Project: PILOT SAFETY TRAINING AUDIT PROGRAM

or
ARE OUR EMPLOYEES USING THEIR
LOCKOUT-TAGOUT SAFETY TRAINING
FOR THEIR OWN PROTECTION?

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PROJECT GOAL:

This project was to determine an improved methodology for the Safety staff to evaluate Facilities Management (FM) Trades Specialists in their application of safety training and proper uses of equipment provided. Federal standard requires safety training and control procedures to protect employees during exposure to hazardous energies involved in preventive and corrective maintenance operations. The proposed method included gaining access to an automatic notification from the work order system. To date this has been entirely under FM’s domain. The goal in translating general hazard awareness into specific procedural compliance is the elimination or at least minimized number or severity of occupational injuries and illnesses.

PROBLEM STATEMENT:

The purpose of performance-based safety training is to encourage a specific behavioral change linked to the organization’s safety and health goals (see Appendix 1, Pages A-2 and 3). Whether job instruction occurred in a classroom or on-the-job, a principle of good training practice is to conduct follow-up testing and/or field observation to determine training effectiveness. “The trainer and/or the supervisor must monitor the worker’s performance to be sure the job is being performed as instructed and to answer any questions the worker may have.”

In other words, the trainer needs to know how much and how accurately employees are actually implementing the instruction into their daily operations. Improper procedures and inadequate training need identification and correction. This is important because using improper procedures leads to injury or illness and lost workdays or work restrictions that reduce capability to provide quality services to our fellow state employees, tenant agencies, and all of our customers. This project focused on just one safety course, Lockout-Tagout (LOTO), because of

2 Krieger & Montgomery, p. 533.
its potential to prevent severe injury, its widespread requirement in maintenance work processes, and suspicion that proper procedures and equipment were not being used to the fullest potential. LOTO teaches employees to be aware of the various types of hazardous energies in the workplace (electricity, hydraulics, pneumatics, thermal, chemical, etc.) and the proper control procedure, called Lockout-Tagout. The Occupational Safety and Health Administration (OSHA) requires the use of LOTO to prevent occupational injury or illness.\footnote{29 CFR 1910.147 The control of hazardous energy (lockout/tagout), and Subpart S – Electrical, 1910.333 Selection and use of work practices} LOTO refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Each employee’s training requirements, such as for LOTO training, are determined by his/her job description, work functions and unique job responsibilities which are consolidated into Individual Training Plans. Employees are registered then attend required initial or recurrent training. Most Trade Specialists in the various FM maintenance teams at General Services are required to have LOTO training. This course involves self-paced computer based training required initially upon hire then annually thereafter. A one-time hands-on instructor-led class that demonstrates the types of LOTO devices typically made available for our employees also follows the initial instruction.\footnote{General Services Safety Training Policy 00-107} During research for a recent update in the electrical standards, Safety became aware that OSHA also requires annual evaluation of each employee required to use LOTO.\footnote{29 CFR 1910.147(c)(6)(i)} However, once the employee leaves the classroom, the chances of the Safety instructor observing LOTO procedures in the field currently occur through random encounter.
In order to determine if our Trade Specialists are following proper LOTO safety precautions in the field, the Safety staff has relied on spotting employees while conducting quarterly fire and life safety inspections of the facilities owned and operated by the Board. The three safety inspectors are each responsible to check about 20 buildings and, besides looking for physical safety issues with the property, each inspector is also to find and observe employee work practices. Without knowing who is working where and when, it is very difficult to find a maintenance employee in a specific facility, especially engaged in a high-risk activity, i.e., needing to follow LOTO procedures.

**DATA COLLECTION:**

The Safety staff attempted to ascertain from the maintenance supervisors and employees when such jobs were scheduled but this method relied on voluntary response and would have required a daily presence by the Safety staff. Further, maintenance area supervisors receive *Demand or Planned Work Orders* as the Work Order Center generates them, and each supervisor assigns the work to specific employees according to their job function (electrician, mechanical, plumber, painter, general maintenance, etc.) and workload. From interaction with these employees for approximately eleven years, remarks from and actions of supervisors and employees indicated they rarely self-identified such projects because 1) they didn’t want to admit they weren’t using LOTO when required and 2) they simply did not want someone observing them, especially when they thought they could get into trouble for “doing it wrong.” The perception among maintenance employees that the Safety staff is “policing” them has a valid basis, as enforcing regulatory compliance is one of Safety’s primary roles. However, the intent in observing employee work practices is to reinforce proper procedures and to correct improper

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6 Planned Work Orders result from preventive (planned) maintenance determined from probable failure rates. Demand Work Orders result from needs for corrective action, i.e., due to equipment failure.
practices in order to prevent injury, not to dispense disciplinary actions, which is the supervisor’s responsibility.

