PROCEDURE NUMBER	APPROVED	DATE
10.4.1	J Martin	2/9/81
VOLUME NAME		
10	MAINTENANCE PROGRAMS AND PROCEDURES	
SECTION		
10.4	TOOL AND EQUIPMENT TESTING AND CALIBRATION	
TITLE		
10.4.1	CRANE OPERATION, INSPECTION AND MAINTENANCE	

10.4.1.1 Purpose

This procedure provides instructions on crane operation, inspection, testing and maintenance. It is designed to guard and minimize injury to workers and plant equipment by prescribing minimum operation, inspection and maintenance requirements.

10.4.1.2 Discussion

This procedure is specifically intended for the reactor and turbine building overhead cranes and all other motor operated cranes and hoists.

The use of cranes, hoists and other rigging equipment is subject to certain hazards that cannot be eliminated by mechanical safeguards, but only by the exercise of intelligence, care and common sense. It is therefore essential to have competent and careful operators and riggers, thoroughly trained in the safe operation of equipment used in handling loads. Serious hazards of overloading, dropping and/or slippage of the load caused by improper attachment, obstructions and/or misuse of equipment from its intended purpose mandate the use of safe procedures.

10.4.1.3 References

A. ANSI B30 Series
B. NRC Regulatory Guide 1.104
C. Whiting Corporation, Crane Maintenance, CVI02-31A-02, sheet 32
D. Clayton Corporation, Crane Maintenace, CVI02-32CD-00, sheet 81
E. Yale Corporation, Crane Maintenance, CVI02-32CD-00, sheet 78
F. WPPSS Industrial Safety and Fire Protection Manual

ENCLOSURE 2

10.4.1.4 Prerequisites

A. Each assigned operator is responsible to confirm that all inspection and preventative maintenance requirements are current and signed off before proceeding with the use of any specific crane or hoist.

B. All operators of the reactor and turbine building cranes shall be certified crane operators or trainees. Trainees shall work under the direct supervision of a certified supervisor or an assigned certified operator.

C. All operators of floor operated motor driven cranes and hoists shall attend the introductory training session on crane operation.

D. Check lists for daily and shift change inspections shall be posted on or near each motor operated crane or hoist.

10.4.1.5 Precautions

A. Immediately prior to any load testing, a thorough inspection of all functional parts will be made to minimize over stressing load carrying components.

B. Only the crane operator will normally be allowed on a crane while it is in operation. If required, additional personnel will receive permission from the operator and keep the operator informed of their activity.

C. Any activity in the vicinity of either the crane or trolley power lines will require deenerization of these exposed conductors.

D. Any work activity on a overhead crane or hoist will require safety roping off of areas directly below until the work is completed.

E. Access to cranes positioned away from their normal storage area will require safety approved catwalks, hand rails and/or ladders.

F. No load shall be transferred over personnel.

G. Personnel shall not work under suspended loads except where the load is sufficiently blocked up with cribbing.

10.4.1.6 Limitations

A. Discrepencies encountered during tests shall be noted and reported to the Shift Supervisor and your immediate supervisor.

B. Defective equipment discovered during tests shall be handled per PPM 1.3.11.

10.4.1.7 Materials, Tools and Test Equipment

No special tooling required.

10.4.1.8 Procedures

A. Discussion

This instruction provides guidelines to be used during maintenance and inspection of motor operated cranes and hoists. It is not intended to be used in place of manufacturer's instruction manuals, but will supplement them with general information.

A manufacturer's service representative will be required during the annual inspection of the Reactor and Turbine Building cranes until WNP-2 Maintenance personnel can be trained as competent inspectors of these units.

All inspection activities other than daily inspections will be documented, signed off and filed for future reference using the annual inspection checklist.

B. Gear Box Inspection

1. There are many sizes and types of gear cases. Those purchased from other vendors will have brochures in the maintenance manual covering care and maintenance procedures and parts catalog. These should be adhered to.

2. A normal inspection would include opening inspection cover where provided, and inspecting visually with a light to see that all parts are being lubricated, gears are not worn badly or cracked or chipped, bearings are intact, gears do not have excessive backlash and proper clearance is maintained between gears so they are not rubbing together. If an inspection shows that there is trouble in the gear case, it should be taken apart for a closer look.

3. Gears should be rotated slowly so that all teeth on all gears can be inspected. This can be accomplished by releasing brake manually and rotating the high speed coupling by hand slowly.

4. Most cases are made in halves bolted together with a center seam sealed with Permatex. When vertically mounted gear cases are disassembled, precautionary measures should be taken to prevent intermediate gear and shaft from rolling out of case. These are held in by top half of gear case and could roll out. To prevent this, lock brake to prevent shaft from turning. Most high speed pinion gears are made as in integral part of shaft. Other gears are pressed onto shaft and keyed.

C. Drum/Inspection

1. Check hoist drums for wear, such as grooves worn deeper or sides of grooves worn to a point. Wear will show up first at center of drums, so groove depth at rope anchor can be used as a reference. If groove root diameter is worn 1/4 rope diameter or more, drum should be replaced. See Figure 1.

2. Most cranes are designed with stub shafts pressed into drums and welded. These welds should be wiped clean and visually inspected carefully for cracks. Overloads, side pulls or other crane abuse may cause cracks in this area. If detected, consult factory for recommended procedure for correction.

D. STR Actual Inspection

1. Visually check all steel fabricated members for cracks. Put particular emphasis on inspecting for cracks, on bridge girders near end trucks, at end of shelf angles where trucks are fastened to girders. See Figure 2. If cracks are detected, consult manufacturer for correct procedure for repairs.

2. If there is loss of camber in girders due primarily to overloading, trolley will tend to roll down toward center span. Loss of camber can be checked with a transit and rod or with taut piano wire on the top of the grider.

3. Make sure that all bumpers are intact and securely bolted to trucks, springs aren't broken and safety cables are intact. All spring bumpers should be equipped with a safety cable fastened to truck in case bumper bolts break.

4. ANSI B30.2, Section 2-1-7.1 states that stops shall be provided at the limits of travel of the trolley. These should be inspected to determine that they are in place, secured to the rail and/or girder and properly located and lined up.

E. Sheaves & Blocks Inspection

1. All sheaves, upper and lower, should be checked for excessive wear, (1/8 rope diameter or more) making sure that all cables are engaged in sheaves. Lift cables out of sheaves to inspect contact surfaces for excessive wear and gouges.

2. Check all bearing housings. Cast housings sometimes break due to side pulls or bad runway conditions.

3. Crane blocks should be inspected regularly for worn or broken sheaves, or bent housing. Pay particular attention to the hook. Check for excessive wear, gouging, or cracks in palm and hook opening, and make sure hook eye has not spread or shank has not stretched.

F. Hoist Brakes

1. These are customarily spring-set and either solenoid-(AC) or magnet-(DC) released. Brakes should be inspected for:

   a. Lining wear (replace when worn to within 1/16" of rivet heads or within 1/16" of shoe on bonded linings).

   b. Cracked or broken shoes or brake-wheel rims.

   c. Worn, bent or broken linkage; missing pins.

   d. Actuation springs (are they cracked or have they taken a set?)

   e. Rated torque when holding, measured with a torque wrench or with a pipe wrench and spring scale, or by load on hook for large brakes.

   f. Tightness of brake wheel on shaft. No free play is allowed.

   g. Condition of key and keyway. Check for rounded corners and sloppy fit.

   h. Release in raising or lowering when power is applied.

   i. Adjustment for wear. Some solenoid brakes have the solenoid and plunger operating in an oil-filled enclosure and this should be checked for leaks and height of oil fill. If the brake has a self-adjusting mechanism, this should be backed out

of adjustment, then the brake released repeatedly by hand to determine if the adjustment device is ratcheting and if the solenoid stroke is within specified limits when it stops ratcheting.

