The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research NIOSH

Maintenance Technician Drowns After Falling From a Turbine Support-Ring Platform at a Hydroelectric Power Generation Facility in South Carolina

FACE 9116

SUMMARY

A 40-year-old male maintenance technician (victim) drowned after falling 2 feet from a turbine support-ring platform into a pool of water approximately 30 feet deep. The victim and another maintenance technician (co-worker) had been lowered by basket approximately 30 feet into a 15-foot-diameter hydroelectric turbine draft tube to install structural steel supports. After being lowered to the working level, both technicians left the basket to inspect welds on the support beams which they had finished earlier. The co-worker got back into the basket, while the victim walked along a wooden plank to continue the inspection. Welds on the structural steel supporting the planks failed, and allowed the victim to fall into the water. The victim (who was unable to swim) could not be rescued by the co- worker and drowned. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- identify hazards and appropriate interventions during the planning and design phases of a project
- thoroughly instruct each employee in the recognition, prevention, and avoidance of unsafe work conditions
- encourage all employees to participate in worksite hazard surveillance and reporting, and support practical strategies for intervention
- ensure that employees receive training considered generally acceptable by a discipline-specific professional organization
- conduct scheduled and unscheduled worksite safety inspections routinely
- provide, require, and enforce the use of personal protective equipment (PPE) appropriate to the task when all feasible methods of hazard removal are exhausted.

INTRODUCTION

On March 26, 1991, a 40-year-old male maintenance technician (victim) drowned after falling 2 feet from a wooden plank into a 30-foot-deep pool of water. On April 4, 1991, officials of the South Carolina Occupational Safety and Health Administration (OSHA) notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On May 29, 1991, two safety specialists and a safety engineer traveled to the site and conducted an investigation. The DSR investigators reviewed the incident with company representatives, the police department, and the South Carolina OSHA compliance officer assigned to the case. Photographs of the incident site were obtained during the investigation.

The employer in this incident was an electric utility with about 20,000 employees that had been in operation for 75 years. The victim was an employee of the utility's central region maintenance and security division which had 952 employees. About 200 of these employees were maintenance technicians. The company had a general written safety policy. Supervisors and co-workers provided on-the-job training, and formal training was provided by the employer for specific disciplines. Periodic recertification testing was done to keep skills current. Company records showed that the victim had been recertified by the company to weld less than 2 weeks prior to the incident. The company had a full-time safety officer, and required the use of personal protective equipment issued to the employees. The victim had a total of 14 years with the employer. The last 2 years were as a maintenance technician.

INVESTIGATION

The employer had undertaken modifications to its hydroelectric generators to increase their output capacity. The modifications increased the length of the turbine by 18 inches, which made it necessary to reposition the turbine support ring inside the draft tube at a level 18 inches lower than the original. Other generators had been modified in the past, and the victim's crew had completed a similar modification in the past 6 months. This modification was to include the installation of three pieces of structural steel, and a wooden deck from which additional modifications and future inspections could be made (Figure). The turbine support-ring platform was positioned 2-feet above a 30-foot-deep pool of water in the bottom of the draft tube. The main water inlet gate was closed while work was underway, so little or no water flow was present.

The crew working on the modification consisted of two maintenance technicians, one crane operator controlling the work basket, one flagman to provide visual instructions to the crane operator, and one supervisor. The supervisor had other jobs in the hydroelectric plant, and was not always with this work unit. The supervisor assumed that most of the welding could be done from the crane-positioned basket.

To install the support ring for the turbine, three steel angle supports were anchored into the concrete draft tube wall (Figure). A manway prohibited the installation of a fourth anchor. The beams were positioned at the supports and welded in place at the wall of the draft tube. A "C-clamp" was used to hold beams B & D (at the center of the draft tube) to a welded plate C. Beam D was configured as a "goal post" to enable welding on both sides of the manway. The technicians noticed that the metal around the manway was different than that of the steel being welded to it. Later, the metal was identified by a company technician as "gray" cast iron–"pot" metal–that had been in place since 1916. It was also discovered that the surface had not been properly prepared for welding.

After returning from a work break (approximately 1 hour after the welds were made at the manway), the victim and his co-worker descended, via the work basket, down the draft tube to the worksite. At about 4:05 p.m., both technicians left the basket to inspect the welds. Neither was wearing a buoyancy (life) vest, even though life vests were available at the site and the company required their use. After deciding on a course of action, the co-worker returned to the basket and tied off to the lifeline in the basket. The co-worker told the victim to put on a life vest if he was going to stay out of the basket. The victim declined, responding that he felt comfortable without one, and walked along the two 2- x 10-inch planks toward the manway. At 4:10 p.m., each of the two welds at the manway securing beam D failed. Both broke away cleanly from the manway ring, leaving all the weld material on beam D. The victim fell into the water, but briefly floated on the surface. The co- worker, who had been looking in another direction, turned and tried to rescue the victim but failed. The victim, not knowing how to swim, quickly sank to the bottom of the draft tube water outlet.

Scuba divers in the area were summoned and entered the water within 20 minutes. A local rescue squad and county ambulance were also called to the scene. The body was pulled from the water by a diver at 4:50 p.m., and cardiopulmonary resuscitation (CPR) was immediately initiated. The victim was transported to a local hospital, where he was pronounced dead at 5:44 p.m. CAUSE OF DEATH

The local medical examiner listed drowning as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should identify hazards and appropriate interventions during the planning and design phases of a project.