Out of the 432 incidents of employee injuries in the last ten years, only eight (8) were due to not fully following LOTO and associated procedures for personal protective equipment, i.e., an employee scalded his leg, another had caustic chemicals get into his eyes, and another employee received an electrical shock (Appendix 2, page A-7). These employees were lucky in only receiving relatively minor injuries. Despite the few injuries reported with failure to follow LOTO as causal, the potential for serious or fatal injury still existed. Does this mean our LOTO training has been effective? Actually, the frequency of employee exposure to hazardous energies is uncertain; the LOTO process has no documentation such as through a work permit program used for welding operations and confined space entry. There is strong suspicion that for every reported injury there most likely have been several other unreported incidents even though there may have been no serious injury. This presumption is supported by the accident pyramid (Appendix 2, page A-8) proposed by H.W. Heinrich in his 1931 book, Industrial Accident Prevention: A Scientific Approach, which states that unsafe acts lead to minor injuries and, over time, to major injury (for every 300 unsafe acts there are 29 minor injuries and one major injury). The assumption still widely used to this day is that if one could intervene to prevent the unsafe behavior then there would be no injury. Safety consultant Fred Manuele indicated that safety professionals should focus on preventing fatal accidents as well as the unsafe act. He said, “Many accidents that result in severe injury are unique and singularly occurring events in which a series of breakdowns occur in a cascading effect.” However, I concur with Bob Eckhardt that current management focus is on OSHA compliance inspections consisting of easier-to-remedy

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7 Source: OSHA Form 300 Injury and Illness Logs (and WCCMS-incident database) for General Services Division
and cheaper-to-repair items because prevention of the rare fatal incident raises potentially severe, adverse political effects of identifying underlying management error, the need for possibly expensive training, failures with orientation, and similar costly issues. This is a bottoms-up versus a top-down approach to the accident pyramid. Eckhardt proposed addressing the following causes to prevent fatal accidents:

- Not establishing written, safe operating procedures for given functions for employees to follow.
- Not having adequate physical safeguards in place for a given process.
- Employees not following procedures, i.e., since the significance of the risk is not perceived, employees, for the sake of personal convenience, commit unsafe practices or operate equipment in an unsafe manner.

My project's approach follows these precepts, which requires a thorough evaluation of maintenance work processes to include a step-by-step Job Safety Analysis (JSA) to enhance existing or develop new written operating procedures for high-risk jobs, training the employees in those procedures then ensuring those procedures are being practiced daily.

I proposed to my supervisor, Marshall Fowler, Program Coordinator for Safety, that the work order system could be used to identify high-risk jobs as they were assigned so that our work schedule could be prioritized to observe and 1) evaluate the effectiveness of the training we provided based on how that training was being used, and 2) ensure OSHA compliance. Marshall granted permission to proceed.

9 "Reevaluating the Incident Pyramid," Bob Eckhardt, Concrete Products,
http://concreteproducts.com/mag/concrete_reevaluating_incident_pyramid/
The next step required gaining access to *Facility Center*, FM's work order database. Woody Waddell, of our Information Services (technology) staff, quickly granted me entry to this system. Knowing what information was available, how the information is used, and how Safety could use the data involved contacting Jeanne Smith of the FM Program Support team who supervised Joyce Hancock, responsible for the Work Order Center. Historical maintenance records appeared to be available for more years than I needed.

**DATA ANALYSIS:**

I wanted to review recent past maintenance activity in order to determine where to limit the scope of my request for a useable report from the work order system. Therefore, the first report I requested was by *Resolution Code* meaning once the maintenance employee completed their jobs, documentation was by method of correction and appropriate billing purposes. Each Resolution Code had a unique description. Examples of Resolution Code Descriptions are outlet/panel board/generator/pump/starter/transformer/compressor was checked/disabled/removed/installed/repaired/replaced/charged. These jobs most likely should have required LOTO procedures. However, the problem was that because Resolution Codes were assigned after-the-fact they would not provide advance notice for the Safety staff, nor confirm LOTO use.

The second report I requested was by *Activity Code* meaning that the Work Order Center categorized the reported problems then assigned them to the appropriate team for troubleshooting and correction. Examples of Activity Code Descriptions were too hot/cold, fixture/light/outlet/switch was non-operational/not working right, minor/major water leak/flood, etc. A review of last year's activity (Appendix 2, page A-6) indicated there were 11,515 work orders using 243 activity codes. 194 or 47% of the 409 available activity codes specifically required LOTO procedures and possibly another 25 that should. Analysis allowed me to select
16 Activity Codes that represented 85% of last year’s LOTO activity. (One reason for the vast number of codes results from the duplication of identical codes for each of the teams.)

My next step was to validate the selected codes with a supervisor review then determine if there was any correlation between the Resolution Codes and the Activity Codes to help narrow my queries. However, interviews with J. Hancock and a FM Maintenance Supervisor indicated that no one before her had entered the Resolution Codes and she had only been working for FM for about six months. Additionally, FM had already realized they were using the database ineffectively and the Activity Codes were too cumbersome. Therefore, FM had already begun working on more effective classifications. Aaron Redmond, Program Manager for the FM Environmental-Energy and Building Systems Teams, had described in his January 2005 CPM project paper that the initial attempts (circa 1998-2005) to establish a preventive maintenance (PM) program had failed. Aaron described many of the problems with the PM work order checklists (such as the need to identify specific pieces of equipment versus just the building or room number, and to get employee buy-in by incorporating lessons learned from workers’ experience in the field). I also discovered that FM was conducting its own “pilot” project to upgrade the work order system. FM had consolidated the Activity Codes for the Statewide Building Services Team based on major groupings (i.e., all electrical problems required coding as “Electrical,” and doing the same for other major functional code groups - plumbing, mechanical, custodial, etc.). I concluded that I could not make a correlation between Activity and Resolution Codes due to lack of data integrity and the simple lack of data.

