CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT

PLANT OPERATING MANUAL

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PART 1

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1.0 PURPOSE

This procedure provides written instructions regarding crane operation, inspection and testing. It is designed (when used in conjunction with other referenced procedures) to assure that plant lifting equipment is capable of performing its design function, minimize unscheduled outages, and provide maximum availability of plant safety equipment. The following cranes fall under the applicability of this procedure:

1. Circular bridge crane in containment building
2. Overhead gantry cranes
3. ~~Spent fuel cask handling~~ Fuel Handling Cask crane
4. ~~Spent fuel bridge crane~~ Fuel Handling — To be deleted in next revision
5. ~~New fuel bridge~~ Fuel Handling Auxiliary crane
6. Hot maintenance shop crane
7. Waste handling bridge crane
8. Mobile cranes
9. Service building bridge crane

2.0 REFERENCES

1.	ANSI	N14.6 - 1978	Standards for lifting devices for shipping containers weighing 10,000 pounds (4500 kg) or more for Nuclear Material.
2.	ANSI	B30.1	Jacks
3.	ANSI	B30.2.0 - 1976	Overhead and Gantry Cranes (Top Running Bridge and Multiple Girder)
4.	ANSI	B30.3 - 1975	Hammerhead tower cranes
5.	ANSI	B30.4	Portal, Tower and Pillar Cranes
6.	ANSI	B30.5 - 1968	Crawler, locomotive and truck cranes
7.	ANSI	B30.6 - 1969	Derricks
8.	ANSI	B30.7	Base Mounted Drum Hoists
9.	ANSI	B30.9 - 1973	Slings

2.0 REFERENCES (continued)

10.	ANSI	B30.10	Hooks
11.	ANSI	B30.11	Monorail System and Underhung cranes
12.	ANSI	B30.15 - 1971	Mobile hydraulic cranes
13.	ANSI	B30.16	Overhead hoists (underhung)
14.	ANSI	B30.17	Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
15.	ANSI	B30.20	Below the hook lifting devices
16.	OSHA	910.179	Overhead and Gantry cranes
17.	OSHA	1910.180	Crawler, locomotive and truck cranes
18.	OSHA	1910.181	Derricks
19.	OSHA	1910.184	Slings
20.	OSHA	1910.550	Cranes and derricks

21. CP&L Safety Manual

22. NRC NUREG 0612

23. N.U.L. Property Loss Prevention Standard, Appendix 1.B.2

24. Crane Manufacturers Association of America

25. CMMA Specification 70, Overhead Electric Cranes

26. Monorail Manufacturers Association

27. MMA Specification for Underhung Cranes and Monorail-Hoists

28. NRC NUREG 0544

29. Code of Federal Regulations, Title 10

30. Clearance Procedure, POM, Volume 1, Part 1, AP-20

3.0 RESPONSIBILITIES

All activities conducted at the plant shall be performed within the guidelines of good maintenance practices.

3.1 Crane Operator

Crane operations shall be conducted in accordance with the guidelines listed in this instruction and its applicable reference data. In no case shall the crane operator move heavy loads, as defined in NUREG 0612, outside the paths as shown in Attachment 7. Deviations from these load paths are not authorized, unless specific directions are received, in writing, from the Manager - Maintenance.

3.2 Manager Maintenance

The Manager Maintenance (or equal/higher authority) has the authority to designate other cranes to which this procedure may apply, such as mobile or fixed cranes that may be required to perform work functions.

The Manager Maintenance shall ensure that all crane operators moving heavy loads, as defined in NUREG 0612, are provided with suitable visual aids (Attachment 7) to ensure movements of heavy loads are only along established load paths. Additionally, during movements of "critical loads," he is responsible to designate a cognizant individual to monitor each critical lift. This individual will have the authority to stop the operation where accepted standards are not being followed. Critical loads/lifts are those falling under the guidelines of NUREG 0612 and N.U.L Property Loss Prevention Standard Appendix 1.B.2.

4.0 DEFINITIONS

4.1 Angle of Loading

The inclination of a leg or branch of a sling is measured from the horizontal or vertical plane. An angle of loading of five degrees or less from the vertical may be considered a vertical angle of loading.

4.2 Basket Hitch

A sling configuration whereby the sling is passed under the load and has both ends, ends attachments, eyes or handles on the hook or a single master link.

4.3 Braided Wire Rope

A wire rope formed by plaiting component wire ropes.

4.4 Braided Wire Rope Sling

A sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook.

4.5 Critical Loads

Any lifted load whose uncontrolled movement or release could adversely affect any safety-related system when such system is required for plant safety or could result in potential off-site exposure.

4.6 Choker Hitch

A sling configuration with one end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling.

4.7 Major Maintenance/Alteration

Is defined as a repair or design change in which load bearing members are subjected to heating above 300°F (150°C), removal of significant quantities of metal, welding other than for surface repair, or plastic deformation of metal.

4.8 Heavy Loads

Any load, carried in a given area that weighs more than the combined weight of a single spent fuel assembly and its associated handling tool.

4.9 Hitch

A sling configuration whereby the sling is fastened to an object or load, either directly to it or around it.

4.10 Master Link or Gathering Link

A forged or welded steel link used to support all members (legs) of a wire rope sling.

4.11 Rated Capacity/Working Load Limit

The maximum working load permitted.

4.12 Selvage Edge

The finished edge of synthetic webbing designed to prevent unraveling.

4.13 Sling

An assembly which connects the loads to the material handling equipment.

4.14 Strand Laid Endless Sling-Mechanical Joint

A wire rope sling made endless from one length of strand wrapped six times around a core formed by hand tucking the ends of the strand inside the six wraps.

4.15 Strand Laid Grommet-Hand Tucked

An endless wire rope sling made from one length of strand wrapped six times around a core formed by hand tucking the ends of the strand inside the six wraps.

4.16 Strand Laid Rope

A wire rope made with strand (usually six or eight) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC).

4.17 Vertical Hitch

A method of supporting a load by a single, vertical part or leg of the sling.

4.18 Rope Lay

The length along the rope which a single stand requires to make one complete spiral or turn around the core.

4.19 Bight

The bend of a line, rope or cable.

4.20 Choker

A sling of wire rope with eyes spliced on each end.

4.21 Mousing

The act of wiring the throat of a hook to prevent a choker from jumping out of the hook.

4.22 Softener

Anything used to protect the load or cable from damage while making a lift. Also used to prevent a load from slipping.

4.23 Spreader

A set of chokers or slings of equal length used to lift a load.

5.0 PROCEDURE

5.1 Safe Operating Practices

General:

1. While operating the crane, the operator shall not engage in any practice which will divert his attention.

2. An operator shall not engage in the operation of equipment when he is physically or mentally unfit.

3. The operator shall respond to signals only from the person who is directing the lift or an appointed signalman; however, a stop signal shall be obeyed at all times, no matter who gives it.

4. Each operator shall be held directly responsible for the safe operation of his equipment. whenever there is any doubt as to safety, the operator shall have the authority to stop and refuse to handle loads until safety has been attained.

5. If a movement warning signal is furnished, it shall be sounded each time before traveling and intermittently during travel, particularly when approaching people.

6. The operator shall maintain familiarization with his equipment and its proper care. If adjustments or repairs are necessary, or any defects are known, he shall report the same promptly to his supervisor and notify the next operator accordingly.

7. All controls will be tested by the operator before beginning a new shift; these tests shall not require written documentation. If any controls do not operate properly, they shall be adjusted or repaired prior to operation.

8. Except for test purposes, the crane shall not be loaded beyond its designated rated load.

9. Operators shall be familiar with the use of fire extinguishers.

10. Attachments used with cranes shall not exceed the capacity, rating or scope recommended by the manufacturer.

11. Operators of outdoor cranes shall secure their crane upon leaving to prevent uncontrolled movement.

5.1 Safe Operating Practices (continued)

12. Cranes shall not be used for side pulls except when specifically authorized by the Mechanical Engineer - Maintenance who has determined that the stability of the crane is not thereby endangered and various parts of the crane will not be overstressed.

13. The operator shall not hoist, or travel while anyone is on the load or hook.

14. The operator should avoid carrying loads over people.

15. Each time a load approaching the rated load is handled, the operator shall test the brakes by raising the load a few inches and applying the brakes.

16. The load shall not be lowered below the point where less than two full wraps of rope remain on the hoist drum.

17. When two or more cranes are used to lift a load, one qualified person shall be in charge of the operation. He shall analyze the operation and instruct all personnel involved in the proper positioning, rigging and movements to be made.

18. The operator shall not leave his position at the controls while the load is suspended.

19. The hoist chain or hoist rope shall be free from kinks or twists nor shall it be wrapped around the load.

20. The load shall be attached to the load block hook by means of slings or other approved devices.

21. Care shall be taken to make certain that the slings or other approved devices clear all obstacles.

22. The individual appointed to direct the lift shall verify that the load is well secured and properly balanced in the sling or approved lifting device before it is lifted more than a few inches.

23. Operators shall avoid (to the extent practical) moving all heavy loads over or near irradiated fuel or safe shutdown equipment. SAFE LOAD PATHS HAVE BEEN DEVELOPED FOR HEAVY LOADS AND HEAVY LOAD FLOW CHARTS ARE LOCATED IN ALL APPLICABLE CRANE CABS. IN ADDITION, SIMILAR FLOW CHARTS SHALL BE AVAILABLE TO ALL SIGNALMEN DIRECTING HEAVY LOADS. THE OPERATOR SHALL BE FAMILIAR WITH ALL APPLICABLE LOAD PATHS PRIOR TO MOVING ANY HEAVY LOADS. In respect to deviation from load paths, the Manager - Maintenance is delegated the authority to approve alternate load paths

5.1 Safe Operating Practices (continued)

and load handling areas identified on the load path drawings. If heavy loads not identified on the current load path drawings must be carried over the open reactor vessel, prior plant nuclear safety committee review must be obtained. Approval of heavy load movement over the open reactor vessel is contingent upon meeting the following conditions:

a. Use lifting equipment (lifting apparatus and crane) with a rated capacity at least twice the load to be handled.

b. Use a four point or redundant lifting arrangement to preclude a load drop in the event of a single lift point failure.

Deviations from the specified load paths will be subsequently reviewed in accordance with plant procedures for changes to the plant procedure.

24. Before starting to hoist, assure that the hoist ropes are not kinked and that any multiple part lines are not twisted around each other.

25. The hook should be is moved to the load in such a manner as to prevent excessive swinging.

26. On a slack rope condition, assure that the rope is properly seated on the drum and in the sheaves.

27. During hoisting, additional care should be taken that there is no sudden acceleration or deceleration of the moving load and that the load does not contact any obstructions.

28. When removing/replacing reactor vessel integrated package to its refueling storage position, the head integrated package shall be raised only 6" above the operating floor area while moving to and from its storage site.

29. Tag lines shall be attached to loads, when necessary, to assist in controlling the movement of the load.

5.2 Crane Operation

This procedure shall apply to all personnel (local, traveling maintenance and contract) involved with operating or directing the operation of overhead, gantry and mobile cranes.

5.2.1 Operators and Signalmen

In general, all operators shall be signalmen and all signalmen shall be operators, except under conditions when the foremen (or higher authority) authorizes the use of a knowledgeable non-operator as a signalman. All crane operators and signalmen will be trained, qualified and instructed to conduct themselves in accordance with the requirements of this procedure with no exceptions.

Cranes shall be operated only by:

1. Certified operators
2. Trainees under the direct supervision of a certified operator.
3. Vendor maintenance and test personnel when it is necessary in the performance of their duties.

Crane cabs shall only be entered by the above listed personnel, PM Crews and applicable maintenance supervisors in the performance of their duties. Signalmen will walk down the load path prior to each lift or in cases where walking the load path is not possible, review the load path with the operator prior to signaling the crane operator to lift or move the load.

5.2.2 Fixed Cranes

At least once each shift, the operator shall test the upper limit switch of each hoist under no load. Extreme care shall be exercised; the block shall be "inched" into the limit or run in at slow speed. If the switch does not operate properly, he shall immediately notify his supervisor. If the crane is operated only on one shift, the upper limit switch need only be tested for that shift.

The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control.

1. The operator shall comply with the manufacturer specifications and limitations applicable to the operation of all permanent cranes and derricks.
2. Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a qualified engineer competent in this field and such determinations will be appropriately documented and recorded.
3. Persons boarding or leaving overhead cranes should do so only at authorized locations and designated boarding locations.

5.2.2 Fixed Cranes (continued)

4. Hands shall be free from encumbrances while personnel are using ladders. Articles which are too large to be carried in pockets or tool belts shall be lifted and lowered by hand line.

5. Necessary clothing and personnel belongings shall be stored in such a manner as to not interfere with access or operation.

6. Tools, oil cans, waste and other material shall be stored in the tool box and shall not be permitted to lay loose in the cab or on the crane.

7. If the operator finds the main or emergency switch open when starting on duty, he shall not close it until he has made certain that no one is in, on, or about the crane. If there is a clearance on the switch, he shall not remove it until the clearance has been removed either by the person placing it there or equal authority as per Operating Procedure AP-20.

8. Before closing the main switch, the operator shall verify that all controls are in the OFF position and that the crane is not under "clearance".

9. If power goes off during operation, the operator shall immediately place all controls in the OFF position.

10. When starting the bridge and the load or hook approaches near or over personnel, the warning signal shall be sounded.

11. Contacts with runway stops or other cranes shall be made with extreme caution.

12. Before any maintenance work on the crane is performed, the operator shall place the main switch in the OPEN position and lock or tag it in accordance with Operating Procedure AP-20 (Reference 2.30).

13. When wind indicator sounds (if equipped with one), the bridge and/or gantry crane shall be anchored. Outdoor cranes shall not be operated when winds exceed the manufacturer's recommended limits.

14. Before leaving his crane unattended, the operator shall land any attached load, place controls in OFF position and open main line switch for that crane.

5.2.3 Mobile Cranes

1. Before operating mobile cranes on the highway, the operator must familiarize himself with the requirements of the Special Permit posted in the cab and ensure he complies with their requirements.

2. If any controls do not operate properly, they shall be adjusted or repaired before operations are begun.

3. Keep all of cranes and loads at least 15 feet from energized electrical power lines.

4. Prior to making any lift, outriggers shall be fully extended, set and the crane level. It is permissible, however, to carry a piece of equipment/material with the crane provided the boom is over front or rear and swing is locked. Care and caution should be exercised.

NOTE: A three (3) degree tilt can reduce capacities by 50% or more.