2. Brake linings are the most frequently replaced crane parts. Linings are attached to the shoes by rivets or cement. Shoes with cemented linings should be replaced when linings are worn to 1/16" thickness. Linings which are riveted on should be replaced before wearing down to the rivet heads, or they will cut grooves in the brake wheel. Grooved brake wheels should be replaced.

3. Brakes are a safety device and should be kept in top-notch condition.

4. If the brake wheel is found to have visual surface cracks, it should be replaced immediately. This thermal fatigue condition progresses rapidly to destroy the lining and to complete disintegration of the wheel.

G. Retarding Brakes on Bridge or Trolley

1. These are low-capacity brakes, generally applied to a shaft running at motor speed. They may be either a foot-operated hydraulic brake; a simple, spring-set drag brake applying a permanent drag torque to the motor shaft; or, like the hoist brakes, automatically spring-set and electrically released. If electrically released, they should be checked by operating with power to determine that release occurs when power is applied to the bridge or trolley (rack) motor. Foot-operated brakes should be checked for operation and sponginess and maintained according to manufacturer's instructions.

2. These brakes should also be checked for worn or bent linkage, worn linings, cracked shoes, and badly scored, cracked or overheated wheels (blue or purple glaze on braking surfaces). Worn, damaged or cracked parts should be replaced immediately. On automatically-set bridge or trolley brakes, torque should be set at such a valve that the load does not swing excessively when the bridge or trolley controller is returned to neutral.

H. Control Braking Devices

1. These are mechanical load brakes and eddy current (electrical) load brakes. They are intended to control the rate at which the load is lowered. Mechanical load brakes, typically, are also designed to hold the load

after hoisting. In such a brake, the brake screw shaft is frictionally coupled to a ratchet which is restrained against turning by a pawl, sprag clutch, or a one-way spring clutch.

The ratchet wheel is gripped from 2 sides by friction washers. The friction washer on one side also bears against a friction collar and the friction washer on the other side bears against a flanged nut. The nut screws onto threads on the brake-screw shaft. Load on the hoist causes the nut to tighten on the brake screw, squeezing the friction washers onto the ratchet on both sides. In raising, this entire assembly then ratchets. When the load is stationary, the load is held by the ratchet and pawl. When the load is lowered the nut is partially unlocked on the screw allowing the load to slip down at a speed controlled by the rotational speed on the nut. Any tendency of the load to get ahead of the nut causes the nut and screw to tighten on the stationary ratchet, retarding the load.

2. Lift a small (1/4 capacity) load approximately one foot off the floor. Release the hoist brake manually to detemine if the load brake holds the load. Let the motor brake set, then power the load down slowly. Observe the backing off the motor gear relative to the ratchet wheel when the load is lowered slowly. Determine whether the brake is operating smoothly or chattering, and whether clearance adjustment is too large.

3. Maintenance

   a. Without Disassembly

      Examine the back-off adjustment of the nut. The brake should release against its adjustment nut only enough to release the load. Lock the adjustment nut in this position. Also examine the pawl and ratchet wheel for cracks, battered or broken pawls or ratchet teeth; inoperative pawl shifter and broken or worn springs.

   b. With Disassembly

      Examine the braking surfaces, the friction washers, the brake screw thread and the nut thread. The latter two should look polished, not galled, and any surface roughness on the load-bearing faces of the brake screw threads should be removed, so that the nut turns freely on the screw thread.

Friction washers should be examined for warpage, cracks, excessive wear, and, if metallic, upsetting or shrinkage onto their pilot surfaces on the nut, ratchet, or friction collar. If any of the above conditions are found, the friction washers should be replaced immediately.

I. Footwalks, Handrails and Ladders

These are for protection against falling and for access of Maintenance personnel to service certain mechanical and/or electrical components of the crane footwalks, ladders and handrails should be inspected to assure that they are in sound and safe structural condition, are not bent, loose, broken or missing and are kept clean and free of debris, grease, oil, oily rags and hand tools.

J. Upper and Lower Limit Switches

1. The upper hoist limit switch is a safety device to prevent hoisting motion to a point where the block and sheave-nest are two-blocked (jammed together) with the hazard of stretching and breaking the ropes and dropping both load and block.

2. The upper limit switch must not be used to stop hoisting motion in normal operation. Its operation should be checked at the beginning of each shift daily with no load and slew jogging motions to observe whether hoist power is cut off before the block is fully raised.

3. If in this test the block can be observed to pass the limit switch operating-point without causing power to be cut off, the crane should be shut down and the problem reported by the operator to his immediate superior for corrective action.

4. ANSI B30.2, Section 2-3, Section 2-3.2.3h states, "the load shall not be lowered below the point where less than two full wraps of rope remain on the hoisting drum." Where the crane has been supplied with a lower limit switch, this limit switch should be checked weekly as to its adjustment, to assure that lowering motion cannot be continued beyond this point. Where cranes are not supplied with such a switch, operators must be trained and cautioned to stop lowering motion when the drum has two full wraps of rope left. Further lowering motion leads to reverse reeving of the rope on the drum which can pull the

block back into the hoisted position, with hazards of breaking the rope, dropping the block and damaging the upper sheave nest and trolley structure. The wire rope will, in this instance, also be kinked at the rope anchors and must be replaced even if not broken.

5. Upper limit switches may be connected in either the hoist control circuit on the main line disconnect circuit. If connected in the hoist circuit, it will not prevent reverse reeving into the upper limit since this is caused by lowering, not hoisting motion.

K. Runways and Rail Inspection

1. Most problems with bridge drives, wheels, axles, trucks and truck-to-girder connections are caused by poor runway condition and alignment. Runway girders and columns should line up straight and parallel. Runway girders should be sized to deflect not more than 1/800 of their span under a loaded crane with the trolley at the near end.

2. Runways should have rails of adequate size for the highest capacity crane to be used, tightly spliced with close and staggered joints, and with rail heads neither cracked, spalled-out nor mashed over to a sharp cutting edge (which will quickly destroy wheel flanges).

3. Rails should be tightly clamped to the girders, not floating. Vertical waviness of the runway rail from a flat and level plane, due to column settling or initial installation, should not be more than $\pm$ 1/8" in 20 ft., and columns or girders should be shimmed periodically as required to maintain this level condition.

4. In the horizontal direction, rails should not curve, wave or bend from a straight line by more than 1" in any 400 ft., and span between rails should be held to a specified dimension within $\pm$ 1/8" as measured with a tape.

5. Columns should be plumb, well-seated on their foundations and rigidly attached to them by tight, sound anchor bolts. The rail should not breathe, sway, or lean toward the crane while the crane is traveling along the runway by any amount sufficient to pinch the bridge wheels. Runway structure should be checked periodically for tightness of bolts and/or rivets, soundness of all welds, tight brackets, seats or girder connections to columns, and absence of rust or sagging of girders between columns.

6. Bumper stops should be square with the rail. A method for checking squareness is shown in Figure 1.

L. Crane Squareness and Structural Damage

1. Cranes when assembled at the factory have both the end trucks and girders aligned for parallelism, with the end trucks squared with the girders to a precision such that diagonals between wheels are equal within 1/4".

2. This parallelism and squareness is then locked into the crane on shop assembly by individual reaming of matching bolt holes in the shelf angles and end-truck to girder gusset plates. These reamed holes are filled with driven, body-bound turn bolts which dowel the structure to maintain the assembly geometry. Turn bolts and matching holes are marked so the crane may be reassembled square at the job site with no difficulty. The rigidity of these connections is such that, in normal service, the crane will remain square, especially in view of the fact that bridge drives are designed to apply equal motion to drive wheels on both ends of the crane; however, the following conditions or abuse can repeatedly overstress the connections to the point where the bolt holes are enlarged, leading to the crane taking a diamond shape and rapidly wearing out both wheel flanges and rail heads:

   a. Striking end stops at high speed.

   b. End stops not on a line square with runway rail.

   c. Rail span varies more than $\pm$ 1/8" causing wheel flange on opposite corners at all times.

   d. Unequal wheel tread circumferences, causing crane to flange or loose anchor bolts.

   e. Breathing or swaying of columns due to spongy footings or loose anchor bolts.

   f. Vertical waviness in runway rail, causing crane to wrap and twist.