IMPLEMENTATION PLAN:

The intent of this project was to have the Facility Center to automatically notify me when one of the identified Activity Codes was assigned to a work order request then I could contact
the employee to determine his/her work schedule so that I could observe the desired activity, i.e., the LOTO procedures. However, Facilities Center currently does not have an automatic notification capability. Jeanne Smith indicated automatic notification capabilities would be available in a web-based and new version of Facility Center. However, according to Barbara Bailey, Program Manager for Information Services, an alternative upgrade option to the current version would be most likely, so automatic notification would not be available. Consequently, the only remaining option to obtain the needed information will be to run a report query based on desired parameters (“Open” and “In-Progress” work orders within “Begin” and “End” dates).

Another barrier is that only one of the maintenance supervisors regularly assigns employees to each work order request. As a result, I would have to contact the supervisor to ask which employee had the job and then I could contact that employee to determine his/her schedule. This would be a daily or at least weekly process.

After selecting a specific job for observation, I intend to use the Job Safety Analysis (JSA) as a tool to document the major steps of the process, the hazards of each step, and the control measures the employees need to use for each hazard.10 Though Redmond proposed to include safety considerations in the PM checklists, they were still too general. For example, where the PM Tasks and Procedures stipulated for the employee to use LOTO, there was no detail of what type of hazardous energies were involved, where those energies were to be controlled, and what type of LOTO devices were to be used. An example JSA is attached (Appendix 4, page A-16). FM employees were prohibited entry into a deaerator tank, a confined space, as no one was qualified. After hiring a qualified employee, I conducted this JSA in August 2005 to establish entry requirements. LOTO was also required prior to entry. The expanded LOTO procedure (Appendix 4, page A-17) shows where to apply appropriate types of

10 Krieger & Montgomery, pp. 134-139.
LOTO devices. As Redmond noted, the PM program was complicated when they tried to write specific procedures for every single piece of equipment. Things were made less complicated when FM realized that most maintenance tasks were identical on the same type of equipment though there may be some installation variations due to being at different locations and even some equipment modifications. For example, it would be easier to have a standard procedure with added custom procedures for non-standard installations. Similarity would allow a standardized maintenance procedure for like use of like equipment, and the same would be true when incorporating safety procedures. In essence, the JSA would finish the job that FM started in upgrading PM work instructions. It will take considerable time for Safety to conduct JSA’s on all of the work processes performed by maintenance even if limited to just high-risk activities. Those work processes requiring LOTO that Maintenance has already identified and documented will have JSA’s completed first. Employees could brain storm to prioritize these work processes to conduct JSA’s on the most hazardous jobs first. However, there are also other hazardous work processes needing controls and follow-up audits such as working around asbestos, lead, welding, confined space entry, fall potential and possibly more. The intent is to expand this project to encompass these work processes. Subsequently, because a Safety staff of only three employees cannot ensure compliance in all of the hazardous work processes at a multitude of locations, maintenance supervisors will eventually undergo training to conduct field observations, on-the-job remedial training and enforcement.

Redmond’s project also required the use of personal protective equipment (PPE) requirements as a safety precaution. However, the PPE requirements in the Tasks and Procedures for the various maintenance activities were also lacking. For example, PPE required for LOTO tasks were absent and/or not up to current standard. The degree of protection
provided by the PPE depends on the severity of exposure such as explained in a new section of the National Electrical Code (NEC).\textsuperscript{11} This resulted in OSHA proposing to update their existing electrical standard\textsuperscript{12} to conform to this most recent edition because it reflected current practice and technology in the field and provided nationally recognized safe electrical installation requirements. Though SC OSHA\textsuperscript{13} has not formally adopted this newest NEC, their inspectors have attended federal OSHA training and can now cite employers under the PPE standard due to cross-referencing the new NEC. General Services’ safety policy and training still need updating to include this change. Yet Safety prompted FM to change its uniform contract in February 2005 to comply with the new NEC in providing fire-resistant clothing for designated Trades Specialists. Safety’s position has always been that PPE is the last defense required when there is employee exposure to a hazard. In spite of this, inconsistent supervisory enforcement complicates compliance with the FM policy for wearing the new fire-resistant uniforms. Some employees resist the new uniform, as they do not agree with FM management that their work exposes them to these hazards. Employees also do not like the new uniforms in part because they were not involved in the selection process but mostly because the employee’s feel they are “hotter.” Protection outweighs comfort in this situation, especially when employees know through CPR-1\textsuperscript{st} Aid classes how to prevent, recognize and treat heat-related illness. Switching between regular uniforms and safety-wear and/or adding appropriate PPE over normal attire is an employee convenience allowed by standard and some supervisors but goes against FM policy. Safety is to advise on applicability of the standard requiring PPE for various maintenance work processes. For example, LOTO is the safe work procedure but PPE involves selecting the

\textsuperscript{12} Title 29 of the Labor/OSHA Code of Federal Regulations (CFR), Standard Part 1910.302-308
\textsuperscript{13} South Carolina Department of Labor, Licensing, and Regulation, Division of Labor, OSHA
appropriate level of personal protective clothing related to the specific type of hazardous energy, in this case, electrical shock and arc flash. Again, the example JSA in Appendix 4 describes specific eye and hearing protection as well as rescue equipment for the hazards involved in the newly evaluated deaerator tank maintenance.