5. When making lifts where outriggers cannot be fully extended, the operator shall obtain permission from his foreman before picking up any load. Extreme caution shall be exercised when operating the crane in this condition due to increased possibility of tipping.

CAUTION

DO NOT SWING EXTENDED BOOM IN QUADRANTS WHERE OUTRIGGERS ARE NOT EXTENDED AND SET - THE CRANE WILL TIP.

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6. In order to ensure safe operation of the crane and to avoid two-blocking, the load should be raised or lowered as the boom is retracted or extended.

7. Avoid sudden starts or stops.

8. Inspect the machine daily, paying particular attention to hoses brakes, attachments and wire ropes.

9. Operating is a full-time job, never eat, read or otherwise divert your attention when operating the crane.

5.2.3 Mobile Cranes (continued)

10. Use common sense. Safe operation depends on the operator and his actions.

11. Manufacturer's ratings shall never be exceeded.

5.3 Signals

Signals to the operator should be in accordance with the standards prescribed in ANSI B30.2.0 - 1976 unless voice communication equipment (telephone, radio or equivalent) is utilized. Signals should be discernible or audible at all times. Some special operations may require additions to or modifications of the basic standardized signals. For all such cases, these special signals should be agreed upon and thoroughly understood by both the signalman and operator and should not be in conflict with the standard signals.

The following describes the various standard crane hand signals pictured in Attachment 1.

Hoist - With forearm vertical, forefinger pointed up, move hand in small horizontal circles.

Lower - With arm extended downward, forefinger pointed down, move hand in small horizontal circles.

Trolley Travel - Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.

Bridge Travel - Arm extended forward, hand open and slightly raised; make pushing motion in direction of travel.

Stop - Arm extended, palm down, hold position rigidly.

Emergency Stop - Arm extended, palm down, move hand rapidly right and left.

Move Slowly - While one hand is signaling motion, place other motionless in front of signaling hand.

Extend Boom (Telescoping Boom) - Both fists in front of body with thumbs point outward (not pictured).

Retract Boom (Telescoping Boom) - Both fists in front of body with thumbs pointing toward each other (not pictured).

5.3 Signals (continued)

Use Main Hoist - Touch right hand to top of hard hat (not pictured).

Boom Up - Thumb up, fingers closed, arm stretched out (not pictured).

Use Whip Line - Touch left hand to right elbow (not pictured).

Boom Down - Thumb down, fingers closed, arm stretched out (not pictured).

5.4 Inspections

Cranes should be inspected, tested and maintained in accordance with Chapter 2-2 of ANSI B30.2 - 1976 "Overhead and Gantry Cranes" with the exception that test and inspections should be performed prior to use where it is not practical to meet the frequency of ANSI B30.2 for periodic inspections and tests or where frequency of crane use is less than specified test and inspection frequency.

5.4.1 Overhead and Gantry Cranes

5.4.1.1 Frequent Inspections

Prior to operation each day, the operator shall visually inspect the crane for:

1. Leakage in lines, tanks, valves, pumps and other parts
2. Deformed or cracked hooks
3. Hook latches (if used) in proper working condition
4. Condition of hoist rope and tightness of end clamp or rope clips
5. Slings
6. All functional operating mechanism
7. Other items that could effect safe operation of the crane.

These inspections will not require written documentation.

5.4.1.2 Periodic Inspection

All overhead and gantry cranes shall be inspected once a year. The inspection shall include the requirements of paragraph 5.4.1.1 above and in addition such items as:

1. Deformed, cracked or corroded members
2. Loose bolts or rivets
3. Cracked or worn sheaves and drums
4. Worn, cracked or distorted parts such as pins, bearings, shafts, gears rollers, locking and clamping devices
5. Excessive wear on brake system parts, linings, panels and ratchets
6. Load, wind and other indicators over their full range for any significant inaccuracies
7. Gasoline, diesel electric or other power plants for proper performance
8. Excessive wear of chain drive sprockets and excessive chain stretch
9. Electrical apparatus for signs of any deterioration of controllers, master switch contacts, limit switches and pushbutton stations
10. Fixed crane support structures and rails shall be visually examined for deformation, cracks and corroded members

5.4.2 Mobile Cranes

5.4.2.1 Frequent Inspections

Prior to operation each day, the operator shall visually inspect the crane for:

1. Leakage in lines, tanks, valves, pumps and other parts
2. Deformed or cracked hooks
3. Hook latches (if used) in proper working condition
4. Condition of hoist rope
5. Slings

5.4.2.1 Frequent Inspections (continued)

6. All functional operating mechanisms

7. Other items that could effect safe operation of the crane

5.4.2.2 Periodic Inspections

Periodic inspections shall be performed, and consideration should be given to the manufacturer's Maintenance Inspection Manual, and performed by an individual designated by the responsible supervisor. The inspection results shall be documented and recorded in the plant equipment files.

5.5 Testing

5.5.1 Overhead and Gantry Cranes

Prior to initial use and after major repairs, all permanent cranes shall be load tested and inspected by or under the direction of an appointed or authorized person; and a written report furnished by such person confirming the load rating of the cranes. The load rating should not be more the 80% of the maximum load sustained during the test. Test loads shall be 125% of the rated load unless otherwise recommended by the manufacturer. Test reports shall be placed on file and readily available to appointed authorized personnel. The rated load test shall consist of:

1. Hoist the test load a distance and hold to assure load is supported by the crane and held by the brake.

2. Transport the load by means of the bridge for the full length of the runway.

3. Transport the test load by means of the trolley for the full length of the bridge.

4. Lower test load, stop and hold load with the brakes.

A procedure will be developed when required for the performance of such a load test.

5.5.2 Mobile Cranes

Mobile cranes shall be tested in accordance with applicable portions of ANSI B30.15. A separate testing procedure shall be written to include the requirements of ANSI B30.5 and B30.15.

5.6 Operator Training and Qualification

The word "Operator" shall be interpreted to mean both operator and signalman as noted in Section 5.2.1.

5.6.1 Physical Requirements

Crane operators will demonstrate adequate physical and mental capabilities by submitting to a medical examination by a company physician. The results of the examination will be placed in the operator's training files (see Attachment 3).

Operators must:

1. Have vision of at least 20/30 in one eye and 20/50 in the other, with or without corrective lenses
2. Be able to identify the colors red, green and yellow regardless of position
3. Have corrected hearing of at least 15/20 for ordinary conversation in one ear
4. Have sufficient strength, endurance, agility, coordination and speed of reaction to meet the demands of equipment operation
5. Good depth perception and field of vision

Operators shall not:

1. Have physical defects or emotional instability which, in the opinion or the examiner, could render the operator a hazard to himself or others
2. Be epileptic or have a disabling heart condition
3. Have tendencies towards dizziness or similar characteristics
4. Have physical defects such as loss of arm, hand, leg, foot or gross loss of function thereof
5. Operate while under the influence of alcohol or prescribed or nonprescribed drugs that could affect operation

5.6.2 Training

After qualifying physically and mentally, the candidate shall receive classroom and practical "hands-on" instruction and practice.

5.6.2 Training (continued)

Classroom instruction will consist of the following:

1. Crane theory

2. Familiarization with this procedure, particularly the crane operation section, Paragraph 3.2

3. Familiarization with the specific crane on which the candidate is to be certified

Practical hands-on training will be given to the potential crane operator. This will include actual (noncritical) material handling. Operator trainees should not be permitted to operate cranes in close proximity to high value, critical, or safety-related equipment.

5.6.3 Testing

Operators shall demonstrate their ability to operate the crane to which they will be assigned or reassigned by passing a performance test approved by the Maintenance Manager or his designated Maintenance Supervisor. This test should permit an evaluation of the operator's depth perception and his ability to take the swing out of the load. A separate test will be administered for each type of crane. Quizzes will be given to crane operators and signalmen, covering the various classroom phases of the crane operating procedure, including the proper and safe handling of heavy loads and the identification of safe load paths. The candidate must receive satisfactory grades on these exams (80% or above).

5.6.4 Certification

Certification will be granted after crane operating proficiency has been demonstrated to the satisfaction of the Maintenance Supervisor or his designee. Certification will be for the crane on which the operator was trained. For certification on other cranes, the operator must become familiar with the crane's operation and satisfactorily demonstrate his operating skill to the maintenance supervisor or his designee.

Certification will be verified by the maintenance supervisor on Attachments 3 and 4 and placed in the operator's training file.

Training records shall be readily available for review.

5.6.5 Recertification

All crane operators will be recertified annually both physically by a medical doctor and practically by the Manager Maintenance or his appointed designee.

1. Physical recertification will consist of the annual physical and will be verified on Attachment 3.

5.6.5 Recertification (continued)

2. Practical recertification will be accomplished by an oral or operational checkout by the maintenance supervisor or his designee and will be verified on attachment 3 and 4.

3. The completed recertification forms are to be entered into the individual's training record.

5.7 Material Handling Attachments and Special Lifting Equipment

This section applies to handling attachments in conjunction with overhead cranes, mobile cranes, hoists, etc., for the movement of material by hoisting. The types of handling attachments include shackles, eyebolts, strongbacks, turnbuckles, hooks, etc.

5.7.1 Shackles

1. Only load rated shackles should be used. See Table 1 for stock diameter vs. maximum safe working load.

2. Manufacturer's safe working load should be stamped on the shackles. In the absence of manufacturer's safe working loads at the time of purchase, the safe working load should be marked on the outside surface by a low stress vibro-etching tool, tagging, painting, etc. Fittings not marked with the safe working load should not be used.

3. Replacement shackle pins shall be of the same size, material and configuration as the original shackle pins.

4. When using a screw pin shackle, the pin shall be screwed into its fullest extent.

5. Shackles shall be returned to the storeroom and scrapped if more than 10% of the original diameter of the crown or pin is worn, pins are bent of if binding occurs during the insertion of the pin due to distortion of the shackle, or the distance between the shackle eyes has increased due to distortion and exceeds the dimensions specified by manufacturer's recommendations.

6. Cotter pins shall be used with all round pin shackles. Screw pin shackles may be used when the shackle is positioned such that the pin tightens under load.

5.7.2 Eyebolts

1. Only load rated eyebolts with shoulders or collars should be used. Table 5 lists eyebolt specifications.

2. Tapped holes for eyebolts should have a minimum depth of one and one-half times the bolt diameter and eyebolts engaged to the full depth of the hole with the collar engaged to the object being lifted. Spacers should be used to maintain alignment if necessary, provided minimum engagement is not violated.

3. Manufacturer's or standard rigging tables should be followed relative to the selection, location and application of eyebolts.

4. Eyebolt efficiency factors, as shown in the following table, should be applied and eyebolt loading thereby calculated:

Eyebolt Efficiency Factors

Direction of Loading in Plane of Eye and:	% of Special Rated Capacity
Along axis of eyebolt shank	100%
15° from axis of eyebolt shank	65%
30° from axis of eyebolt shank	30%
45° from axis of eyebolt shank	20%
60° from axis of eyebolt shank (NOTE: 60° is the maximum angle.)	15%

5.7.3 Turnbuckles

1. All turnbuckles used in hoisting or rigging operations should be of weldless construction and forged low alloy steel. See Table 2 for safe working loads.

2. Before each use, turnbuckles should be inspected for cracks in the end fittings (especially at the neck of the shank). Deformed end fittings, deformed and bent rods and bodies, cracks and bends around the internally-threaded portion and signs of thread damage should be reason for removal from service.

5.7.3 Turnbuckles (continued)

3. When turnbuckles are supplied with hook fittings, safety latches should be provided, or the hooks should be moused.

4. Manufacturer's safe load should be stamped on turnbuckles. In the absence of the manufacturer's stamp, the safe working load should be vibro-etched, where practicable, on the outside surface of the turnbuckle.

5.7.4 Hooks

An annual magnetic particle or liquid penetrant examination shall be performed and documented on all hooks associated with permanent or fixed cranes, chain falls and come-a-longs. Table 3 lists various strengths of standard types of hooks.

5.7.4.1 Crane Hooks

1. Any hook found to be cracked, or showing evidence of excessive wear (a decrease of 10% or greater of the original thickness), or open at the throat more than 10 degrees from the plane of the unbent hook should be destroyed to prevent any inadvertent use.

2. All hoisting hooks should be stamped by the manufacturer with rated safe working load.

3. All hoisting hooks should be equipped with safety latches or should be moused.

5.7.4.2 Hooks, other than Crane Hooks

1. Manufacturer's identification should be forged, cast or die stamped on a low stress and nonwearing area of the hook.

2. The weight of the load to be lifted shall not exceed the load rating of the hook.

3. Shock loading shall be avoided.

4. A hook shall not be used in a manner other than that for which it was intended.

5. Visually inspect hooks prior to use; hook shall be disposed of if the twist exceeds 10% from the plane of the unbent hook or the throat opening is 15% in excess of the normal throat opening.

5.7.5 Slings

1. This section applies to slings used in conjunction with overhead cranes, "cherry pickers", hoists, etc., for the movement of material by hoisting. The types of slings covered are those made from wire rope and synthetic web (nylon, polyester and polypropylene). Slings made from alloy steel chain, natural or synthetic fiber rope, or metal mesh are not to be used without express permission of the maintenance supervisor.

2. Only load rated slings should be used. Slings should be proof tested by the manufacturer. Table 4 lists rated capacities for single leg slings.

3. Slings should be visually inspected before each use.

4. All slings shall be identified and tested in accordance with the "Sling and Lifting Equipment Marking and Inspection Procedure."

5.7.5.1 Safe Operating Practices

Whenever any sling is used, the following practices shall be observed:

1. Slings that are damaged or defective shall not be used.

2. Slings shall not be shortened with knots or bolts or other makeshift devices.

3. Sling legs shall not be kinked.

4. Slings shall not be loaded in excess of their rated capacities.

5. Slings used in a basket hitch shall have the loads balanced to prevent slippage.

6. Slings shall be securely attached to their loads.

7. Slings shall be padded or protected from the sharp edges of their loads.

8. Suspended loads shall be kept clear of all obstructions.

9. All employees shall be kept clear of loads about to be lifted and of suspended loads.

5.7.5.1 Safe Operating Practices (continued)

10. Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.

11. Shock loading is prohibited.

12. A sling shall not be pulled from under a load when the load is resting on the sling.

13. Tag lines shall be employed to guide and prevent excessive sway when transporting a load.

14. Slings shall be stored in an area where they will not be damaged by moisture, extreme heat, corrosion or subject to physical damage.

15. Nylon web slings shall not be used where fumes, vapors, sprays, mists, liquids, acids or phenolics are present.

16. Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

17. Web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

18. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 180°F. Polypropylene web slings shall not be used at temperatures in excess of 200°F.