3. To check a crane for squareness, drop blumb bob from identical points at four corners of crane on end truck. Most cranes have a machined surface on the bearing strap next to the axle. Drape the plumb line over the shaft at these points. Put center-punch mark under point of plumb bob, on runway grider top flange.* Check diagonals between punch marks with tape and scale. The two diagonals should not differ by more than 1/4" per 100 ft.

4. If the crane is suspected of being out of square, check for the following structural and mechanical conditions:

   a. Check end trucks for damage, bending or cracks. See Figure 3.

   b. Check worn wheel flanges or runway rail worn on side of the rail head. If worn on inside flanges only, the rail span is too short. If worn on outside flanges on two opposite corners, and on inside flanges on other corners, crane may be out of square or wheels are of unequal diameter, and running skewed.

   c. Check bolts for tightness on truck ends, girder end connections and girder tie connections.

   d. If shifting of trucks is suspected, remove bolts and check for elongation of bolt holes or mashing of the shank on body-bound bolts. This will show whether truck has been moving relative to girders.

5. If crane is out of square, it will be necessary to realign crane with jigs. Jigs for realigning Whiting cranes can be rented on a per diem basis from Whiting. When the crane is realigned and before it is returned to service, it will be necessary to ream all accessible bolt holes and drive in larger turn-bolts.

   *On some cranes, it may be perferable to drop plumb bob from center line of wheel tread to rail head and place center punch mark there.

M. Hook Inspection

1. Hooks shall be inspected for damage, corrosion, wear, cracks, twist and opening. Hook opening will be checked against the dimension of a new hook or by measuring between reference points if scribbed or center punched on the hook. Hooks with 15% more than original throat opening, 10 degree twist from original plane, 5% shank elongation or 10% wear in the throat section shall be replaced.

   Later model hooks have center punch marks on them showing original hook throat opening. See Figure 4. At least once a year, regardless of external physical appearance and condition of hook, the hook should be checked for this dimension between punch marks and for cracks by magua-fluxing or some other accepted method.

2. Small nicks and scratches on the hook surface may be removed by filing or grinding.

3. Hooks shall be visually inspected daily at the start of each shift and shall receive a magna-flux/ultra-sonic inspection annually.

4. Hook swivels shall be checked for freedom of movement and checked to ensure the swivel locking device is secure.

5. Make sure top nut on hook shank is secure and has not turned on shaft. Some are secured with a pin and others by a set screw. Make sure these are intact. Check hook to see that it swivels easily and thrust bearing is in good condition.

6. The Reactor Building crane hook shall be inspected prior to each refueling outage.

N. Wire Rope Inspection

1. All wire ropes will be inspected visually before each major use (50% rated load or greater). An inspection of all wire rope will be made during the annual crane inspection and a dated report of the condition of the rope will be kept on file.

2. Sections of rope which are normally hidden during visual and maintenance inspection, such as parts passing over sheaves, should be given close inspection as these are points most likely to fail.

3. The following are items to be considered when inspecting wire rope:

   a. Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, stretch, or wear of outside wires.

   b. A number of broken outside wires and the degree of distribution or concentration of such broken wires.

   c. Corroded or broken wires at end connections.

   d. Corroded, cracked, bent, worn or improperly applied end connections.

   c. Severe kinking, crushing, cutting or unstranding.

4. The following items shall be cause for replacement of the wire rope being inspected:

   a. 3 broken wires in one strand of 6 x 7 wire rope.
      6 broken wires in one strand of 6 x 19 wire rope.
      9 broken wires in one strand of 6 x 37 wire rope.

   b. Wear of one fourth the original diameter of outside individual wires.

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

   d. Evidence of heat damage from any cause.

   e. Reduction from nominal diameter of more than:

      3/64" for diameters to and including 3/4"; 1/16" for diameters 7/8" to 1-1/8" inclusive; 3/22" for diameters 1-1/4" to 1-1/2" inclusive.

5. Wire rope must be thoroughly cleaned before it is lubricated. All foreign material and old lubricant must be removed from the valleys between strands and the spaces between the outer wires. This can be accomplished with the use of wire brushes, scrapers and compressed air if necessary.

6. The reactor building crane (MT-CRA-2) shall use GE silicone grease 351N. All others shall use Texaco Crates "A", C.W. Crown and heavy duty willrupe lube., and Shell Cordium EP Fluid F or approved equivalent.

O. Rated Load Test

1, Prior to initial use, all new, extensively repaired, and altered cranes should be tested and inspected by, or under the direction of, an appointed or authorized person and a written report be furnished by such person, confirming the load rating of the crane. The load rating should not be more than 80 percent of the maximum load sustained during the test. Test loads shall not be more than 125 percent of the rated load, unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel.

2. The rated load test, if made, shall consist of the following operations as a minimum requirement.

a. Hoist the test load a distance to assure that the load is supported by the crane, and held, by the hoist brake(s).

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

c. Transport the test load by means of the bridge for the full length of the runway in one direction with the trolley as close to the extreme right-hand-end of the crane as practical and in the other direction with the trolley as close to the extreme left-hand end of the crane as practical.

d. Lower the test load, and stop and hold the load with the brake(s).

3. Complete Rated Load Test Check Sheet

P. Operational Load Test Reactor Building Crane (MT-CRA-2)

1. At the side of each refueling outage the reactor building crane shall be operationally tested by hoisting the top middle step plug (90 tons) and transporting it per steps 2a, b, c, and d.

2. The results of the test shall be recorded on the Operational Load Test Check Sheet.

10.4.1.7 Documentation

A. Inspection instructions and checklists will be maintained for each type and manufacturer of motor operated cranes and hoists. Inspection check lists will be used on all scheduled maintenance.

B. The completed checklist should be attached to its companion work request or PM Card. When both are complete, they shall be returned to the Shift Supervisor per PPM 1.3.7.