**EVALUATION METHOD:**

Performance-based training involves observing and measuring a worker’s performance against the expected performance. Evaluation of field maintenance operations for LOTO procedures is straightforward and can be measured in the percent of employees observed using correct procedure (see Appendix 1 page A-3). GSD safety training follows the OSHA regulation that clearly stipulates the required steps. Additionally, GSD has conducted a review of work processes to determine what PPE is required. A recent change to electrical standards required an update to this PPE analysis. The change mandated appropriately rated fire-resistant clothing around electrical work to protect against electrical shock and arc flash. The employee should be safe and compliant as long as he/she followed the OSHA LOTO steps and wore appropriate PPE. I developed a form for the Safety inspector to take on site (Appendix 3 pages A-11 through 13). This form has the OSHA LOTO steps and PPE requirements listed and would be used to document whether or not the employee followed procedure. If an inspector observes employees working exposed to a hazard and they are unprotected, the inspector should identify the hazard and ask the employee’s professional recommendation on what procedures, LOTO devices and/or PPE is necessary. If the employee has no recommendation, then Safety should make a recommendation. Additionally, in case this was a work process not yet documented, the Safety inspector should have blank JSA worksheets available. Each of the Safety staff also carries a

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15 29 CFR 1910.132(d)(1) requires a workplace assessment for hazards which necessitate the use of PPE
camera-phone so he/she can fully document the job and/or any non-compliance issues, or contact
the supervisor, as required.

CONCLUSION:

In order to have better data integrity, Facilities Management needs to continue their
efforts to improve their consistency in using the work order system through better activity code
definition and selection, supervisors assigning workers, and completing work orders with
appropriate Resolution Codes. Even though the work order system is limited as such, it can still
provide the required information to identify jobs using LOTO procedures. The first goal then is
to observe the current process over the next few months and determine what the work force is
doing. Data from using the LOTO inspection checklist will establish a baseline of current
adherence to prescribed OSHA LOTO procedures. (See Appendix 1, Action Plan, pages A-4
and 5 for the proposed timeline to achieve this and subsequent milestones.) Evaluation of the
data collected will help determine individual and/or work force trends where there may be
departure from the prescribed LOTO procedure. Where there is deviation, corrective strategies
need to be developed, and individual workers and/or the work force can regain compliance by
selecting and implementing the best option. This discovery and improvement process must
include Safety, employee and supervisor representation. Together we can brainstorm and use
management tools (Appendix 2 page A-8) to analyze the work processes and the related data.
We would determine possible changes, how to make improvements then establish the priority for
implementation. Cause-and-effect analysis and other root cause problem-solving tools can help
us focus on why there are deviations and categorize them into basic (potential) mishap factors.
We could also use a Pareto chart\textsuperscript{16} to help us focus on those couple of most commonly occurring

\textsuperscript{16} The Pareto chart graphically displays the relative importance of groups of data based on Pareto's Principle which
states that 80\% of the problems are from 20\% of the causes.
deviations having the greatest impact on hazard mitigation. For example, observation may determine that many valves or electrical switches remained unlocked because appropriate lockout devices were not accessible. 17 If these lockout devices were commercially available, then Safety could recommend their purchase in adequate quantity. Safety would also need to train the work force in proper application of these devices before placing them into readiness in the employees’ toolboxes. After implementing such a corrective process then follow-up observances of the modified work process must determine its level of adherence. This is in accordance with the steps of the Plan-Do-Check-Act cycle of continuous improvement (Appendix 2, page A-9). 18

Eventually, this being a pilot project, the other members of the Safety staff would be granted access to Facility Center so they could determine applicable work orders and coordinate observations of employee work practices in the field. Additionally, since Safety’s responsibilities over hazardous work processes are broader than just LOTO, observations and JSA’s would expand to include other high-risk activities. The magnitude of the number of field observations, on-the-job remediation and enforcement also eventually requires maintenance supervisors to assist. Further, as part of the continual improvement process, current technical and safety training would need upgrading to include, for example, site-specific or work-process specific procedures, photographs and diagrams that identify the safety hazards, procedures and equipment necessary to protect the employee. Such documentation could lead to new or improved work tools such as on-site checklists so the employee will not have to rely on memory to ensure proper and safe procedure. The ultimate goal of this project was to make certain our

17 Facilities Management received an OSHA violation in 1994 for this problem. Proper equipment and training resulted but, as noted, follow-up in the field has been ineffective thus, the need for this project/process change.

18 Walter A. Shewhart, a Bell Laboratories scientist, who created Statistical Process Control in the 1920s, developed Plan-Do-Check-Act (PDCA). W. Edwards Deming popularized The “Deming Cycle,” a derivation of the PDCA cycle, in the 1950s.
employees were not only aware of the hazards in their workplace but that they followed proper
work procedures to protect themselves and fellow employees and to prevent injury or illness.
Only then will General Services be most capable to provide quality, efficient, safe and
economical services, which our customers expect.

Dan Petersen, a renowned consultant in safety management and organizational behavior,
has long argued in favor of such an integrated approach - "We do not want production and a
safety program, or production and safety, or production with safety - but rather, we want safe
production."19

Appendices:
1. Project Alignment with Agency Mission
2. Data Analysis
3. Evaluation of LOTO Program
4. Job Safety Analysis (JSA)

APPENDIX - 1: Project Alignment with Agency Mission

General Services Division Mission Statement

The General Services Division exists to achieve efficiency and economy in the operation of state government by providing experts in areas of common need.

Safety Mission Statement

The General Services Division Safety Program trains and imparts safety skills to all employees through Team concepts and identifies, corrects, and prevents hazards to provide a safe environment for our employees, customers and the general public.

In order to do so, we must adhere to the following guidelines:

1. Safety and health is a shared responsibility. Everyone from top management to supervisors to each and every worker must take ownership of our own safety and that of our co-workers.