19. Repair of synthetic web slings is not permitted.

20. All slings used in moving heavy loads will meet or exceed the requirements of ANSI B30.9-1971.

21. All slings utilized will have a minimum safety factor of 5. The rated load when selecting sling size will be the sum of the static and dynamic load or greater. The dynamic load being the greater of 15% of the static load or 5% for every foot/minute of hook spread.

22. The rating identified on the sling should be in terms of the static load which reduces the maximum static and dynamic load. Where this restricts the slings for use on only certain cranes, the slings shall be clearly marked as to the crane on which they may be used.

5.7.5.1 Safe Operating Practices (continued)

23. The weight of the load shall be determined prior to lifting the load.

24. Slings should be well lubricated to prevent corrosion.

5.7.5.2 Inspections

1. Frequent Inspections - A visual inspection shall be performed each day prior to use. These inspections shall be without written report. All slings and lifting attachments shall be visually inspected for damage or defects in accordance with MMM-21. Additional inspections shall be performed during use where service conditions warrant. Damaged or defective equipment shall be immediately removed from service and returned to storeroom for repair and/or disposal.

2. Periodic Inspections - A visual inspection shall be performed annually and documented. Sling fastenings and attachments shall be inspected for damage and defects in accordance with the criteria established in Paragraph 5.9 of this procedure. Damaged or defective slings shall be immediately removed from service and returned to storeroom for disposal.

5.7.5.3 Inspection Criteria

5.7.5.3.1 Wire Rope Slings

1. If any strap or sling does not pass the required inspection, or any doubt exists as to the condition of the strap or sling, consult with the appropriate Maintenance Foreman.

2. Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperatures in excess of 200°F. When nonfiber core wire rope slings of any grade are used at temperatures above 400°F or below minus 60°F, recommendations of the sling manufacturer regarding use at the temperature shall be followed.

3. Wire rope slings shall not be used with loads in excess of the rated capacities.

4. Wire rope straps shall be immediately removed from service if any of the following conditions exist:

5.7.5.3.1 Wire Rope Slings (continued)

a. Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay

b. Wear or scraping of one third the original diameter of outside individual wires

c. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire, rope structure

d. Evidence of heat damage

e. End attachments that are cracked, deformed or worn

f. Corrosion of the rope or end attachments

5. 6 x 19, 6 x 37 and cable laid slings shall have a minimum clear length of rope ten (10) times the rope diameter between splices, sheaves or end fittings.

5.7.5.3.2 Synthetic Web Slings

1. Each sling shall be marked to show the rated capacity and type of synthetic web material and shall not be used with loads in excess of its rated capacity.

2. Web slings shall be immediately removed from service and returned to the storeroom for disposal if any of the conditions as noted below exists:

a. Acid or caustic burns

b. Melting or charring of any part of the sling surface

c. Snags, punctures, tears or cuts

d. Broken or worn stitches

e. Distortion of fittings, or sharp edges on the fittings

f. Nonuniform webbing thickness and width

g. Split selvage edging

5.7.5.4 Storage

Slings shall be stored in a location protected from physical damage and the detrimental effects of weather.

5.8 Hoists/Jacks

This section applies to hoists in conjunction with overhead cranes, mobile cranes, monorails, etc., for the movement of material by hoisting. The types of hoists include chain falls, come-alongs, jacks, etc.

5.8.1 Chain Falls and Come-alongs

1. Only load rated chain falls and come-alongs should be used.

2. Manufacturer's safe working load should be marked on the chain falls/come-alongs. In the absence of manufacturer's safe working load at the time of purchase, the safe working load should be marked on the outside surface by a vibro-etching machine, stencilling, taggings, painting, etc. Come-alongs/chain falls not marked with the safe working load should not be used.

3. Chain falls used in a four-point lift should be of sufficient rated capacity to bear 50% of the total vectored load.

4. Shackles of correct load capacity should be used to attach the chain hoist to the load and the crane hook.

5. Safe load capacity should be clearly indicated on the chain hoist.

6. Chain hoists should not have load bearing parts constructed of cast-iron or other brittle material.

7. Chain links should be closed by welding and the chain approved for the lifting capacity intended.

8. Chain hoists should be of the self-locking design.

9. Chain hoist should be visually inspected along with all other rigging before each use.

10. Chains should be inspected annually and discarded when links are worn or stretched to a gage length exceeding the manufacturer's specifications, or in the tables in OSHA 1910.184. Chains with repaired sections should not be used unless repaired with manufacturer's specifications.

5.8.2 Jacks

1. Control parts shall be designed to provide a means of operation and adjustment which will minimize the operator exposure to injury.

2. The general construction of every jack shall incorporate a positive stop or method to prevent overtravel which will not alter the operating characteristics of the jack.

3. All features of general design should be such as to minimize the hazard(s) in the use, handling and operation of the jack.

5.8.3 Rings, Links and Swivels

1. Rings, links and swivels should be load rated.

2. Manufacturer's safe working loads should be stamped on the fittings. In the absence of manufacturer's stamp, the safe working load should be marked on the outside surface where practicable, using low stress vibro-etching tool.

5.8.4 Spreader and Equalizer Beams

1. Spreader and equalizer beams should be designed to suit the specific application and in accordance with the specifications within the AISC "Manual of Steel Construction." The maximum safe working load should not exceed 20% of the ultimate strength of the base material.

2. Distance between attachment points should not exceed the design specifications in relation to the load.

5.8.5 Inspections

Prior to use, the hoists shall be visually inspected for damage or defects. Additional inspections shall be performed as described in the following paragraphs:

1. Frequent Inspection - Visual examination by the operator or other designated personnel with records not being required.

2. Periodic Inspection - Visual inspections by appointed persons making records annually of apparent external conditions to provide the basis for a continuing evaluation. Results of such inspections shall be documented in accordance with the applicable Preventive Maintenance Procedures.

5.9 Special Lifting Equipment

This section applies to Special Lifting Equipment in conjunction with overhead cranes, mobile cranes, monorails, etc., for the movement by hoisting.

5.9.1 Safe Operating Practices

1. Comply with the manufacturer's specifications and limitations applicable to the special lifting equipment.

2. Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a qualified engineer competent in this field and such determinations will be appropriately documented and recorded.

5.9.2 Inspections

1. Frequent Inspections - Special Lifting Equipment shall be visually inspected for damage or defects prior to use. These inspections shall be without written reports.

2. Periodic Inspections - Inspections shall be performed by an individual designated by the responsible supervisor at intervals not to exceed three months in length for indication of damage or deformation.

3. Welding, fabrication, heat treatment, testing and inspection procedures and qualifications involved in repair or alteration of special lifting devices shall be in accordance with the design specification. If no special requirements for repairs or alterations are provided in the design specification, these operations shall be governed by the same requirements applying to the original fabrication.

4. Defective bolts, studs and nuts shall be replaced rather than repaired.

5. Testing - Testing will be in accordance with Reference 1.

5.10 General Hardware

1. All rigging accessories should be visually inspected prior to each use.

2. Only "load rated" hardware (safe working load stamped on the hardware where practical) should be used for lifting.

5.10 General Hardware (continued)

3. Rigging accessories and slings used for critical lifts should be reserved for that use where practical.

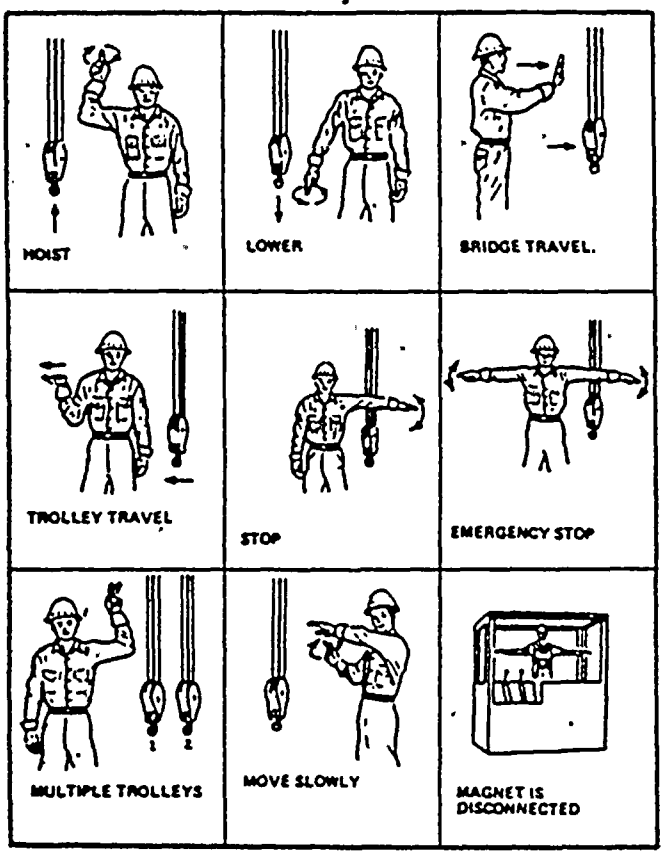
5.11 Maintenance and Repair

All welding during crane repairs is done by a welder in accordance with procedures that meet applicable American Society of Mechanical Engineers of American Welding Society Standards and according to manufacturer's directions. Where required, repairs should be inspected by the manufacturer. Repairs should meet or exceed the original design safety factors.

6.0 Attachments

Standard Hand Signals for Controlling Overhead and Gantry Cranes

Hand Signals for Controlling Overhead and Gantry Cranes



Crane Operator Certification

Physical Examination

Date _____

This is to certify that _____ _____
(name) (badge no.)

has completed the physical examination and meets the below listed minimum mental and physical requirements.

1. He must:

   a. have vision of at least 20/30 Snellen in one eye, and 20/50 in the other, with or without glasses.

   b. be able to identify the colors red, green and yellow, regardless of position.

   c. have hearing, with or without hearing aid, of a least 15/20 for ordinary conversation in one ear.

   d. have sufficient strength, endurance, agility, coordination and speed of reaction to meet the demands of equipment operation.

   e. have good depth perception and field of vision

2. He shall not:

   a. have physical defects or emotional instability which, in the opinion of the examiner, could render the operator a hazard to himself or others

   b. be epileptic or have a disabling heart condition

   c. have tendencies to dizziness or similar characteristics.

   d. have physical defects such as loss of arm, hand, foot or gross loss of function thereof

Verified by: _____
Maintenance Supervisor

Crane Operator Certification

Physical and Mental Examination

This is to certify that I have reviewed the physical and mental requirements for Crane Operator and verify that _____ _____
(name) (badge no.)
meets these requirements, and based on the results of written examinations and operational check-out or previous experience in crane operation, the above-named man is qualified to operate the crane(s) listed below:

	X	Initial	Date
Polar Crane			
Turbine Building Crane			
Spent Fuel Cask Handling Crane			
New Fuel Crane			
Waste Handling Bridge Crane			
Maintenance Shop Overhead Crane			
Mobile Cranes _____			
_____			
_____			
_____			
_____			
_____			

Verified by _____

_____
Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) Polar Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____ Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) Turbine Building Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____ Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) Spent Fuel Cask Handling Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____ Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) New Fuel Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____
Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) Waste Handling Bridge Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____
Maintenance Supervisor

Crane Operator Certification

	(X)	(Initial)	(Date)
Crane(s) Maintenance Shop Overhead Crane	_____	_____	_____

A. Pass a written examination consisting of ANSI B30.2-1976, CH2-2&3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation

_____ Date _____ Crane Operator

2. Storage Procedure

_____ Date _____ Crane Operator

3. Safety Aspects of Operation

_____ Date _____ Crane Operator

4. Controls-Layout Function

_____ Date _____ Crane Operator

5. Standard Hand Signals

_____ Date _____ Crane Operator

C. Crane Operator meets the physical standards established by Attachment 6.2

_____ Date _____ Maintenance Supervisor

This is to certify that I have reviewed the physical and mental requirements for crane operator and verify that

_____ (Name) _____ (Badge Number)

meets the requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____
Maintenance Supervisor

Mobile Crane Operator Certification

Crane/Cranee Make/Model _____ Capacity _____

A. Pass a written examination consisting of ANSI B30.15-1973, Ch. 15 - 2 and 3, and other classroom instructions.

_____ Date _____ Training Unit

B. Demonstrate the ability to perform the following:

1. General Operation _____ Date _____ Crane Operator

2. Safety Aspects of Operation _____ Date _____ Crane Operator

3. Controls-Layout and Function _____ Date _____ Crane Operator

4. Standard Hand Signals _____ Date _____ Crane Operator

C. Crane Operator meets the physical standards as established by Attachment 6.2.

_____ Date _____ Training Unit

This is to certify that I have reviewed the physical and mental requirements of Mobile Crane Operator and verify that

_____ (Name) _____ (Badge Number)

meets these requirements and based on the results of written examination and operational checkout or previous experience in crane operation, the above named is qualified to operate the crane(s) listed hereon.

Verified by: _____
Maintenance Supervisor

Crane Operator Recertification

Name _____ _____
(name) (badge no.)

