive apparel. Some PEMs were seen wearing neck lanyards with metal parts and keys on hip during electrical work.

References:

CalOSHA 2320.7 and OSHA 1910.333(c)(8) "Conductive apparel." Conductive articles of jewelry and clothing (such a watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.

NFPA 70E 130.6 (D) Conductive Articles Being Worn. Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Employees who routinely work on electrical equipment should not wear any conductive articles such as jewelry, watches, necklaces and key rings. Those who may occasionally work on electrical equipment should remove conductive materials before beginning any work.

POLA employees are required to wear ID badges. Neck lanyards with no metal parts should be purchased for the PEM employees.

10.2 PPE CLOTHING

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**10.2**	Some PPE clothing not being worn as required.

10.2 Observation

Proper PPE clothing is available for most employees. POLA uses the simplified 2 category PPE program for arc flash (Category 2 for 0-1 and Category 4 for 3-4), which is the recommended practice, although the application of when to wear Category 2 or 4 has been misapplied. The practice of supplying Category 2 overalls (11.2 calories) for daily wear for the staff is an excellent practice. Workers are each provided their own PPE equipment. Some employees don't have Category 4 pants and didn't know they were available.

Some PEMs complained about the heat and discomfort of the Category 2 coveralls for everyday wear.

Although equipment is provided, employees are not using PPE clothing when they are within shock boundaries or arc flash boundaries. Rubber insulated gloves are not always worn for shock hazards on both low and high voltage work. Protective clothing is not being worn for all arc flash hazards; big focus is on high voltage and little focus is on low voltage. Sock hoods are not being worn as part of Category 2. Employees were observed not using arc rated face shield and voltage rated gloves when out in the field.

Workers are mixing Category 2 and Category 4 equipment for Category 4 situations.
In the following picture, the PEM is using Category 2 headgear and without the required balaclava, Category 4 on the torso and Category 2 on the legs.

Supervisors on site are not wearing the proper PPE and are within the arc flash boundaries. Not only is this an unsafe practice, it sends the wrong message to the PEMs about the importance of PPE.

References:

CalOSHA 2320.2 and OSHA 1910.335(a)(1)(i) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

NFPA 70E 130.7 (A) General. Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and

constructed for the specific part of the body to be protected and for the work to be performed. NFPA 70E 130.7 describes proper PPE for electrical safety.

NFPA 70E 130.7 (C) (1) Personal Protective Equipment. General. When an employee is working within the Arc Flash Protection Boundary, he or she shall wear protective clothing and other personal protective equipment in accordance with 130.3. All parts of the body inside the Arc Flash Protection Boundary shall be protected.
(6) Hand and Arm Protection. Hand and arm protection shall be provided in accordance with (a), (b), and (c) below.
(a) Shock Protection. Employees shall wear rubber insulating gloves with leather protectors where there is a danger of hand injury from electric shock due to contact with energized electrical conductors or circuit parts. Employees shall wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed.
Exception: Where it is necessary to use rubber insulating gloves without leather protectors, the requirements of ASTM F 496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves shall be met. FPN: Table 130.7(C) (9) provides further information on tasks where rubber insulating gloves are required.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Be certain to use properly rated gloves when there is a danger of electric shock due to contact with energized electrical conductors or circuit part. Gloves should be worn anytime employees are within the Limited Approach Boundary.

Proper PPE for arc flash and electrical shock should be worn any time employees are within the Arc Flash Boundary. Failure to do this may be part of either proper training or no discipline ramifications for not following codes and standards, so these two topics should be addressed.

PEMs complained about the heat and discomfort of the current Category 2 coveralls. The FR rated material is heavy and with overalls, most PEMs wear a layer underneath, which adds to the heat. Further, some PEMs complained of ill-fitting overalls or movement restrictions with the overalls since there is little give to the material. In recent years, advancements in FR clothing have been made that allow cooler and lighter weight materials. If overalls are going to be replaced with new materials, it might also help PEMs with heat and comfort if they wore FR rated pants and shirts as opposed to overalls. The pants and shirts allow greater flexibility in motion and can be cooler as there is no need to layer. FR rated shirts are available in bright orange, so the visibility of the PEMs will remain the same. Typically with a shirt and pant

combination, the employee will purchase and maintain their own FR jeans while the employer will purchase and maintain the shirts.

Be sure each employee that performs work on energized electrical equipment receives NFPA 70E Training and has the proper PPE clothing. It is employer's responsibility to make sure OSHA Safety Regulations are followed and to provide the appropriate PPE for the workers.

All parts of Category 4 clothing should be given to all PEMs and should be worn anytime a PEM works inside a Category 4 arc flash boundary.

Sample Cat 2 Arc Rated PPE Clothing with Insulated Gloves
Not Port personnel.

Supervisors and managers on site should be wearing the same PPE as the PEMs if they are within the arc flash hazard boundaries.

10.3 PPE CLOTHING STORAGE & CARE

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
NA	**10.3**	NA

10.3 Observation

PPE is being properly cared for.

References:

CalOSHA 3380(d) The employer shall assure that all personal protective equipment, whether employer-provided or employee-provided, complies with the applicable Title 8 standards for the equipment. The employer shall assure this equipment is maintained in a safe, sanitary condition.

OSHA 1910.335(a)(1(ii) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137.

NFPA 70E 130.7 (B) Care of Equipment. Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use. Protective equipment shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agents.

NFPA 70E 130.7 (C) (6) (c) Maintenance and Use. Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection. Electrical protective equipment shall be subjected to periodic electrical tests.

NFPA 70E 250.1 Personal Safety and Protective Equipment. Maintenance Requirements for Personal Safety and Protective Equipment. Personal safety and protective equipment shall be maintained in a safe working condition.

Recommendations:

In general, store PPE in locations and in manners where they are not subject to damage.
Inspect PPE prior to each use for damage.

10.4 GLOVE & INSULATED RUBBER TESTING

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0-		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**10.4**	Some gloves not tested.

10.4 Observation

Gloves are being tested on a regular basis, but how the PEMs are notified about this is something to be desired. Some PEMs seem to not be getting the information to turn in their gloves for testing. There needs to be a more robust and consistent program for testing the gloves.

Gloves are mixed together after testing and PEMs may pick up a pair that someone else had been using. Although the gloves have been tested, this makes some PEMs uncomfortable as they don't know how the other PEM may have used the gloves.

References:

CalOSHA 2320.2(a)(3) and OSHA 1910.335(a)(1)(ii) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137.

OSHA 1910.137 Electrical Protective Devices has requirements for the testing, care, marking, and use of rubber goods such as insulating blankets, matting, covers, line hose, gloves and sleeves.

OSHA 1910.137 (b)(2)(xii) Table I-6 Rubber Insulated Gloves Shall be tested before first issue and every 6 months thereafter.

NFPA 70E Table 130.7 (C) (7) (c) Rubber Insulating Equipment, Maximum Test Intervals

Rubber Insulating Equipment	When to Test	Governing Standard for Test Voltage
Blankets	Before first issue; every 12 months thereafter	ASTM F 479
Covers	If insulating value is suspect	ASTM F 478
Gloves	Before first issue; every 6 months thereafter	ASTM F 496
Line Hose	If insulating value is suspect	ASTM F 478
Sleeves	Before first issue; every 12 months thereafter	ASTM F 496

NFPA 70B 7.4.5.3 All insulating tools and PPE should be tested periodically.

ASTM F 496 This specification covers the in-service care, inspection, testing, and use voltage of insulating gloves and sleeves for protection from electrical shock. Gloves and sleeves covered under this specification are designated as type I or type II; class 00, class 0, class 1, class 2, class 3, or class 4. Type I - nonresistant to ozone, made from a high-grade cis-1,4-polyisoprene rubber compound of natural or synthetic origin, properly vulcanized, and type II - ozone resistant, made of any elastomer or combination of elastomeric compounds. The recommended sequence of inspection and testing of gloves and sleeves at an electrical testing facility are: check-in, washing, and preliminary inspection; repair; electrical test; drying; final inspection; record-keeping and marking; and powdering, pairing, and packing for storage or shipment. Electrical testing shall be performed to meet the requirements prescribed.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

- Test gloves before each use with air test.
- Have gloves tested or replaced every six months. Create a more robust program so that all PEMs know when to turn in their gloves. A sign in/out sheet for the controller will help establish that all gloves are being accounted for in testing.
- Mark gloves in bags with name of the owner so that gloves are not mixed up upon return.
- Test other insulated rubber equipment per ASTM guidelines.

10.5 CONFINED SPACE & OTHER PPE USE

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
NA	**10.5**	NA

10.5 Observation

Other insulated materials are being used when needed to provide protection to employees when working in a confined space.

References:

NFPA 70E 130.6 (F) Confined or enclosed work spaces. When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized electrical conductors or circuit parts operating at 50 volts or more, or where an electrical hazard exists, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts and the effects of the electrical hazards.

Recommended Corrective Actions:
In general, when working in confined spaces, protective barriers, shields or insulated equipment must be used. Make sure this equipment is available near the confined spaces, is used when required, and is tested per requirements.

Examples of insulated protective barriers

10.6 INSULATED & VOLTAGE RATED TOOLS

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**10.6**	Insulated tool not available and / or not being used.

10.6 Observation

Insulated tools are available for high voltage switching, and insulated tools are available in the maintenance shop but aren't being used. Some PEMs have purchased their own insulated tools to keep on their trucks. Other PEMs have no concept about why to use insulated tools.

References:

CalOSHA 1910.335 (2) General Protective Equipment and Tools: when working near exposed energized conductors or circuit parts, each employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

NFPA 70E 130.7 (D) (1) Insulated Tools and Equipment. Employees shall use insulated tools and/or handling equipment when working inside the Limited Approach Boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact. Table 103.7 (C)(15)(a) and Table 103.7 (C)(15)(b) provide further information for tasks that require insulated and insulating hand tools. Insulated tools shall be protected from damage to the insulating material.

NFPA 70E Table H.1
Note other PPE required for the specific tasks listed in Tables Table 103.7 (C)(15)(a) and Table 103.7 (C)(15)(b), which includes arc-rated face shields or arc flash suit hoods, hardhat liners, safety glasses or safety goggles, hard hat, hearing protection, leather gloves, voltage-rated gloves, **and voltage-rated tools.** Arc rating for a garment is expressed in cal/cm2.

NFPA 70E 130.2 (C) Approach to Exposed Energized Electrical Conductors or Circuit Parts Operating at 50 Volts or More**.** No qualified person shall approach or take any **conductive object** closer to exposed energized electrical conductors or circuit parts operating at 50 volts or more than the Restricted Approach Boundary set forth in Table 130.2(C), unless any of the following apply:

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Each electrician should have voltage rated/insulated tools to work with when troubleshooting circuits operating at 50 volts or more.


Sample Voltage Rated / Insulated Tools

It is recommended that electricians have their own set of commonly used tools so they do not have to go to the maintenance inventory control room to check out any tools.

Tool sets don't need to be extravagant or expensive. Pick the common tools for a kit.

10.7 INSULATED TOOLS STORAGE, CARE & TESTING

OVERALL SCORE (COMBINED WITH 10.1 THROUGH 10.7) = 6.0		
Hazard Risk Rating	**Item #**	**Description of Deficiency**
2	**10.7**	Unable to audit tool storage and care, because no tools were present within C&M

10.7 Observation

Because tools were not present at the site, the audit team was unable to assess proper storage, care and testing for tools. This item was unable to be audited.

References:

CalOSHA 3356(a) Each employer shall be responsible for the safe condition of tools and equipment used by employees, including tools and equipment which may be furnished by employees.

OSHA 1910.335(a)(1)(ii) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137.

NFPA 70E 130.7 (B) Care of Equipment. Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use. Protective equipment shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agents.

NFPA 70E 130.7 (C) (6) (c) Maintenance and Use. Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection. Electrical protective equipment shall be subjected to periodic electrical tests.

NFPA 70E 250.1 Personal Safety and Protective Equipment. Maintenance Requirements for Personal Safety and Protective Equipment. Personal safety and protective equipment shall be maintained in a safe working condition.

NFPA 70B 7.4.5.3 All insulating tools and PPE should be tested periodically.

Recommendations:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Store voltage rated insulated tools in locations and in manners where they are not subject to damage.

Inspect voltage rated insulated tools prior to each use for damage.

SECTION 11 - WORK PRACTICES

OVERALL RATING = 6.0				
ITEM	**DESCRIPTION**	**COMPLIANT**		
		YES	NO	IMP
11.1	JOB PLANNING & PROCEDURES PROGRAM			X
11.2	ESTABLISHING A SAFE WORK CONDITION			X
11.3	TEMPORARY GROUNDING			TBD
11.4	LOTO (LOCKOUT / TAGOUT) PROGRAM		X	
11.5	LOTO PROCEDURE ACCESS		X	
11.6	ENERGIZED ELECTRICAL WORK PERMIT	X		
11.7	ALERTING TECHNIQUES			X

IMP= In Place, but Needs Some Improvement

Section 11 Overview

Electrical Safety work practices define work processes that must be followed to help prevent accidents. Establishing and following these work practices is the beginning of any electrical work process prior to the work beginning.

Section 11 Summary

Most of the work practices have core aspects that are place, but are lacking some details or requirements that could make the programs fully functional. The current gaps in these areas create potential safety hazards.