2. Maintaining a safe and healthful work environment is not just an idea – it is a top priority and must be a part of every work process.

3. It is everyone’s job to spot hazards and to correct them or report them in a timely manner.

4. Where hazards cannot be completely eliminated, they must be reduced through engineering or administrative controls or, as a final precaution, through the proper use of personal protective equipment.

5. Every individual will be trained to perform work safely. Should an individual feel inadequately trained to perform a certain procedure, he or she will immediately discuss the problem with his or her supervisor. Employees are not to operate or maintain equipment, vehicles or tools for which they have not been trained unless they have received instruction and are under direct supervision, i.e., on-the-job training.

6. As a condition of employment, each employee must work consistently in a safe manner in conformance with GSD policies, state and federal safety health and environmental laws and regulations.
Objective

Improve post-class evaluation method for safety training.

WHICH STRATEGIC GOAL DOES THIS OBJECTIVE ADDRESS? (Please check all that apply.)

1. **Technology** - To provide and maintain information systems to support the services we provide by developing systems which:
   - [ ] A Support business decisions
   - [ ] B Improve quality of data
   - [ ] C Enhance efficiency
   - [ ] D Improve timeliness of data retrieval
   - [ ] E Enhance services

2. **Human Resources** - To implement human resource practices that:
   - [ ] A Help to employ and develop a professional and qualified workforce to provide quality services and facilitate business growth.
   - [ ] B Help to create a work environment that allows employees to reach their full potential.

3. **Quality Services** - To provide continuous improvement in the services provided in our program areas through initiatives which:
   - [ ] A Provide quicker response time without sacrificing quality
   - [ ] B Increase level of professional assistance
   - [ ] C Enhance teamwork
   - [ ] D Promote better understanding of customers needs
   - [ ] E Promote better understanding of competitive market
4. **Business Planning and Reporting**

*Planning* - To plan, develop, implement and check flexible business strategies for long-term competitive success by:

- A: Annually reviewing and updating business plans
- B: Benchmarking for best practices
- C: Analyzing rate structures or revenue sources
- D: Utilizing customer information

*Reporting* - To develop reporting systems that will:

- A: Document performance and results
- B: Identify areas for improvement
- C: Provide information for managerial planning and decision-making

5. **Customer Communications** - To increase customer confidence in and satisfaction with our services to retain or increase the level of business they will do with us by:

- A: Marketing the services we provide to our customers
- B: Listening to our customers, identifying their needs, and incorporating those needs into our services.
- C: Establishing lasting relationships with our customers

**HOW WILL PROGRESS BE MEASURED? (Please list measurable indicators that will reflect the success or failure of the project.)**

<table>
<thead>
<tr>
<th>Performance Measurement</th>
<th>Reporting Frequency</th>
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</thead>
<tbody>
<tr>
<td>Percent of employees using Lockout-Tagout Procedure for identified jobs</td>
<td>Monthly/Quarterly/Annually</td>
</tr>
</tbody>
</table>
# ACTION PLAN

Objective: **Improve post-class evaluation method for safety training.**

<table>
<thead>
<tr>
<th>Critical Steps</th>
<th>Responsible Agent</th>
<th>Plan Date</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gain Access to Facility Center (Work Order System)</td>
<td>Information Services</td>
<td>9/1/05</td>
<td>Done</td>
</tr>
<tr>
<td>• Learn what data and reports are useable from Facility Center</td>
<td>Safety &amp; FM Program Support</td>
<td>10/1/05</td>
<td>Done</td>
</tr>
<tr>
<td>• Determine Correlation between Activity Codes &amp; Resolution Codes</td>
<td>Safety (FM Program Support)</td>
<td>11/1/05</td>
<td>Data Not Available / Lacks Integrity</td>
</tr>
<tr>
<td>• Develop means to Notify Safety</td>
<td>FM Program Support</td>
<td>1/1/06</td>
<td>Done - Standard Report from Facilities Center</td>
</tr>
<tr>
<td>• Develop Evaluation Tool with Certification criteria</td>
<td>Safety</td>
<td>1/1/06</td>
<td>Done - Checklist</td>
</tr>
<tr>
<td>• Update LOTO Program</td>
<td>Safety &amp; FM Maintenance</td>
<td>4/1/06</td>
<td>In Progress</td>
</tr>
<tr>
<td>• Update PPE Assessment</td>
<td>Safety &amp; FM Maintenance</td>
<td>4/1/06</td>
<td>In Progress</td>
</tr>
<tr>
<td>• Update LOTO Training</td>
<td>Safety &amp; FM Maintenance</td>
<td>7/1/06</td>
<td>Planned</td>
</tr>
<tr>
<td>Task</td>
<td>Department</td>
<td>Date</td>
<td>Frequency</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Determine Top (5) Most-Hazardous work processes in FM maintenance requiring LOTO (Brain Storming session with employees)</td>
<td>Safety &amp; FM Maintenance</td>
<td>7/1/06</td>
<td>Planned</td>
</tr>
<tr>
<td>Conduct Job Safety (Hazard) Analysis of selected work processes</td>
<td>Safety &amp; FM Maintenance</td>
<td>9/1/06</td>
<td>Phase 1 - Planned Phase II – As Required</td>
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<tr>
<td>Conduct Periodic Inspections</td>
<td>Safety</td>
<td>7/1/06</td>
<td>Planned - Monthly</td>
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<tr>
<td>Train FM Maintenance Supervisors in Periodic Inspections &amp; Training Audits</td>
<td>Safety &amp; FM Maintenance</td>
<td>7/1/07</td>
<td>Planned</td>
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<td>Report results periodically to Management</td>
<td>Safety</td>
<td>10/1/06</td>
<td>Planned - Quarterly</td>
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<td>Update LOTO program &amp; training</td>
<td>Safety &amp; FM Maintenance</td>
<td>7/1/07</td>
<td>Planned - Annually (Plan-Do-Check-Act)</td>
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<tr>
<td>Determine other applicable programs for training audit implementation</td>
<td>Safety &amp; FM Maintenance</td>
<td>7/1/07</td>
<td>Planned</td>
</tr>
</tbody>
</table>
APPENDIX – 2: Data Analysis