1. Verified to be physically and mentally qualified.

   Verified by _____ Date _____
   Maintenance Foreman

2. Oral or operational check-out by Maintenance Supervisor or his designee.

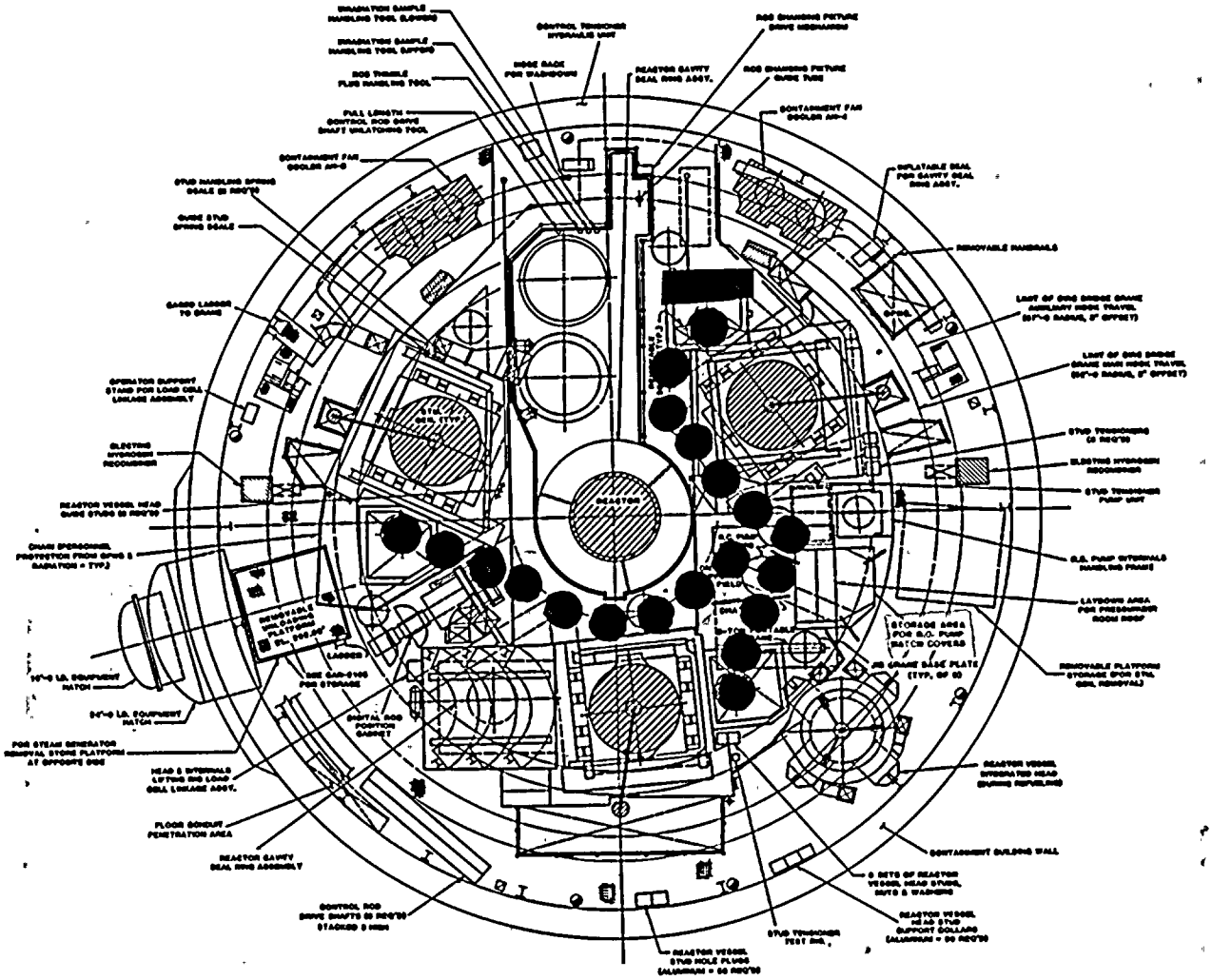
   Verified by _____ Date _____
   Maintenance Supervisor

Recertified as a crane operator on the following cranes:

	X	Initial	Date
Polar Crane			
Turbine Building Crane			
Spent Fuel Cask Handling Crane			
New Fuel Crane			
Waste Handling Bridge Crane			
Maintenance Shop Overhead Crane			
Mobile Cranes _____			
_____			
_____			
_____			
_____			
_____			

_____ _____
Maintenance Supervisor Date

Safe Load Paths



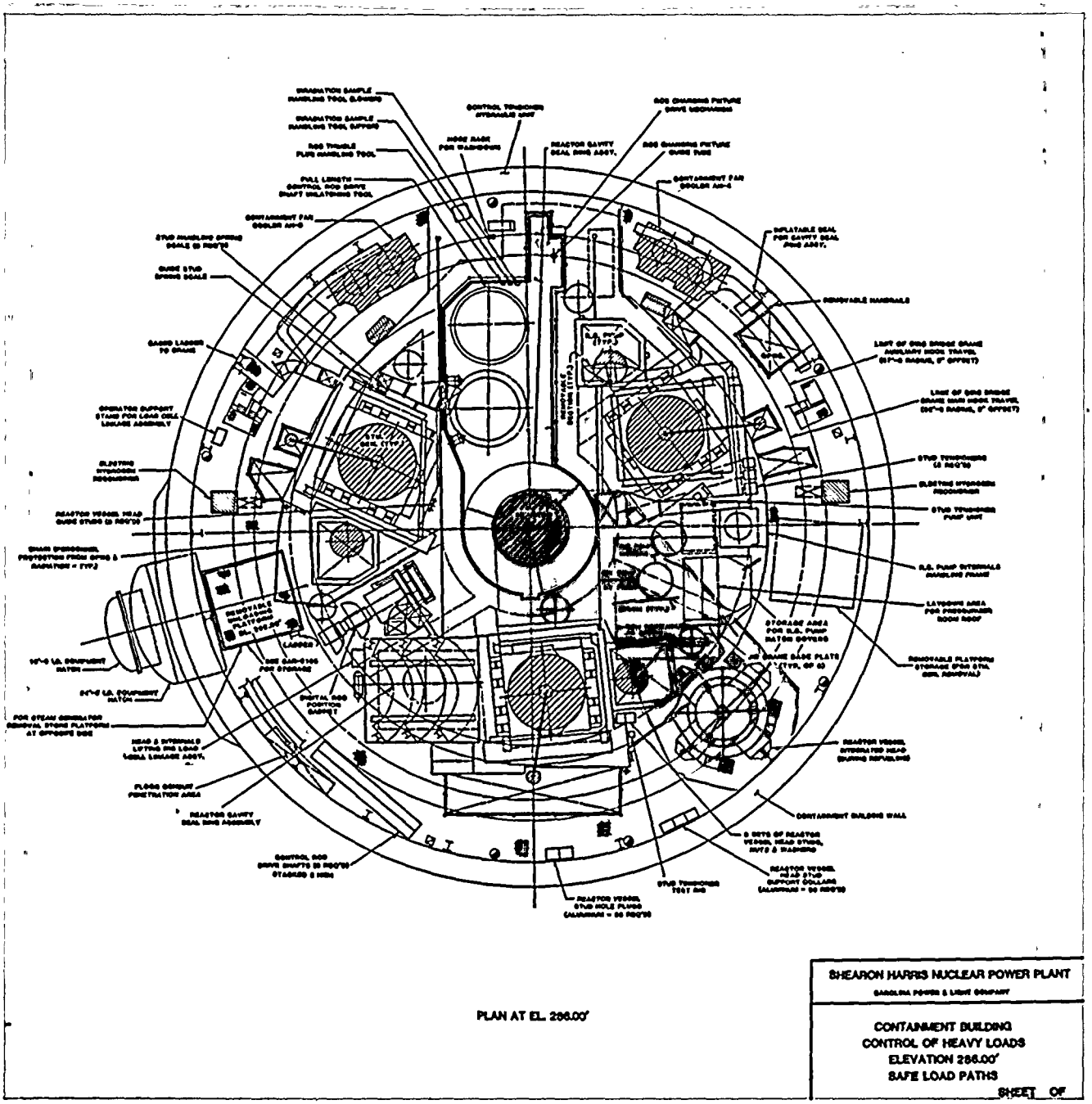
PLAN AT EL. 286.00'

SHEARON HARRIS NUCLEAR POWER PLANT
CAROLINA POWER & LIGHT COMPANY

CONTAINMENT BUILDING
CONTROL OF HEAVY LOADS
ELEVATION 286.00'
SAFE LOAD PATHS
SHEET OF

- SAFE LOAD PATHS FOR..REACTOR COOLANT PUMP MOTORS, AND REACTOR COOLANT PUMP HATCH COVERS.

Safe Load Paths



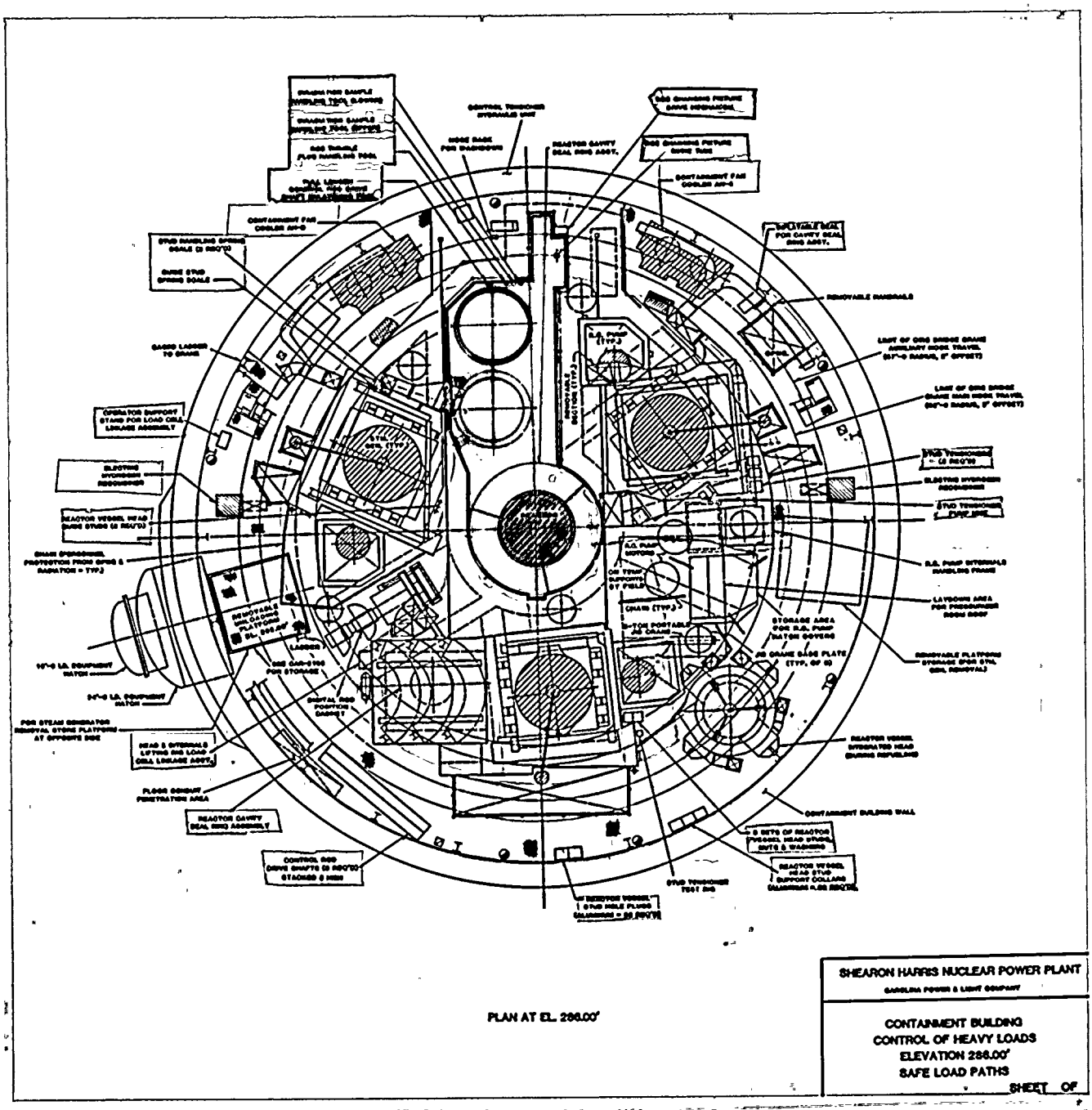
PLAN AT EL. 286.00'

SHEARON HARRIS NUCLEAR POWER PLANT
CAROLINA POWER & LIGHT COMPANY

CONTAINMENT BUILDING
CONTROL OF HEAVY LOADS
ELEVATION 286.00'
SAFE LOAD PATHS
SHEET OF

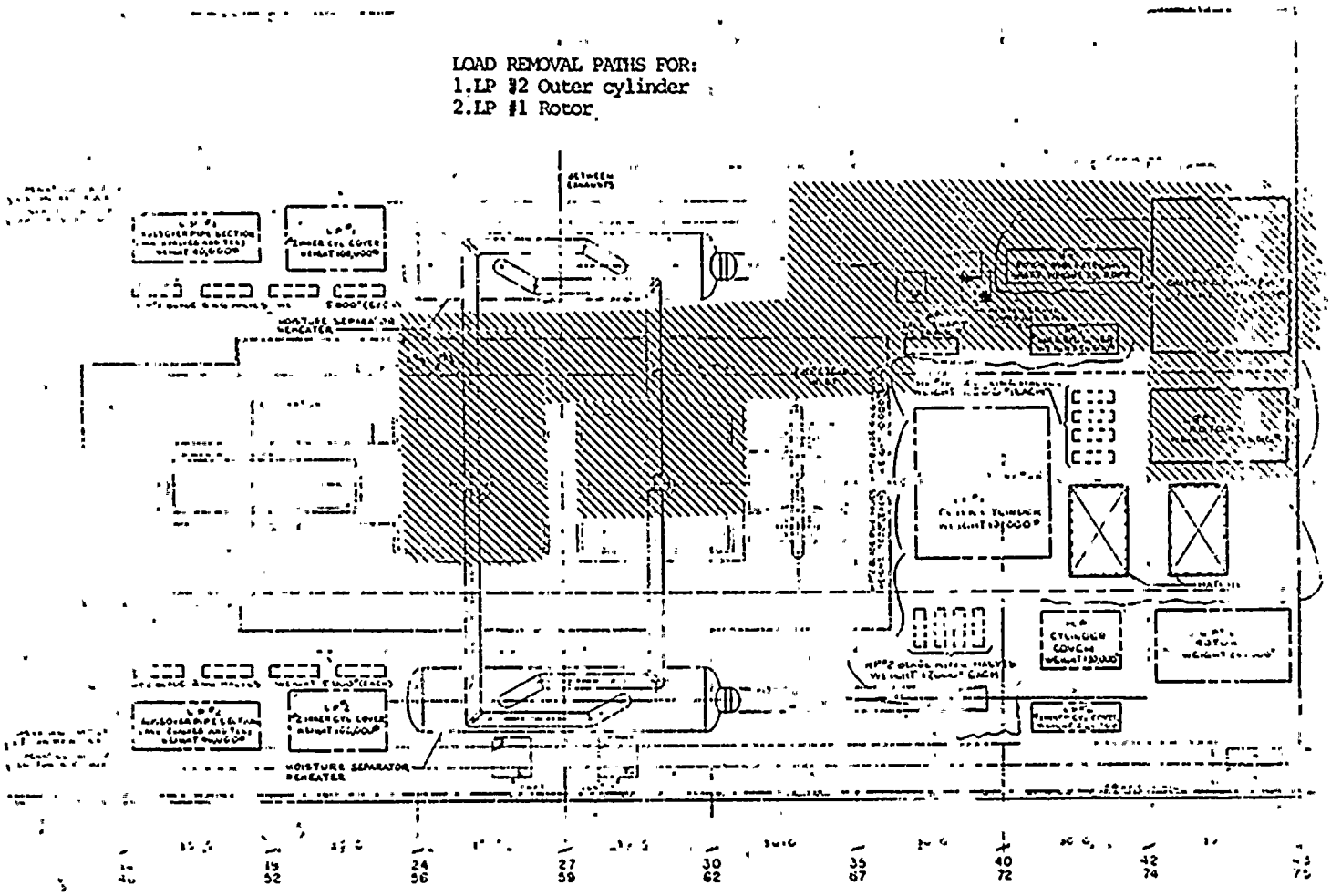
SAFE LOAD PATH..REACTOR VESSEL HEAD:

Safe Load Paths



SAFE LOAD PATHS FOR VARIOUS EQUIPMENT AS IDENTIFIED BY EACH SPECIFIC COLOR

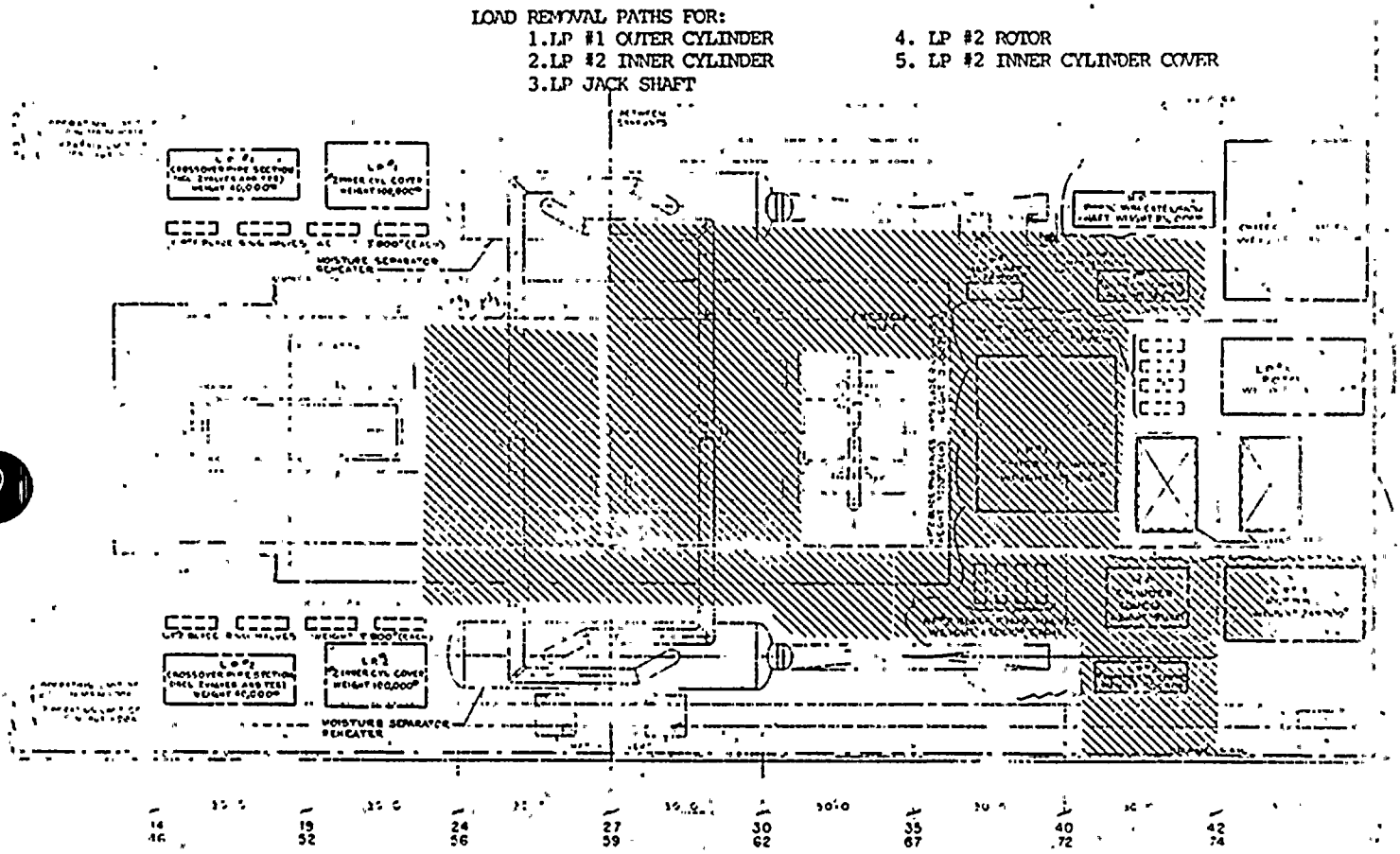
Safe Load Paths



Safe Load Paths

LOAD REMOVAL PATHS FOR:

1. LP #1 OUTER CYLINDER
2. LP #2 INNER CYLINDER
3. LP JACK SHAFT
4. LP #2 ROTOR
5. LP #2 INNER CYLINDER COVER

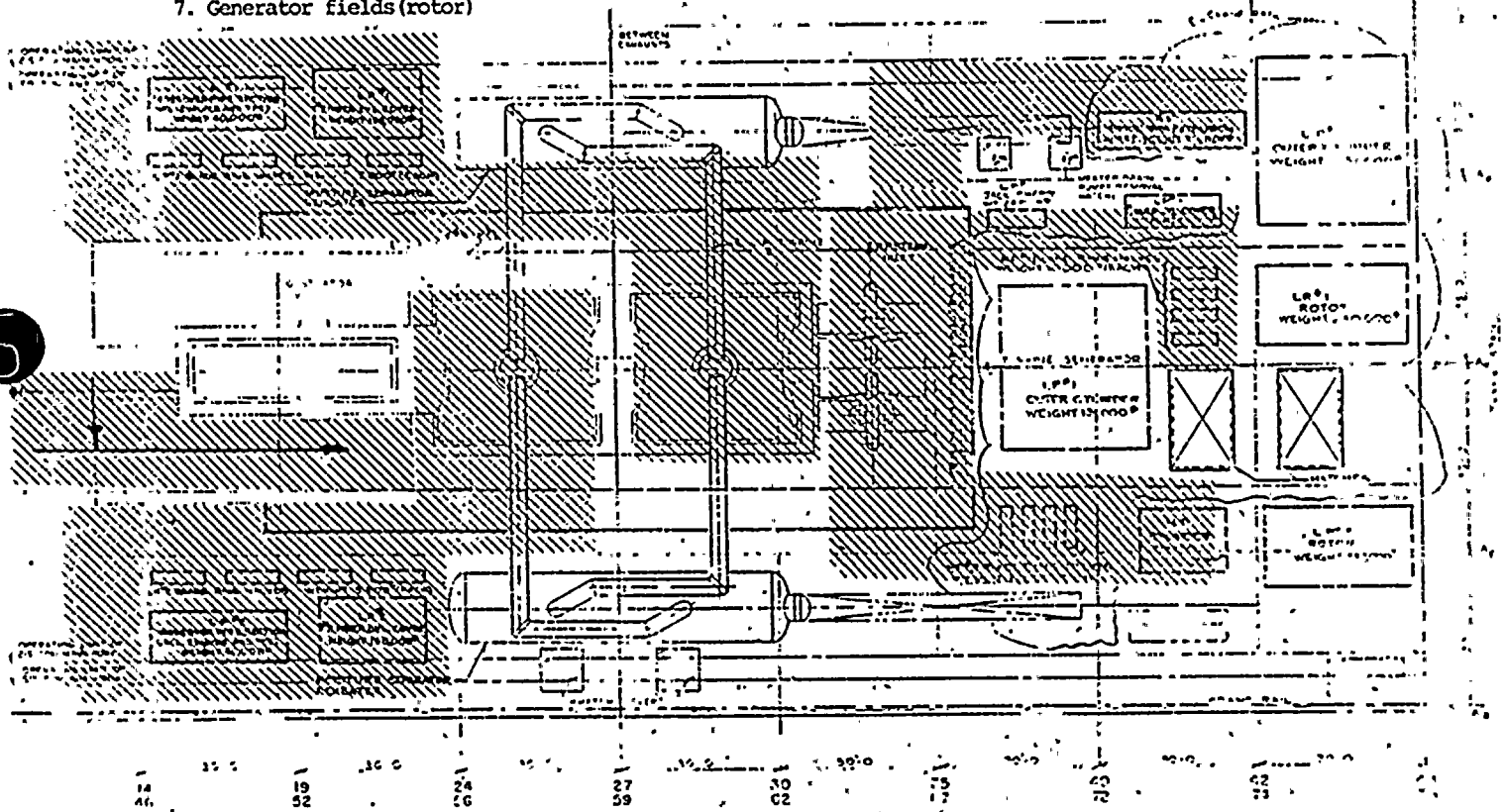


Safe Load Paths

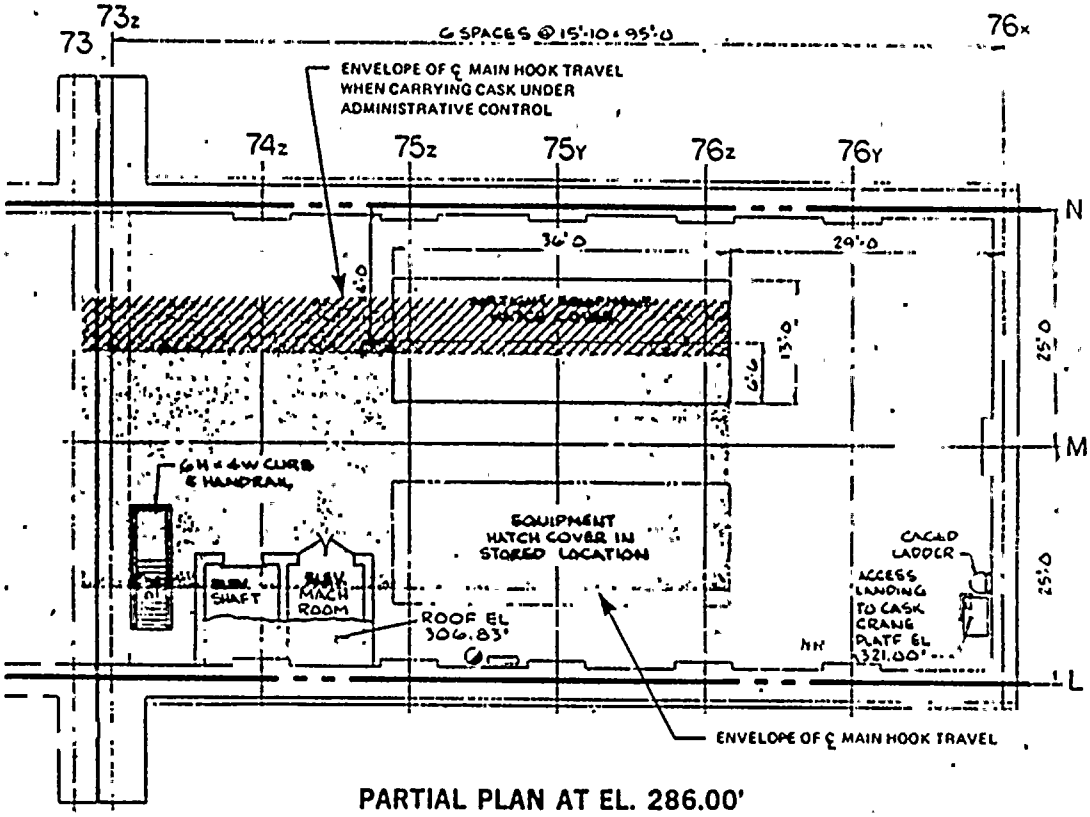
LOAD REMOVAL PATHS FOR:

4. HP Rotor with extension
5. HP Blade ring halves
6. HP Cylinder cover
7. Generator fields(rotor)

1.LP #1 & #2 Crossover pipe sections + valves and tee's
2.LP #1 & #2 Blade ring halves
3.LP #1 & #2 Innner cylinder covers



Safe Load Paths

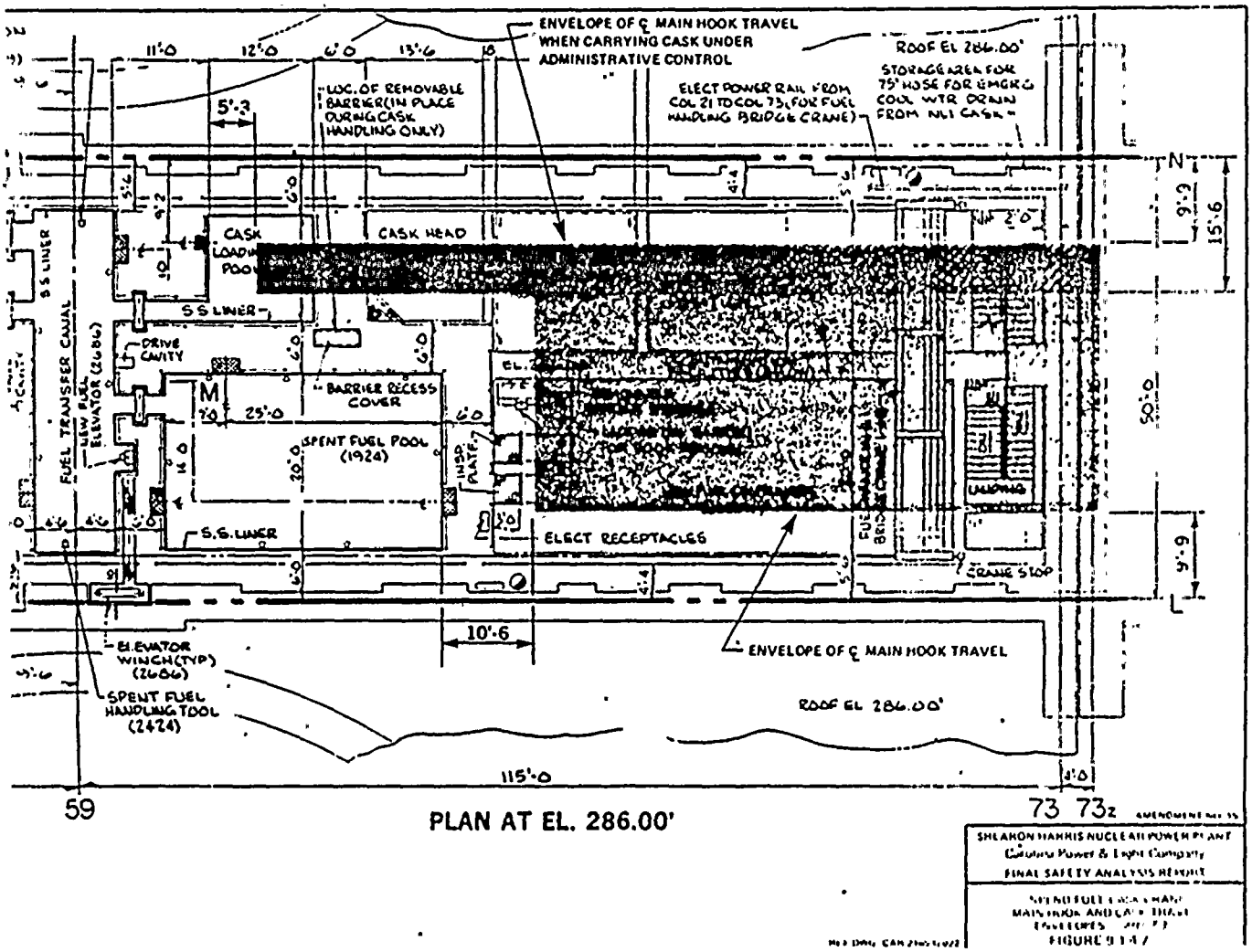


PARTIAL PLAN AT EL. 286.00'