11.1 JOB PLANNING & PROCEDURES

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) – 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**11.1**	Job Planning is done, but could be more robust

11.1 Observation

Job planning is done in some situations, but not all and has room for improvement. Consistent with other aspects of the program, there is a strong focus on high voltage equipment and weak focus on low voltage equipment.

References:

CalOSHA 2320.2(a) and NFPA 70E 110.3 (F) Hazard Identification and Risk Assessment Procedure. An electrical safety program shall include a hazard identification and a risk assessment procedure to be used before work is started within the limited approach boundary or within the arc flash boundary of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists. The procedure shall identify the process to be used by the employee before work is started to identify hazards and assess risks, including potential risk mitigation strategies.

NFPA 70E (G) Job Briefing. (1) General. Before starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, personal protective equipment requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.

CalOSHA 1510 and OSHA – Best Practice / Job Briefings – Job Briefing provides a uniform methodology and outlines key components of job briefings. PRACTICE DESCRIPTION: Document job sequence, hazards to be encountered, and steps taken to control/eliminate hazards by doing the following: 1) Define task. 2) Identify roles & responsibilities. 3) Identify hazards. 4) Determine risk mitigation. 5) Documentation shall include I&I to be used. 6) Personal Protective Equipment to be used. 7) Emergency response information. 8) Number of briefings to be held.

All crew members shall participate in a documented job briefing. Job briefings are to be held at the start of the work shift, as work tasks or hazards differ from original briefing, and as additional personnel arrive at the job site. These job briefings shall include the components of a Hazard Analysis or use your company specific hazard analysis program associated with the work steps, hazards associated with the work step, and ways to eliminate or control the hazards. The job briefing form shall have a provision for each employee to sign to verify they have participated in the job briefing.

ADDITIONAL REFERENCES:

- National Electric Safety Code (NESC, ANSI C2 - Part 4)
- NFPA 70E Annex I

Recommended Corrective Actions:

Job Planning should take place with management prior to each shift. The job planning should review at the minimum the following:

The hazards involved	Voltage levels / shock hazard	Skills required
Secondary voltage sources	Unusual work conditions	Quantity of people required
Shock protection boundaries	Arc Flash PPE and boundaries	Alerting techniques

Increase the job planning on low voltage jobs.

Use a form for job planning when working on a job that is done infrequently and the hazards aren't readily known.

Benefits:

Job Planning / Briefing Provides for essential job safety planning guidelines and lists key elements.

- Enhances compliance with OSHA regulatory requirements.
- Incorporates use of a specific hazard identification process in the job planning process that will provide for enhanced controls for risks.
- Proper pre-planning reduces the risk of injury.
- The process and required documentation enhances inclusion and participation of job team members in the safety planning processes associated with the job.

SEE APPENDIX G FOR JOB PLANNING FORM EXAMPLE.

11.2 ESTABLISHING AN ELECTRICALLY SAFE WORK CONDITION

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**11.2**	Minor improvements in steps

11.2 Observation

All PEMs go through most steps to establish an electrically safe work condition. Minor details were overlooked as deterimed from in interviews and direct observation.

PEMs, in general, will not work on energized equipment and PEMS do properly follow steps for de-energization and lockout / tagout, although some individuals were observed to be deficient on particular equipment or were using equipment or methods not considered as the safest best practice. Specific examples include observation of a PEM who failed to properly lockout a solar activation device on a piece of equipment, PEMs who routinely rely on tick tracers for their sole means of identifying zero energy, and PEMs who stated they had occasionally worked on energized electrical equipment in order to save time.

References:

CalOSHA 2340.2 De-energize equipment prior to working on it.

NFPA 70E 120 describes proper steps in establishing an Electrically Safe Work Condition.

NFPA 70E 120.1 Process of Achieving an Electrically Safe Work Condition. An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process: (1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags. (2) After properly interrupting the load current, open the disconnecting device(s) for each source. (3) Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout type circuit breakers are withdrawn to the fully disconnected position. (4) Apply lockout/tagout devices in accordance with a documented and established policy. (5) Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily. (6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

NFPA 70E 130.2 Electrically Safe Working Conditions. Energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work

condition before an employee performs work if either of the following conditions exist: (1) The employee is within the limited approach boundary. (2) The employee interacts with equipment where conductors or circuit parts are not exposed, but an increased risk of injury from an exposure to an arc flash hazard exists.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Re-train and enforce the six steps in establishing an electrically safe work condition.
(1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
(2) After properly interrupting the load current, open the disconnecting device(s) for each source.
(3) Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout type circuit breakers are withdrawn to the fully disconnected position.
(4) Apply lockout/tagout devices in accordance with a documented and established policy.
(5) Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.
(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

11.3 TEMPORARY GROUNDING

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**11.3**	TBD low voltage

11.3 Observation

Grounding is well used and understood for high voltage, but there was no equipment or knowledge regarding low voltage. Because a full investigation was not performed, it was not determined if low voltage equipment that requires temporary grounding is worked on.

References:

NFPA 70E 120.2 (F)(2)(f)(5)(g) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment shall be installed for the duration of the task or is temporarily established by the procedure. Grounding needs or requirements shall be permitted to be covered in other work rules and might not be part of the lockout/tagout procedure.

ASTM F 855 Standard Specification for Temporary Protective Grounds to be Used on De-energized Electrical Power Lines and Equipment.

NFPA 70E 250.3 (C) Grounding and Testing Devices. Grounding and testing devices shall be stored in a clean and dry area. Grounding and testing devices shall be properly inspected and tested before each use. Informational Note: Guidance for testing of grounding and testing devices is provided in Section 9.5 of IEEE C37.20.6-2007, Standard for 4.76 kV to 38 kV-Rated

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

- Identify equipment that would require temporary grounding.
- Train employees on temporary grounding for low voltage.

11.4 LOCKOUT / TAGOUT (LOTO)

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) - = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**11.4**	Lockout / Tagout program is insufficient or doesn't exist. Equipment specific procedures do not exist.

11.4 Observation

General Lockout / Tagout procedures exist, but a written Lockout / Tagout program that identifies the Lockout / Tagout procedures for each piece of equipment, which is required, does not exist.

Lockout / Tagout program exists, but is not being updated or audited on an annual basis.

Lockout / Tagout program exists, but includes only electrical sources and not all energy sources (water, chemical, steam, etc.)

C&M management is currently working on operation procedures for high voltage switchgear. The procedures will meet the needs of equipment Lockout / Tagout requirements when published.

References:

CalOSHA 3314 and OSHA 1910.333 (b) Defines lockout/tagout requirements. The content covering Lockout/ Tagout is too long to be published here. The followings a summary of the requirements. Annual periodic inspections of equipment specific lockout tagout procedures are required by CalOSHA and OSHA when locking out to clean, repair, service or adjust machinery, prime movers. and equipment. Within California, the periodic inspection includes a written review of all lockout tagout equipment specific procedures to ensure they are correct and up-to-date. In addition, in CalOSHA and OSHA, the periodic inspection includes a review with each Lockout Tagout Authorized Employee to review with each employee in an individual or group setting of their responsibilities under lockout tagout out and to ensure that employees are correctly following the procedures. Lockout retraining shall be performed when there are changes to job assignments, equipment, or new hazards are presented. Periodic inspections shall be performed annually and based upon the frequency of new equipment coming on line. Equipment specific procedures are to be generated for each unique piece of equipment."

OSHA 1910.147 Defines Lockout / Tagout requirements for equipment outside subpart S.

NFPA 70E 120.2 Defines Lockout / Tagout requirements. The content covering LOTO is too long to be published here. A summary of the standard is:
120.1 (4) Apply lockout/tagout devices in accordance with a documented and established policy.
120.2 (A) General. General Lockout/tagout requirements.

120.2 (B)(3) Plan. A plan shall be developed on the basis of the existing electrical equipment and system and shall use up-to-date diagrammatic drawing representations.
120.2 (B)(3) Coordination. The established electrical lockout/tagout procedures shall be coordinated with all of the employer's procedures associated with lockout/tagout of other energy sources.
102.2(C) (1) Procedures. The employer shall establish lockout/tagout procedures for the organization, provide training to employees, provide equipment necessary to execute the details of the procedure, audit execution of the procedures to ensure employee understanding/compliance, and audit the procedure for improvement opportunity and completeness.
102.2(C) (3) Audit Procedures. An audit shall be conducted at least annually by a qualified person and shall cover at least one lockout/tagout in progress and the procedure details. The audit shall be designed to correct deficiencies in the established electrical lockout/tagout procedure or in employee understanding.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

- Lockout / Tagout procedures should be written specifically for each piece of equipment.
- Lockout / Tagout procedures should be audited and updated annually.

Sample Lockout / Tagout placard

Lockout-Tagout Posted Procedure

ID #	MT104
Created:	9/2/08
Revised:	6/10/09

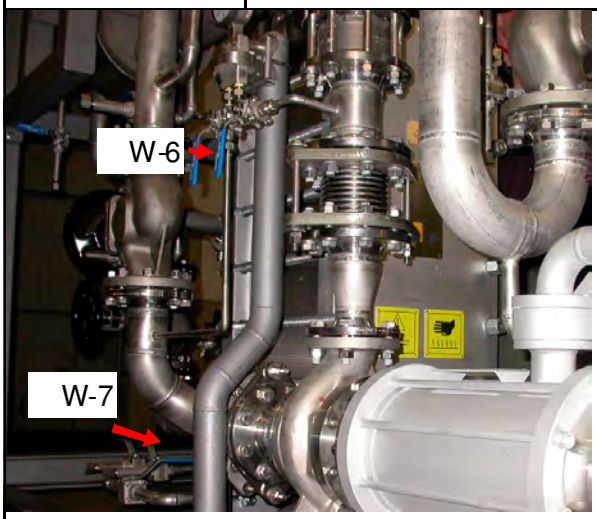
Water Pump

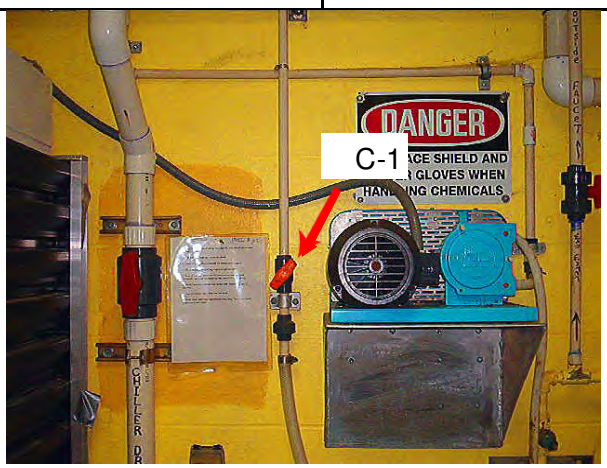
Building #2 | North Wall

LOCKOUT APPLICATION PROCESS

1. Notify affected personnel 2. Properly shut down machine 3. Isolate all energy sources 4. Apply lockout devices, locks, and tags 5. Verify total de-energization of all sources

Lockout Points	Notes	Lockout Authority
4	Drain Water Return after lockout	





ENERGY SOURCE	LOCATION	METHOD	QUALIFIED TASK
ELECTRICAL 480 VAC	MCC-2 3B	Turn off breaker, rackout	E-6
WATER Water Supply	Valve W-6 On East Side	Turn off valve	W-2
WATER Water Return	Valve W-7 On East Side	Turn off valve	W-2
CHEMICAL Chemical Feed	Chem 1 Valve C-1	Turn off valve	C-1

LOCKOUT REMOVAL PROCESS

1. Ensure all tools and items have been removed 2. Confirm that all employees are safely located. 3. Verify that controls are in neutral. 4. Remove lockout devices and reenergize machine 5. Nofity affected employees that servicing is completed.

11.5 LOCKOUT / TAGOUT (LOTO) ACCESS

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**11.5**	Lockout / Tagout procedures are not posted for easy access to workers

11.5 Observation

The Lockout / Tagout program is not posted for easy access to workers. PEMs did not know where to find the Lockout / Tagout procedures, and equipment specific Lockout / Tagout procedures are not posted near the equipment to be worked on.

References:

Easy access to Lockout / Tagout procedures is a best management practice. It is apparent that if Lockout / Tagout procedures are not available, they will not be utilized by staff. Lockout / Tagout procedures should be made available for easy reference for those working on the equipment that will apply the Lockout / Tagout. Having Lockout / Tagout procedures kept in a office is not conducive to use or reference for workers in the facility

Substantiation: There are no specific codes or regulations on where Lockout / Tagout procedures should be posted, only that written Lockout / Tagout procedures be on file and followed.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Lockout / Tagout procedures for each piece of equipment should be in a binder in the maintenance office and posted near the equipment that needs to be locked out / tagged out. Common ways to post the Lockout / Tagout procedures are to laminate and attach directly to the equipment with double-sided tape or magnet clips. When posting the Lockout / Tagout procedures on the equipment is not feasible or logical, a binder with the equipment in that area can be kept posted on the wall nearby or with the Lockout / Tagout equipment. Mobile applications can also be used for implementing Lockout / Tagout instructions in the field.

Examples of wall mounted Lockout / Tagout stations for procedures.

11.6 ENERGIZED WORK PERMIT APPLICATION

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**11.6**	Energized Electrical Permit Program is not in place or is not being enforced.