WORK ORDERS: Between September 10, 2004 and September 9, 2005, there were 11,515 work orders submitted. These work orders were categorized into 243 separate activity codes for the various teams within Facilities Management to correct. Removing the teams and grouping these work orders resulted in the following general areas.

![Work Orders 9/04-9/05 Pie Chart]

These general Activity Codes did not allow a specific focus on jobs requiring LOTO (it would have required selecting 6 of the 8 areas meaning 86% of work orders, many unrelated).

Therefore, 16 specific (6.6% of the) Activity Codes representing almost 40% of last year’s work orders were selected for the pilot audit program. When one of these selected activity codes is entered into the work order system it would appear on a daily/weekly report conducted by Safety so an audit of field operations can determine the effectiveness of LOTO safety training.

![Pilot Audit Program - LOTO Pie Chart]
INCIDENTS: Between June 11, 1993 and September 9, 2005, there were 432 safety incidents reported in the General Services Division. Of these, 235 involved days away from work, restricted workdays or some other criteria that made them reportable to OSHA. Of the 432 incidents, 8 could be classified as LOTO related and 3 of these were OSHA-reportable, all of which were either related to electrical or plumbing maintenance.

1. 7/23/1996 (OSHA-reportable) - FM Mechanical, Trades Specialist III; chemical boiler treatment sprayed into eyes when filling injector port; improper eye protection and not trained in operation; 2 Days Away / 0 Restricted Days.

2. 5/19/1998 – FM Statehouse Maintenance, Trades Specialist IV; burned left wrist when made incidental contact with active steam pipe while checking actuator; not wearing PPE; 0 Days Away / 0 Restricted Days.

3. 7/26/1998 – FM Custodial, Contract (Night); electrical burn to right hand when unplugged buffer from wall outlet; 0 Days Away / 0 Restricted Days.

4. 8/25/1999 – FM Custodial, Contract; thermal (heat) burn to left hand while taking belt off of vacuum after it started smoking (equipment had been tagged for repair but used anyway); 0 Days Away / 0 Restricted Days.

5. 3/24/2000 – FM Custodial; FM Building Maintenance did not warn users that they had used a chemical drain opener on a water fountain drain line and Custodial employee splashed chemical into face when tried to unstop the drain; 0 Days Away / 0 Restricted Days.

6. 3/1/2001 (OSHA-reportable) – FM Mechanical, Trades Specialist II; chemical solution sprayed into employee’s face and onto back when the boiler chemical injection line was opened for cleaning; unaware of hazard; 0 Days Away / 0 Restricted Days.

7. 3/5/2001 (OSHA-reportable) – FM Mechanical, Trades Specialist II; employee stood in chemical solution from opened boiler chemical injection lines and footwear became soaked resulting in chemical burn to left foot; not wearing proper PPE; 0 Days Away / 0 Restricted Days.

8. 6/27/2002 – FM Building Maintenance, Trade Specialist IV; employee received electrical shock when made incidental contact with 480 volt “live” HVAC equipment; only one side of dual system was shutdown and no barrier and/or PPE used; 0 Days Away / 0 Restricted Days.
Accident Triangle: H. W. Heinrich (1931)

Although the numbers vary from safety expert to safety expert, Heinrich’s concept is valid, in that, by allowing events to occur without intervention we can expect some serious outcome at some point of time. In other words, investigating near-miss incidents (with no injury) is an effective and proactive means of identifying and correcting hazards.

Ishikawa fishbone diagram: A commonly used, scientific, problem-solving tool in the investigation process, similar to fault-tree or cause-and-effect analysis. Training is a basic mishap factor.

5 WHY’s: A Six Sigma tool/method to get to the root cause(s) of the problem; often used with the Ishikawa/fishbone diagram. (http://www.isixsigma.com/library/content/c020610a.asp)

Example: A man sprained his left wrist when he slipped and fell on a water-slick floor.

(#1) Why was there water on the floor? – Leaking water cooler (direct cause)
(#2) Why was there a water leak? – Not repaired (indirect cause)
(#3) Why wasn’t the cooler leak repaired? – No work order request (indirect cause)
(#4) Why was there no work order request? – Not reported (indirect cause)
(#5) Why was the leak not reported? – No reporting procedure for tenant (root cause)
PLAN – DO – CHECK – ACT

Model or set of tools, usually associated with ISO-9000 standards but is also incorporated into six sigma plans, for continuous improvements also sometimes referred to as the Shewhart Cycle or the Deming Cycle

PLAN

Step 1: Identify the Problem
- Select the problem to be analyzed
- Clearly define the problem and establish a precise problem statement
- Set a measurable goal for the problem solving effort
- Establish a process for coordinating with and gaining approval of leadership