FOR DIMENSIONS SEE SHEET 1

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT
SPENT FUEL CASK HANDLING MAIN HOOK AND CASK "PAZEE" ENVELOPES - SHEET 2
FIGURE 9.1-4a

Safe Load Paths

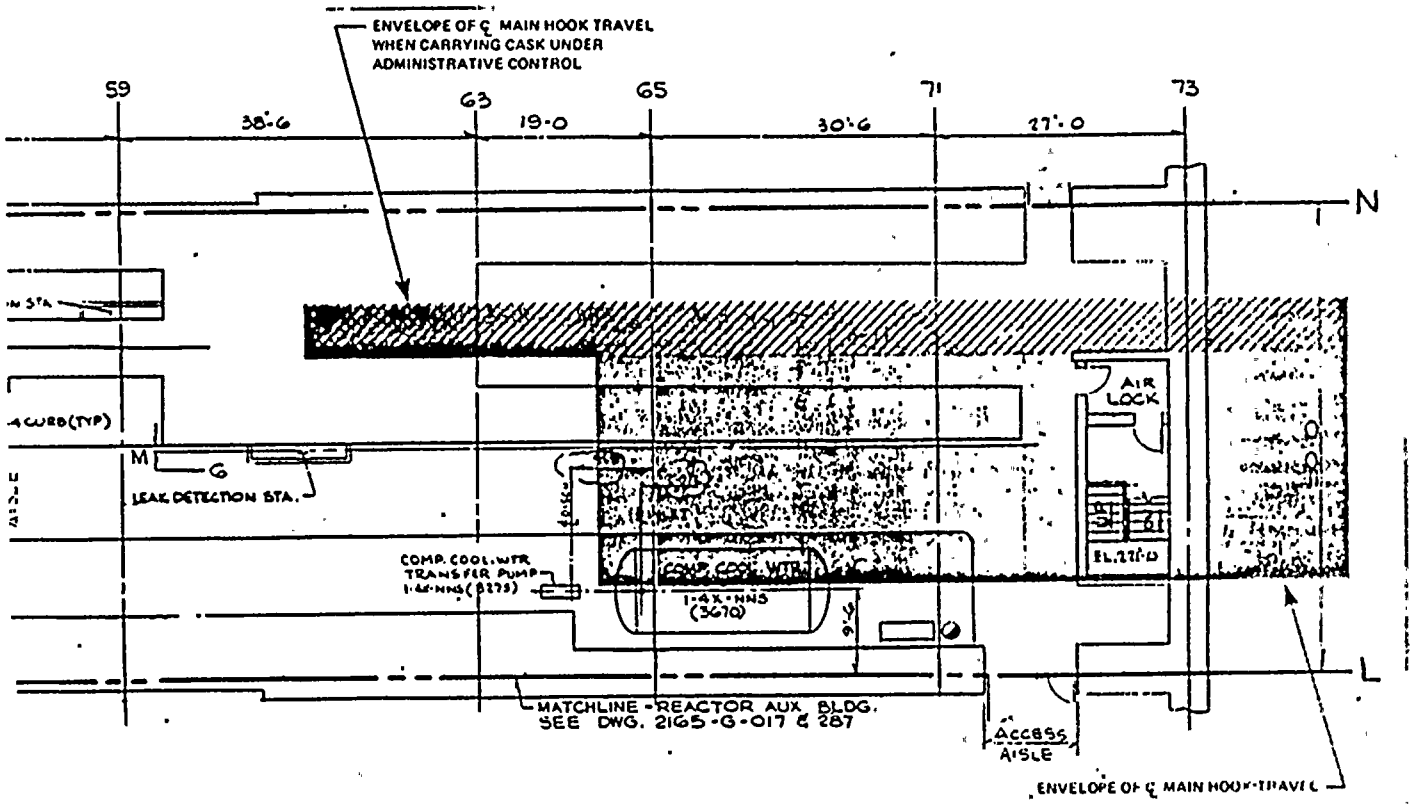


PLAN AT EL. 286.00'

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

SPENT FUEL HANDLING MAIN HOOK AND CASK TRUNNION ENVELOPES
FIGURE 9.1.4-7

Safe Load Paths

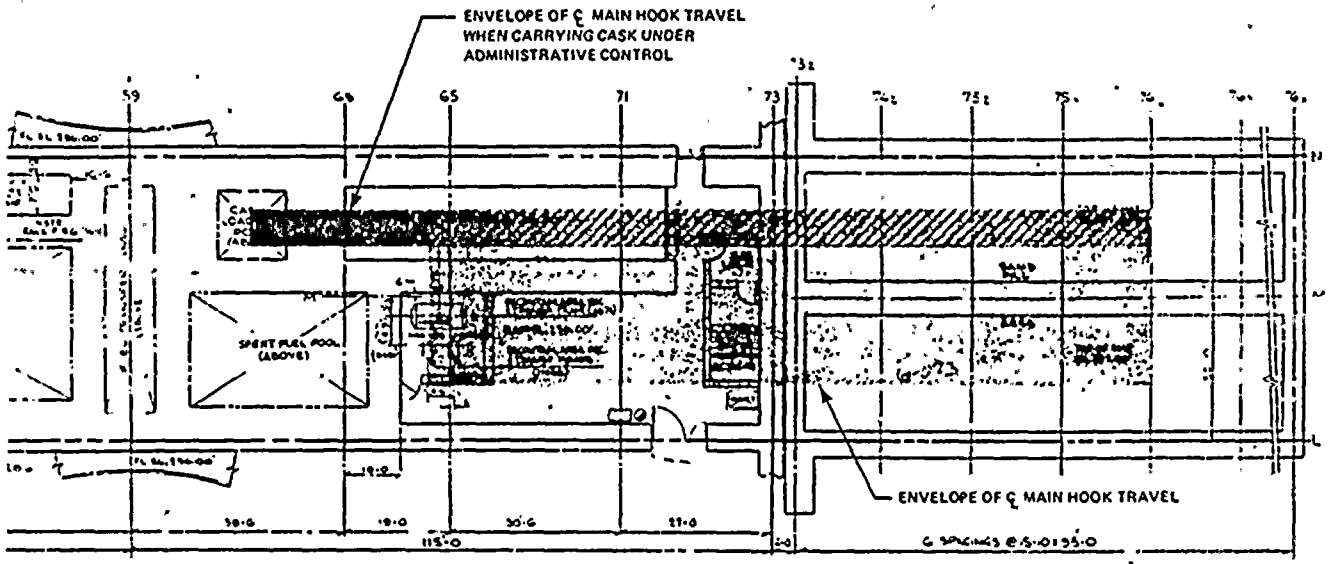


PLAN AT EL. 216.00'

FOR DIMENSIONS SEE SHEET 1

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT
SPENT FUEL CASK CRANE MAIN HOOK AND CASK TRAVEL ENVELOPES SHEET A
FIGURE 9.1.4-12

Safe Load Paths



PLAN AT EL. 236.00'

FOR DIMENSIONS SEE SHEET 1

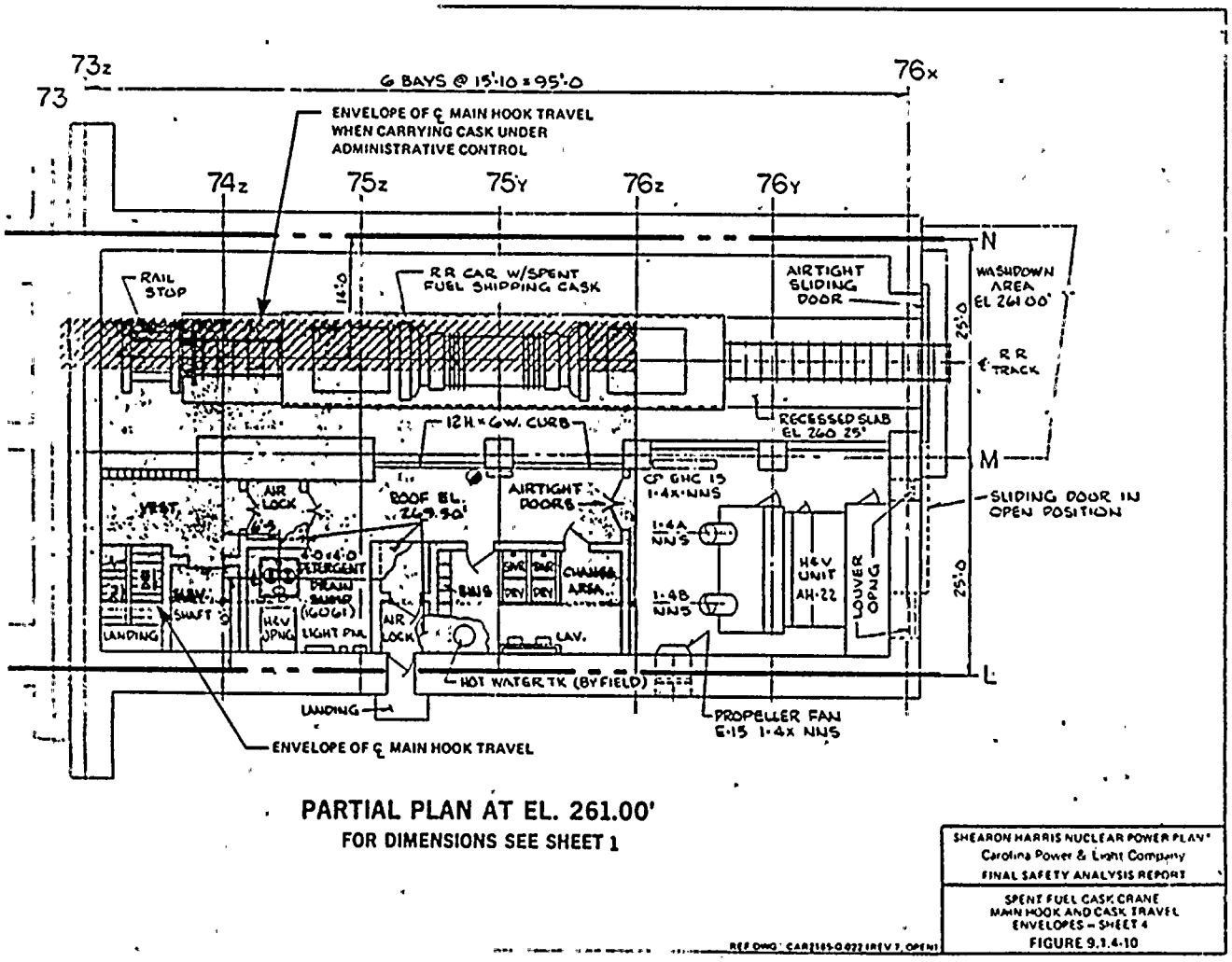
AMENDMENT NO. 15

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

SPENT FUEL CASK CRANE
MAIN HOOK AND CASK TRAVEL
ENVELOPES - SHEET 5
FIGURE 9.1.4-11

REF DWG CAR 2146 G-023

Safe Load Paths



PARTIAL PLAN AT EL. 261.00'

FOR DIMENSIONS SEE SHEET 1

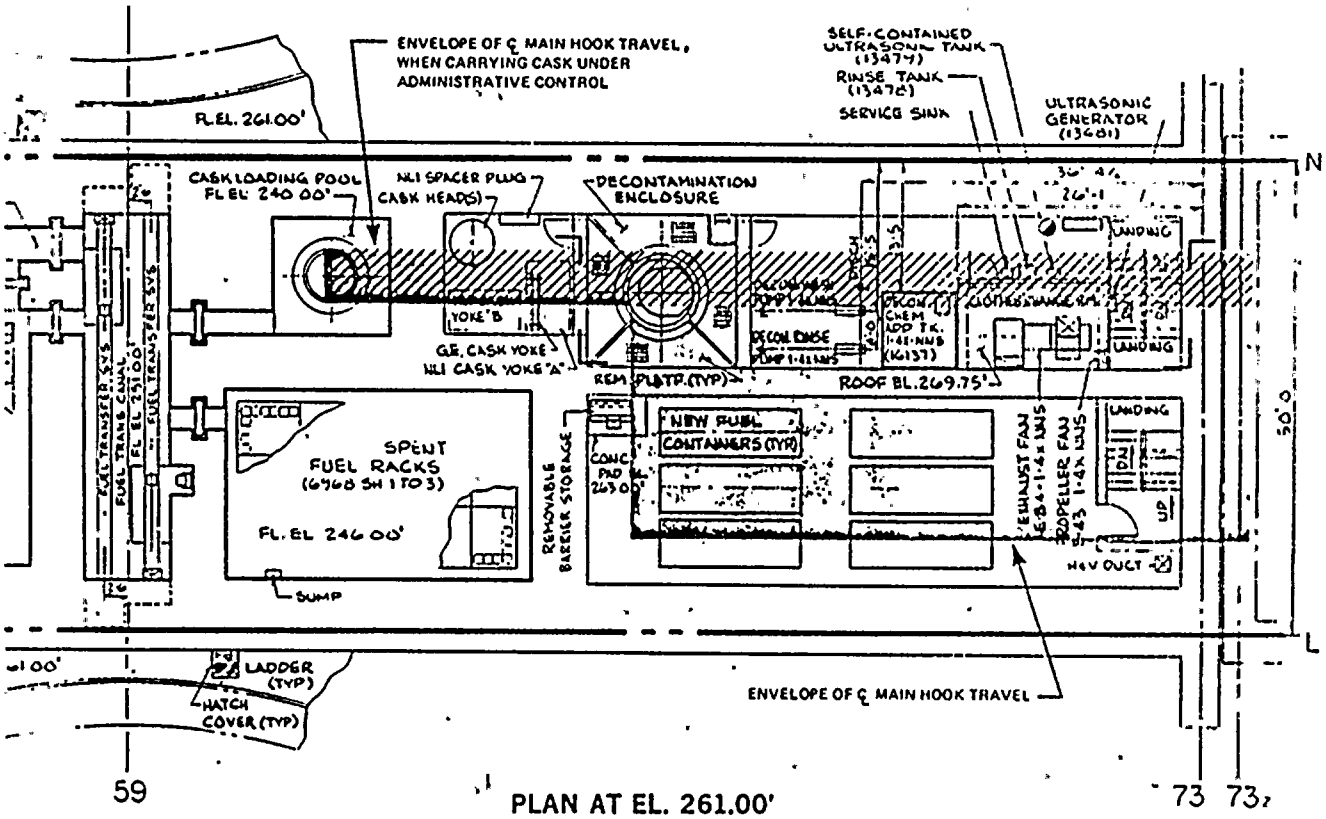
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

SPENT FUEL CASK CRANE MAIN HOOK AND CASK TRAVEL ENVELOPES – SHEET 4

FIGURE 9.1.4-10

REF DWG: CAR2185-G-022 (REV 7, OPEN)

Safe Load Paths



PLAN AT EL. 261.00'

FOR DIMENSIONS SEE SHEET 1

AMENDMENT NO. 18

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

SPENT FUEL CASK CRANE MAIN HOOK AND CASK TRAVEL ENVELOPES SHEET 1

FIGURE 9.1.4-9

Shackle Specification

SHACKLES:

There are two types of shackles commonly used in rigging. They are the anchor (bow type) shackle and chain ("D" type) shackle both of which are available with screw pins or round pins.