11.6 Observation

There is no formal understanding as to when working on energized equipment requires management notification or signed documentation. No energized work permits are used.

References:

CalOSHA 2320.2(a) Although CalOSHA does not explicitly state that documentation be retained related to live work, it definitely requires the Port to evaluate and have a decision making process on why live work is necessary.
Work shall not be performed on exposed energized parts of equipment or systems until the following conditions are met:

(1) Responsible supervision has determined that the work is to be performed while the equipment or systems are energized.
(2) Involved personnel have received instructions on the work techniques and hazards involved in working on energized equipment.
(3) Suitable personal protective equipment and safeguards (i.e., approved insulated gloves or insulated tools) are provided and used.

NFPA 70E 130.2 (B) Energized Electrical Work Permit
(1) When Required. When working within the limited approach boundary or the arc flash boundary of exposed energized electrical conductors or circuit parts that are not placed in an electrically safe work condition [that is, for the reasons of increased or additional hazards or infeasibility per 130.2 (A)], work to be performed shall be considered energized electrical work and shall be performed by a written permit only.
(2) Elements of a Work Permit. The energized electrical work permit shall include, but not be limited to, the following items:
(1) Description of the circuit and equipment to be worked on and their location.
(2) Justification for why the work must be performed in an energized condition.
(3) Description of the safe permit work practices to be employed.
(4) Result of the shock hazard analysis.
(5) Result of the arc flash hazard analysis.
(6) Means employed to restrict the access of unqualified persons from the work area.
(7) Evidence of completion of a job briefing, including a discussion of any job-specific hazards.
(8) Energized work approval signatures.
(3) Exemptions to Work Permit. Work performed within the limited approach boundary of energized electrical conductors or circuit parts by qualified persons related to tasks such as testing, troubleshooting, and voltage measuring shall be permitted to be performed without an energized electrical work permit, if appropriate safe work practices and personal protective

equipment in accordance with Chapter 1 are provided and used. If the purpose of crossing the limited approach boundary is only for visual inspection and the restricted approach boundary will not be crossed, then an energized electrical work permit shall not be required.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

- Implement and follow Energized Work Permit Program.
- Establish guidelines with PEMs on what tasks can be done without an Energized Work Permit and that anything outside of those tasks requires a permit to be submitted and completed with management and supervisor sign-off.

SEE ALSO APPENDIX H FOR SAMPLE OF ELECTRICAL WORK PERMIT.

11.7 ALERTING TECHNIQUES

OVERALL SCORE (COMBINED WITH 11.1 THROUGH 11.7) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
2	**11.7**	Alerting techniques are not being properly used when working on energized equipment.

11.7 Observation

Alerting technique materials and supplies are being provided to the PEMs, but alerting techniques are often not properly being used. PEMs state that only alerting techniques are not required because everyone around the equipment is a Qualified Person.

References:

Observation: Barricades, tape or an attendant are not used when working on opened panels; it was stated that energized work is never performed.

CalOSHA 2340.2(a)(4) and OSHA 1910.335(b) Alerting techniques. The following alerting techniques shall be used to warn and protect employees from hazards which could cause injury due to electric shock, burns, or failure of electric equipment parts:
1910.335(b)(1) Safety signs and tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by 1910.145.
1910.335(b)(2) Barricades. Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard.
1910.335(b)(3) Attendants. If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees.

NFPA 70E 103.7 (E)
(1) Safety Signs and Tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of ANSI Z535, Series of Standards for Safety Signs and Tags, given in Table 130.7(F).
(2) Barricades. Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing energized conductors or circuit parts. Conductive barricades shall not be used where it might cause an electrical hazard. Barricades shall be placed no closer than the limited approach boundary given in Table 130.4(C)(a) and Table 130.4(C)(b).
(3) Attendants. If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to

electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to the electrical hazards.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

While there are areas where only Qualified Persons are present in the area, work is also done where a variety of other personnel, including Unqualified Persons may be nearby.

Construct non-conductive barricades to warn unqualified workers about electrical hazards. This applies to both conditions where work is being done and arc flash and shock hazard boundaries are set as well as any other condition that could be hazardous to workers, whether it is being worked on or not. If signs or barricades do not provide sufficient warning and protection, use an attendant to warn and protect employees while work is being done.

Not Port personnel.

Examples of barricades

SECTION 12 - HAZARDOUS (CLASSIFIED) LOCATIONS & SPECIAL EQUIPMENT

OVERALL RATING = 6.0					
ITEM	**DESCRIPTION**	**COMPLIANT**			
		YES	NO	IMP	NA
12.1	MAINTENANCE REQUIREMENTS				TBD
12.2	BATTERIES AND BATTERY ROOMS		X		

Section 12 Overview

This covers maintenance requirements in those areas identified as hazardous (classified) locations. These locations need special types of equipment and installation to ensure safe performance under conditions of proper use and maintenance. It is important that inspection authorities and users exercise more than ordinary care with regard to installation and maintenance.

Section 12 Summary

A full investigation was not completed in this area as it was not part of the full scope. Battery stations exist at the Port as does a new battery bank for the hybrid boat. No other hazardous areas are expected.

PEMs should be properly trained in PPE and maintenance requirements for battery stations.

12.1 MAINTENANCE REQUIREMENTS FOR HAZARDOUS LOCATIONS

OVERALL SCORE (COMBINED WITH 12.1 THROUGH 12.2) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**12.1**	Not fully determined – requires further examination

12.1 Observation

The following maintenance requirements for Hazardous Locations were not met:
Location:

- [x] Battery / Battery Room
- [ ] Lasers
- [ ] R&D Laboratory
- [ ] Electrolytic Cells
- [ ] Power Electronic Equipment

Deficiency:
Not fully determined – requires further examination.

References:

CalOSHA 2540.3
a) Equipment, wiring methods and installations of equipment in hazardous (classified) locations shall be one or more of the following:
(1) Intrinsically safe.
(2) Approved for the hazardous (classified) location.
(3) Safe for the hazardous (classified) location.

NFPA 70E 235.2 Maintenance Requirements for Hazardous (Classified) Locations
Equipment and installations in these locations shall be maintained such that the following criteria are met:
(1) No energized parts are exposed. Exception to (1): Intrinsically safe and nonincendive circuits.
(2) There are no breaks in conduit systems, fittings, or enclosures from damage, corrosion, or other causes.
(3) All bonding jumpers are securely fastened and intact.
(4) All fittings, boxes, and enclosures with bolted covers have all bolts installed and bolted tight.
(5) All threaded conduit are wrenchtight and enclosure covers are tightened in accordance with the manufacturer's instructions.
(6) There are no open entries into fittings, boxes, or enclosures that would compromise the protection characteristics.
(7) All close-up plugs, breathers, seals, and drains are securely in place.
(8) Marking of luminaires (lighting fixtures) for maximum lamp wattage and temperature rating is legible and not exceeded.
(9) Required markings are secure and legible.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Examine battery area equipment to make sure it complies with NFPA 70E 235.2 & NEC.

12.2 BATTERIES & BATTERY ROOMS

OVERALL SCORE (COMBINED WITH 12.1 THROUGH 12.2) = 6.0		
Hazard Rating	**Item #**	**Description of Deficiency**
1	**12.2**	Battery room safety practices not being followed.

12.2 Observation

☐ Insufficient ventillation for battery area.

☒ Proper PPE not available for batteries (face shields, aprons & rubber gloves)

☐ Eyewashing station not within 25'

☐ Abnormal battery alarm not being tested annually.

References:

CalOSHA 2535.1 and OSHA 1910.305(j)(7) Storage Batteries. Provisions shall be made for sufficient diffusion and ventilation of gases from storage batteries to prevent the accumulation of explosive mixtures.

OSHA 1926.441(a) Batteries of the unsealed type shall be located in enclosures with outside vents or in well ventilated rooms and shall be arranged so as to prevent the escape of fumes, gases, or electrolyte spray into other areas. Ventilation shall be provided to ensure diffusion of the gases from the battery and to prevent the accumulation of an explosive mixture.

OSHA 1926.441(a)(5) Face shields, aprons, and rubber gloves shall be provided for workers handling acids or batteries.

OSHA 1926.441(a)(6) Facilities for quick drenching of the eyes and body shall be provided within 25 feet (7.62 m) of battery handling areas.

NFPA 70E 240.1 Ventilation. Ventilation systems, forced or natural, shall be maintained to prevent buildup of explosive mixtures This maintenance shall include a functional test of any associated detection and alarm systems.

NFPA 70E 240.2 Eye and Body Wash Apparatus. Eye and body wash apparatus shall be maintained in operable condition.

NFPA 70E 320 Safety Requirements Related to Batteries and Battery Rooms Describes electrical safety requirements for the practical safeguarding of employees while working with exposed stationary storage batteries that exceed 50 volts nominal.
320.3(3) Abnormal Battery Conditions – Alarms, if present, shall be tested annually
320.3(4) Warning Signs – The following signs or labels shall be posted.
(1) Electrical Hazard Warning

(2) Chemical Hazard Warning
(3) Notice for personnel to use and wear PPE
(4) Notice prohibiting access to unauthorized personnel

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Follow safety related maintenance practices for batteries and battery rooms per NFPA 320.

SECTION 13 - ENGINEERING CONTROLS

Section 13 Overview

Safeguarding of personnel and equipment should be given prime consideration in electrical system design and installation. This section covers the design specifications used for installing new equipment in the field.

OVERALL RATING = 9.0

Summary

POLA provides specifications to their vendors who fulfill the design work and installation. A city inspector performs a quality check on the system design. The engineering division has demonstrated that they have a high concern for safety when designing and implementing systems. National Electrical Code is followed with no known deviations for new installations.

Engineering tries to keep consistent with equipment choices which allows for more familiarity in the field for the maintenance technicians and reduces inventory requirements. Some creative engineering controls have been developed by the Engineering team to help reduce hazards to human life, showing a thought process and concern above just meeting the minimal requirements.

All electrical safety depends on good engineering design and the POLA has demonstrated strong organization and engineering processes that meet or exceed expectations. Only minor deficiencies in communications with PEMs were found.

Recommended Corrective Actions

See One-Line Drawing section.

SECTION 14 - PLANNING & DOCUMENTATION CONTROLS

Section 14 Overview

Planning & Documentation Controls covers additional efforts that can be made to keep electrical maintenance organized and efficient. The use of CMMS (computerized maintenance management systems), inventory controls and operating procedures are considered part of efficient electrical maintenance planning.

OVERALL RATING = 7.0

This section addresses best practices to make maintenance departments safer and more efficient. No code deficiencies apply.

CMMS

Two years ago, the POLA implemented MainStar, a well-known computerized maintenance management system, especially with municipal governments. At this time, the system is being used as a simple work order processing tool for electrical maintenance. Fleet and backflow maintenance is more fully integrated into the system than electrical is at this time. PM on generators is the only known electrical program that is currently implemented into the system.

- Inventory controls, safety orders, prescribed tools, prescribed parts, drawing and OEM manuals are not implemented into the system to date.
- Qualified Persons / QEW tied to qualified equipment or tasks is not implemented.
- Reports tied to equipment has not been implemented.
- PM orders are generated through the system, but not currently for most electrical maintenance.
- Mobile applications for efficiencies have not been implemented.

The C&M team currently understands many of the capabilities of Mainstar, but simply has not had enough time and resources to implement all the programs. Populating the CMMS for the electrical systems is a large project that will take significant time and resources, so it is unreasonable to think that the C&M team would have this system running efficiently after only 2 years given the resources available.

The recent implementation of MainStar shows a progressive effort to create a more efficient maintenance program.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Focus on leveraging the CMMS for electrical maintenance and safety. At this time, the CMMS is used primarily for efficiency, but it is a great tool for safety as well. Completely inventorying the electrical system and leveraging the capabilities is too large a task to look at as a whole. Development of this program should be segmented by locations, equipment, and tasks with implementation being taken on segment by segment.

Consider the following to implement:

- OEM manuals attached to the equipment.
- Developing PM schedule based on OEM manual.
- One-line diagram links for the job or equipment.
- Safety orders that include any required documents and safety procedures for each job or piece of equipment.
- Connect inventory with the work orders for better controls and efficiency.
- Required replacement parts or tools for the job.
- Matrix of Qualified Person and QEW that can handle the job.
- Reports of work order tied to equipment.
- Mobile applications for maintenance technicians. Access to all CMMS information in the field can be a tremendous resource and reduce time if used properly.

WORK ORDER PROCESS

Work orders can be generated by a variety of individuals. Some have direct access to the CMMS work order process while others send an e-mail for entry by another person. Orders are entered through the MainStar CMMS. Tasks that are routine or too small are not entered through the system.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Work order process can be improved with more implemented features of CMMS as described in the CMMS section.

SOP & Documentation

C&M currently uses an intern to develop Standard Operating Procedures (SOPs) for connecting the utility to the ships (amping) and have also began SOPs for other equipment. The intern works with knowledgeable PEMs and assembles their information to an organized format. This is a good process that should continue.

Recommended Corrective Actions: Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Continue with development of SOPs and extend it to other electrical activities outside of the high voltage amping. Racking breakers is a common and hazardous task that should have a SOP written for it and place in the MCC rooms. Other common tasks should also have SOPs. Consulting with OEM manuals will provide information on other equipment or may replace the need to develop SOPs.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) MANUALS

OEM manuals are often critical to properly operate and maintain electrical equipment. While many OEM manuals are available, some are not, making work difficult and potentially dangerous for the PEMs. PEMs have taken their own initiatives to find OEM manuals online or contact the OEM to find copies of the manuals.