10.4.1.8 Attachments

Motor Operated Crane and Hoist Inspection Instructions

A. Figure 1, Inspection for Drum Groove Wear

B. Figure 2, Examination of Trucks

C. Figure 3, Squareness of Bumper Stops

D. Figure 4, Inspection of Crane Hooks

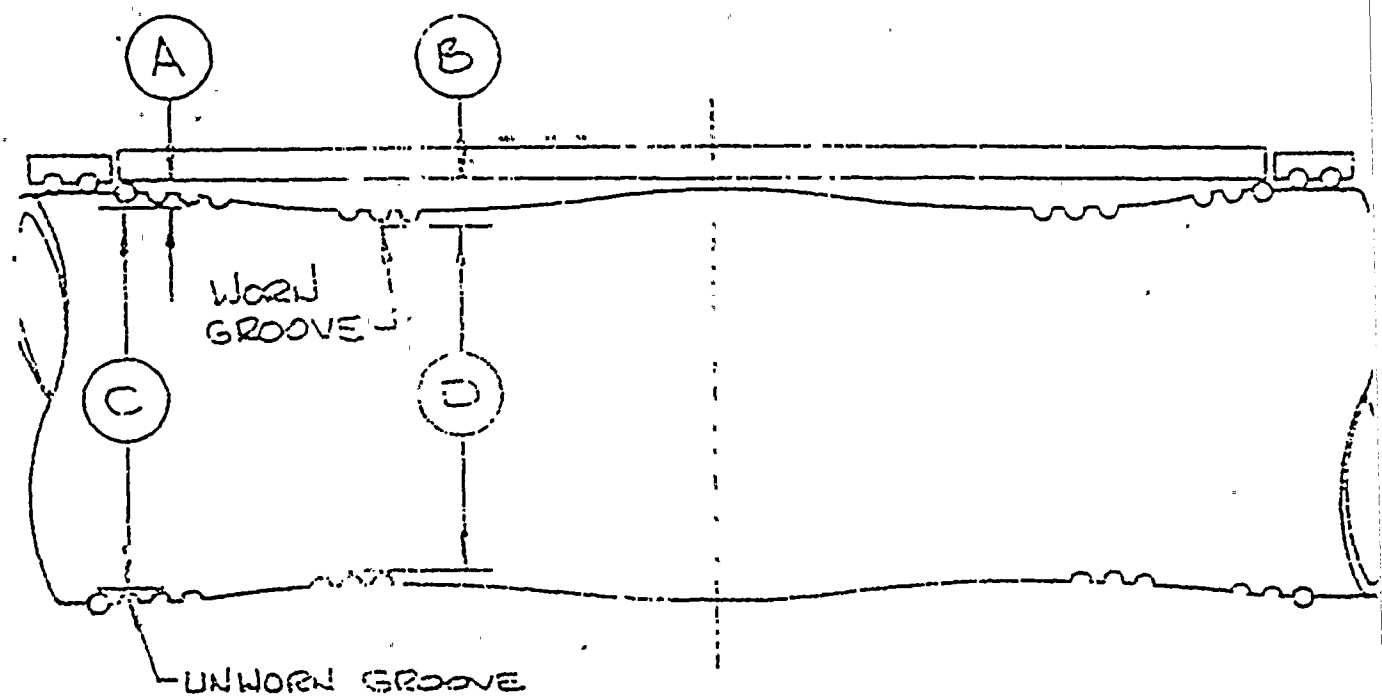
E. Figure 5, Inspection for Wheel Wear

F. Daily or Pre/Use Inspection Checklist

G. Annual Inspection Checklist

FIGURE 1

INSPECTION FOR DRUM GROOVE WEAR



METHOD I — USING STRAIGHT EDGE OVER UNWORN ROPES NEAR ROPE ANCHORS MEASURE DEPTH (A) OF UNWORN GROOVE. THEN MEASURE DEPTH (B) OF ANY GROOVE WITH MAXIMUM WEAR. WHEN (B) EXCEEDS (A) BY MORE THAN 25% OF ROPE DIA - REPLACE DRUM.

METHOD II — USING LARGE CALIPERS TO DETERMINE (C) & (D) - WHEN THE DIFFERENCE BETWEEN (C) & (D) BECOMES MORE THAN 50% OF ROPE DIA, REPLACE DRUM.

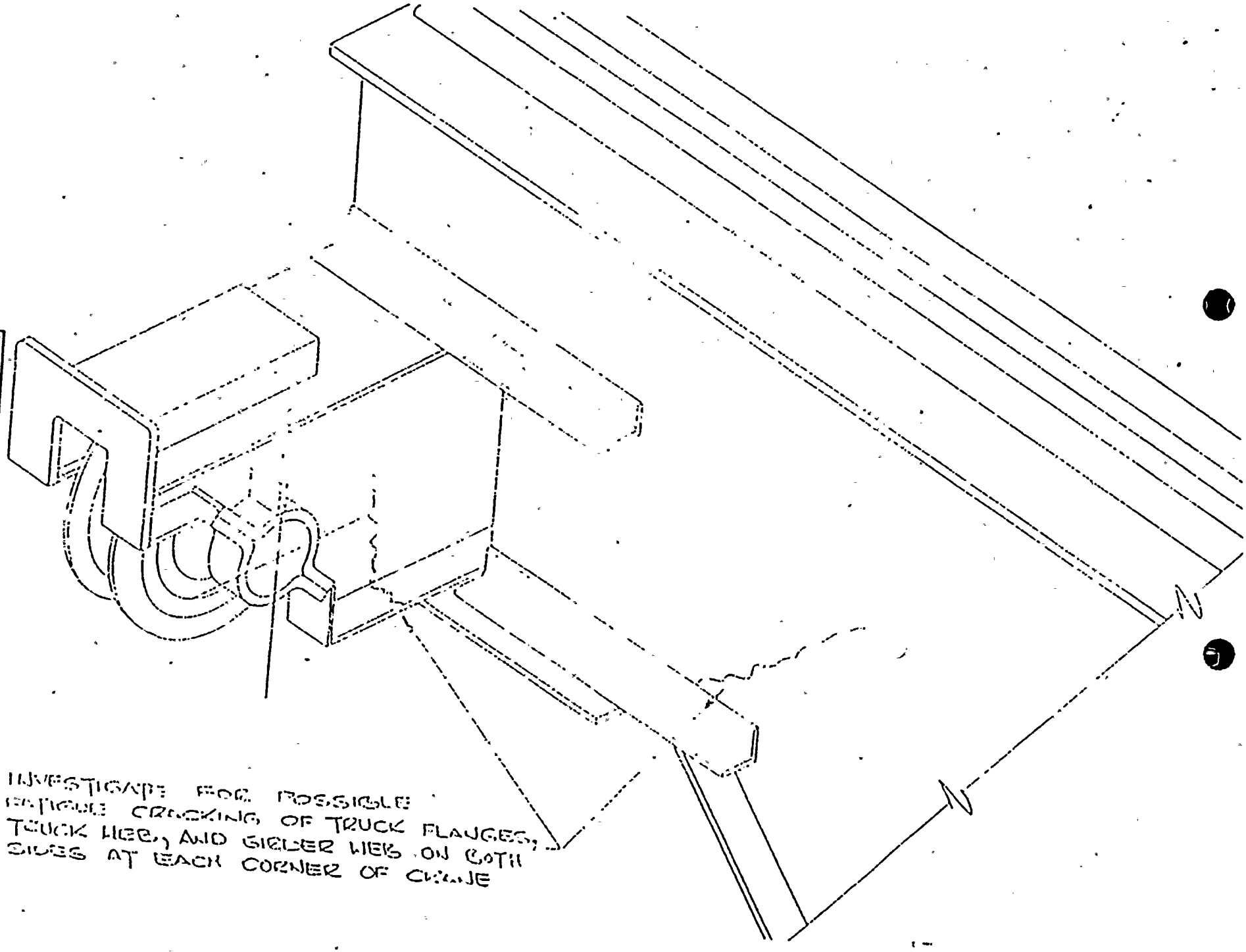
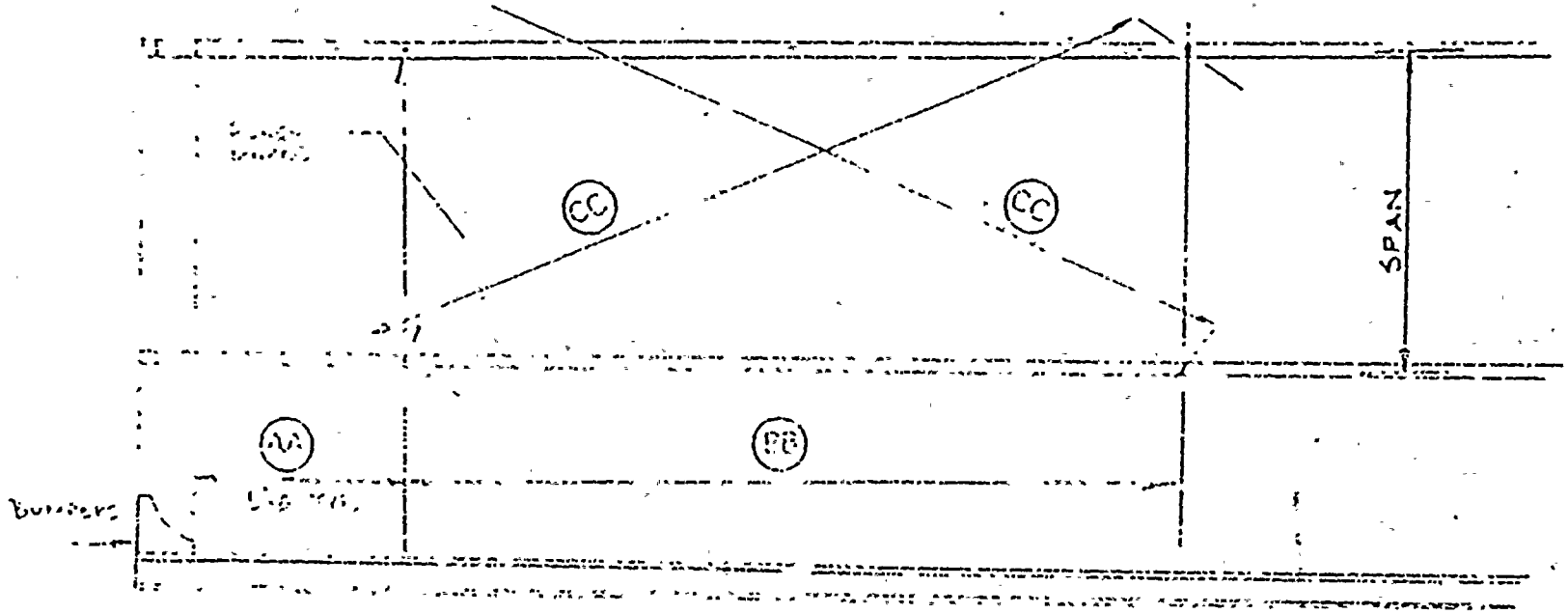

