



## Safety Challenges Remain

Hoisting and Rigging (H&R) incidents continue to be pervasive and present serious hazards as indicated by the events reported to date. For instance, during the 36-month period from January 1, 2001 through December 31, 2003, 18 workers were injured and approximately 86 others were involved in near miss events. Hoisting and rigging activities typically involve the lifting, moving, and laying down of heavy loads; these tasks require careful planning, preparation, and implementation by a variety of individuals, including managers, work planners, supervisors, riggers, spotters, equipment operators, and maintenance personnel. [See DOE Standard DOE-STD-1090-2001, *Hoisting and Rigging* (URL <http://www.eh.doe.gov/techstds>)] Individually and collectively, these workers are responsible for executing their assigned responsibilities and ensuring that safety is addressed at all times while performing their duties.

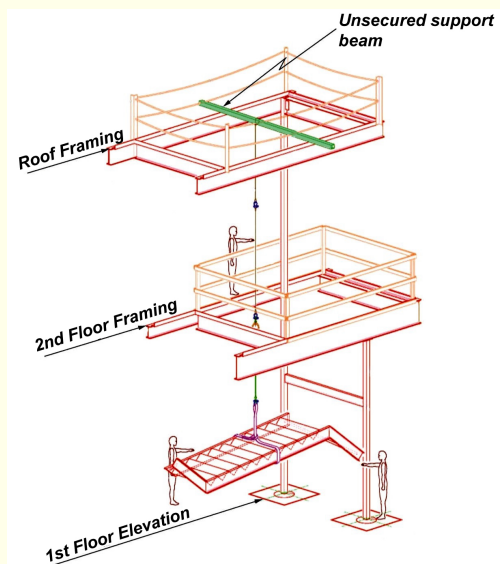
The purpose of this report is to describe the commonly made errors in these incidents and to identify the lessons learned and specific actions that should be taken to prevent similar incidents from recurring.

## Unforeseen Conditions

Deactivation and dismantlement, environmental restoration, and general construction operations are often accompanied by unforeseen problems that must be addressed before the overall project can continue as planned and on schedule. Many times these problems require the use of H&R equipment in a “one-time” application,

### Type B Accident Investigation During 2003

Rather than defer a task until later in the day when a mobile crane would be available, construction workers improvised using an unsecured steel beam supporting a chainfall to lift a metal stairway. Two personnel were injured when the steel beam slipped sideways and fell two stories to the ground. The falling beam caused a serious crushing injury to the foot of one worker and the falling stairway cut the shin of another worker. A hazards analysis for this specific activity was not performed, and appropriate hazards controls, such as securing the beam supporting the chainfall, were not in place.



or an operation that has never before been performed by the personnel assigned. Often pressure to “get the job done” results in

actions that can permit disastrous consequences (i.e., personal injury and/or property damage). These pressure-related actions have included using whatever H&R equipment is readily available without determining its fitness for the task at hand, assigning personnel that are inexperienced or unfamiliar with the specific H&R technique required, devising an approach that is beyond the capability of the equipment selected, performing the task without thoroughly addressing the hazards, or improvising with an unapproved or unauthorized technique.

### **Crane Load Drops, is Damaged, and Narrowly Misses Workers in 2002**

A qualified crew unfamiliar with the assigned task failed to follow labels on nylon straps warning that appropriate anti-chafing material be used; this precaution was not emphasized in the job safety analysis. Sharp edges on the load cut the nylon straps causing the load to drop, damaging it and narrowly missing the workers below. Despite recommendations by the general foreman to delay the lift until the following day when sufficient supervisory personnel would be available to oversee it, management elected to disregard the suggestion and perform the activity.

### **Thinking Prevention**

Too often H&R tasks are performed without sufficiently “thinking through” the entire activity (from lift to lay-down) prior to execution. This failure is found in work planning and control, work practices, and equipment selection. Deficiencies in these areas lead to a variety of simple mistakes that either singularly or in combination, result in personal injuries and/or property damage. In most instances, “thinking before doing” would have prevented the event. Some of the occurrences resulted in near misses instead

of serious injuries because safeguards or other safety practices were in place. In other instances, however, good fortune prevailed. Nonetheless, near misses must also be prevented, because they are precursors to events having serious consequences.

### **Gantry Crane Collapses, Injuring Worker and Damaging Equipment in 2002**

Workers were having difficulty laying down a 14,000-pound milling machine spindle column suspended from a gantry crane. Subsequently, the workers departed from standard rigging techniques and the lift plan and attached a chain from a forklift truck to the spindle column to facilitate lay-down of the load. The lateral force placed on the gantry crane by the forklift caused it and its load to fall. The forklift operator and a nearby lathe worker had to take extreme measures to avoid the falling equipment; the lathe worker received neck and back injuries as a result of his actions to avoid the falling load. Property damage to the milling machine and a nearby lathe and associated workstation exceeded \$10,000. Upon experiencing difficulty with the lay-down, workers failed to stop work and re-evaluate the lift, and neither adequately evaluated the lift plan nor controlled the work zone.

### **Work Planning and Control**

The level of rigor applied to planning and controlling H&R tasks to ensure that they are performed safely is often insufficient and subsequently is responsible for many reported events. Prevalent work planning and control deficiencies include:

- Failing to prepare lift calculations for mobile crane activities that address the entire evolution – load lift, load movement along the boom path, and load lay down

- Failing to establish and/or maintain work control boundaries, compromising personnel safety and property in situations involving suspended loads in confined areas. Workers and other equipment are often too close to the load or its pathway, and equipment operators experience difficulties maneuvering the load around personnel and other obstacles

**Deficient Planning Results in Dropped Roof Panels in 2003**

Workers dropped a bundle of metal roof panels from a mobile crane, causing extensive damage to the roof and windshield of a pick-up truck parked below the load. The nylon slings used during the lift were not secured to the load. As the bundle of metal roof panels was being lifted, one of the slings slipped as the load was being lowered, causing it to fall. Had the lift plan been sufficiently designed and evaluated, the slings would have been required to be secured to the load.

- Failing to perform comprehensive hazards analyses. Hazards analyses should consider the terrain the work is going to be performed on; other work scheduled in the vicinity; the entire evolution – load lift, load movement, and load lay down; and the potential for unbalanced loads and load shifting during moves. Hazards that could materialize at the time of the lift rather than at the time of the hazard analysis should also be considered, such as workers scheduled to perform work in the immediate vicinity at the same time that a crane critical lift is scheduled
- Failing to ensure there is adequate space for laydown of the load

- Failing to control immediate and adjacent workspaces by monitoring workers traversing a pathway to execute a task that is commonly used by forklift trucks, or failing to monitor personnel working in close proximity to a load suspended by a crane or hoist

**Work Practices**

Deficient work practice is a major contributor to all H&R events. Disregard for protocols, poor judgment, and bad habits are characteristic of individual behaviors that demonstrate this deficiency, including:

- Failing to use adequate anti-chafing materials according to warning labels
- Failing to properly secure loads and ensure loads are balanced
- Failing to communicate effectively with spotters in heavily congested areas
- Failing to invoke “stop work” authority when work instructions or procedures are not commensurate with the assigned task, when the lift plan is ambiguous or inadequate, and when an unsafe condition appears while performing a lift
- Allowing unauthorized personnel to operate equipment
- Using unauthorized and/or unplanned compensatory measures (rather than stopping work) to correct for an unsafe condition experienced during a lift.

**Failure to Stop Work Causes Worker to Suffer Foot Injury in 2002**

A worker suffered a severe contusion to his foot when an unbalanced crane load unexpectedly rotated. Workers failed to take necessary precautions to ensure that rigging and load were suitable for lift per the task plan, and did not stop work when the load began to move in an unexpected manner.

## Equipment Selection

Workers often fail to assess “below-the-hook” rigging equipment prior to use. This includes:

- Failing to thoroughly inspect lifting equipment for wear (slings, wire rope, and threads) prior to use
- Checking the rated capacity of lifting fixtures and rigging to ensure that it can sustain the load given the lifting conditions
- Ensuring that rigging equipment is used correctly and in accordance with the manufacturer’s specifications.

### **I-Beam Drops Due to Damaged Rigging Equipment in 2003**

Workers using a 22-ton mobile crane to lift an I-beam caused damage to the handrail of a man-lift basket as the load fell to the ground, nearly striking personnel. The I-beam was being lifted to a vertical position using two previously damaged sling chokers; the pre-existing condition of the slings was not noticed by the workers prior to their use. A job safety analysis had not been performed prior to performing the lift, and the riggers were not trained in proper rigging of an I-beam.

## Equipment Maintenance

Inappropriate maintenance of H&R equipment has resulted in equipment failures and dropped loads. Common maintenance errors include:

- Failing to perform scheduled maintenance in accordance with manufacturer’s recommendations

- Failing to identify worn components and degraded equipment during inspection and maintenance activities
- Failing to lubricate equipment appropriately
- Failing to inspect and test equipment after maintenance to ensure that equipment integrity has not been compromised by repairs

### **Forklift Tines Fail Due to Improper Maintenance During 2001**

The tines of an unloaded forklift fell approximately two feet, hitting the floor and resulting in a near miss event. Although the frequency of carriage chain lubrication was consistent with the manufacturer’s recommendations, the lubricant used was not. Equipment maintenance personnel used heavy grease rather than light oil, as recommended. The heavy grease permitted a build-up of dirt, creating an abrasive condition causing the chain pin to fail.

### **Crane Lifting Ball Drops Due to Improper Maintenance Inspection During 2002**

A mobile crane headache ball and the attached spreader bar weighing 1,250 pounds fell approximately 7 feet to the ground resulting in a near miss event. The swivel mechanism and associated ball bearings of the headache ball were worn and would not operate due to lack of lubrication. This condition was due to a failure by maintenance personnel to perform periodic inspections and associated maintenance on the equipment, as well as visual inspections by riggers prior to use.

## **Safety Responsibilities**

Roles and responsibilities for performing H&R tasks should be clearly defined, understood, and reviewed prior to initiating a lift to ensure safety. Further, all workers must know that they are authorized to stop work whenever the safety of the operation is questionable, and they must understand how to execute this authority. Recent H&R events provide the following important lessons learned pertaining to safety responsibilities prior to performing a lift:

- **Managers**

- Has sufficient rigor been applied to hazards analyses, work planning, and equipment inspection in work environments involving multiple tiers of contractor and subcontractor personnel?
- Have site-specific H&R requirements been provided to subcontractors for implementation?
- Have workers been reminded of their stop work authority and how to take this action?

- **Work planners**

- Have hazards analyses been reviewed for completeness, including risks presented by collocated activities?
- Are mock-ups and walk-downs used when developing task-specific procedures?
- When multiple cranes are operating in a work area, are their movements planned to avoid crossing paths?
- Have crane and forklift load paths been analyzed and determined safe?

- **Supervisors**

- Have thorough pre-job planning meetings been conducted?

- Have lift plans and associated calculations been assessed?
- Is the lay down of the load calculated and planned, as well as the load center of gravity during its movement?
- Have equipment maintenance and inspection schedules been reviewed?
- Do all personnel understand the need to follow procedures and work with caution?
- Do qualified supervisors oversee personnel in training?
- Have all personnel been directed to refrain from improvising?
- Have workers been reminded of their responsibility to exercise stop work amidst emerging problems rather than implement ad hoc compensatory measures?
- Has the person in-charge been appointed to direct the lift?
- Are equipment operators qualified and familiar with the equipment operating manual, and applicable specific procedures and requirements?
- Have the work control boundaries been established and is the work area clear of obstacles?
- Have communications (both visual and oral) been checked between spotters and equipment operators?

- **Riggers**

- Does the equipment satisfy all requirements and evolutions of the planned lift?
- Have the equipment and lifting fixtures selected been reviewed and inspected to determine fitness for use, especially rated capacities and worn components?

- **Riggers (continued)**
  - Has the weight of the load been accurately determined?
  - Have special anti-chafing precautions been noted?
  - Are torque values for swivel hoist rings understood and followed?
  - Are threaded connections fully engaged?
- **Equipment operators**
  - Are loads appropriately rigged and secured?
  - Are all load factors and dynamics understood for all evolutions
  - Are load movement pathways monitored?
  - Have exposed components been visually inspected for wear?
  - Have potential obstructions or uneven surfaces been identified and compensated for?
  - Are training and qualification requirements up-to-date to operate the equipment and perform the lift?
- **Spotters**
  - Is position adequate to assess all evolutions of the activity?
  - Have steps been taken to ensure that communications with equipment operators are unimpaired?
  - Are tag lines used to keep loads from swinging?
- **Equipment maintenance personnel**
  - Have corrective and preventive maintenance activities been performed in accordance with manufacturer's recommendations?
  - Have applicable repair and lubrication procedures been reviewed for understanding to ensure they are executed appropriately?
  - Is the maintenance history retained for review throughout the equipment service life?
  - Are inspections performed in accordance with manufacturer's recommendations on equipment that is difficult to access?
  - Are periodic visual inspections conducted in accordance with manufacturer's recommendations that address properly operating control and limit switches; cracked and deformed hooks; kinked, crushed, or eroded ropes; worn, distorted, or corroded chains; and identified suspect/counterfeit or defective items?



## ***About the Office of Environment, Safety and Health***

### **Office of Corporate Performance Assessment**

The Office of Environment, Safety and Health, Office of Performance Assessment and Analysis (EH-3) has two overarching responsibilities. These are to review existing operational safety data streams to determine if significant safety vulnerabilities exist, and to provide information in support of DOE decision making. Significant safety vulnerabilities are communicated to appropriate management so intervention can take place before serious safety issues or events arise.

Although safety is difficult to measure in terms of accidents prevented, existing safety operational data identify safety vulnerabilities both at a site-level and complex-wide level. The Office of Performance Assessment and Analysis strives to provide line management with useful information to drive changes in the workplace that will continue to improve safety performance across DOE.



### **U.S. Department of Energy Office of Corporate Performance Assessment**

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