Recommended Corrective Actions:
Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

C&M should have a repository of manuals that is easily accessible by PEMs. Placing a duplicate in the field near specialized equipment is a good work practice if the equipment is a one-of-a-kind at the facility or if it is worked on often.

MOBILE DEVICE DEPLOYMENT

Mobile technology is not used at POLA for PEMs. Younger PEMs will adopt mobile technology more easily than older PEMs will. It is predicted that mobile technology will eventually be mainstream for maintenance technicians. Many large employers have already implemented mobile programs, especially those with large field areas to cover.

Recommended Corrective Actions: Recommended corrective actions are discussed below. An overall listing of corrective actions is presented in Appendix C.

Mobile technologies for maintenance management has made tremendous strides in the past few years. Tablets have become relatively inexpensive and have screens large enough for field use. Implementing a mobile program for the PEMs can increase efficiency and safety by having the proper documentation and instructions available at the equipment at all times. Documents that can be accessed by mobile technologies include:

- Operating Procedures
- Specific Safety Instructions, including required PPE and boundaries
- Equipment specific Lockout / Tagout procedures
- PM procedures including required tools and parts
- OEM manuals

Mobile devices can also connect directly to the CMMS for reporting and data input.

SECTION 15 – MANAGEMENT: ELECTRICAL SAFETY SUPERVISION AND LEADERSHIP

Section 15 Management: Electrical Safety Supervision and Leadership Overview

An electrical safety program is only as good as the understanding, efforts, and organization of the management.

In order for an electrical safety program to be effective, management must share the safety vision and provide a structure in which the safety culture is strong.

OVERALL RATING = 3.0

This section addresses best practices to make maintenance departments safer and more efficient. No code deficiencies apply.

Summary

General

All supervisor s and managers were interviewed for their outlook on safety and electrical safety at POLA. PEMs were interviewed about their interaction with managers and supervisors as it relates to electrical safety and safety culture.

The managers been in place for approximately four years and has been making marked improvements in electrical safety. Most of the strong parts of the POLA electrical safety program were implemented by the current managers and supervisors in the past years. Managers stated that they desire to build a world-class maintenance program with safety and customer satisfaction as the top priorities. Continuous improvements and programs are already in motion. Managers and supervisors shows a genuine concern for the safety of their employees and works to create a safe environment. There are no concerns with the the managers' ability to implement a high level electrical safety program.

Supervisors follow the direction of managers and are responsible for implementing and overseeing electrical safety in the field. Supervisors have a genuine concern for safety of their employees, but at times demonstrates negative safety behavior as previously discussed in Part II. In certain detailed aspects of electrical safety, supervisors lack the proper knowledge to properly implement all aspects of the program and to serve as a strong leader in this area, especially when the workforce below them has more knowledge. The vast array of electrical equipment at POLA and the hazards and challenges that go with them require a level of expertise that is lacking in the supervisors. The lack of knowledge is seen by some PEMs as a lack of concern for electrical safety as the right steps are not always taken. This is most prevalent in the day shift.

Put simply, there is strong management, deep electrical knowledge on the PEM teams, but the program is getting lost in translation with some of the supervisors. That is not to say that the supervisors are not good leaders but rather that they have some have gaps in electrical safety and electrical systems knowledge that is required for an environment as complex as the Port of Los Angeles. PEM shop supervisors and managers come from a primarily mechanical or other non-electrical background, with the exception of Director of Construction and Maintenance II who has little interaction with activities in the field. The majority of the work performed by PEMs and by far the most dangerous work performed by PEMs is electrical, but there no supervisor or field management that has deep expertise in this area. The lack of a deep electrical knowledge within he supervisor staff, and no electrical safety leader or electrical safety team, has resulted in a program that has some gaps that need to be filled, is the source of a major conflict, and is a safety issue within the PEM group.

Gaps that need to be filled are identified throughout the report.

Mechanical vs. Electrical Conflict

Conflicts between mechanical and electrical shops and personnel is common in many organizations. Mechanical tradesmen can be a jack-of-all trades and typically perform some electrical work. The conflict is that electrical tradesmen often find deficiencies in the quality or safety of the work and express concerns.

Different approaches are taken when troubleshooting and repairing between mechanical and electrical trades background. A mechanical philosophy to troubleshooting or repairing equipment can be very different than the electrical philosophy and is not always in alignment with electrical safe work practices. Mechanical technicians tend to have "hands on" solutions and fixes problems by physically touching or moving a component for evaluation. Mechanical fixes often have components or pieces that can be fixed, often with common tools and without compromising safety. When an electrical component malfunctions, the electrical technician will approach it from a safety procedural and logical troubleshooting aspect. Equipment is rarely touched if it malfunctioned. Testing procedures are done first and if the equipment has been found to be damaged, the equipment is replaced, not repaired.

This philosophical difference in approaching equipment problems is part of a large conflict with workers with deep electrical backgrounds feeling managers and supervisors with mechanical backgrounds are disregarding electrical safety. While the mechanical philosophy may be more effective at times, it is not in alignment with proper electrical safety practices. Reports of supervisors being directly involved with or responsible for some electrical incidents can't be overlooked.

Separating Out Complaints from Legitimate Concerns

PEMs have complained about their work environment, unsafe work practices, and unfair hiring practices. Because this is all intertwined, it can be difficult for the C&M managers and supervisors to separate out what is a complaint because someone has felt cheated and what is a legitimate safety complaint. The conflicts with the PEMs has potentially blinded the managers and supervisors about the real safety issues.

Communication & Dissemination of Information

As discussed in Part II Item 3, there is a communication gap between supervisors and some PEMs. The same information is not being distributed to all PEMs creating potential safety issues and further deepening the mistrust.

There is not a good line of communication for electrical safety needs from the PEMs to the managers. Information from the PEMs is filtered before it hits managers.

Electrical Safety Leadership

As already discussed in Part II Item 1, safety management currently falls under the direction of the C&M managers and supervisors with informal communications with Engineering. There is no formal electrical safety team nor a head person for electrical safety, which has contributed to some of the observed gaps. When PEMs, supervisors, and managers alike were asked who is responsible for electrical safety or who is the expert on electrical safety, everyone had a different answer, and in most cases there was no particular person that was identified.

Because there is a significant population of workers below the supervisor level that have deep knowledge and understanding of electrical systems and electrical safety, conflicts arise when directions are taken or given by supervisors or managers who do not have as strong as background.

PEM Strategy & Conflict

The PEM position is a multi-craft position, which is common with many employers that want to leverage the most out of their workforce. Multi-craft technicians can be very effective and there is nothing improper about the strategy of creating a PEM position.

The core conflict in the PEM shop revolves around workers and supervisors or managers from different backgrounds and varying degrees of knowledge and electrical experience and the jobs they each perform under C&M. In particular, some of those who began as electricians believe some workers who come from a predominantly mechanical background are unfit and unsafe to work on some of the electrical tasks they are given and that supervisors from mechanical backgrounds are unfit to lead electrical maintenance operations. Although the conflictis driven by partisan interests, it is also a legitimate safety concern. The problem is significantly more prevalent in the day shift compared to the night shift.

Some individuals who began as electricians are concerned about their safety when working as an equal to, or under someone they believe doesn't have proper knowledge of the equipment they are working on or the safety procedures involved. They fear that a mistake will be made that could endanger their safety and therefore, do not always trust their co-workersor work as a team. Additionally, some of those who began as electricians are upset that higher-level work or supervision is given to those with less knowledge and experience than themselves. As a result, these individuals take a reserved approach in showing the less experienced workers the correct or safe way to perform work, and instead let the less experienced person potentially struggle with

their task as a statement of the inequity they see. This lack of concern is contrary to a good electrical safety system.

On the other hand, some individuals with less electrical experience do not always feel safe working with more experienced individuals because they feel their partner is waiting for them to make a mistake in order to demonstrate the lack of knowledge of the less experienced. As a result, these less experienced individuals tend to work in a more isolated way, and are hesitant to ask for help so that they don't expose any weaknesses that could be used against them.

Both the more experienced and less experienced individuals have valid concerns. These concerns have created a lack of trust and lack of teamwork which is essential for electrical safety.

Recommended Corrective Actions:

Electrical work at POLA represents the majority of the work done by the PEMs, is the most dangerous work performed by the PEMs, and is the most vital to POLA customers. Having a safe and efficient electrical workforce should be one of the highest, if not the highest concern for C&M management.

The following are suggested to create a safer and more efficient electrical safety program:

1. Create a Cross Functional Electrical Safety Team
As discussed in Part II Item 3, a cross-functional electrical safety team should be created to address the continuous improvements and management of the electrical safety program. It's important to have members from different areas on the team. The team should consist of the following members:

- Both Operations & Maintenance Managers / Supervisors (all C&M workers need representation, not just PEMs)
- Risk Management representative
- Engineering representative
- PEM representative
- Electrician representative

2. Assign Electrical Safety and Electrical Systems Leader at Supervisor Level
As discussed in Part II Item 1, POLA C&M has a deep talent pool, but not all the resources are being properly leveraged for electrical safety. Someone with deep knowledge of electrical systems and a high concern for electrical safety should be assigned to a leadership and supervisor position for the PEM group. This may include the addition of two positions of the electrical technical advisor and Senior PEM. This individual needs to be interacting daily with the PEMs in the field.

This individual would be responsible for:

- In-field electrical operational decisions
- Keeping up to date with codes and compliance standards
- Dissemination of electrical safety information to all PEMs
- Helping support and train those with less experience
- Helping determine who is qualified for what tasks and equipment
- Representing the electrical safety needs in the field to management
- General oversight of electrical safety in the field

3. Hire a Safety Expert

As discussed in Part II Item 2, currently, the Port has one safety engineer housed in Risk Management who has responsibility for the entire Port. The C&M division has a large workforce and faces a variety of specific safety issues. Increased safety staffing can assist with the achievement and institution of OHSAS 18001, coordination of safety committee; demonstrate the Port's commitment to safety, and to provide further leadership and visibility in health and safety at the Port. The Port can also consider hiring an electrical safety expert in addition to a traditional safety generalist as traditional general safety personnel do not have expertise in electrical safety.

4. Proper Assignment of Resources & Continued Cross-training

Resources should be assigned only to those who have had been properly trained and have demonstrated skill and knowledge for a particular equipment or tasks. As part of the Qualified Person and QEW program, individuals should not be assigned to do work alone until they have become qualified for the job. Team sent out should consist of at least one Qualified Person who has a high level of knowledge with the equipment and system.

Cross-training should continue by pairing those with less knowledge and those with more knowledge of particular systems or tasks. Cross-training is discussed briefly in Part II Item 3.

5, Job Classification review of PEM

In order to properly assign PEMs, it may be necessary to re-classify the PEM job requirements in order to introduce varying levels or qualifications of PEMs. Currently, a PEM is "qualified" to work on all electrical equipment at POLA regardless of their experience on their equipment, which is a direct conflict with how "Qualified Person" is applied by CalOSHA and the similar codes. Once the PEM status is achieved, all employees in that group are treated equal and deemed capable of any job, however, not all PEMs have the same skill sets or are Qualified

Persons for all equipment or all tasks. For instance, a PEM might have experience and be a Qualified Electrical Worker for high voltage switching, but may not know the racking out procedures for particular low voltage equipment or may not be familiar with how to properly choose equipment, bend conduit, size wires and properly ground a new piece of equipment.

It should be noted that these recommendations to improve electrical safety and comply with Cal/OSHA on definitions of "Qualified Persons" may be in conflict with the Civil Servant job descriptions or regulations as it would restrict tasks and jobs that individuals could perform, despite their job classification or job description. In order to implement a proper "Qualified Person" system that identifies individuals to tasks they can perform based on safety and knowledge, it may require changes in the PEM job description and / or changes to the Civil Servant regulations regarding these types of jobs.

See section 2.0 for detailed recommendations on creating a Qualified Person program based on tasks and equipment.

APPENDIX A

ACRONYMS

List of Acronyms

AED	Automated External Defibrillator
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
AQMD	Air Quality Management District
ASTM	American Society for Testing and Materials
BMP	Best Management Practices
CalOSHA	California Occupational Safety and Health Administration
CFO	Chief Financial Officer
CCR	California Code of Regulations
CMMS	Computerized Maintenance Management System (e.g. C&M uses Mainstar)
CPR	Cardiopulmonary Resuscitation
C&M	Construction & Maintenance
DHS	Department of Health Services
EPA	Environmental Protection Agency
FPN	Fine Print Note
FRA	Federal Railroad Administration
GFCI	Ground Fault Circuit Interrupter
HRC	Hazard/Risk Category
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
IIPP	Injury, Illness, and Prevention Program
IR	Infrared
LADWP	Los Angeles Department of Water and Power
LFMC	Liquid-Tight Flexible Metal Conduit
MCC	Motor Control Center
NEC	National Electrical Code
NESC	National Electric Safety Code
NFPA	National Fire Protection Agency
OEM	Original Equipment Manufacturer
OHSAS	Occupational Health and Safety Assessment Series
OSHA	Occupational Safety and Health Administration
PEM	Port Electrical Mechanic(al)
PLC	Programmable Logic Controller
PM	Preventive Maintenance
POLA	Port of Los Angeles
PPE	Personal protective equipment
QEW	Qualified Electrical Worker
SCCR	Short-Circuit Current Ratings
SOP	Standard Operating Procedure
VFD	Variable Frequency Drive

APPENDIX B

DEFINITIONS

Definitions

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, and so forth.
Affected Employee - an employee who performs the duties of his or her job in an area in which the energy control procedure is implemented and servicing or maintenance operations are performed, or work with the equipment to be locked or tagged out.