Shackles, like most other rigging hardware are sized by the diameter of the steel in the bow section rather than the pin size. They should only be of forged alloy steel.

Never replace the shackle pin with a bolt, only the proper fitted pin should be used. Bolts are not intended to take the bending that is normally applied to the pin.

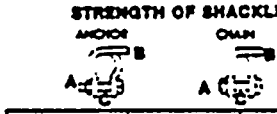
Never use a shackle if the distance between the eyes is greater than listed in the following table. All pins must be straight and all screw pins must be completely seated. Cotter pins must be used with all round pin shackles.

Shackles worn in the crown or the pin by more than 10% of the original diameter should be destroyed

Never allow a shackle to be pulled at an angle because the capacity will be tremendously reduced. Centralize whatever is being hoisted on the pin by suitable washers or spacers

Do not use screw pin shackles if the pin can roll under load and unscrew

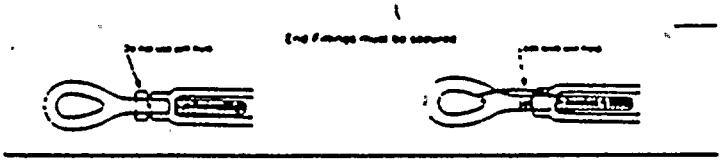
STRENGTH OF SHACKLES

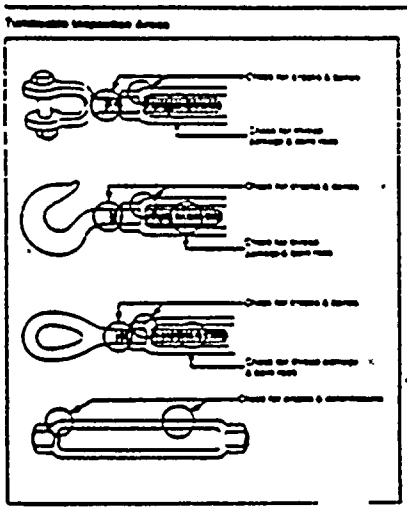


Stock Diameter (Inches) B	Inside Width At Pin (Inches) C	Max. Safe Working Load Single Vertical Pull (Pounds)
3/16	3/8	665
1/4	15/32	1,000
5/16	17/32	1,500
3/8	21/32	2,000
7/16	23/32	3,000
1/2	13/16	4,000
5/8	1 1/16	6,500
3/4	1 1/4	9,500
7/8	1 7/16	13,000
1	1 5/8	17,000
1 1/8	1 13/16	19,000
1 1/4	2 1/32	24,000
1 3/8	2 1/4	27,000
1 1/2	2 3/8	34,000
1 3/4	2 7/8	50,000
2	3 1/4	70,000
2 1/2	4 1/8	100,000
3	5	150,000
3 1/2	5 3/4	200,000
4	6 1/2	260,000

Turnbuckles
Weldless Construction
Forged Alloy Steel

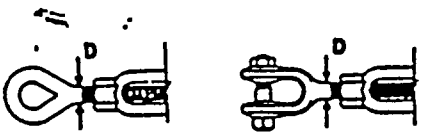
* SWL = Safe Working Load





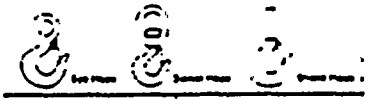
TURNBUCKLES — Weldless Construction — Forged Alloy Steel		
End Fitting Stock Diameter (Inches)	SWL of Any Combination of Jaw End Fittings, Eye End Fittings and Stub End Fittings (Lbs)	SWL of Any Turnbuckle Having a Hook End Fitting (Lbs)
⅜	500	400
½	1,000	700
⅝	2,000	1,400
¾	3,500	2,250
⅞	5,200	3,000
1	7,200	4,000
1⅛	10,000	5,000
1¼	13,200	5,000
1⅜	21,400	7,500
1½	28,000	—
2	37,000	—
2½	60,000	—
3	71,000	—

Strength of Turnbuckles Vs. Wire Rope



Eye / Jaw			
Turnbuckles		Wire Rope	
Size D. (Inches)	Safe Load (Tons)	Max. Dia. for T.B. (Inches)	Safe Load Guys, Etc. (Tons)
¾	2.2	⅜	2.1
⅞	3.1	½	3.6
1	4.1	⅝	5.5
1¼	6.6	¾	7.9
1½	9.7	⅞	10.7
1¾	13.1	1	14.0
2	17.2	1⅛	17.6
2¼	22.5	1¼	21.6
2½	28.0	1⅜	26.1
2⅝	28.0	1½	30.8
2¾	36.7	1⅝	36.0
3	41.0	1¾	41.3

EYE HOOKS, SHANK HOOKS, SWIVEL HOOKS
FORGED ALLOY STEEL
(SAFETY FACTOR = 5)

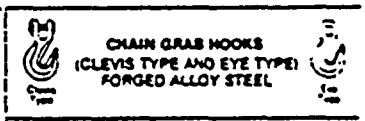


Throat Opening (Inches)	Maximum Safe Working Load (Pounds)
9/16	600
11/16	800
1	1,500
1 1/16	2,000
1 1/8	2,500
1 3/16	4,000
1 1/4	4,500
1 5/16	5,000
1 3/8	5,500
1 7/16	6,000
1 1/2	6,800
1 9/16	8,000
1 5/8	8,400
1 11/16	10,000
2 1/16	10,400
2 1/8	11,000
2 3/16	12,500
2 1/4	13,000
2 5/16	16,000
2 3/8	18,000
2 7/16	19,200
3	20,000
3 1/16	24,000
3 1/8	28,000
3 3/16	28,000
4	33,400

TYPICAL SORTING HOOK
FORGED ALLOY STEEL

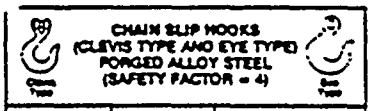
I.D. of Eye	1 1/16"
Opening at Top of Hook	2 3/16"
Safe Working Load 2" from Tip	2 Tons
Safe Working Load at Bottom of Hook	7 1/2 Tons

CHAIN GRAB HOOKS
(CLEVIS TYPE AND EYE TYPE)
FORGED ALLOY STEEL



Throat Opening (Inches)	For Size of Chain (Inches)	Maximum Safe Working Load (Pounds)
11/32	1/4	2,750
5/16	5/16	4,300
1/2	3/8	5,250
9/16	7/16	7,000
21/32	1/2	9,000
25/32	5/8	13,500
15/16	3/4	19,250
1 1/16	7/8	28,000
1 3/16	1	34,000

CHAIN SLIP HOOKS
(CLEVIS TYPE AND EYE TYPE)
FORGED ALLOY STEEL
(SAFETY FACTOR = 4)

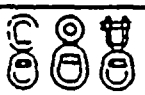


Throat Opening (Inches)	For Size of Chain (Inches)	Maximum Safe Working Load (Pounds)
11/16	1/4	2,750
1 1/16	5/16	4,300
1 3/16	3/8	5,250
1 5/16	7/16	7,000
1 13/16	1/2	9,000
2	5/8	13,500
2 1/8	3/4	19,250
2 3/8	7/8	28,000
3	1	34,000

SLIDING CHOKER HOOKS
FORGED ALLOY STEEL
(SAFETY FACTOR = 5)

Throat Opening (Inches)	For Rope Size (Inches)	Maximum Safe Working Load (Pounds)
1/2	1/4 - 5/16	1,500
5/8	3/8	2,600
7/8	1/2	3,400
1 1/8	5/8	5,100
1 1/4	3/4	8,000
1 7/16	7/8 - 1	15,000
1 3/4	1 1/8 - 1 1/4	23,000
2 1/16	1 3/8 - 1 1/2	30,000

SWIVELS (ALL TYPES)
— Weldless Construction
— Forged Alloy Steel



Stock Diameter (Inches)	Max. Safe Working Load (Pounds)
1/4	850
5/16	1,250
3/8	2,250
1/2	3,800
5/8	5,200
3/4	7,200
7/8	10,000
1	12,500
1 1/8	15,200
1 1/4	18,000
1 1/2	46,200

DOUBLE CLEVIS LINKS
— Weldless Construction
— Forged Alloy Steel

Small Pin Diameter (Inches)	Large Pin Diameter (Inches)	Maximum Safe Working Load (Pounds)
5/16	1/2	3,250
7/16	5/8	6,600
9/16	11/16	8,750
5/8	3/4	11,250

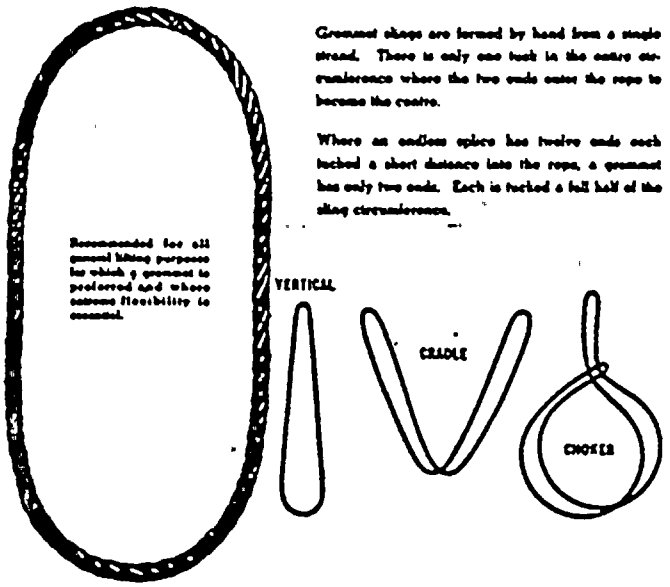
Strength of Standard Sling Hooks

Standard Hook Number	Inside Diam. of Eye A *Inches*	Throat Opening B *Inches*	Rated Capacity *Tons*
22	¾	1	0.5
23	⅞	1 1/16	0.6
24	1	1 3/16	0.7
25	1 1/8	1 5/16	1.2
26	1 1/4	1 3/8	1.7
27	1 3/8	1 1/2	2.1
28	1 1/2	1 3/4	2.5
29	1 5/8	1 7/8	3.0
30	1 3/4	2 1/16	4.0
31	2	2 1/4	4.7
32	2 1/8	2 1/2	5.5
33	2 1/4	3	6.8
34	3 1/8	3 3/8	8.0
34a	3 1/4	3 5/8	10.0
35	3 1/2	4	11.0
36	4	4 1/2	20.0
38	4 1/2	5	30.0

The above values are for "Vulcan" and similarly designed standard hooks.

The capacity can be found by the diameter of the hole in the eye of the hook. If the throat opening of any hook exceeds the dimension given above for the corresponding diameter of eye, the *hook has been overstrained and must not be used.*

GROMMET SLINGS



Grommet slings are formed by hand from a single strand. There is only one tuck in the entire circumference where the two ends enter the rope to become the centre.

Where an endless splice has twelve ends each tucked a short distance into the rope, a grommet has only two ends. Each is tucked a full half of the sling circumference.

RATED CAPACITY OF GROMMET SLINGS

Dia. of Grommet Inches	Rated Capacity—Tons			Dia. of Grommet Inches	Rated Capacity—Tons		
	Vertical	Cradle	Choker		Vertical	Cradle	Choker
⅛	.7	1.4	.5	1⅛	13.2	23.4	9.9
⅜	1.8	3.2	1.2	1⅛	16.4	32.8	12.3
½	3.0	6.0	2.3	1⅜	20.8	40.0	15.6
⅝	4.4	8.8	3.3	1½	24.1	48.2	18.1
¾	6.4	12.8	4.8	1⅝	28.3	56.6	21.2
⅞	8.8	17.2	6.5	1¾	32.5	63.8	24.4
1	11.2	22.4	8.4	2	41.7	83.4	31.2

WIRE ROPE SLINGS
6 x 19 Classification Group, Improved Plow Steel, IWRC

MAXIMUM SAFE WORKING LOADS — POUNDS
(Safety Factor = 5)

Rope Diameter (inches)	Single Vertical Hitch	Single Choker Hitch	Single Basket Hitch (Vertical Legs)	2-Leg Bridle Hitch & Single Basket Hitch With Legs Inclined 60°	45°	30°
1/4	880	440	1,200	1,100	800	880
5/16	1,150	885	2,300	2,000	1,600	1,150
3/8	1,750	1,300	3,000	3,000	2,500	1,750
7/16	2,360	1,800	5,100	4,400	3,800	2,550
1/2	3,460	2,600	6,900	6,000	4,900	3,450
9/16	4,700	3,500	9,400	8,150	6,650	4,700
5/8	5,700	4,200	11,400	9,900	8,050	5,700
3/4	7,100	5,300	14,200	12,300	10,000	7,100
7/8	10,200	7,850	20,400	17,700	14,400	10,200
1	13,750	10,300	27,500	23,800	19,400	13,750
1 1/8	17,960	13,460	35,900	31,100	25,400	17,960
1 1/4	22,750	17,000	45,500	39,400	32,200	22,750
1 3/8	28,200	21,200	56,400	48,800	39,900	28,200
1 1/2	34,800	26,100	69,600	60,300	49,200	34,800
1 5/8	41,300	31,000	82,900	71,500	58,400	41,300
1 3/4	48,800	36,400	97,200	84,200	68,700	48,800
1 7/8	55,900	41,900	111,800	96,800	79,000	55,900
2	66,400	49,000	130,800	113,300	92,500	65,400
2 1/4	72,600	54,500	145,200	125,700	102,700	72,600
2 1/2	90,300	67,600	180,600	156,400	127,700	90,300
2 3/4	111,600	83,700	223,600	193,600	158,100	111,800
3	131,100	98,200	262,200	227,000	185,400	131,100

If used with Choker Hitch multiply above values by 4/5.