Discussion: Potential worksite hazards should be identified during the planning and design phases of a project, and strategies to avoid them should be developed and implemented in the construction phase of the project. In this case the existence of the manway at the bottom of the draft tube was not recognized during the design phase. When it was encountered by the technicians, they did the best they could to adapt the design to the actual situation.

Recommendation #2: Employers should thoroughly instruct each employee in the recognition, prevention, and avoidance of unsafe work conditions.

Discussion: Employers should ensure the implementation of 29 CFR 1926.21(b)(2) which states, “The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.” Employers should also ensure that each employee understands the importance of hazard prevention and recognition, and the role he plays in preventing occupational injury. Employers should encourage employees to actively participate in making the worksite safer. An increased level of employee participation and surveillance will enable prompt intervention for the prevention of occupational injury.

Recommendation #3: Employers should encourage all employees to participate in worksite hazard recognition, and support any practical strategies for intervention.

Discussion: Management could encourage employee participation in worksite hazard recognition through safety award programs, and by implementing the practical interventions suggested by employees. Although not required, this mechanism can be justified by 29 CFR 1926.20(b)(1) which states that it shall be the responsibility of the employer to initiate and maintain “such programs as may be necessary” to comply with his accident prevention responsibilities of the Act as designated in 29 CFR Part 1926. Compliance with 29 CFR 1926.21, Safety Training and Education, provides a firm basis on which to build a higher level of worksite surveillance.

Recommendation #4: Employers should provide employees training that is considered acceptable by a discipline-specific professional organization.

Discussion: The technical training an employee receives should be accepted as adequate by a professional organization that remains current in the practices of the specific discipline. For example, craft unions for electrical workers, pipefitters, boilermakers, etc., will be good sources for such training programs. This will better enable employers to match the skill and proficiency level of an employee to those needed at the worksite. Although this level of effort in employee training is not required, it is in compliance with 29 CFR 1926.20(b)(4) which states, “The employer shall permit only those employees qualified by experience or training to operate equipment and machinery.” The victim had been recertified to weld by the company less than 2 weeks prior to the incident, and felt confident, as shown by his actions, that the manway welds he made were proper. The proper surface preparation technique required to make the type of weld needed at the manway is widely known by persons properly trained in the welding craft, but was not practiced by the victim.

The following ANSI consensus standards can be used as training materials: ANSI/AWS D10.12-89, Recommended Practices and Procedures for Welding Low Carbon Steel; ANSI/AWS D11.2-89, Guide for Welding Iron Castings; and ANSI Z49.1-1988, Safety in Welding and Cutting.

Recommendation #5: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Scheduled and unscheduled safety inspections should be conducted by a safety professional. This provides motivation for employee compliance, and brings another level of safety awareness to the worksite. Regardless of how detailed or comprehensive, a safety program will not reduce occupational injury unless implemented at the worksite. Employer safety inspections are no guarantee of eliminating worker fatalities, but they do demonstrate the employer's commitment to enforcing safety policies and reducing occupational injury.

Recommendation: #6: Employers should provide and enforce the use of PPE when all feasible methods have failed to remove a hazard.

Discussion: Employers should implement 29 CFR 1926.28 (a) which states, "The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions. . ." It is the objective of each safety professional to make every feasible effort to remove a hazard. If the hazard cannot be feasibly eliminated, then appropriate PPE must be worn by those employees working around the hazard. Of all interventions, PPE provides the least significant long-term, overall worker protection; it should be considered as the final effort in providing protection, when all other strategies have been considered. The implementation of 29 CFR 1926.106, "Working Over or Near Water," will provide excellent injury prevention. It states that wherever the danger of drowning exists, employees will be provided with a U.S. Coast Guard-approved life jacket, or buoyant work vest. In addition, 29 CFR 1910.252(b)(1)(i), "Protection of Personnel," states that "a welder or helper working on platforms, scaffolds, or runways, shall be protected against falling. This can be accomplished by the use of railings, safety belts, life lines, or some other equally effective safeguards." Other general welding safety requirements to reduce occupational injury can be found in 29 CFR 1910.252 which discusses the general requirements for welding, cutting, and brazing. The content of 29 CFR 1910.132, General Requirements for PPE, should be used as a guide in determining the appropriate PPE. In 29 CFR 1926 Subpart E, other requirements are given for personal protective and life saving equipment, such as safety nets, lifelines, safety belts, and lanyards.

REFERENCES

Office of the Federal Register: Code of Federal Regulations, Labor, Title 29, Subtitle B, Chapter XVII, Part 1926.21(b)(2), p.20. July 1,1990.

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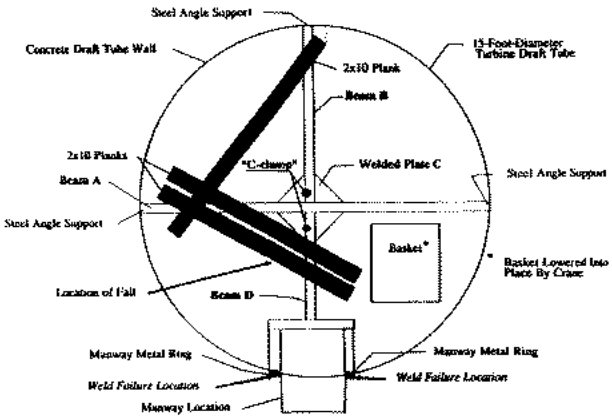

Figure - Plane View of the Hydroelectric Draft Tube

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