Authorized Employee - an employee who performs servicing or maintenance on machines and equipment. Lock-out or Tag-out is used by these employees for their own protection.

Approach Boundaries. A very specific distance from an energized, uninsulated conductor or circuit part.

Arc Flash Protection Boundary. A flash protection boundary is the distance from the energized part where the burn hazard is less than a second degree burn. This boundary requires the person to be trained in electrical safety and wearing the appropriate PPE.
Limited Approach Boundary. A shock protection boundary. An approach limit at a distance from an exposed live part within which a shock hazard exists. This shock protection boundary is to be crossed only by qualified employees. If an unqualified person is to cross this boundary, they must be escorted by a qualified person.
Prohibited Approach Boundary. A shock protection boundary. An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part
Restricted Approach Boundary. A shock protection boundary. An approach limit at a distance from an exposed live part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part. Under no circumstances shall an unqualified person be permitted to cross this boundary. This shock protection boundary is to be crossed only by qualified employees. This boundary constitutes working near energized conductors or circuit parts.

ATPV. The "arc thermal performance value" is the highest incident energy which does not cause a Fire Resistant fabric to breakopen and does not exceed the second degree burn criteria.
Arc Flash. The rapid and forceful release of superheated air, hot gases, vaporizing metal, droplets of molten metal and other physical debris when electrical current flows across a gap between electrical conductors.
Arc Flash Hazard Analysis. A study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices and the appropriate levels of PPE.

Arc Rating. The maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to breakopen or at the onset of a second-degree skin burn. Arc rating is normally expressed in cal/cm2.
Attendant. The primary duty and responsibility of an attendant shall be to keep unqualified employees outside a work area where the employee might be exposed to electrical hazards
Barricade. A physical obstruction such as tapes, cones, or other structures intended to provide a warning about and to limit access to a hazardous area.

Block-out - A type of energy-isolation device that physically prevents the flow or movement of energy. Use appropriate blocks if a hazard still exists from equipment cycling or gravity.

Bond/Bonding/Bonded. The permanent joining of metallic parts to form an electrically conductive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed.

Cable tie – A long thin plastic or nylon fastening device that locks when the point on one end is threaded through the loop on the other.

Chemical energy - Power created by the reaction between two or more substances.

Control of Hazardous Energy – OSHA's proper title for the lock-out/tag-out/block-out standard.

Coordination (Selective). Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.

Dead Front. Without live parts exposed to a person on the operating side of the equipment.

De-energized. Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential difference from the earth.

Disconnecting. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Electrical Hazard. A dangerous condition such that contact or equipment failure can result in electric shock, arc-flash burn, thermal burn, or blast.

Electrical Single-Line (One-Line) Diagram. A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used in the circuit or system.

Electrically Safe Work Condition. A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Energized. Electrically connected to, or is, a source of voltage.

Energy Isolating Device - any mechanical device that physically prevents the transmission or release of energy. These include electrical circuit breakers, disconnect switches, line valves, and blocks.

Energy Source - any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other energy.

Energy Control Procedure - written documentation that contains all information needed for authorized employees to safely control hazardous energy during servicing or maintenance of machines or equipment.

Equipment. A general term including material, fittings, devices, appliances, luminaires (fixtures), apparatus, and the like used as a part of, or in connection with, an electrical installation.

Exposed (as applied to live parts). Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.

Flame-Resistant (FR). The property of a material whereby combustion is prevented, terminated, or inhibited following the application of a source of ignition, such as an arc-flash.

Flash Protection Boundary. An approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc-flash were to occur.

Flash Suit. A complete FR clothing and equipment system that covers the entire body, except for the hands and feet. This includes pants, jacket, and bee-keeper-type hood fitted with a face shield.

Ground. A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

Grounded / Grounding. Connecting stray electrical current to earth or to some conducting body that serves in place of the earth.

Grounded, Effectively. Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages that may result in undue hazards to connected equipment or to persons.

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.

Grounding Conductor, Equipment. The conductor used to connect the non–current-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment or at the source of a separately derived system.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

Hasp - A metal or plastic locking mechanism consisting of a hinged closure with a slot that closes over a loop. The loop is then secured with a lock.

Hydraulic Energy - Power created by the compressive force or movement of a liquid in a confined area. Machines that lift objects often use hydraulic energy.

Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular Code requirement.

In Sight From (Within Sight From, Within Sight). Where this Code specifies that one equipment shall be ``in sight from,'' ``within sight from,'' or ``within sight,'' and so forth, of another equipment, the specified equipment is to be visible and not more than 15 m (50 ft) distant from the other.

Incident Energy. The amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm2).

Interrupting Rating. The highest current at rated voltage that a device is intended to interrupt under standard test conditions.

Job Briefing. Prior to any work beginning, a Job Briefing discussion must be held amongst all employees who are to be in the work area. The purpose of the discussion is to make all affected employees aware of the job specific hazards, work procedures, special precautions, energy source controls and PPE.

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Limited Approach Boundary. A safe approach limit at a distance from an exposed live part within which a shock hazard exists.

Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
Live Parts. Energized conductive components.
Lock-out - "Locked out" means the use of devices, positive methods and procedures, which will result in the effective isolation or securing of prime movers, machinery and equipment from mechanical, hydraulic, pneumatic, chemical, electrical, thermal, or other hazardous energy sources.

Machine Guard – A shield or cover over hazardous areas on machine to prevent accidental contact with body parts or to prevent debris (e.g. metal chips) from exiting the machine.

Mechanical energy - A combination of kinetic and potential energy resulting from the force of gravity or the movement or release of a machine component, such as a spring, clamp, or wheel.

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.
Pneumatic energy - Power created by the compressive force or movement of air or gas in a confined area. Assembly tools often use pneumatic energy to force parts together.

Potential energy - Power that is stored or suppressed or that exists because of its position and the effects of gravity. Machines that have large components that raise and lower, such as a press, contain potential energy that becomes kinetic energy when it is released.

Prohibited Approach Boundary. An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part.
Qualified Person. A person, designated by the employer, who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.
Restricted Approach Boundary. An approach limit at a distance form an exposed live part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part.
Safety Watch. A person assigned the task of watching a qualified person perform a potentially hazardous task. The Safety Watch has the primary responsibility of de-energizing the circuit in the event of an accident and or removing the qualified person from the immediate hazard.
Standby Person. Same as "Safety Watch".
Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments.

Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.

Tag-out - placement of a tag, sign or label to an energy isolating device as a warning to others that the equipment or machine cannot be operated until the Tagout device is removed. A tag attachment is a device such as cable ties that connect tags to energy isolation mechanisms or locks.

Thermal energy - Power created by or in the form of heat. Heat can be retained in machine parts and cause burns

Working Near (live parts). Any activity inside a Limited Approach Boundary.

APPENDIX C

CORRECTIVE ACTIONS TABLE

Port Authority Los Angeles
Recommended Corrective Actions Report

Area	Corrective Action/ Item# Reference	Raw Score (1 to 10)	Risk Ranking (1 to 3)	Topic	Recommended Corrective Action(s)
Safety Culture	II - 1.1a	4	1	Management	8 CCR 8 3203(a)(1) - Establish an overall electrical safety technical advisor.
	II - 1.1b			Management	8 CCR 8 3203(a)(1) - Establish a Senior PEM position for oversight of electrical safety operations in the field.
	II - 1.2			IIPP	8 CCR 3203(a)(2) - Institute an employee recognition program, institute a process to hold supervisors accountable for safety and to provide a good role model for safety.
	II - 1-3a			Safety Committee	8 CCR 3203(a)(3) - Create a cross-functional electrical safety team consisting of members from various departments.
	II - 1.3b			Safety Committee Meetings	8 CCR 3203(a)(3) - Establish regular electrical safety meetings.
	II - 1.4			Safety Audits	8 CCR 3203(a)(4) - Develop field work inspection program and document field inspections, perform risk analysis on aging equipment and associated corrective action plan.
	II - 1.5			Accident Investigation	8 CCR 3203(a)(5) - Perform formal accident/incident/near miss investigations and flow down findings and lessons learned to front line workers. Educate employees on importance of reporting near misses, first aid incidents, and accidents.
	II - 1.6			Tracking	8 CCR 3203(a)(6) - Develop a process to track unsafe items to ensure that corrective actions are implemented to correct the noted issues. Perform root cause analysis and disseminate lessons learned to front line workers.
	II - 1.7			Safety Meetings	8 CCR 1509(e) - Conduct tailgate meetings with content focused on immediate tasks, concerns or incidents.
	Best Management	NA	NA	ISO	ISO 18001 - As a best practice, it is strongly recommended for the Port to implement ISO 18001 to bring health and safety items to the forefront of the business culture.
General Safety Training	III - 1.1a	7	2	Training	8 CCR 3203(a)(7) - Define training populations to understand which employees are authorized and required to take specific training.
	III - 1.1b			Training	8 CCR 3203(a)(7) - Generate a training calendar to ensure employees receive training in required time frame.
	III - 1.1c			Training	8 CCR 3203(a)(7) - Consolidate Risk Management and C&M training records.
	III - 1.1d			Training	8 CCR 3203(a)(7) - Conduct a gap analysis of training requirements.
	III - 1.1e			Training	8 CCR 3203(a)(7) - Provide training based on the gap analysis.
	III - 1.2			Aerial Lift Training	8 CCR Subchapter 7 Group 4 - Provide PEMs with aerial lift training initially as required by regulations and every 3 years as directed by POLA and as recommended by ANSI A92.6.
	III - 1.3			Confined Space Training	8 CCR 5157(g) - Determine population of PEMs who are confined space entrants, attendants, and rescue personnel and create a list of these persons. Provide training for non-rescue personnel initially as required by regulations and every 3 years as directed by POLA. Provide rescue operations drill and training every 12 months as required by the regulations.
	III - 1.4			Forklift Training	8 CCR 3668(d)(2) - Determine population of PEMs who require forklift training and create a list of these persons. Provide training every 3 years as required by regulations.
	III - 1.5			Hand Tool Training	8 CCR Subchapter 4 Construction Safety Orders - Provide hand tool and power tool safety training initially as required by regulations and every 3 years as directed by POLA.
	III - 1.6			Hearing Conservation Training	8 CCR 5099(a)(2) - Determine Hearing Conservation Enrollee Personnel. Provide annual hearing conservation training to these employees as required by regulations.
	III - 1.7			Hot Work Training	8 CCR 4779 - Determine list of employees who require hot work training. Train these employees in hot work initially as required by regulations and every 3 years as recommended by POLA.
	III - 1.8			Ladder Safety Training	8 CCR 1509 and 1510 - Provide ladder safety initially as required by regulations and every 3 years as directed by POLA.
	III - 1.9			LOTO Training	8 CCR 3314 - Provide LOTO authorized training initially as required by regulations and every 3 years as directed by POLA.
	III - 1.10			Respirator Training	8 CCR 5144 - Define personnel who are required or may need to wear respirators as part of their job. Provide annual respirator training, medicals, and fit testing to these employees as required by regulations.
	III - 1.11			Rigging Training	8 CCR 5006(a) - Determine who is a qualified operator of a hoist or crane. Provide rigging activities initially as required by regulations and every 3 years as directed by POLA.
	III - 1.12			Shop Tool Safety Training	8 CCR 3203(a)(7) - Provide Shop Tool Safety training to employees initially as required by regulations and every 3 years as directed by POLA.