INVESTIGATE FOR POSSIBLE FATIGUE CRACKING OF TRUCK FLANGES, TRUCK WEB, AND GIRDER WEB ON BOTH SIDES AT EACH CORNER OF CRANE

FIGURE 2



How to check for bumper squareness.

First make sure rails are parallel and set at correct span.

Measure equal distance (AA) from bumper stops. Put center punch mark in center of rail.

Measure (BB) equidistant from these marks (20' or 30'); put center punch marks in center of rail at these points. Diagonals (CC) should be equal. If not equal, bumpers are out of square.

FIGURE 3

FIGURE 4

INSPECTION OF CRANE HOOKS

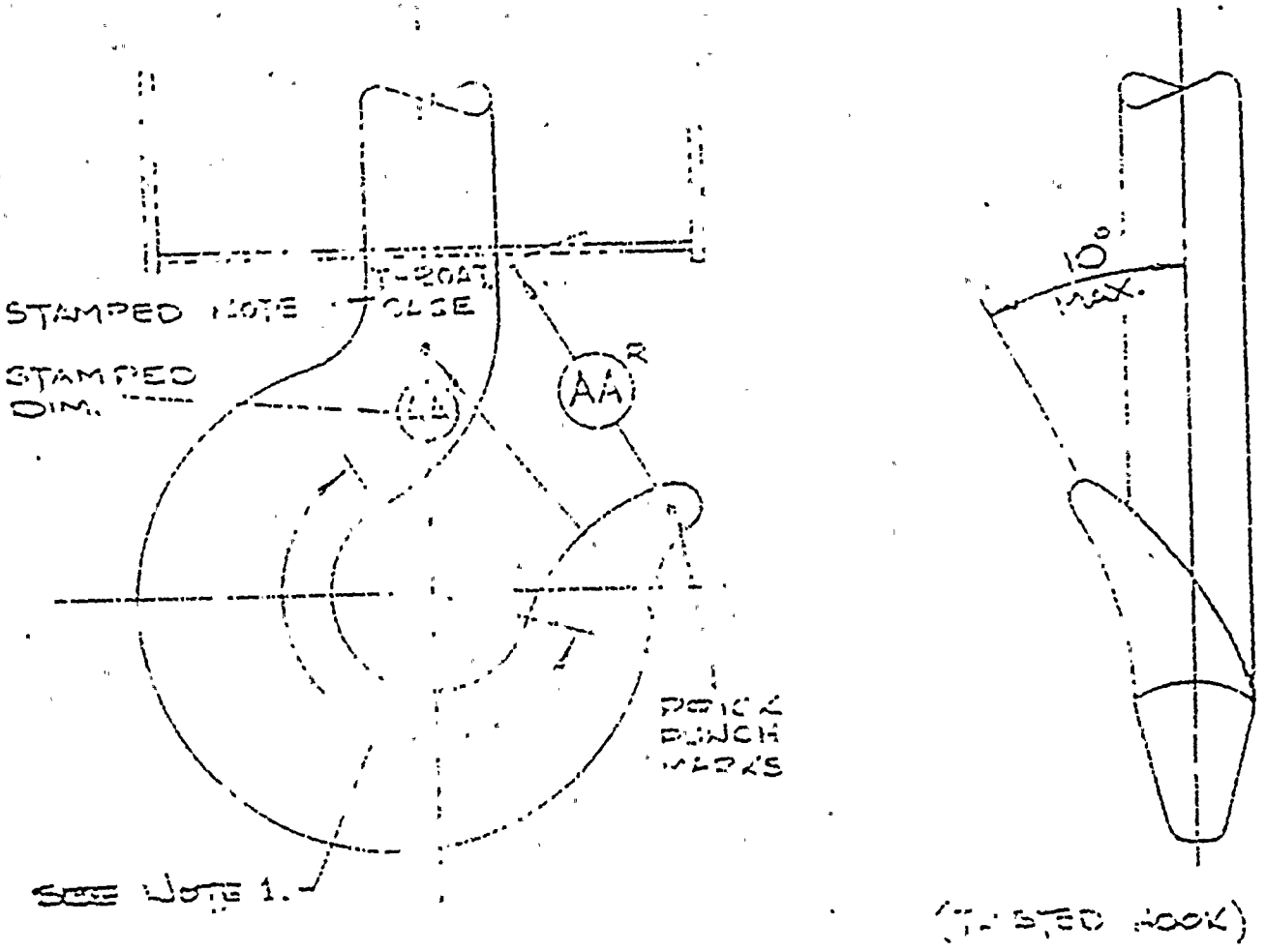
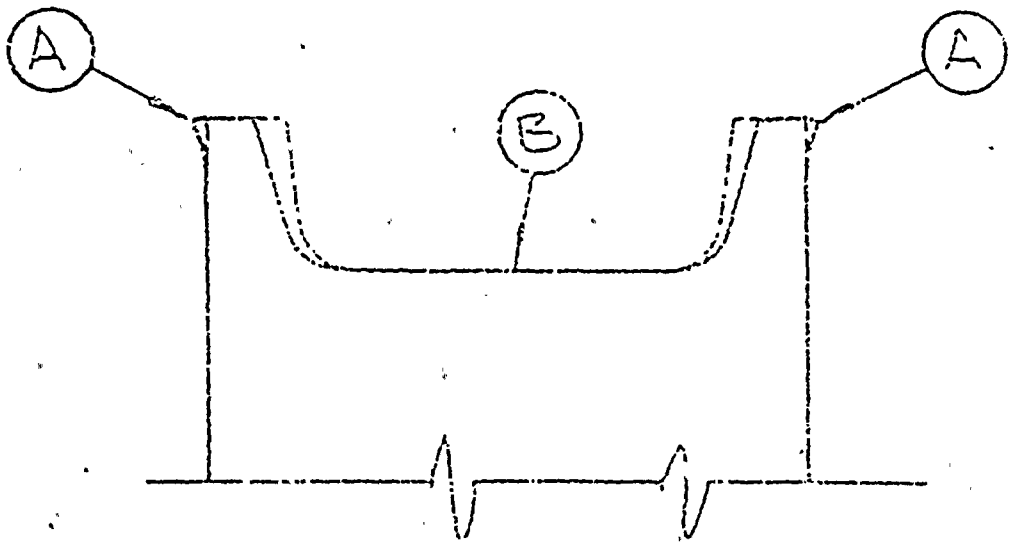


FIG. 4 INSPECTION OF CRANE HOOKS

1. NO CRACKS, NICKS, ETC.
2. MEASURE (AA) BETWEEN PEICE PUNCH MARKS. REPLACE HOOK IF (AA) MEASURES MORE THAN (A) + ORIGINAL THROAT GAGE STAMPED ON HOOK
3. IF HOOK IS TWISTED MORE THAN 10°, HOOK SHALL BE REPLACED.

FIGURE 5

INSPECTION FOR WHEEL WEAR



1. WHEELS SHOULD BE REPLACED WHEN WHEEL FLANGES BECOME THIN & VISIBLE CURLING BEGINS TO APPEAR AT (A).

2. WHEN CRANE OR TROLLEY TENDS TO RUN OUT OF SQUARE AS EVIDENCED BY PERSISTENT WHEEL FLANGING, CHECK TREAD DIA. (B) OF ALL MECHANICALLY INTERCONNECTED WHEELS. IF MISMATCHED BY MORE THAN 1/16 ON THE CIRCUMFERENCE AT THE CENTER OF THE TREAD, WHEELS SHOULD BE RESURFACED OR REPLACED.

DAILY OR PRE/USE INSPECTION CHECKLIST

Crane or Hoist Number _____ Date _____

ITEM

1. Functionally test all controls, limit switches and stops.
2. Visually check for oil and hyraulic leaks.
3. Visually check hooks for cracks and deformation.
4. Inspect hook latches for proper operation.
5. Inspect crane for general cleanliness, guards installed on electrical components and warning devices operational.

NOTE 1 Check all limit switches without a load on the hook. Each motion shall be inched into its limit switch or run in at slow speed.

NOTE 2 The crane operator shall report any malfunction or problem in the above list to his supervisor immediately.

ANNUAL INSPECTION CHECKLIST

Crane or Hoist Number _____ Date _____

Inspector _____

Item		Remarks
1.	Automatic hoist brakes.	
2.	Bridge and trolley brakes.	
3.	Mechanical load brakes.	
4.	Inspect gearcases for damaged or worn parts.	
5.	Check all bolts and rivets for tightness.	
6.	Check all couplings for loose bolts, elongation of bolt holes, and keys for tightness in keyways.	
7.	Check all wheels for flanging, flat spots and measure diameter.	
8.	Check all welds for cracks.	
9.	Check hoist drums and sheaves for wear.	
10.	Check runway columns for plumbness, being seated and being rigidly bolted to foundations.	
11.	Check that runway girders do not sag between columns.	
12.	Check girder connections to columns for tightness.	
13.	Check that runway does not sway or breathe as crane passes over.	
14.	Rails level within $\pm$ 1/8" in 20 feet.	
15.	Rails straight within 1" in 400 feet.	
16.	Rail span $\pm$ 1/8".	

Item	Remarks
17. Rail joints closed and splice bars tightly bolted.	
18. Rail heads not cracked, indented, spalled out, mashed down to a sharp edge or worn on a side.	
19. Rail clips tightly bolted to runway girder.	
20. Check that crane is square.	
21. Check crane for structural damage.	
22. Inspect end stops.	
23. Check for loss of camber in crane girders.	
24. Inspect hooks, hook bearings and safety latches.	
25. Inspect wire rope.	
26. Check the following safety devices:	
a. Footwalks, handrails and ladders.	
b. Fire extinguisher available.	
c. Warning device operable.	

NOTE 1: If an item on this checklist is not applicable to the particular crane or hoist being inspected, mark the item NA in the Remarks column.

NOTE 2: The manufacturer's instruction manual and the inspection instructions for motor operated cranes and hoists shall be used to perform this inspection.

RATED/OPERATIONAL LOAD TEST CHECK SHEET

CRANE EQUIPMENT PIECE NUMBER _____

DATE OF TEST _____

REASON FOR TEST (NEW CRANE, EXTENSIVELY REPAIRING, OPERATIONAL) _____

DESIGN RATING OF CRANE _____

MAXIMUM CRITICAL LOAD FOR CRANE _____

TEST LOAD USED _____

HOISTED LOAD IS SUPPORTED AND HELD BY HOIST BRAKES _____

TEST LOAD IS TRANSPORTED BY TRAILER FULL LENGTH OF BRIDGE _____

TEST LOAD IS TRANSPORTED BY BRIDGE FULL LENGTH OF RAIL RIGHT HAND END _____

TEST LOAD IS TRANSPORTED BY BRIDGE FULL LENGTH OF RAIL LEFT HAND END _____

TEST LOAD IS LOWERED, STOPPED AND HELD BY BRAKES _____

ENCLOSURE 3

INTEROFFICE MEMORANDUM

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Distribution:
- ☐ EDC WNP-1/4
- ☒ EDC WNP-2
- ☐ EDC WNP-3/5
- ☐ Admin File

EA Fredenburg - 906D REF
BA Holmberg - 906D
BAH/lb
EAF/lb
sf 2 pf 1

Date: November 2, 1981

To: J. W. Hedges, Manager Maintenance, WNP-2 -- 907M

From: B. A. Holmberg, Deputy Project Manager-Engineering, WNP-2

Subject: SINGLE FAILURE PROOF
REACTOR BUILDING CRANE

Reference:
(1) Whiting Corporation letter to Burns & Roe, dated September 19, 1975 (Transmittal No. 39)
(2) BRWC-31A-76-006, dated February 13, 1976
(3) Conference Notes No. 473, (BRWP-76-595)
(4) Whiting Corporation letter to Burns and Roe, September 1, 1976, including "Crane Characteristics List", Rev. 1
(5) Tech Memo 989, Rev. 1, (BRWP-77-1113)

Following is our response to your request for assistance in identifying references for design and characteristics of the reactor building crane, per NUREG 0612, Appendix C. If Project Engineering can be of further assistance in developing a response to the December 22, 1980 NRC letter on "Control of Heavy Loads", please advise.

(1) Allowable Stress Limits:

- Ref. 3, pg. 12, item B.1.b: "Maximum allowable stress for any member under tension or compression subject to repeated load is 17.6 psi, which is less than 1/2 the yield stress for this material (ASTM A36)."
- Ref. 3, pg. 14, item B.3.a: "Dual load attaching points, consisting of sister hook and eye block, can each safely support a static load of 3.9 times the design rated load."
- Ref. 3, pg. 15, item B.3.d: "Load block can support 4.83 times the design rated load."
- Ref. 3, pg. 16, item B.3.e: "Stress in lead line is 16% of rated, vs. 20% allowable. Static stress in rope is 10.4% vs. 12.5% allowable."
- Ref. 3, pg. 18, item B.3.g: "Vertical hoisting system components are designed to sustain 265% of design load, vs 200% NRC requirement."

(2) Minimum Operating Temperature:

- Drop weight tests or Charpy impact tests have not been performed on the reactor building crane. Typical values for NDTT for A36 steel are 40°F. (Ref. 3, pg. 12, item B.1.b).

- NUREG-0554, Section 2.4, says that as an alternative to impact testing, to determine fracture toughness properties and minimum operating temperatures, the crane may be operated only at temperatures above which it was cold-proof tested at 125% of rated load, followed by periodic nondestructuve examination of welds whose failure could result in drop of a critical load. Temperatures measured in the reactor building refueling floor elevation during the 156 ton (125%) static load test were 64° - 60° , between 10:05 AM until 3:05 PM. Therefore, as long as the crane is operated above 64°F, it need not be retested or fracture toughness tested. (Ref. Reactor Building Crane load test report)

(3) Seismic Design

Crane is designed as Seismic Categoy 1. (Ref. 3, item 1C). Also see Contract 31A vendor submittals including seismic calculations, approved by Burns and Roe, and Reference (3), item B.1.c.

(4) Controls and Limiting Devices

- Ref. 3, page 14, item B.2 and Ref. 4, item 2a: More than one device would have to fail simultaneously for crane to be unable to stop and hold load.

- Ref. 5, and WPBR-77-457: Redundant lower limit switch for main block travel, redundant equalizer bar travel limit switch, and upper limit mechanical paddle type limit switch to prevent two-blocking and load hangup have been added to the reactor building crane.

- Ref. 3, pg. 19, item B.3.i: "...electrical controls ensure hoist motor power will cease prior to reaching 175% of full-load-motor torque."