Step 2: Analyze the Problem
- Identify the processes that impact the problem and select one
- List the steps in the process as it currently exists
- Map the Process
- Validate the map of the process
- Identify potential cause of the problem
- Collect and analyze data related to the problem
- Verify or revise the original problem statement
- Identify root causes of the problem
- Collect additional data if needed to verify root causes

DO:

Step 3: Develop Solutions
- Establish criteria for selecting a solution
- Generate potential solutions that will address the root causes of the problem
- Select a solution
- Gain approval and supporter the chosen solution
- Plan the solution

Step 4: Implement a Solution
- Implement the chosen solution on a trial or pilot basis
- If the Problem Solving Process is being used in conjunction with the Continuous Improvement Process, return to Step 6 of the Continuous Improvement Process
- If the Problem Solving Process is being used as a standalone, continue to Step 5

CHECK:

Step 5: Evaluate the Results
- Gather data on the solution
- Analyze the data on the solution

Achieved the Desired Goal?
- If NO, go back to Step 1
- If YES, go to Step 6

ACT:

Step 6: Standardize the Solution (and Capitalize on New Opportunities)
- Identify systemic changes and training needs for full implementation
- Adopt the solution
- Plan ongoing monitoring of the solution
- Continue to look for incremental improvements to refine the solution
- Look for another improvement opportunity

APPENDIX – 3: Evaluation of LOTO Program

Safety Inspection Checklist

This checklist includes common items for which OSHA inspects. An asterisk (*) indicates one of the most frequently cited in general (29CFR 1910) and/or construction (29CFR 1926) industry safety standards. Though comprehensive, this checklist is not as detailed as the standard on a specific issue and this checklist does not cover all issues. If there is an area of general non-compliance, please reference the standards for more information.

(Unrelated portions of the list, Sections 1-23, were deleted for brevity)

24. CONTROL OF HAZARDOUS ENERGY - LOCKOUT/TAGOUT (LOTO)
   A. Does OGS have a written energy control procedure and have all employees
      been trained in the LOTO program? 1910.147(c)(1) & (7)
   B. Does OGS have and use procedures for control of hazardous energy with
      specific requirements for securing machines, placement, transfer and removal
      of lockout devices and testing locked machinery? 1910.147(c)(4)
   C. Does OGS provide lockout hardware, and is it durable, standardized,
      substantial and identifiable? 1910.147(c)(5)
   D. If an energy-isolating device cannot be locked out, is a tagout procedure used? 1910.147(c)(2)(i)
   E. *Before any maintenance, inspection, cleaning, adjusting or servicing of
      equipment that requires entrance into or close contact with the
      machinery or equipment, is the main power disconnect switch or valve
      controlling its source of power locked out? 1910.261(b)(4); 1926.416(a)(1)
   F. On operations where injury to the operator may occur if motors were to restart
      after power failure, are provisions made to prevent automatic restarting upon
      restoration of power? 1910.262(c)(1)
   G. Are there periodic reviews conducted to assure compliance with the LOTO
      program? 1910.147(c)(6)

as of: Feb 10, 1998
Energy Control (LOTO) Procedure
Annual Periodic Inspection
In accordance with 29 CFR 1910.147(c)(6)

Authorized Employee: ___________________________

Team: ___________________________    Supervisor: ___________________________

Machine/ Equipment Location: ___________________________

1. **NOTIFY:**

Yes  No  Before LOTO controls were applied, did the Authorized Employee tell all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out and/or tagged out?

Yes  No  Were affected and other employees informed not to attempt to operate the machine or equipment, or to remove the LOTO?

Yes  No  Were affected and other employees informed when the machine or equipment is returned to service?

2. **PREPARE FOR SHUTDOWN:**

Yes  No  Did the Authorized Employee know where each hazardous energy/power source was located?

Yes  No  Were the appropriate lockout/tagout devices available to be applied?

3. **SHUTDOWN:**

Yes  No  Was the machine or equipment turned off using the normal established procedure/controls?

4. **ISOLATE:**

Yes  No  Were all energy isolating devices located and de-activated so that the machine or equipment was isolated from all energy sources?

5. **APPLY LOTO:**

Yes  No  Were LOTO devices applied to each energy source?

Yes  No  Was a safety hasp used when more than one employee was servicing/maintaining the same machine or equipment?

Yes  No  Did each employee apply his/her own lock?

N/A  N/A
Yes No  When conducting a shift change, did the oncoming employee apply his/her lock prior to the employee going off shift removing his/her lock?
N/A

Yes No  Did the oncoming employee verify LOTO was properly implemented prior to beginning work?
N/A

6. SAFE STORED ENERGY:

Yes No  Were all potentially hazardous stored or residual energies relieved, disconnected, restrained or rendered safe?
N/A

7. VERIFY ISOLATION: Before starting work on machines or equipment that have been locked out or tagged out, did the Authorized Employee:

Yes No  Check that no persons were exposed?
Yes No  Push the “On” button or other operational controls or use test equipment to make certain the machine or equipment will not operate?
Yes No  Return operating controls to Neutral or the “Off” position after verification?
Yes No  Use test equipment to determine that no electrical power was being stored or supplied to the machine or equipment?

8. TESTING OR REPOSITIONING EQUIPMENT (TEMPORARY RE-ENERGIZATION):

Yes No  Did the machine or equipment need to be temporarily re-energized in order for a part of the machine to be repositioned or tested as part of the servicing or maintenance?