Port Authority Los Angeles
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Area	Corrective Action/ Item# Reference	Raw Score (1 to 10)	Risk Ranking (1 to 3)	Topic	Recommended Corrective Action(s)
General Safety Training (cont.)	III - 1.13	7	2	Railway Safety Training	49 CFR 214 .343 - Determine population of PEMs who work as "roadway workers" when working adjacent to railways. Train PEMs annually in Roadway Worker Protection on an annual basis. 8 CCR 1599(g) - Provide flagger training initially as required by regulations and every 3 years as directed by POLA.
	III - 1.14			Excavation Training	8 CCR 1541 - Provide trench and excavation training initially as required by regulations and every 3 years as directed by POLA.
	III - 1.15			Lead and Asbestos Training	8 CCR 1529(k) and 1532.1(l) - Provide lead and asbestos awareness training on an annual basis as required by regulations.
	III - 1.16			Storm Water Awareness Training	40 CFR 122.21 - Provide storm water awareness training to employees initially as required by regulations and every 3 years as directed by POLA.
Electrical Safety Written Program	1.1A	8	1	Low Voltage Electrical Safety Written Program	Develop a written electrical safety program for low voltage. Train workers to the contents of the program.
	1.1B			High Voltage Electrical Safety Written Program	Update the current document with notes as identified on page 62 in Item #1.1B.
Qualified Persons	2.1A	4	2	Qualified Person Program (low voltage)	Develop a program that identifies a Qualified Person (training, skill & knowledge) for low voltage equipment & tasks. See Appendix C of report for details. In order to implement a proper "Qualified Person" system that identifies individuals to tasks they can perform based on safety and knowledge, it may require changes in the PEM job description and / or changes to the Civil Servant regulations regarding these types of jobs.
	2.1A			Qualified Person Program (low voltage)	Appoint someone to oversee this program (see 2.8 in report).
	2.1A			Qualified Person Program (low voltage)	Perform regular supervision and inspections of workers (see 2.8 in report).
	2.1A			Qualified Person Program (low voltage)	Document all activities for Qualified Person program for each individual including the tasks they can perform and equipment they can work on (see 2.9 in report).
	2.1B	8	2	Qualified Electrical Worker Program (high voltage)	Document time spent on high voltage equipment. Make QEW specific to equipment / tasks.
	2.1B			Qualified Electrical Worker Program (high voltage)	Establish a formal process of observing or inspecting employee safety-related work practices on at least an annual basis (see 2.10 in report).
	2.2	6	1	Qualified Person General Electrical Safety Training	Re-train on electrical safety with emphasis on: release methods of victims, arc flash protection, insulated tool use, setting boundaries, role of PPE, flexible cord use.
	2.2			Qualified Person General Electrical Safety Training	Update high voltage training. Make certain the instructor is an expert at high voltage.
	2.2			Qualified Person General Electrical Safety Training	Conduct electrical safety training for boom trucks and lifts.
	2.6			Qualified Person Lockout / Tagout Training & Retraining	Conduct Lockout / Tagout training annually and provide periodic inspection. Document training and inspection.
	2.7			Qualified Person Job Task Training	Provide additional and deep equipment specific training.
	2.7			Qualified Person Job Task Training	Provide NEC training specific to maintenance technicians (field application) (2 day course).
	2.7			Qualified Person Job Task Training	Improve cross-training of PEMs / make program more formal / trackable.
	2.7			Qualified Person Job Task Training	Make certain there is one individual with expertise in CFR Title 46 Subchapter J, 110-113 for marine codes.
	2.7			Qualified Person Job Task Training	Provide / make accessible additional specialty training as needed, such as PLCs and VFDs.
	2.7			Qualified Person Job Task Training	Provide Grounding & Bonding training for field applications (2 day course).
	2.7			Qualified Person Job Task Training	Re-Training is required if a worker has not used the skills or knowledge for extended time (i.e. over a year).

Port Authority Los Angeles
Recommended Corrective Actions Report

Area	Corrective Action/ Item# Reference	Raw Score (1 to 10)	Risk Ranking (1 to 3)	Topic	Recommended Corrective Action(s)
Qualified Persons (cont.)	2.11	6	1	Limited Task Qualified Person Training & Qualification	Train non-electrical employees on tasks which require them to be a Qualified Person (i.e. breaker switching).
	2.11			Limited Task Qualified Person Training & Qualification	Document the training and demonstration of skills and knowledge (see 2.12 in report).
	2.13		3	Unqualified Person Electrical Safety Training	Provide electrical safety awareness training for unqualified workers.
	2.13			Unqualified Person Electrical Safety Training	Document the unqualified person training (see 2.14 in report).
	2.15		2	Hazardous Locations & Special Equipment Training	Identify Classified Hazardous locations that require training (battery stations, fuel docks, sewage, explosive areas…).
	2.16		3	Hazardous Locations & Special Equipment Training	Train to requirements for identified hazardous locations.
	2.16			Contractor & Visitor Program	Provide a sign-off contract program for contractors specific to electrical safety.
Design & Installation (NEC)	3	3	1	Equipment in Safe Conditions and to Code	Re-instate standards for returning equipment to proper safety conditions after work has been performed.
	3			Equipment in Safe Conditions and to Code	Develop a plan to fix equipment that currently is out of code and / or poses a hazard. See detailed 8-step recommended process in section 3.0 of the report.
Identification & Labeling	4.1	4	3	Equipment Name Identification Labels	Assign and apply missing Equipment ID labels missing on equipment. See section 4.1 in report for details.
	4.2		2	Equipment Voltage Identification Labels	Assign and apply missing Voltage Rating / Shock Hazard labels missing on equipment. See section 4.2 in report for details.
	4.3		2	Equipment Feed Identification Labels	Assign and apply missing Equipment Feed labels missing on equipment. See section 4.3 in report for details.
	4.4		1	Arc Flash Warning Labels	Put arc flash labels on equipment that identify PPE and boundaries. See section 4.4 in report for details.
	4.6		2	Arc Flash Label Content	Engineering specifications on arc flash labels should be updated per section 4.6 findings.
	4.8		2	Electrical Room Warning Labels	Proper "Warning" signs need to be place on electrical room doors.
	4.9		2	Hazardous Area Warning Labels	Identify Classified Hazardous locations (battery stations, fuel docks, sewage, explosive areas…).
	4.9			Hazardous Area Warning Labels	Apply proper warning signs in identified hazardous locations.
	4.10		2	Disconnect Labels	Properly label all circuit breaker & disconnects.
	4.11		3	SCCR Labels	Engineering to add specifications to require SCCR label on outside of all industrial control panels.
Electrical Maintenance & PM	5.1	3	1	Preventative Maintenance	Develop and implement an Electrical Preventive Maintenance program. See section 5.1 for details on steps.
Electrical Drawings	6.1	6	3	Electrical One-Line Drawings	Provide better availability of one-line drawings to workers in the field. See section 6.1 for suggestions.
	6.1			Electrical One-Line Drawings	Develop a process for updating one-lines and creating new one-lines. This may include hiring a drafter to update drawings. See section 6.1 for suggestions.
Reports & Studies	7.1	6	2	Arc Flash Analysis	Conduct an arc flash analysis for existing equipment. See section 7.1 for details.
	7.5			Short Circuit Study	Conduct short circuit studies on existing equipment when conducting the arc flash analysis.
	7.7			Protective Device Coordination Study	Conduct Protective Device studies on existing equipment when conducting the arc flash analysis.
	7.8			Electrical Safety Audit	Conduct regular electrical safety audits. Recommended once every 3 years.
Testing	8.1	2	2	Infrared / Thermography Inspection	Implement infrared inspection as part of your preventive / predictive maintenance program.
	8.2			Circuit Breaker Testing	Perform circuit breaker testing to manufacturer's recommendations as part of your preventive maintenance program.

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Area	Corrective Action/ Item# Reference	Raw Score (1 to 10)	Risk Ranking (1 to 3)	Topic	Recommended Corrective Action(s)
Testing (cont.)	8.3	2	2	Relay Testing	Perform relay testing to manufacturer's recommendations as part of your preventive maintenance program.
	8.4		3	Transformer Oil Analysis	Perform Transformer Oil Analysis to manufacturer's recommendations as part of your preventive maintenance program.
	8.5		2	GFCI Testing	Perform GFCI testing: before each use, after repairs & once every month with documentation.
Equipment	9.1	7	1	Test Instruments & Equipment	Workers should only use Tick Tracers for initial information and not as a sole source to identify zero energy. Implement rules on use of Tick Tracers.
	9.4		2	Portable Ladders	Remove portable ladders with conductive siding found near electrical equipment and PEM shops.
	9.4			Portable Ladders	Purchase only ladders with non-conductive sidings across all of C&M going forward.
PPE, Protective Equipment & Tools	10.1	6	1	Conductive apparel	Reinforce removal of conductive equipment on the body. Accomplish through continued safety training and worker inspections.
	10.2		1	PPE Clothing	Reinforce proper use of PPE. Accomplish through continued safety training and worker inspections.
	10.4		2	Glove & Insulated Rubber Testing	There is a glove testing system, but some gloves were found out of date. Establish a more robust system for checking gloves with a sign in/out sheet as some gloves are slipping through the system. See section 10.4 for details.
	10.6		1	Insulated & Voltage Rated Tools	Provide insulated tools for each PEM and electrician.
Work Practices	11.1	6	1	Job Planning & Procedures	Improve Job Planning to include specific tasks scheduled for each day.
	11.4		2	LOTO (Lockout / Tagout) Program	Continue development of Lockout / Tagout information for each specific piece of equipment that requires LOTO.
	11.4			LOTO (Lockout / Tagout) Program	Make LOTO procedures for each piece of equipment available in the field where it is needed. See section 11.5 for details and suggestions.
	11.6		2	Energized Electrical Work Permit Program	Establish a formal energized electrical permit program that determines when equipment can be worked on while energized and when sign-off from management and supervision is required.
Hazardous (Classified) Locations & Special Equipment	12.1	6	1	Maintenance Requirements for Hazardous Locations	Battery room maintenance requirements are not being met.
	12.2		1	Batteries and Battery Rooms	Battery room safety practices not being followed.
Engineering Controls	13	9	3	Engineering Controls	No recommendations.
Planning & Documentation Controls	14	7	3	Engineering Controls	Continue to implement MainStar CMMS for electrical maintenance and safety. See section 14 for details.
	14			Engineering Controls	Continue development of standard operating procedures for equipment where it is required. See section 14 for details.
	14			Engineering Controls	Develop a repository of OEM manuals that is easily accessible .
	14			Planning and Documentation Controls	Consider mobile device deployment for access to one line drawings, OEM manuals, work orders and reporting.

NOTES:
These recommended corrective actions summarize the suggestions in the report. The same recommendation may be given in different areas of the report to satisfy needs of the specific deficiency noted, but will only be reflected in one section of this summary to eliminate duplication.

APPENDIX D

QUALIFIED PERSONS PROGRAM

The Qualified Person Program
& Electrical Skills Training Needs Identification

Qualified Person Requirements

CalOSHA 2300, OSHA 1910.399 & NFPA 70E 110.6

According to OSHA & NFPA, A Qualified Person is “one who has received training in **and** has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.”

Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment.

While OSHA defines what a “Qualified Person”, they do not define specifically “how” to determine if a worker is a “Qualified Person” or what specific testing or observations are required and leaves this decision to each employer. There is no legal requirements on determining “Qualified Person” status and therefore, it’s up to each employer to determine what their acceptable standards and values are for determining “Qualified Person” status. The important part here is that this is YOUR program and you can design it to best suite your needs.

The components that must exist to be a Qualified Person are:

1. **Training**
    a. Electrical Safety Training must be done live in either a classroom or on-the-job setting.
    b. Electrical Safety training is required and recommended every three years by NFPA 110.2 (D)(3).
    c. CPR / AED training every year.
    d. Electrical Skills training to do the job properly. For most, this is a combination of classroom and on-the-job training.
    e. There are no set hours or requirements on any training
    f. Training that is provided should be documented.
2. **Demonstration of Skills & Knowledge**
    a. There are no specific legal guidelines on this, only that a Qualified Person demonstrate their skill and knowledge to another person who is a Qualified Person for that task.
    b. It is important to note that demonstration of skills and knowledge applies to specific tasks and equipment. A person may be “Qualified” to do particular tasks or work on particular equipment, but may be “Unqualified” on other tasks or equipment.
3. **Documentation**
    a. Training must be documented for the electrical safety
    b. Job training should be documented both in terms of on-the-job training and formal training. Past training experience can apply.
    c. Documentation on what tasks and equipment the person is qualified to do.

4. **Annual Inspection**
    a. Per NFPA 70E 110.2 (D) (1) (f) The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices.

Setting Up a Qualified Person Program & Determining Training Needs

The over-riding concern here should be that employees are working safely. Simply complying or documenting information does not necessarily make one a safe worker.

Setting up a Qualified Person Program can be done internally or by outsourcing the program to a professional electrical safety organization, such as Martin Technical. Third party service providers will set up a program based on your needs. They will define the tasks required based on the equipment and maintenance your team does and will test and observe employees.

Programs can also be set up and managed internally, which is significantly less expensive, but also takes considerable time. A Qualified Person within your organization should test and observe employees on their skill and knowledge in working safely on electrical equipment. One caution with internal programs is that if the employee doing the observation does not have a full understanding of all the proper procedures to work safely, he or she is training and observing others to the same standard as their own which may be deficient. Make certain the employee leading the observation has reviewed all aspects of NFPA 70E before implementing a program.

1. Segment by task / equipment / areas

Segment as far down as you can by task / equipment / area.

- Segment what will be done only by outside electrical contractors and what will be done internally.
- Most facilities will also find natural segment breaks by areas or equipment such as high voltage, ammonia room (hazardous), CIP pumps, line equipment panels & motors.
- Within each of the areas and specific to equipment, define the main tasks (i.e. replacing a motor, racking out a breaker, troubleshooting circuits…). If you have a CMMS, you should be able to quickly pull out the main tasks that are being done on each piece of equipment.

Once you have this segmented, you now have a chart to start filling in. Fill in the chart with the names you want working on the equipment and / or who you think is qualified for that equipment and tasks.

A survey of the maintenance technicians asking them what they feel qualified and comfortable doing versus what they feel they are unqualified to do or would like more training on can be revealing as to where the biggest gaps might lie.

2. Training

Obviously you want to spend your training dollars wisely, which the following will help you do. (*See Training Needs Substantiation at the end of this document*).
1. Step 1 from above will help identify some strengths and gaps and areas where you need immediate training.

