

Project Hanford Lessons Learned

Title: Failure to Take Appropriate Actions Leads to Electrical Shock

Date: October 10, 2005

Identifier: 2005-RL-HNF-0037

Lessons Learned Summary:

Failed or degraded equipment or equipment found in an unusual condition should be promptly tagged out of service and reported. Management should thoroughly evaluate unusual equipment conditions and not make assumptions about equipment status. Power cords, plugs, and cord grip devices should be inspected frequently to provide for the early identification of degraded conditions. Cord plug use should be evaluated and grip restraint devices should be used when necessary to prevent plug/cord damage and to prolong cord life.

Discussion of Activities:

On June 21, 2005, an operator identified and reported to the Shift Operations Manager (SOM) that a power cord on a hoist in the 105KE basin had a surgeon's glove taped over the cord's plug. No log entries pertaining to the hoist problem could be found and workers had no knowledge of the issue. It was assumed that the glove was placed on the plug because it was contaminated. During this time another hoist became available and was used instead of the hoist with the gloved plug. The glove was not removed and no action was taken to log or disposition the condition of the hoist cord at this time.

On June 24, 2005, a work crew entered 105 KE Basin to perform debris removal activities. A hoist with a long reach was required for the job. The only suitable hoist available for the job was the hoist identified on June 21, 2005, with the gloved plug. The SOM was again contacted by the operator regarding the surgeon's glove over the plug. At the direction of Shift Operations personnel, the glove was removed and the cord was surveyed and no contamination was found. Then the plug was inspected by an operator who saw no apparent damage to the plug or cord. The operator then plugged the hoist into a nearby receptacle, but the hoist failed to operate. Believing that the receptacle was inoperable, the operator decided to use a receptacle that was labeled "CAMS ONLY". At the moment that the plug was being inserted into the receptacle a spark was observed and the cord separated (Figure 1) from the plug (Figures 2 & 3), with the plug remaining in the receptacle.



Figure 1



Figure 2



Figure 3

Analysis:

Inspection of the plug cap indicated that the internal strain-relief in the cap was not snug around the cord. The short inside the plug at the cord interface occurred because the cord pulled loose from the plug. This caused the wires to come in contact with each other as they were plugged into an energized electrical receptacle, resulting in a short circuit.

Stress placed on the cord/plug interface during normal hoist operation likely caused the cord to pull out from the plug as the power cords are commonly stretched to full extension. The plugs are shop stock standard and the cord restraint clamping mechanism is smooth and not robust enough to handle the size/weight of the 30 foot long by ~5/8 inch diameter hoist power cord. The above conditions, combined with the failure to routinely perform electrical inspections of these power cords, plugs, and cord grips, contributed to the failure of the plug.

Cord strain relief devices had previously been provided to relieve the strain of the cords on the plugs and to hold the plugs into the receptacles. However, use of the devices was not a mandatory requirement. Operators were permitted to hold plugs into receptacles in lieu of using the strain relief devices.

Inadequate communications resulted in personnel being unaware of the reason for the gloved plug. Even after the glove on the plug was identified and reported to shift operations no action was taken to log or disposition the potential adverse condition. Shift operations assumed that the glove on the plug was likely the result of a radiological condition (contamination). Once this assumption was found to be invalid, no consideration was given to further evaluation of the condition of the power cord. While the operators recognized that another possible reason for the glove might be due to a damaged/defective plug, they did not fully assess this condition, and only performed a visible inspection. Had the assumption been made that the plug may be defective electricians could have been contacted to help identify and safely resolve the problem.

Workers had become acceptant of non-functioning receptacles and did not always report them so they could be repaired. When a receptacle was found inoperable workers would merely try another receptacle. In this instance they chose to use a receptacle marked for "CAMS Only" which was a violation of signage/label requirements.

The hazards analysis process for the hoist operation failed to identify the potential hazards associated with the use of the long heavy power cords and ensure that appropriate controls were implemented to prevent damage. The fact that the heavy power cords were being pulled out of the receptacles should have been recognized as a precursor to damaged plugs, cords, and receptacles, especially when the use of strain relief devices were viewed as optional. Monthly and Annual Preventative Maintenance (PM) procedures for the hoists and the operations pre-use procedure for hoists did not include requirements for inspection of the power cord, plug, and its cord grip.

During the investigation of this event it was determined that the initial event scene response was not properly implemented. Changing of event scene conditions should be avoided. After the cord had separated from the plug, the plug was then removed from the receptacle because it was perceived to pose a safety hazard. The appropriate action would have been to barricade the scene and document its condition.

Recommended Actions:

Management expectations should be established and communicated to ensure defective

equipment or problems are reported, logged, and tagged in a timely manner and that event scenes are secured and evidence preserved until the investigation has been completed.

Hoist power cords should be inspected and the cord plug interfaces verified to be adequately secured. Cord plugs should also be inspected to determine if they are robust enough for the cord weight and replaced plugs when necessary.

Examine power cords to determine if cord grip or other strain relief devices should be used to prevent damage and install the appropriate devices where necessary. Proceduralize the mandatory use of cord grip devices where necessary.

Perform routine preventative maintenance to ensure that power cords, plugs, and cord grip devices are inspected to provide for the early identification of degraded conditions to prevent their failure.

Ensure that pre-use inspection procedures include a check of the hoist cord and plug and the position of the cord grip devices.

Estimated Savings/Cost Avoidance: Not evaluated

Priority Descriptor: Yellow/Caution

Work / Function: Conduct of Operations-General, Maintenance-Electrical

Hanford Functional Categories: Associated Causal Factors - A4B1C03, A4B1C01

Hazard: Electrical/NEC

ISM Core Function: Identify and Analyze Hazards, Develop and Implement Controls, Perform Work Within Controls

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Authorized Derivative Classifier: Not required

Reviewing Official: Gerald Whitney

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References:

Occurrence Reports:

RL--PHMC-SNF-2005-0013, Electrical Short Circuit/Minor Shock at 105KE Facility

RL--PHMC-SNF-2003-0018, Near Miss - Potential for Electrical Shock at the 105KE Facility

KBC-26992, Rev.0, Root Cause Analysis Report "Electrical Short Circuit/Minor Shock at the 105KE Facility"--June 24, 2005