For Double Basket Hitch multiply above values by 2

TABLE 1.11

Rope Diameter	Efficiency
5/8" and Smaller	95%
11/16" — 1 1/8"	90%
1 1/4" — 1 1/2"	85%
1 5/8" — 2"	80%
2 1/4" and Larger	75%

Note: Table values are for slings with eyes and thimbles in both ends, Flemish Spliced Eyes and mechanical sleeves.
Hand tucked spliced eyes — reduce loads according to table 1.11.
Eyes formed by cable clips — reduce loads by 20%.

WIRE ROPE SLINGS
6 x 19 Classification Group, Improved Plow Steel, Fibre Core

MAXIMUM SAFE WORKING LOADS — POUNDS
(Safety Factor = 5)

Rope Diameter (inches)	Single Vertical Hitch	Single Choker Hitch	Single Basket Hitch (Vertical Legs)	2-Leg Bridle Hitch & Single Basket Hitch With Legs Inclined 60°	45°	30°
1/4	800	450	1,200	1,050	850	800
5/16	1,100	825	2,200	1,900	1,550	1,100
3/8	1,650	1,250	3,300	2,850	2,350	1,650
7/16	2,400	1,800	4,800	4,150	3,400	2,400
1/2	3,200	2,400	6,400	5,550	4,500	3,200
9/16	4,400	3,300	8,800	7,600	6,200	4,400
5/8	5,200	4,000	10,600	9,300	7,500	5,300
3/4	6,800	4,950	13,200	11,400	9,350	6,600
7/8	9,500	7,100	19,000	16,500	13,400	9,500
1	12,800	9,600	25,600	22,200	18,100	12,800
1 1/8	16,700	12,500	33,400	28,900	23,600	16,700
1 1/4	21,200	15,900	42,400	36,700	30,000	21,200
1 3/8	26,200	19,700	52,400	45,400	37,000	26,200
1 1/2	32,400	24,300	64,800	56,100	45,800	32,400
1 5/8	38,400	28,800	76,800	66,500	54,300	38,400
1 3/4	45,200	33,900	90,400	78,300	63,900	45,200
1 7/8	52,000	39,000	104,000	90,000	73,500	52,000
2	60,600	45,600	121,600	105,300	86,000	60,600
2 1/4	67,800	50,700	135,200	117,100	95,800	67,800
2 1/2	84,000	63,000	168,000	145,500	118,800	84,000
2 3/4	104,000	78,000	208,000	180,100	147,000	104,000
3	122,000	91,500	244,000	211,300	172,500	122,000

If used with Choker Hitch multiply above values by 4/5.

For Double Basket Hitch multiply above values by 2

TABLE 1.11

Rope Diameter	Efficiency
5/8" and Smaller	95%
11/16" — 1 1/8"	90%
1 1/4" — 1 1/2"	85%
1 5/8" — 2"	80%
2 1/4" and Larger	75%

Note: Table values are for slings with eyes and thimbles in both ends, Flemish Spliced Eyes and mechanical sleeves.
Hand tucked spliced eyes — reduce loads according to table 1.11.
Eyes formed by cable clips — reduce loads by 20%.

WIRE ROPE SLINGS
6 x 37 Classification Group, Improved Plow Steel, IWRC

MAXIMUM SAFE WORKING LOADS — POUNDS
(Safety Factor = 5)

Rope Diameter (inches)	Single Vertical Hitch	Single Choker Hitch	Single Basket Hitch (Vertical Legs)	2-Leg Bridle Hitch & Single Basket Hitch With Legs Inclined 60°	45°	30°
1/4	1,050	800	2,100	1,800	1,300	1,050
5/16	1,700	1,300	3,400	2,950	2,400	1,700
3/8	2,350	1,750	4,700	4,100	3,300	2,350
7/16	3,200	2,400	6,400	5,550	4,500	3,700
1/2	4,300	3,200	8,600	7,450	6,100	4,300
9/16	5,350	4,000	10,700	9,250	7,550	5,350
5/8	6,900	5,200	13,800	11,950	9,750	6,900
3/4	9,500	7,100	19,000	16,450	13,400	9,500
7/8	13,000	9,750	26,000	22,500	18,400	13,000
1	17,000	12,750	34,000	29,450	24,000	17,000
1 1/8	21,600	16,750	42,000	36,400	29,700	21,000
1 1/4	26,250	19,650	52,400	45,400	37,000	26,200
1 3/8	32,000	24,000	64,000	55,400	46,200	32,000
1 1/2	38,500	29,000	76,000	66,400	55,900	38,500
1 5/8	45,400	34,000	90,800	78,600	64,200	45,400
1 3/4	52,000	39,000	104,000	90,000	73,500	52,000
1 7/8	61,000	45,750	122,000	105,700	86,300	61,000
2	66,600	49,950	133,200	115,400	94,200	66,600
2 1/4	86,400	64,800	172,800	149,600	122,200	86,400
2 1/2	105,300	79,000	210,600	182,400	148,900	105,300
2 3/4	126,000	94,500	252,000	218,200	178,200	126,000

If used with Choker Hitch multiply above values by 4/5.

For Double Basket Hitch multiply above values by 2

TABLE 1.11

Rope Diameter	Efficiency
5/8" and Smaller	95%
11/16" — 1 1/8"	90%
1 1/4" — 1 1/2"	85%
1 5/8" — 2"	80%
2 1/4" and Larger	75%

Note: Table values are for slings with eyes and thimbles in both ends, Flemish Spliced Eyes and mechanical sleeves.
Hand tucked spliced eyes — reduce loads according to table 1.11
Eyes formed by cable clips — reduce loads by 20%.

WIRE ROPE SLINGS
6 x 37 Classification Group, Improved Plow Steel, Fibre Core

MAXIMUM SAFE WORKING LOADS — POUNDS
(Safety Factor = 5)

Rope Diameter (inches)	Single Vertical Hitch	Single Choker Hitch	Single Basket Hitch (Vertical Legs)	2-Leg Bridle Hitch & Single Basket Hitch With Legs Inclined 60°	45°	30°
1/4	1,000	750	2,000	1,750	1,400	1,000
5/16	1,600	1,200	3,200	2,750	2,250	1,600
3/8	2,200	1,650	4,400	3,800	3,100	2,200
7/16	3,000	2,250	6,000	5,200	4,250	3,000
1/2	4,000	3,000	8,000	6,900	5,650	4,000
9/16	5,000	3,750	10,000	8,650	7,100	5,000
5/8	6,400	4,800	12,800	11,100	9,050	6,400
3/4	8,900	6,700	17,800	15,400	12,600	8,900
7/8	12,100	9,100	24,200	21,000	17,100	12,100
1	15,800	11,900	31,600	27,400	22,300	15,800
1 1/8	19,800	14,700	39,200	33,900	27,700	19,600
1 1/4	24,400	18,300	48,800	42,200	34,500	24,400
1 3/8	29,800	22,300	59,600	51,600	42,100	29,800
1 1/2	36,000	27,000	72,000	62,400	50,900	36,000
1 5/8	42,200	31,700	84,400	73,100	59,700	42,200
1 3/4	48,400	36,300	96,800	83,800	68,400	48,400
1 7/8	56,800	42,600	113,600	98,400	80,300	56,800
2	62,000	46,500	124,000	107,400	87,700	62,000
2 1/4	80,400	60,300	160,800	139,300	113,700	80,400
2 1/2	98,000	73,500	196,000	169,700	138,600	98,000
2 3/4	117,300	87,900	234,600	203,000	165,700	117,300

If used with Choker Hitch multiply above values by 4/5.

For Double Basket Hitch multiply above values by 2.

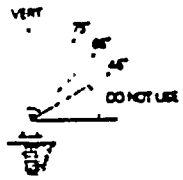
TABLE 1.11

Rope Diameter	Efficiency
5/8" and Smaller	95%
11/16" — 1 1/8"	90%
1 1/4" — 1 1/2"	85%
1 5/8" — 2"	80%
2 1/4" and Larger	75%

Note: Table values are for slings with eyes and thimbles in both ends, Flemish Spliced Eyes and mechanical sleeves.
Hand tucked spliced eyes — reduce loads according to table 1.11.
Eyes formed by cable clips — reduce loads by 20%.

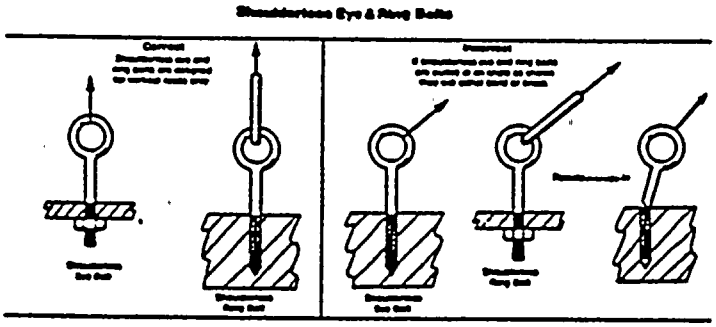
Eyebolt Specifications

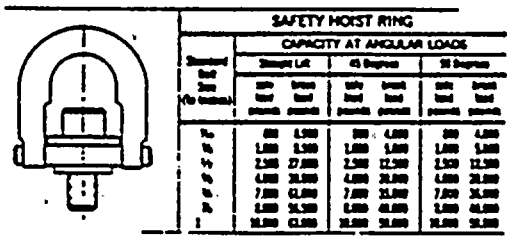
EYE BOLTS
— Shoulder Type Only
— Forged Carbon Steel



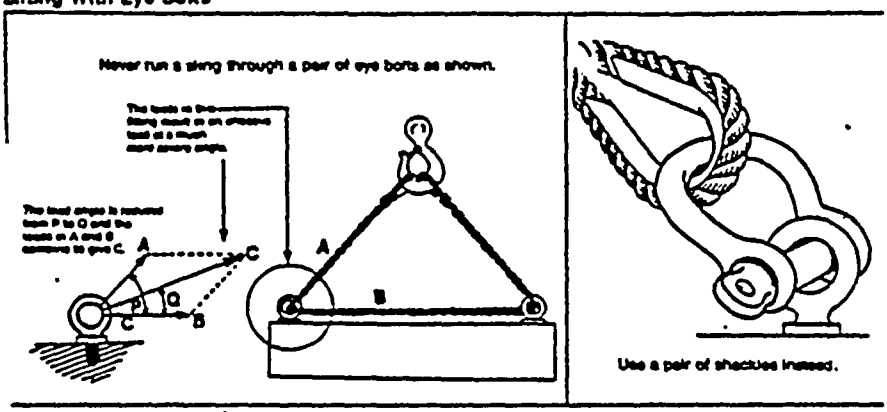
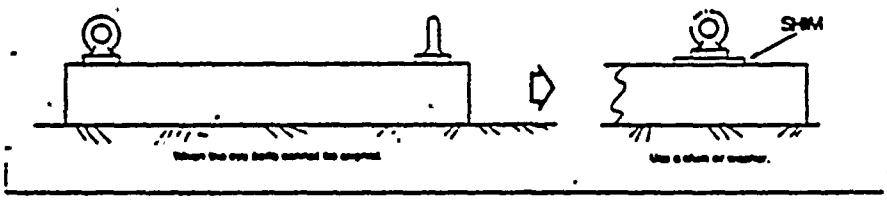
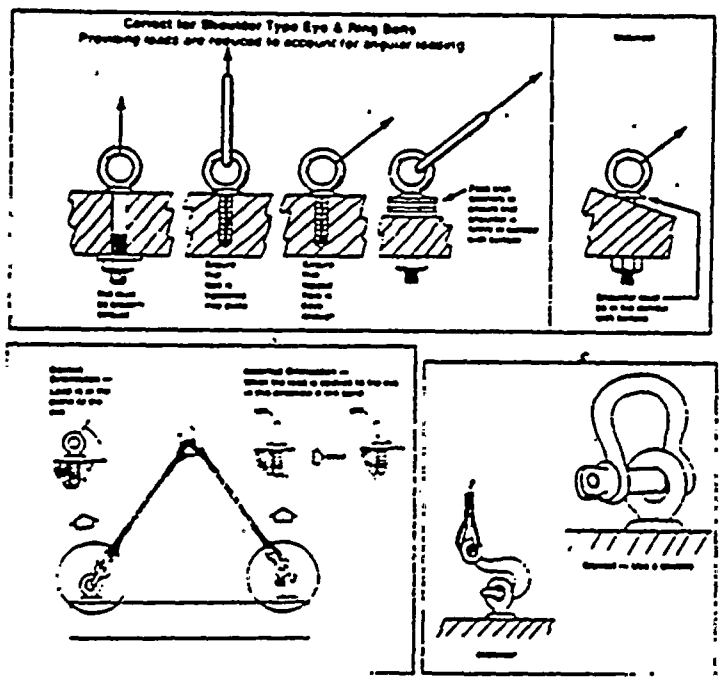
Stock Diameter (Inches)	SAFE WORKING LOADS (LBS) CORRESPONDING TO ANGLE OF PULL				
	Vertical	75°	60°	45°	Less than 45°
1/4	500	Reduce Vertical Loads By 45%.	Reduce Vertical Loads By 65%.	Reduce Vertical Loads By 75%.	NOT RECOMMENDED
5/16	800				
3/8	1,200				
1/2	2,200				
5/8	3,500				
3/4	5,200				
7/8	7,200				
1	10,000				
1 1/4	15,200				
1 1/2	21,400				

Note: S.W.L. for plain (shoulderless) eye bolts are same as for shoulder bolts under vertical load. Angular loading is not recommended.





Lifting With Eye Bolts



Alignment of Eye Bolts