2. On-the-job training. If you have someone who is an expert at a particular task & piece of equipment, you can have them train others on-the-job.
3. Determine group size training. If fewer than 6 people need training for something, it's normally less expensive to have them attend open enrollment courses versus in house training.
4. Customized training sessions. You don't have to buy "off the shelf" training programs. Your training provider can customize your training to maximize your employee's time and your dollars. There is a lot of repeat information in taking multiple classes and you can combine them / condense them.

Suggested Training:

Divide your training into two parts:
1) training that you know you need already
2) training that needs to be discovered after you implement some of your Qualified Person program and the full audit is complete.

1) training that you know you need already based on your initial assessment of equipment and workers.

2) training that needs to be discovered after you implement some of your Qualified Person program and the full audit is complete.

Once you complete steps 1 & 3 (below) and a complete audit is done, you will have a better idea of the rest of the training you might need. Don't invest in any additional training until you have the audit and have done some of the Qualified Person program. It's better to get a "deficient" mark on the audit for skills training and know exactly what should be trained instead of spending money now on things that you might not need that much training on or come to find out you have bigger training needs.

Below are the most common training needs for multi-craft technicians.

- Electrical Safety
- CPR / AED
- Basic Electrical Skills / Electrical Troubleshooting
- Reading Electrical Diagrams / Drawings
- Grounding & Bonding
- Industrial Wiring
- Industrial Installations & Conduit Support
- National Electrical Code (NEC)

3. Demonstration of Skills and Knowledge

Demonstration of skill and knowledge is your most valuable tool to identify what your skill gap needs are and what your training needs are along with verification of a Qualified Person.

Outsourced Method:
Contact an electrical safety consulting company proficient in setting up Qualified Person programs.

Internal Method:
Assign a manager or someone who is very qualified on a particular task to be the observer and do the following:

- Using the matrix from step 1, create a checklist of the steps that need to be done (see sample below)
- Using the matrix from step 1, ask the employee if they feel they are qualified and comfortable with all aspects, tasks, equipment they are assigned to. Interviewing can be an easy way to find out where strengths and weaknesses are.
- Have workers demonstrate their skill and knowledge for the tasks and equipment they are assigned to based on a checklist for that task / equipment.

Checklist example for remove / replace / insert MCC bucket:

☐ 1. Determine the Shock and Arc Flash Hazard Boundaries: Understand and follow the Limited, Restricted, and Prohibited Approach Boundaries.
☐ 2. Choose the proper PPE & tools to perform troubleshooting or repair.
☐ 3. Determine and observe working space requirements and alerting requirements.
☐ 4. Identify all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags. Determine if other hazardous energy is associated with this equipment (mechanical, pneumatic, hydraulic, thermal, fluid and gases, water under pressure, and gravity).
☐ 5. Identify location of Line (input) and Load (output) terminals.
☐ 6. Identify location for energy isolation / follow proper LOTO procedure including verification of de-energization.
☐ 7. Follow proper procedures required to remove, replace, and insert MCC bucket.
☐ 8. Properly re-energize the equipment.

The observer can also use the sheet on the last page to observe the basic skills and knowledge.

Once the Qualified Person program is implemented and the observations are done, you will start to build a profile of the gaps that identify your training and skills needs and can go back to step 2. After observing a few employees, you will most likely see some trends which will help identify training needs. You won't need to observe everyone before you get the big picture, but you will find that individuals may have some specific gaps unique to them that need to be filled.

If a person is deficient, eliminate them from the task until they get trained and can go back through the demonstration without problems.

Time & Project Management: Based on our experience, it might take 2 – 3 hours per person, so there is some significant time involved here to do this properly. You don't have to do it all at once. Following are my suggestion on making this more manageable.

1. Focus first on the most dangerous and unique jobs and equipment.
2. Spread the responsibilities around on observation tasks. Have David do a "train the trainer" on things to look for on PPE, Alerting techniques, proper use of multimeter….. so that all observers are looking for the same things.
3. When work orders come up and a job needs to get done, have an observer watch them and check that off.
4. Set aside 2 -3 hours at a given time each week for the observer to qualify a person. If you have 3 observers doing a person a week, you can have the program completed in 15 weeks.

From an audit & standpoint, the most important thing is to have a process in place and be working on it. It doesn't have to be completed by the time of the audit.

Other Methods:
Remember, this is your program to define what a Qualified Person is, so you can make deviations from this as long as you can back them up and they seem reasonable.

4. Documentation

Document all training and what individuals are qualified for what tasks / equipment. This should be part of the individual's personal record and also kept as a master with maintenance. A sample of general maintenance safety requirements documentation follows on the next page.

5. Annual Inspection
NFPA 70E 110.2 (D) (1) (f) The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices.

As part of being a Qualified Person, demonstration of skills and knowledge should be done annually.

Individual Electrical Skills Assessment and Certification		
Name:	Date:	Review Date:
Observer:	Lic#:	Certification Date:
Tasks the above Mechanic is certified to complete.	**Authorized**	**Comments**
	"X" for yes	
Proper use of Test Equipment:		
1. Voltage Meter		
2. Amp Probe		
3. Megger		
4. Proper care of Equipment		
5. Inspection of equipment		
PPE Required		
1. Safety Glasses		
2. Rubber and Leather Gloves		
3. Insulated Tools		
4. PPE for arc flash		
Identification of Circuit Voltage		
1. 24vdc		
2. 110vac		
3. Control voltage high or Low		
4. 3 phase 480 phase to phase		
5. 3 phase 480 phase to grnd		
6. 3 phase 208 phase to phase		
7. 3 phase 208 phase to grnd		
Proper Troubleshoot methods		
1. Circuit Isolation		
3. Machine Specific LOTO		

Individual Electrical Skills Assessment and Certification		
4. Low voltage		
5. High voltage (nothing above 480vac)		
6. Ohm fuses		
7. XFMR input output		
8. Contactor operation		
Proper sizing of circuit feed, control and overload		
1. Fuses		
2. Breakers		
3. Control wiring		
4. Feeder Circuits		
5. Contactors		
6. Overloads		
Comments:		
Safety Note: Any electrical circuit that maintenance is being performed on will be isolated and de-energized except when troubleshooting the circuit if required. Trouble-shooting is considered live work and requires appropriate PPE.		

Training Needs Substantiation for Maintenance Workforce

The president of Motorola once told his management team that all employees would be required to complete no less than 40 hours of training each year. A high-level manager raised his hand and asked, **"But what if we train them and they leave our company?"** To that, the president replied…**"What if we don't train them and they stay?"**

For many managers, this often-referenced statement quickly crystallizes the importance of training their workforce. Without the need of any scientific backing, a manager can quickly run this scenario through their head and come up with the vast differences between working with a team that is constantly improving versus one that is destined to never improve and make the same mistakes over and over.

Despite the obvious need for training, many companies and organizations still struggle with committing to properly train their teams. In every job, being properly trained can help the company become more profitable or run more efficiently, but nowhere is this more pronounced than in training for the skilled workforce, which includes facility and plant maintenance technicians.

Training Needs Substantiation

Properly trained personnel are the heart of safe and reliable plant maintenance and operations. But with rising operating and maintenance costs and continuing demands for cost reduction, facility and plant management can find difficult to substantiate the need to maintain or increasing their training budgets. While reducing training can quickly lower the budget, the full ramifications of the reduced training need to be considered.

Cost

There are a dozens of studies from multiple industries that have determined that human error is a major contribution to equipment downtime. With electrical distribution equipment, it is projected that 70% - 80% of unplanned shutdowns is due to human errors.[1] Many of the human errors can be traced directly back to the lack of knowledge or proper training. A continued decrease in training will lead to increasing equipment breakdown resulting in both downtime costs and more workforce required to repair the equipment. These costs are normally significantly more than the investment in the cost of training.

Conversely, while an investment in training is an up front cost, it reduces the unknown and unplanned costs of downtime, ultimately saving money. To increase the effectiveness of plant training programs, available resources should be applied to areas that can most quickly curb plant operations and maintenance costs.

Most companies find it worthwhile to collect and maintain data that help justify the costs of training programs. Information on reducing human errors, repair or maintenance time for certain tasks and outage durations can easily justify substantial investments in personnel training.

Those companies & organizations that monitor their training results have found direct links to performance in their business and spend 31% more on training per employee than the average company or organization.[2]

Safety

Safety should be at the core of every maintenance management program and the best way to ensure a safe work environment is through continuous training. A long tenure as a maintenance technician does not mean that training is no longer required. As regulations, programs and technologies change, workers need to be kept up to date with these changes.

A lack of knowledge about safety requirements can lead to injuries, death as well as big financial losses. On average, in the United States, nearly 11,000 workers are treated in emergency departments each day, and approximately 200 of these workers are hospitalized.[3] When these accidents happen, the financial considerations can include regulatory fines, medical bills, insurance premium rate increases, equipment or facility downtime, equipment replacement, worker loss and third party legal suites.

According to a National Safety Council report in 2000, the average cost of an industrial accident involving a death was $940,000 and the average cost of an accident involving a disabling injury was $28,000. While these are averages, many of the accidents in industrial settings can be much higher. The Electric Power Research Institute estimated the
total of direct and indirect costs of a major electrical accident at $17.4 million in 2003 dollars.

Aging Workforce Crisis

For most organizations, people are considered to be the greatest asset because of what they know. In some industries, up to 40% of the skilled workforce is set to retire in the next ten years[4], taking with them their skills and knowledge. In the maintenance industry, the loss of personnel and information combined with an aging infrastructure has been identified as an impending crisis known as the "maintenance crisis".

In an online poll conducted by ASTD between December, 2005 and January, 2006, 96 percent of the 396 respondents said they had a skills gap within their organizations or expected one within a year. This gap is expected to greatly increase in the coming years as a large population of Baby Boomers retiring.

This exodus of a large population of skilled maintenance workers is presenting a challenge for the US to maintain its plants and facilities. Organizations must not only be able to attract a new workforce, but they must also be able to quickly transfer the knowledge of the older workforce to the newer.

An examination of your current maintenance workforce should be assessed to include the retirement rate of the workers. In the coming years, finding a skilled maintenance technician to hire will become a very difficult task as well as more expensive. The best strategy for today is to identify and train young workers now to be competent by the time the older worker retires.

[1] Electrical Construction & Maintenance (EC&M) magazine, 2004, A Practical Guide for Electrical Reliability
[2] ASTD American Society for Training & Development – ASTD 2007 State of the Industry Report
3 Centers for Disease Control and Prevention, MMWR, April 2005
[4] 2005 Skills Gap Report, Delloitte

Establishing Training Budgets

In the past few years, employees average 31.9 to 36.3 hours of formal training while top producing companies spend an average of 40 hours of training per employee per year with only 11% of that training for mandatory compliance training.[6] For certain skilled specialists, the training is often more and can reach 80 – 120 hours a year.

It is estimated that corporate America spends more than 2.5% of payroll on training. It is also estimated that companies who are "training investment leaders" spend as much as 4.1% of payroll on training programs[6] Based on this, a good tool for setting a budget for those that want to be "better than average" is about 2.5% - 4% of the maintenance staff's salary. For a $40,000 salaried employee, this would equate to $1,000 - $1,600 in annual training budget. Despite tight budgets in a economic downturn, the average annual learning expenditure per employee for all companies surveyed grew from $1,068 in 2008 to $1,081 in 2009—an increase of 1.2 percent.[6]

Depending on how the training dollars were spent,$1,000 - $1,600 can be enough for about 30 – 40 hours of training in a year per employee. A typical 2-day maintenance training program will cost around $1,000, which eats up a lot of the budget, but with on-site training, online training and some other options, the per person cost for training is a lot less. A typical 2-day on site training program for maintenance technicians will cost $6K - $7K, but if there are 20 people in the class, the cost per person would only be $300 - $400. Online training is effective for soft skills and compliance training in particular, although not all compliance training can be done online (electrical safety training must be done live in classroom or OTJ). Manufacturers and vendors offer less expensive training. This type of training is good for learning a particular product or piece of equipment and is most effective after the basic or general skills have been attained. Community colleges also offer some low cost training options that can be taken advantage of. The downside to some of this training can be the time to complete the training and often less practical and more theoretical approach.

[6] ASTD American Society for Training & Development – ASTD 2010 State of the Industry Report

APPENDIX E

EQUIPMENT LABELING IMPLEMENTATION

Electrical Equipment Identification & Labeling

Electrical Equipment Identification

Methods of electrical equipment identification include:

A. Label all disconnecting devices as to the load and the location of the load. Each disconnecting means (switch or device used to disconnect the circuit from the power source) must be clearly labeled to indicate the circuit's function unless it is located and arranged so the purpose is evident.
B. Identification should be specific rather than general; a branch circuit serving receptacles in a main office should be labeled as such, not simply labeled "receptacles".
C. All labels and marking must be durable enough to withstand the environment to which they may be exposed.
D. Label all switchboards, motor control centers, industrial control panels and utilization equipment identifying the power source and power source location.
E. Each service disconnect shall be permanently marked to identify it as a service disconnect. NEC 270(B)
F. Where a building is supplied by more than one service a permanent plaque or directory shall be installed at each service disconnect location denoting all other services. NEC 230.2(E)

Attach a unique identification number to each panel. This allows positive identification and tracking for work orders, Lockout / Tagout procedures and other safety matters where identification of the proper panel(s) is required.

Label electrical panels room by room until completed. As equipment is replaced or added, updating the labels should be part of the work order close out process.