If No, skip to Step 9

Yes No  Were all tools, materials and non-essential items cleared from the machine or equipment?
Yes No  Were Affected Employees cleared from the vicinity?
Yes No  Were LOTO devices (required to reposition or test the machine or equipment) removed?
Yes No  Were the Energy Isolation Devices energized and the machine or equipment turned on using normal procedures?
Yes No  When repositioning and testing were completed, was the equipment or machine de-energized in accordance with the previously described LOTO procedure (return to Step 3) prior to continuing servicing/maintenance?

9. RESTORING THE MACHINE OR EQUIPMENT TO SERVICE:

Yes No  Were tools and nonessential items removed and machine or equipment components returned to their operational positions?
Yes No  Were Affected Employees safely positioned or removed from the area and told that LOTO controls were going to be removed?

Yes No  Were the operational controls verified in Neutral or Off (prior to removing LOTO devices)?

Yes No  Did the Authorized Employee who installed the LOTO devices remove and account for all LOTO devices that were installed?

Yes No  Did the Authorized Employee tell the Affected Employees that the servicing or maintenance had been completed and the machine or equipment is ready for use?

Inspector Comments:

Deviations or Inadequacies Identified: 


Reasons for Deviation/Inadequacy: 


Recommendations: 


___________________________ of the __________________
(Employee Name) (Employee Team)

Is / Is Not certified as an Authorized Employee to conduct LOTO operations.

Inspector: ___________________________  Date: __________________

The Inspector has reviewed my responsibilities under the energy control procedure as authorized employee.

Employee: ___________________________  Date: __________________
(Signature)

Supervisor: ___________________________  Date: __________________
(Signature)

If the Supervisor does Not Concur with the Inspector’s evaluation, the Supervisor will meet with the Inspector for resolution. If there is still non-concurrence after conference, the Team Leader will meet with the Program Manager for Safety for resolution.

Cc: Safety  As of: January 10, 2006
APPENDIX – 4: Job Safety Analysis (JSA)

The following pages are an example where a hazardous operation (confined space entry into a deaerator tank for a boiler) requiring the use of LOTO procedures was documented for training purposes as well as a reference tool for maintenance actions.

- First page - a physical and photographic description of the equipment.
- Second page - a JSA worksheet that briefly describes the basic work steps, hazards of each work step, and the controls and safety precautions required for each of those hazards.
- Third page - details the locations of manual shutoff controls for the hazardous energies associated with this equipment and prescribes the types of LOTO devices to establish positive employee control while that worker performs servicing or maintenance to the equipment.

To date, only the information on pages 1 and 2 have been made available to our employees and just for confined space operations. Part of the intent of this project is to provide the page 3 information, also.
• DEAERATOR TANKS = PERMIT REQUIRED CONFINED

ENTRY PORTAL

INTERNAL VOLUME = 73.5 cubic feet (approx.)

15"

11"

6' 10"

10'

10'

FM ENERGY FACILITY, Bldg 100410, 1121 College St

Also at COLUMBIA MILLS - ENERGY FACILITY, Bldg 110708, 301 Gervais St

RESCUE: Entrant Must Use Wristlets
## CONFINED SPACES SURVEY
### Job Safety Analysis Worksheet

**State Complex/Energy Facility**

**Title of Job/Operation**
Inspect/Maintain Deaerator Tank

**Position/Title(s) of Person(s) Who Do Job**

**Department**
Energy-Environmental

**Section**
Facilities Management

**Date**
8/2005

**No.**

**Name of Employee Observed**
Ronnie Taylor

**Analysis Made By**
Bernie Lee

**Analysis Approved by**

### Sequence of Basic Job Steps | Potential Accidents or Hazards | Recommended Safe Job Procedures
--- | --- | ---
1. Prepare to enter | 1A. Electrical, Steam, Water (CW) | 1A. Drain Tank; **Apply LOTO** (see diagram)
1B. Awkward body position for entry (OE, FB) | 1B. Erect scaffold; use ladder to climb onto scaffold
1C. Caustic Chemical for boiler water treatment (CW) | 1C. IAW MSD Sheets - PPE; Thoroughly rinse inside of tank with water; air sampling
1D. Hot tank (CW) | 1D. Allow tank to cool to the touch
1E. Lack of Oxygen (E) | 1E. Mechanical ventilation; air sampling
1F. Confined Space with IDLH (E) | 1F. Permit required

2. Enter/Work in deaerator | 2A. Noise (E) | 2A. Wear Hearing Protection
2B. Lack of Oxygen (E) | 2B. Mechanical ventilation; continuous air sampling
2C. Slag, fumes from welding (CB, E) | 2C. Hot Work Permit; PPE (welding goggles, face shield, gloves); fire extinguisher; continuous air sampling; mechanical ventilation

3. Exit | 3. Hatch size restricts exit (CI) | 3. Permit Required Confined Space; Attendant; Rescue equipment (wristlets & lanyard)

### General Hazards

- Struck By (SB)
- Struck Against (SA)
- Contacted By (CB)
- Contact With (CW)

- Caught On (CO)
- Caught In (CI)
- Caught Between (CBT)
- Fall to Same Level (FS)

- Overexertion (OE)
- Exposure (E)
**DEAERATOR TANKS** = **PERMIT REQUIRED CONFINED SPACES**

1. Overhead Steam Lines
   1) Gate Valve to Reducing Station
   2) Bypass Gate Valve

   Use Gate Valve Lockouts or Chain, and Lock with Tag on 1, 2 & 3

2. Overhead Condensate Valve

3. Makeup Water Valve

Electric – Turn Off & Use Lock and Tag