- Ref. 3, pg. 20, item B.3.m: The mechanical brake will automatically set and sustain the load under any failure of any component upstream from the brake, including motive power.

(5) Wire Rope Reeving System:

- Ref. 4, item 3f: A dual reeving system is provided. See Whiting figures T-55301 and T-55302.
- Ref. 3, pg. 15-18, items B.3.c to B.3.f: Description of dual reeving system is provided.

(6) Sensing Devices:

- Ref. 3, pg. 18, item B.3.h: "Means are provided to sense electric current, temperature, overspeed, overloading, and overtravel."
- Ref. 5 and WPBR-77-457: Redundant lower limit switch, equalizer bar limit switch, upper paddle type limit switch, and critical travel path limit switches to prevent travel over the spent fuel pool have been provided.

(7) Two-Blocking:

- See item (5) above.
- Ref. 3, pg. 19, item B.3.j and Ref. 5: A redundant upper "paddle type" limit switch has been added to prevent two-blocking.

(8) Hoisting Drum Failure:

- Ref. 3, pg. 20, item B.3.k: The main hoisting drum has physical retainers to maintain the drum and gear mesh in the event the drum, shaft, or bearings fail.

(9) Limit Switches:

- Ref. 4, item 2a, 3h, and 3r: Limit switches and backups for crane travel and load travel are provided. Redundant limit switches were added as indicated in item 4 and 6 above.

(10) Cold Proof Test

See item 2 above, and Contract 207 Transmittal No. 256.

BAH:EAF:cph

WHITING CORPORATION
HARVEY, ILLINOIS, U. S. A.
(CHICAGO SUBURB)

PROPOSAL
SPECIFICATIONS

To WASHINGTON PUBLIC POWER SUPPLY SYSTEM
HANFORD UNIT NO. 2
Richland, Washington

Proposal No. C-2444 Clearance Sketch No. -B- Date November 16, 1972
Item B

CAPACITY:
Main Hoist (Vertical Lift) 125 tons; Aux. Hoist (Vertical Lift) 15 tons

SPAN: (Center to Center of runway rails) 126 ft. 1½ in.

LIFT: (Vertical travel of main hook) 190 ft. 0 in. Auxiliary: 193'0"

ELECTRIC CURRENT: 3 phase, 60 cycle, 460 volts, alternating current

SPEEDS: Approximate speeds in feet per minute:

		Main Hoist	Auxiliary Hoist	Trolley Traverse	Bridge Travel
Speeds:	Full load	5½ FPM ~~5½ IPM~~	20 FPM ~~6 IPM~~	~~40~~	~~50~~
	No load	5½ FPM ~~5½ IPM~~	20 FPM ~~6 IPM~~	~~40~~	~~50~~
Motor horsepower		60 ~~7½~~	25 ~~1~~	~~7½~~	~~4 @ 7½~~
Motor speed RPM		1200 ~~1800/216~~	900 ~~1800/20~~	1200	~~1200~~
Motor Frame No.					

MOTORS: Louis Allis, Westinghouse, General Electric, or equal, selection by Whiting, enclosed, ball bearing, wound rotor, crane type motors, with Class B insulation, rated 60 minute 75° C rise for hoists; 30 minute 75° C rise bridge and trolley. Squirrel cage gearhead inching drive motors rated continuous duty 75° C rise. Motors will comply with NEMA standards.

CONTROLLERS: Whiting full magnetic reversing variable speed type, in NEMA-3 enclosures, with overload protection, complete with Class 162 resistors. See page 8. Hoists arranged with Whiting eddy current braking control with Class 162 resistors to allow full motor torque on 1st point hoisting and 50% motor torque on 1st point lowering. Plain reversing bridge and trolley, with bridge control being quadruplex type with modified Selsyn resistor Tie. Clutch coupled single speed reversing inching drive control for hoists.

SWITCHBOARD:

MAGNETIC BRAKES Manual magnetic main line disconnect switch.

Two (2) Whiting 13" SESA, electric operated, oil immersed, self-adjusting solenoid brakes per Bulletin CE-2 plus AB-706 eddy current brake complete with rectifier for main hoist. Two (2) 13" SESA brakes plus AB-705 eddy current brake complete with rectifier for

WHITING MAGNETIC CONTROLS

Whiting magnetic controls provide variable speed for each crane motion by means of variance of motor secondary currents through resistors.

The number of steps of control in each direction will be as indicated;

Main Hoist	5	Steps
Auxiliary Hoist	5	"
Trolley Travel	4	" plus drift point
Bridge Travel	4	" plus drift point

Each control panel consists of a three pole reversing contactor for handling motor primary current and the proper number of accelerating contactors for handling of the motor secondary current through the resistors. All contactors to be solenoid operated type. Overload relay provided on reversing contactor to prevent damage to motor, control or wiring system in case of current overloads. Contactors are mounted on steel panels and neatly wired with control circuit wires ending at a terminal board to facilitate proper connections. A time delay relay is included between all control points, except 1st and 2nd points on 5 step control.

Controls are furnished in gasketed sheet metal enclosures with hinged doors.

NEMA class 152 resistors (unless specified elsewhere) are provided for each motion to give proper secondary currents for smooth acceleration.

For cab controlled cranes - A master switch for each motion will be provided which operates the contactors on the control panel by means of 110 volt pilot currents only, obtained through transformer which is included, thus eliminating danger of crane operator coming in contact with high voltages. Master switches can be provided with maintained contacts, or with spring return to "off" position handles, whichever is desired.

For floor operated cranes - A pendant pushbutton station will be provided which operates the contactors on the control panels by means of pilot currents only, obtained through a transformer which is included, thus eliminating danger of crane operator coming in contact with high voltages.

Crane is arranged for floor operation.

WHITING CORPORATION

PROPOSAL SPECIFICATIONS

Bridge

Proposal No. C-2444 Item B

Bridge End Trucks:	Welded box section per Unit 83, with 16 wheel equalizing bogie type construction, pin connected as shown on page -2- with fixed saddles. Wheel Diameter 16 @ 27" Material Rolled Steel
Bridge Drive:	Motor, double reduction per Unit 58 plus an enclosed Abart speed reducer located between motor and double reduction unit at each corner of bridge. Floating shaft with half-flexible coupling connecting gearcase output direct to wheel axles. A total of four (4) wheels driven.
Bridge Brake:	Four (4) Whiting 6" SESA, electric operated, oil immersed, self-adjusting solenoid brakes per Bulletin CE-2.
Girders:	Welded box sections per Unit 31.
Cage:	Open type cab located at end of span with apron, shelf at front for mounting of pendant station for cab operation, seat, foot gong, 2# CO_2 fire extinguisher, and ladder to walk.
Bridge Conductors:	Insul-8 or equal.
Footwalk:	All steel footwalk closed to girder extending full length of bridge on drive side all similar to Unit 60. plus a drive support platform at each end with crossrailings and ladders.
Bumpers:	Four rubber bumpers provided on end trucks.
Runway Collectors:	Insul-8
Runway Conductors and Fittings	Copper clad Insul-8 runway wiring complete with hardware for runway 146'0" long.
Lubrication:	All crane bearings inside of gear cases are splash lubricated. Other bearings are lubricated by High speed gearing is splash lubricated. Alemite grease fittings.

WHITING CORPORATION

PROPOSAL SPECIFICATIONS

Proposal No. C-2444 Item B — **Trolley** — Page -10-

Trolley Type:	Three motor type similar in general design to that shown on Unit Special Redundant with welded steel frame. Center to center of trolley rails 26'0"
Trolley Drive:	Enclosed speed reducer type as on Unit 23. except to be three reduction type.
Wheels:	Djameter 27" Material Rolled Steel
Drum:	Main Hoist 60" dia. Aux. Hoist 18" dia.
Ropes:	Main Hoist 12 parts 1-3/8" Aux. Hoist 8 parts 1/2" Silicone lubricated alloy steel w/steel center. A-304 Stainless Steel with Independent Wire Rope Center.
Limit Switch:	Screw type plus weight operated control circuit type for upper and lower hoist limits.
Hoist Mechanisms:	Similar to that shown on Unit 26 with mechanical load brake. plus two extra gear reductions on main hoist.
Load Block:	Main - Redundant type with bronze bushed sheaves. Aux. - With bronze bushed sheaves.
Trolley Brake:	Two (2) Whiting SESA brakes per Bulletin CE-2.
Collectors:	Insul-8 or equal.
Stops:	Four rubber trolley bumpers.

GENERAL

DESIGN CRITERIA: All crane parts shall equal or exceed design criteria as established by C.M.A.A. Specification #70.

This proposal covers equipment which complies with the mandatory requirements of the William-Steiger Occupational Safety & Health Act of 1970 (OSHA) as ammended August 13, 1971.

ASSEMBLY: Crane will be assembled at our works, marked for reassembling, and taken apart sufficiently for proper handling and shipment.

PAINTING: The crane will be cleaned and painted using a rust inhibiting primer, and a finish coat of Colonial Yellow enamel.

Special painting if required to be as follows: 3 mil K&L #6040 Tri-Polar White Primer.

Electrical equipment and purchased components will be furnished with manufacturer's standard finish.

SPECIAL CRANE DESIGN FEATURES:

Seismic calculations included by Option C method and based on exception to seismic criteria as noted.
"Walk-in" type girders to meet seismic and access requirements.
Earthquake up-kick lugs and tornado lock bars on bridge and trolley trucks.
Tornado racks included for bridge travel on both runways and trolley travel along one girder.
Controls and resistors on walk. Pendant station on motor driven reel with manual travel along messenger track under cab girder with push button control of all motions and reel motor in pendant station. Push button unit for reel motor also in cab.
Track type bridge and trolley limit switches.
Tool box and standard maintenance tools on walk.
Six (6) 1000 watt incandescant floodlights (exclusive of bulbs) mounted in walks.
Walk, cab and control enclosure lighting. Service receptacles on walk and in cab.
Girder end connections limit hook approaches at both ends of crane due to horizontal seismic criteria.
Certified material tests and reports provided for hooks, hoist ropes, and load carrying structural members only.
Lifting lugs on sub-assemblies.
Steel drums and live sheaves at 24 rope diameters minimum.
Main hoist redundant reeved and provided with safety lugs and shock absorbing equalizer assembly to prevent loss of load due to rope, drum shaft, or sheave shaft failure.
Main hoist machinery redundant except single drum right and left grooved.
Both blocks with bronze bearing sheaves, stainless steel hook thrust bearings, and special painting for underwater operation.
Auxiliary hook, auxiliary drum, and auxiliary rope stainless steel.

Continued.....

Special Crane Design Features cont'd.....

Hooks 200% load and magnetic particle tested.
Load sensing system for overload and slack line limit signals on each hoist with limit adjustments at trolley only.
Two brakes on each hoist and on trolley drive.
Eddy current speed control on hoists.

Bridge Weight: 700,300 lbs. Trolley Weight: 166,350 lbs.

DEVIATIONS FROM SPECIFICATIONS:

1. Crane design based on use of 2% damping curve on both SSE and SSE/2 and increasing $\frac{SSE}{2}$ stress limit in accord with AISC seismic criteria allowances.
2. Stepped magnetic controllers and continuous duty inching drives provided on all hoist motions for maximum safety without time limitations in all spotting operations and compatibility with mechanical load braking on both hoists. Stepless controllers and load floating not included.

WHITING CORPORATION

Page -13-

Proposal No. C-2444 Item B

PROPOSAL

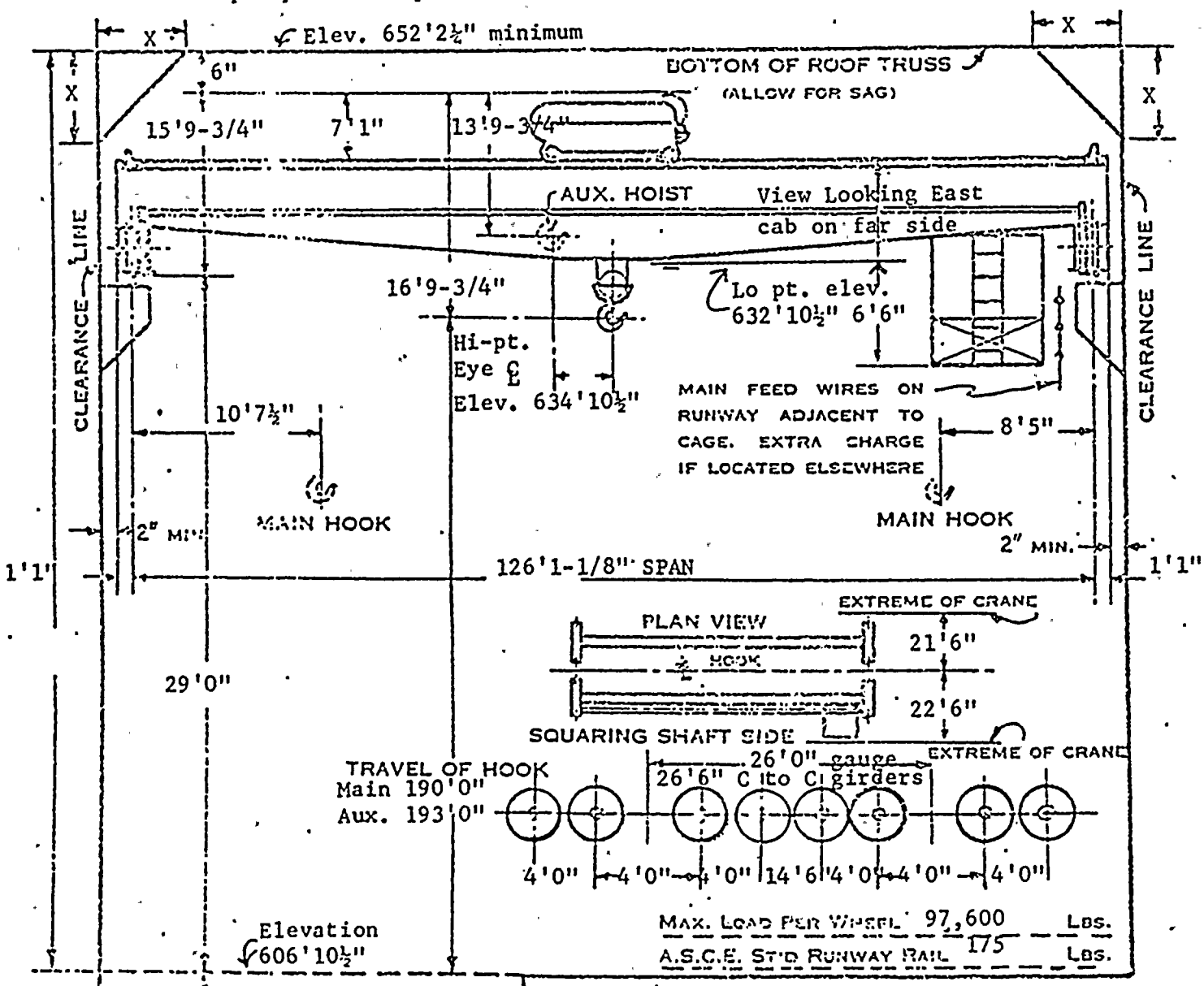
Sketch -B-

Date November 16, 1972

The clearance dimensions of the electric crane covered by accompanying proposal are given on diagram below. The measurements conform to our regular practice and will govern unless changes (subject to extra charge) are specifically made in the order.

Capacity of main hoist 125 tons

Capacity of auxiliary hoist 15 tons



161'10½" effective both hoists

LOWEST LEVEL BELOW FLOOR LINE TO BE SERVED BY CRANE.

DO NOT USE FOR ERECTION

Blue prints showing arrangement of parts for use in erecting will be furnished.