Identification Scheme

The following is a common method of identifying electrical equipment. The method described allows for all electrical equipment to be identified by type, individual number, and location by inserting a "/" before the location. An example of this method is LP8-4 / M5; which would indicate the second circuit/circuit breaker down the right side of lighting panel number 8 which is located at or near the 13th column from the north and 5th column from the west.

A. Specify type of equipment
   1) T – transformers
   2) SWBD – switchboard
   3) MSWBD – main switchboard
   4) DP – distribution panelboard
   5) PP – power panelboard, and EPP – emergency power panelboard
   6) LP – lighting panelboard and ELP– emergency lighting panelboard
   7) RP – receptacle panelboard and ERP-emergency recpt panelboard
   8) DISC – disconnect
   9) BD – bus duct
   10) M – motor
   11) ATS – automatic transfer switch
   12) UPS – uninterruptible power supply
   13) MS – motor starter
   14) ASD – adjustable speed drive
   15) CP – control panel
   16) MCC – motor control center
   17) AV – Air Valve
   18) WV – Water Valve
   19) CV – Chemical Valve
   20) HV – Hydraulic Valve

B. Specify all electrical equipment with unique alpha-numeric identification. For example: T1, T2, PP15, MSWBD3, etc.

C. Specify each panelboard circuit numerically, utilizing odd numbers for the left column and even for the right column. For example PP15-5 would be the identification of third circuit/circuit breaker located down the left side of panelboard number 15.

D. Specify the identification of each motor control center bucket (compartment) using an alpha-numeric system. Use the alphabet to identify each vertical section from left to right, and use numbers to identify each horizontal row from top to bottom. For buckets containing two circuits, identify the circuits by l and r for left and right. For example the MCC3-B1 would be the top bucket in the second section from the left in motor control center 3, and MCC12-F4r would be the right half of the fourth bucket down in the 6th section from the left in motor control center 12.

E. Specify location of the equipment
   1) Preferably specify location by closest column; based on grid layout of the facility. For example columns can be numbered A to Z, north to south, and 1 to 35, west to east. Each column, corner or wall would be identified alpha-numeric, such as C15.
   2) Depending on the layout of the facility an alternative to a grid identification system would be to use room numbers.

Label Content

Getting all content on one label so that it is easily readable can be difficult, so two labels may be required; a basic label and an arc flash label.

Basic Label typically can include:

- Equipment ID number

- Purpose of Equipment (if applicable)
- ID number of equipment feed the panel or piece of equipment
- Nominal voltage
- Available Short Circuit and Short Circuit Current Rating (SCCR) if applicable

Arc Flash Label typically can include:

- Equipment ID number
- ID number of equipment feed the panel or piece of equipment
- Nominal voltage
- PPE required for both arc flash and shock hazard (glove class)
- Arc flash and shock hazard boundaries

APPENDIX F

ARC FLASH LABELS AND LABEL APPLICATION

Arc Flash Labels & Label Application

Labels

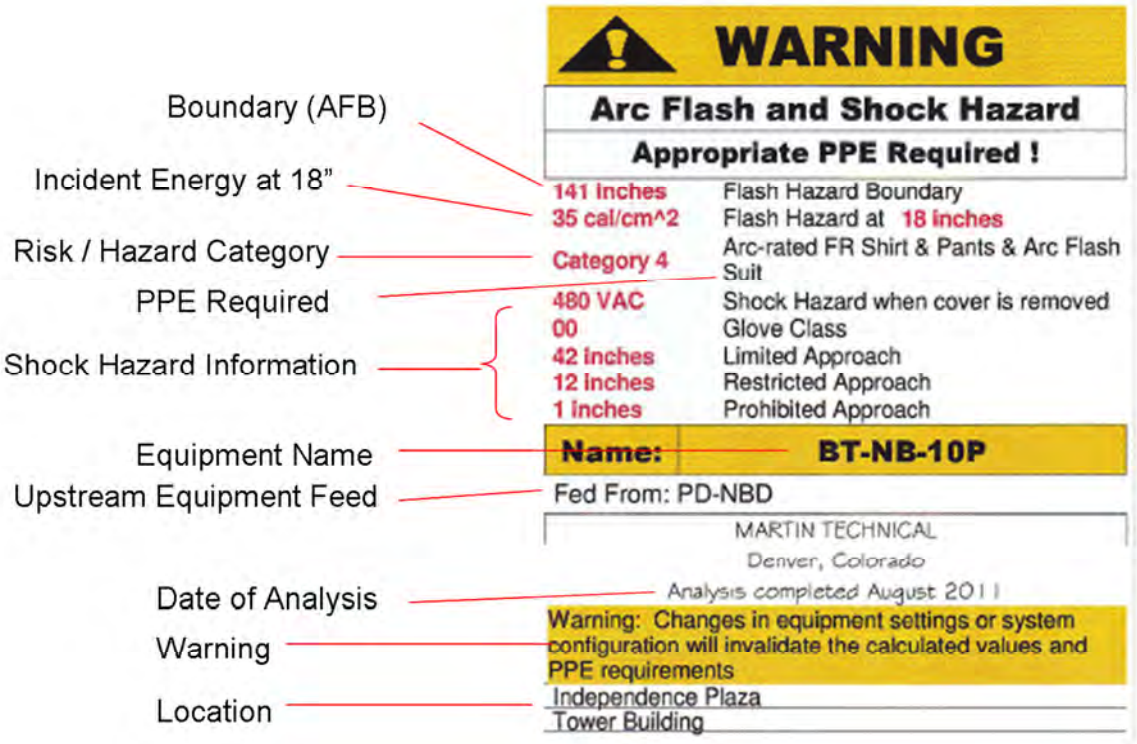
Code

NFPA 70E 130.5 (C) Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

(1) At least one of the following:
   a. Available incident energy and the corresponding working distance
   b. Minimum arc rating of clothing
   c. Required level of PPE
d. Highest Hazard/Risk Category (HRC) for the equipment
(2) Nominal system voltage
(3) Arc flash boundary

Label Information

Although there are only 3 requirements for information on the arc flash label, additional information is available from the study that can be put on the labels that provides information to help employees work safer and meet other NEC & NFPA 70E needs.



ANSI Z535.4 Defines the colors, wording and physical labels.

Summary as applied to arc flash labels:

- Orange "Warning" for category 0,1,2,3 and 4;
- Red "Danger" for above category 4.
- Rounded corners on labels

How to Apply Arc Flash Labels

1. **Remove of Old Labels**: Remove or cover up old arc flash labels.
2. **Clean Surface**: Make sure the surface of the panel is clean and free of dirt or oil
3. **Position**: Position Labels around 5 feet high for easy reading, when possible
4. **Outdoors Application**: UV rays from the sun, moisture and changing temperatures can quickly make most labels fade, crack or fall off. Placing the labels inside the panel door is acceptable and helps labels last longer in outdoor environments.

Where to Apply Arc Flash Labels

The following is a guide to help identify where arc flash labels should be applied.

1. **Floor Standing Equipment**: Apply labels on the front of each individual enclosure section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area.
2. **Wall Mounted Equipment:** Apply labels on the front of the equipment enclosure or a nearby adjacent surface, depending upon equipment configuration.
3. **For each Switchgear**, Apply one label for each vertical section. Labels should be applied on the front and rear of each switchgear vertical section if the switchgear includes rear access.
4. **For each Low Voltage Switchboard**, Apply one label field for each vertical section. Labels should be applied on the front of the Switchboard and on the rear if the Switchboard includes rear access.
5. **For each Motor Control Center**, Apply one label for each vertical section. Labels should be applied on the front of the Motor Control Center and on the rear if the Motor Control Center includes rear access.
6. **For each Distribution Panel**, Apply one label on the front of the Distribution Panel.
7. **For each Panelboard**, Apply one label on the front of the Panelboard
8. **For each Facility Transformer**, Apply one label on the front. If the Transformer includes access to the internal components with removable panels, one label should be applied on each removable panel.
9. **For each Enclosed Disconnect Switch or Enclosed Circuit Breaker external to electrical distribution equipment**, Apply one label shall on the front of the enclosure.
10. **For each Combination Starter**, Apply one label on the front of the enclosure.
11. **For each Control Panel with Motor Starters**, Apply one label on the front of the Control Panel.

12. **For each Variable Frequency Drive**, Apply one label on the front of the VFD.
13. **For each Uninterruptable Power Supply**, Apply one label on the front of each removable panel. This should include removable panels on the front, rear and sides of the UPS.
14. **For each Bus Duct**, Apply one label every 50 feet of bus duct length run. For plug-in bus ducts, apply one label on the front cover of each plug-in disconnect switch and/or plug-in circuit breaker.
15. **For all other equipment and locations**, Apply one label on the front of the equipment enclosure

APPENDIX G

JOB PLANNING FORM EXAMPLE

JOB BRIEFING AND PLANNING CHECKLIST

Know

- ☐ What the job is
- ☐ Who is in charge
- ☐ Who else needs to know / be communicated to about the job

Identify

- ☐ The hazards
- ☐ How many people are needed
- ☐ The voltage levels involved
- ☐ The shock protection boundaries
- ☐ Skills required
- ☐ The arc flash PPE level
- ☐ Any secondary voltage source
- ☐ Arc flash protection boundaries
- ☐ Any unusual or hazardous conditions

Ask

- ☐ Can the equipment be de-energized?
- ☐ Is a standby person required?
- ☐ Are backfeeds of the circuits to be worked on possible?

Check

- ☐ Job Plans
- ☐ Safety Procedures
- ☐ Single-line diagrams & vendor prints
- ☐ Vendor Information
- ☐ Status board
- ☐ Individuals familiar with equipment
- ☐ That information on plant and equipment is up to date

Think

- ☐ About unexpected events..what if?
- ☐ Install and remove grounds
- ☐ Lock – Tag – Test – Try
- ☐ Install barriers and barricades
- ☐ Test for voltage – FIRST
- ☐ Correct tools & equipment

Prepare for an Emergency

- ☐ What is the exact work location?
- ☐ How is the equipment shut off?
- ☐ Where is nearest emergency equip
- ☐ Is the standby person CPR trained?
- ☐ Is confined space rescue available?
- ☐ Where is nearest fire extinguisher?
- ☐ Where is nearest exit?
- ☐ Are radio communications available?
- ☐ Where are emergency numbers and nearest telephone?

APPENDIX H

SAMPLE OF ELECTRICAL WORK PERMIT

ENERGIZED ELECTRICAL WORK PERMIT

PART I – To Be Completed by the Requester:			
Work site location: (building & room number)		Work order/project no.:	
Planned **start** date/time:		Planned **end** date/time:	
Description of the work to be performed:			
Equipment requested to be shut down: (specify how long)			
	☐Until work is complete ☐Temporarily, while barriers are being placed		
Requested by:	Signature:	Title:	Date:

PART II – To Be Completed By The Electrically Qualified Person Doing the Work		
Shock Analysis/Approach Boundaries:	(from Table 130.2(C))	
Limited approach boundary-	_____ft _____in	
Restricted approach boundary-	_____ft _____in ☐Work will be conducted within this boundary.	
Prohibited approach boundary-	_____ft _____in ☐Work will be conducted within this boundary.	
Results of the flash hazard analysis -	☐The flash protection boundary is **4 ft 0 in** for systems that are 600 volts or less based on the product of clearing times of 6 cycles (0.1 second) and the available bolted fault current of 50 kA or any combination not exceeding 300 kA cycles (500 ampere seconds). ☐Calculation results: _____ft _____in	
Hazard/risk category for the task: ATPV rating (in cal/cm^2) for FR clothing:	☐ 0 ☐1 ☐2 ☐3 ☐4 (from Table 130.7(C)(9)(A) & (11)) ☐N/A (Cat 0) ☐4 (Cat 1) ☐8 (Cat 2) ☐25 (Cat 3) ☐40 (Cat 4)	
☐Voltage-rated tools ☐Voltage-rated gloves ☐Safety glasses ☐Hearing protection ☐Leather gloves ☐Leather work shoes ☐Hard hat ☐Hard hat FR liner (ATPV)	☐Short-sleeve shirt (nat fiber) ☐Long-sleeve shirt (nat fiber) ☐Long pants (natural fiber) ☐Long-sleeve FR shirt (ATPV) ☐Long FR pants (ATPV) ☐FR coveralls (ATPV) ☐FR jacket/rainwear (ATPV)	☐Multi-layer FR flash suit jacket (ATPV) ☐Multi-layer FR flash suit pants (ATPV) ☐Arc-rated face shield (ATPV) ☐Flash suit hood (ATPV) (from Table 130.7(C)(10)
Means employed to restrict the access of unqualified persons from the work area:	☐Signs/tags ☐Barricades ☐Attendants	
Has a documented job briefing with detailed procedures been conducted?	☐Yes, see attached ☐No	
Do you agree that the work described above can be done safely?	Electrically Qualified Person(s)	Date
Justification for the live work request:	☐Shut down creates an increased/additional hazard (specify): _____ ☐Shut down is infeasible due to design or operational limitations (specify): _____	
The next available date for shutdown is:		
Request for energized electrical work:	Electrical qualified person:	Date:

PART IIII - Approvals		
Proposed energized electrical work has been reviewed by:	Supervisor:	Date:
	Safety Representative:	Date:
	Departmental Management:	Date: