Fermilab

Section Office
ES&H Section
630.840.8069 (phone)
630.840.3390 (fax)

Memorandum

March 25, 2008

To: Bruce Chrisman

From: William Griffing

Subject: FESHM Chapter 5021 – Overhead Cranes and Hoists

FESHM 5021, "Overhead Crane and Hoists" has been revised. References to slings and rigging hardware have been removed to a new, separate chapter. Clarification on recurring operator training was added. In addition, the Mechanical Safety Subcommittee has reviewed the DOE Hoisting & Rigging Manual's definition of "Hostile Environment' and have determined that no such conditions exist at Fermilab. If it did, a lift in such an environment would fall under "Special Lifts".

This chapter was reviewed site-wide and all comments were addressed. Bruce Chrisman, Chief Operating Officer, has reviewed the chapter and his questions have been addressed as well.

After final approval, please return to Elizabeth Bancroft at MS 119 for posting on the web.

Recommended for Approval:

Bruce Chrisman — Date 3/27/08

Approved:

Piermaria Oddone — Date 3/26/08

OVERHEAD CRANES AND HOISTS

INTRODUCTION

Cranes and hoists are found in many buildings and experimental enclosures throughout Fermilab. Improper use of material handling equipment creates a significant potential for property loss and serious injury. This chapter contains procedures for proper design, testing, and safe operation of cranes and hoists.

This chapter applies to Fermilab employees, users, and subcontractor employees.

POLICY

Hoisting and rigging equipment and all design, installation, inspection, testing, and operations activities shall be in accordance with Fermilab Work Smart Standards WSS). For cranes, hoists, monorails, jib cranes and rigging activities, these regulations (available in the library) are:

29 CFR 1910, Subpart N, OSHA General Industry Standards, Materials Handling and Storage.
ANSI/ASME B30.10 (Hooks)
ANSI/ASME B30.11 (Monorails and Underhung Cranes)
ANSI/ASME B30.16 (Overhead Hoists (Underhung))
ANSI/ASME B30.17 (Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist))
ANSI/ASME B30.2 (Overhead and gantry cranes)
ANSI/ASME B30.21 (Manually Lever Operated Hoists)
ANSI/ASME B30.22 (Articulating Boom Cranes)
ANSI/ASME B30.23 (Personnel Lifting Systems)

DEFINITIONS

Appointed - assigned specific responsibilities by the employer or the employer's representative.

Crane - a machine for lifting and lowering a load, and moving it horizontally. Cranes are driven manually, by power, or by a combination of both.

Hoist - a machinery unit that is used for lifting or lowering a freely suspended (unguided) load. Hoists may be integral to a crane or mounted in affixed position, permanently or temporarily. Hoists may be hand-operated, air, or electric powered.

Initial Load Test – The test performed when a crane is newly installed or re-installed. Refer to ASME/ANSI B30.20. Although an initial service lift may exceed the capacity of

OVERHEAD CRANES

INTRODUCTION

Cranes are found in many buildings and experimental enclosures throughout Fermilab. Improper use of material handling equipment creates a significant potential for property loss and serious injury. This chapter contains procedures for proper design, testing, and safe operation of cranes.

This chapter applies to Fermilab employees, users, and subcontractor employees.

POLICY

Hoisting and rigging equipment and all design, installation, inspection, testing, and operations activities shall be in accordance with Fermilab Work Smart Standards WSS). For cranes, hoists, monorails, jib cranes and rigging activities, these regulations (available in the library) are:

29 CFR 1910, Subpart N, OSHA General Industry Standards, Materials Handling and Storage.
ANSI/ASME B30.10 (Hooks)
ANSI/ASME B30.11 (Monorails and Underhung Cranes)
ANSI/ASME B30.16 (Overhead Hoists (Underhung))
ANSI/ASME B30.17 (Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist))
ANSI/ASME B30.2 (Overhead and gantry cranes)
ANSI/ASME B30.21 (Manually Lever Operated Hoists)
ANSI/ASME B30.22 (Articulating Boom Cranes)
ANSI/ASME B30.23 (Personnel Lifting Systems)

DEFINITIONS

Appointed - assigned specific responsibilities by the employer or the employer's representative.

Crane - a machine for lifting and lowering a load, and moving it horizontally. Cranes are driven manually, by power, or by a combination of both.

Hoist - a machinery unit that is used for lifting or lowering a freely suspended (unguided) load. Hoists may be integral to a crane or mounted in affixed position, permanently or temporarily. Hoists may be hand-operated, air, or electric powered.

Initial Load Test – The test performed when a crane is newly installed or re-installed. Refer to ASME/ANSI B30.20. Although an initial service lift may exceed the capacity of

the crane, it is not considered a "Planned Engineered Lift".

Inspection frequency definitions:

Monthly Inspection – Recorded visual examinations by the operator or other designated required as follows:

Normal Service – Monthly
Heavy Service – Weekly to Monthly
Severe Service – Daily to Weekly

Annual Inspection – Recorded visual inspection of the equipment in place by a designated person of apparent external conditions to provide the basis for a continuing evaluation, as follows:

Normal Service – Yearly
Heavy Service – Yearly

Landlord - The division/section responsible for the space.

Load - The total weight superimposed on the load block or hook. This includes not only the material being lifted but also all the rigging equipment necessary to attach the load to the load block; i.e., lines, shackles, rigging, etc.

Modified - A variation or alteration that changes the original configuration of the crane or adds other features not originally installed with the crane and impacts the crane's lifting capacity or load bearing components.

Planned Engineered Lift - A lift in excess of the crane's rated load.

Person-in-Charge (PIC) – A Qualified Person appointed to be responsible for the safe execution of a Planned Engineered Lift or a Special Lift.

Qualified Person - a person who, by possession of a recognized degree in an applicable field or a certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

Qualified Operator - A person who has successfully completed the training requirements outlined in this chapter and has been so designated by the division/section head.

Rated Load (Capacity) - The posted maximum load designated by the manufacturer for which a crane or individual hoist is designed and built.

Re-installed - When a crane or hoist or portions of a crane is/are physically removed from their original location and later moved to a different location or returned to the original location. This definition does not include portable hoisting equipment.

Service Definitions:

Normal Crane Service – Service that involves operating at less than 85% of rated load and not more than 10 lift cycles/hr except for isolated instances.
Heavy Crane Service – Service that involves operating at 85 to 100% of rated load or in excess of 10 lift cycles/hr as a regular specified procedure.
Severe Crane Service – Service that involves normal or heavy service with abnormal operating conditions. (Typically found in steel mills and similar service – these conditions are not anticipated at Fermilab.)

Special Lift - Load requires exceptional care in handling because of size, shape, close-tolerance installation, high susceptibility to damage, value, impact to operations, or other unusual factors.

ROLES AND RESPONSIBILITIES

The Division/Section Head is responsible for implementing this program. Specifically he/she is responsible for:

- Assuring, through the line management, that employees assigned to perform rigging or crane operation duties are qualified to perform the work assigned. Successful completion of crane training is necessary, but not necessarily sufficient, to deem a person qualified to perform all rigging and crane operation tasks.
- Ensuring that documentation on cranes and hoists is maintained.
- Ensuring that all cranes and hoists within their areas of responsibility are inspected, tested, maintained, and repaired as required in this document.
- Assuring that service subcontractors who perform inspection, testing, maintenance and repair of cranes have adequate oversight; usually provided by Facilities Engineering Services Section.

The Facilities Engineering Services (FESS) Section is responsible for:

- Maintaining manuals and manufacturer information and records related to testing, inspection, and repair of overhead cranes and hoists. This includes the distribution of related reports to the landlord division/section head or his/her designee.
- Providing consultation and design of all new overhead cranes and hoists that are attached to building structural supports.
- Arranging for an initial inspection of all new, modified or re-installed overhead bridge cranes, hoists and monorails that are attached to building structural supports.
- Arranging contracts with qualified subcontractors to perform annual inspection, testing, maintenance and repair of cranes.
- At the request of divisions/sections, arranging for qualified subcontractors to perform annual inspection, testing, maintenance and repair of cranes. FESS will provide oversight of the subcontractor.

The ESH Section is responsible for:

- Providing consultation services to division/section heads regarding safety of operations and training opportunities.
- Coordinating and scheduling training opportunities for newly selected and qualified operators.
- Maintaining training records of operators in the TRAIN database.

The Person-in-Charge (PIC) is responsible for:

- Reviewing HA and lift plan for planned engineering and special lifts with all involved or affected by the lift before the lift is initiated.
- Directing the operation of assigned lift in accordance with the HA, lift plan, and all appropriate rigging and lifting best practices.
- Identification of appropriately trained individuals participating in the lift. Skill level of each participant in the lift shall be commensurate with the assigned duty.

The Qualified Operator is responsible for:

- Recognizing if a lift or rigging task is within his/her capability based on previous experience or training. If level of training or experience is insufficient to assure a safe lift, operator must state this to their supervisor or the Person-in-Charge and not proceed with the task.
- Following best practices in rigging and hoisting to assure a safe lift.
- Identify hazards and mitigations associated with the hazard, including appropriate personal protective equipment (PPE).
- Identifying appropriately trained individuals, if required, to participate in the lift. Skill level of each participant in the lift shall be commensurate with the assigned duty.
- Performing a pre-lift inspection of lift site location. If a problem or situation appears to not be safe, or if the crane is not operating properly, contact FESS to have a pre-lift inspection/repair completed by a subcontractor.
- Conducting crane inspection and checks prior to use.
- Inspecting slings, fastenings and attachments for damage or defects prior to each use and remove from service if damaged or defective. (See FESHM Chapter 5024.)
- Ensuring the sling identification is legible and shows the rated capacities for each type of hitch (vertical, basket and choke). (See FESHM Chapter 5024.)
- Performing lift in accordance with any formal hazard analysis (HA) or lift plan, if one exists.

PROGAM DESCRIPION

Training

1. Operator Training for Fermilab Employees – Initial Training Course

   a. Operators are required to be initially trained and re-qualify every 3 years. The training consists of three phases:
      1) Classroom
      2) On-The-Job Training (OJT)
      3) Evaluation
   b. Supervisors may "waive" the OJT requirement for operators who use the equipment on a frequent basis. Operators who fail the performance evaluation may be required to complete additional OJT.
   c. Operators who fail the performance evaluation shall NOT operate a crane without supervision until they have successfully completed the evaluation.
   d. Detailed qualifications for operators are listed in ASME 30.22 section 22-3.1.2.
   e. If warranted, at their discretion, supervisors may require re-evaluation of already qualified operators.
   f. The specific portions of the training are as follow:

      1) Classroom Phase - This phase of the program will be presented as needed. Coordination and scheduling will be the responsibility of the ESH Section. The training is currently provided by an outside contractor and is eight (8) hours in length. It includes classroom training, field exercise, and a written exam. Prospective operators must successfully complete the written exam and field exercise before continuing with the remainder of the qualification process. Operators are NOT allowed to test-out of the initial phase since this is the only opportunity for all operators to be exposed to the same material, changes to the program and lab policies, lessons learned, etc.
      2) Practical (OJT) Phase - Divisions/Sections will designate OJT trainers and present this phase within their respective areas. This training may consist of demonstrations, supervised exercises and coaching with the type of equipment to be operated and within the work environment where work activities take place. The Operator will be fully aware of all safety features of the equipment and safety-related activities surrounding the work. Supervisors may waive this phase of the qualification process for experienced operators. The Crane Operator Performance Evaluation form will be forwarded to the division/section by the ESH Section after the classroom phase is successfully completed, and must be used to document the dates/times of OJT training or the waiver.
      3) Performance Evaluation Phase - The evaluation is completed after the classroom/OJT training phases. It is conducted by a qualified and designated person within the division/section. The Crane Operator Performance Evaluation form must be used to document the completion of

this phase. If the operator is not successful in the evaluation, appropriate remedial training should be provided before attempting the evaluation again. The evaluation form must be completed by the evaluator and signed by both the evaluator and the operator's supervisor. If the supervisor wishes to waive this phase of the qualification process for experienced operators, they shall document this on the Crane Operator Performance Evaluation form and forward it to the ESH Section for filing and documentation.

2. Retraining
   a. Crane operator training expires three (3) years after the initial training. This re-training shall consist of the classroom phase, OJT, and evaluation. OJT and evaluation may be waived by the supervisor and shall be documented on the Crane Operator Performance Evaluation Form.
   b. Retraining must be completed within 120 days of the expiration of the previous training or all training must be repeated.

3. Incidental Operator Qualification- Non-employee Operator
   a. Non- employees, such as subcontractors and users/visitors are permitted to operate cranes in the course of their work activities provided that they have the appropriate qualifications and training.
   b. The task manager/construction coordinator/service coordinator that is overseeing the subcontractor work activity must review the qualifications and training of subcontractor workers.
   c. Permission to use the crane is also required from the landlord division/section. Subcontractor use of cranes should be included in the Procurement exhibits and must be in the written hazard analysis when applicable.
   d. The landlord division/section is responsible for determining any visiting scientist's crane operator qualifications and establishing internal mechanisms to verify those qualifications prior to use.

Control of Cranes and Hoists

1. The division/section that owns the crane or hoist should develop means to restrict crane and/or hoist use by unqualified personnel (e.g., restricting access, locking crane controls or hoist chains, or other appropriate measures - generally by use of administrative configuration locks (See FESHM 5120 for Administrative Lockout procedures).

2. The Division / Section head may, through the line management, restrict the use of cranes and hoists to individuals who have received supplemental training on the use and operation of any specific crane or hoist

Inspection, Maintenance, and Repair

1. Each division/section is responsible for assuring cranes and hoists are inspected annually and maintained/repaired as necessary. If a crane is not inspected annually because of lack of use or location in an inaccessible area then it must be inspected before it is placed back in service.

2. Contracts

   a. FESS maintains inspection and repair contracts to assist the division/section in accomplishing these activities.
   b. Each division/section shall advise FESS of times when the equipment will be available for inspection. The inspection shall be conducted by a qualified crane inspection organization and if repairs are necessary, a qualified subcontractor who was not part of the initial inspection must perform such repairs.
   c. If a division/section head wishes to assume the responsibility for performing the inspection, maintenance and repair of cranes, they must notify FESS and provide copies of any and all records to FESS.

3. Pre-Use Inspection
   The **daily inspection** is a non-recorded visual inspection meant to be a pre-operational check to detect discrepancies that are obvious to the naked eye. Operators shall visually inspect such items as the following:

   a. Controls and operating mechanisms.
   b. If the crane has not been in regular service the hoist upper limit switch requires functional verification prior to or in the beginning of the shift when the crane will be used.
   c. Lines, valves and other parts of air systems for leakage.
   d. Hooks for cracks, deformations, and damage from chemicals.
   e. Hoist rope for significant wear, kinking, crushing, bird-caging, and corrosion.
   f. Hook latch for proper operation, if used.

4. Monthly Inspection
   A **monthly inspection** is more stringent than the daily pre-operational check and can be used as a substitute for the daily inspection on cranes that are used infrequently. As an example, a crane is used infrequently and the last time the crane was in use was ninety days ago. A crane operator using the crane today would be required to do a monthly type inspection and a daily inspection. Because of the stringent nature of the monthly inspection, this inspection counts as the monthly and the daily.

   a. A record must be kept of the monthly inspection. Forms are located at the rear of this document.

b. The monthly inspection record must be submitted to the FESS Crane Records Office to be filed with crane maintenance, inspection and repair records.

Crane/Structure Modification

a. Structure modifications or extensive repairs to cranes and new crane/hoists that may impact the load capacity of the building structural components shall be reviewed by FESS before proceeding with the reviewed application.
b. FESS shall review the drawings and technical specifications for all new cranes and modification to existing cranes in consultation with the landlord division/section.

New, Re-installed, Altered, Repaired and Modified Cranes and Hoists

1. Operational Tests
   a. New, re-installed, altered, repaired, and modified cranes shall be tested by the qualified person prior to initial use to comply with current standards. A qualified Fermilab employee will supervise subcontractors conducting operational tests. Tests shall include the following functions:

      ii. lifting and lowering;
      iii. trolley travel;
      iv. bridge travel;
      v. hoist-limit devices;
      vi. travel-limiting devices;
      vii. locking and indicating devices, if provided.

      Note: Operational testing of altered, repaired, and modified cranes may be limited to the functions affected by the alteration, repair, or modification, as determined by the qualified person.

2. Load Tests
   a. New, re-installed, altered, repaired and modified cranes shall be load tested prior to initial use as determined by the qualified person.
   b. A load test performed at Fermilab shall not be less than 100% of the rated load of the crane or more than 125% of the rated load of the crane.

Crane Damage

1. When a crane is damaged or fails operational testing, it shall be tagged and locked out of service by the division/section responsible for the crane (See FESHM 5120 for Administrative Lockout procedures).

2. Incidents resulting in damage to a crane shall be investigated and adequately documented by the responsible division/section.
3. The crane shall not be returned to service until it is repaired and acceptance testing is complete in accordance with Operational Tests, above.

Special Lifts

1. When lifting a load requires exceptional care in handling because of its size, shape close tolerance installation, a high susceptibility to damage, value, impact to operations, or other unusual factors, a written Hazard Analysis (per FESHM 2060) and lift plan shall be prepared. They shall include the following:

    a. Identification of Person-in-Charge of the lift.
    b. Selection of proper equipment and tools to control hazards, including PPE.
    c. Pre-lift inspection of lift site location.
    d. Pre-lift inspection of equipment.

2. A Post-lift critique shall be written, if beneficial, to identify any lessons learned.

Planned-Engineered Lifts (Lifts in Excess of the Crane Capacity)

1. The division/section head prior to the lift taking place must approve documented planned engineered lifts. Only two (2) lifts per crane are allowed in a 12-month continuous time period. Every planned-engineered lift will be treated as a special and separate event. The following procedures will be followed before the lift is executed.
2. Planned engineered lifts are limited to powered cranes having a load rating of 5 tons and above and shall not exceed 125% of rated capacity. The ESH Section shall be consulted if a lift will exceed 100 percent of rated load.
3. The division/section will advise FESS-ENG and the ESH Director in writing of the planned-engineered lift.
4. The division/section shall prepare a hazard analysis (per FESHM 2060) and lift plan that identifies the Person-in-Charge and the procedures to be used to perform the lift and all safety hazards associated with the lift. A copy of the plan (including the HA and lift plan) shall be sent to ESH Director prior to the planned engineering lift taking place.
5. A written review of the crane service history will be prepared, including reference to previous planned-engineered lifts, structural repairs, and modifications of the original design.
6. FESS-ENG shall review the design of the crane-supporting structure and the conditions of the crane supports. Any deterioration or damage must be taken into consideration in design calculations for the load to be lifted. He/She will determine the maximum load that can safely be lifted.

7. The division/section and FESS-ENG shall meet to assure that the lift and its limitations are understood
8. Prior to the lift, the crane will be inspected as follows:

    a. Inspect for deformed, cracked or corroded members;
    b. Loose or missing bolts, nuts, pins, or rivets;
    c. Cracked or worn sheaves and drums;
    d. Worn, cracked, or distorted parts such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers and stops;
    e. Excessive wear of brake system parts;
    f. Excessive wear of chain drive sprockets and excessive chain stretch;
    g. Deterioration of controllers, master switches, contacts, limit switches, and push-button stations, but not limited to those items;
    h. Motion limit devices that interrupt power or cause a warning to be activated for proper performance. Each motion shall be inched or operated at low speeds into the limit device with no load on the crane;
    i. Rope reeving for compliance with recommendations of the crane manufacturer;
    j. Function labels for legibility and replacement.

9. The operator shall test the crane at the planned-engineered load by lifting the load to ensure the entire weight bears on the crane and rigging components and setting the brakes. The lift will be continued ONLY if the brake stops and holds the load. Any failure to hold the load must be corrected before continuing with the lift.
10. A record of the planned-engineered lift, including calculations, inspections, and all distances moved, will be provided to FESS-ENG and will be made available upon request to appointed personnel.
11. The crane manufacturer shall be consulted if a planned engineering lift exceeds the number allowed in a continuous twelve-month period or exceeds 125 percent of rated load.
12. The crane shall be inspected in accordance with item 8 above after every planned engineering lift is completed and prior to being used for lifting any other load.
13. Pre and post inspections shall be documented.

Cranes as Work Platforms

1. There are systems, lighting equipment and sprinkler heads that require periodic maintenance or servicing. These activities require the use of bucket trucks or elevated work platforms to reach the work area.
2. Using a crane platform may be a suitable alternative method to perform maintenance activities. Workers using the crane as a work platform face several hazards, which include mechanical pinch points, overhead hazards and electrical shock and fall hazards.
3. Prior to starting work from a crane platform, the crane platform and the specific work activity must be evaluated and potential hazards identified.

4. A hazard analysis in accordance with FESHM 2060 shall be performed and the actions or precautions taken must address the hazards and the conditions stated below:
    a. Work cannot be performed from a suspended load or hook.
    b. Fall protection and standard guardrails shall be provided and used.
    c. Ladders shall not be erected and/or used on cranes to gain access to areas that are not directly accessible from a crane without the use of a ladder.
    d. Only a qualified electrician shall be permitted to perform work on or near electrical equipment (See FESHM 5042).
    e. Machinery and live electrical equipment shall be guarded.
    f. Work from cranes shall be performed only when a crane is stationary.
    g. Crane operators shall be notified before work is performed from a crane.
    h. Crane shall not be moved until all employees on the crane are in locations where they will not be exposed to injury.
    i. Rail stops or other suitable methods shall be used to prevent a crane from being struck, whenever other cranes are in operation on the same runway.
    j. Signs, which indicate work is being performed, shall be posted whenever work is performed from a crane (on the crane or from a manbasket hanging below the crane). Such signs shall be visible from the floor. If a manbasket is being used, review ASME B30.23 following all inspection requirements and perform a crane inspection. The crane inspection must be done prior to using the manbasket and after lifting a dead load.
    k. Lockout/Tagout procedures shall be implemented, as appropriate, when work is being performed from a crane.
    l. Safe egress to and from a crane shall be provided.
    m. Work performed from a manbasket hanging below the crane is permitted only if ASME B30.23 is followed and that both the crane and manbasket are inspected prior to work being performed.

Records

1. The ESH Section will maintain all training records. Divisions/Sections may retain copies, but the original completed Crane Operator Performance Evaluation form will be forwarded to the ESH Section. Completion of each phase of the training will be entered into the TRAIN database. Waived and OJT and performance evaluations shall be documented by the supervisor on the appropriate form.
2. Records dealing with annual inspections, modifications or additions to overhead cranes will be kept on file by FESS. Divisions/Sections arranging for these activities shall provide FESS with copies of such documents/records
3. Divisions/Sections are to provide FESS with any records generated by subcontractors in regards to maintenance and repair of cranes when the equipment owner is the requisition originator.
4. Copies of division/section records of planned engineering lifts shall be provided to FESS-ENG.
5. Records of monthly inspections will be kept at the division/section level and made available upon request. The form at the end of this chapter shall be used for this

purpose. If division/section prefers these documents may be stored in the FESS Crane Management Office.