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ELECTRIC ENGINEERING
DEPARTMENT

August 2, 1982

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Calvert Cliffs Nuclear Power Plant
Units Nos. 1 & 2; Dockets Nos. 50-317 & 50-318
Control of Heavy Loads

Reference: (a) BG&E letter of 1/4/82 from A. E. Lundvall, Jr. to D. G. Eisenhut.

Dear Mr. Eisenhut:

Enclosed are forty copies of Section IV - Background Material for Section III of our Phase I Report of reference (a), which was not available when the original submittal was made.

Very truly yours,

R. F. Ash
Supervising Engineer
Nuclear Generation Engineering

RFA/smn
Enclosure

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IV Background Material for Section III

REVIEW OF SPECIFICATIONS FOR MAJOR PLANT CRANES AGAINST CMAA 70 AND ANSI B30.2 STANDARDS

Polar Crane

Turbine Building
Main and Auxiliary Cranes

Spent Fuel Crane

Intake Structure Crane

	CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.1**	Material - ASTM -A36 or equivalent	2-1.4.2** meets CMAA	11.1**- ASTM - A36 or equivalent	16**ASTM A-7 or equivalent
3.2	Welding - In accordance w/ current issue of AWS D14.1 with the exception of Section 705 which shall be replaced by Crane Manufacturer's Standard	2-1.4.1 Meets CMAA	5.1.1 - Conform with AWS standard	17 Conforms with AWS Standard
3.3	Girder Design			
	Manufacturer to specify type	2.1.4.2 requires CMAA AISC, or AISE	11.5.1 requires EOCI 61	18A meets CMAA
3.3.1	Loadings of Girder			
	Vertical Forces*			
	Dead Load: Weight of all effective parts of bridge machinery parts and fixed equipment attached	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
	Live Load: Weight of Trolley and lifted load	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
	Impact Allowance: ½% of the load per foot per min. of hoisting speed but not less than 15% nor more than 50% (See Note 1)	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B - Impact Allowance: 15% of rated capacity

* Indicates items verified by calculations
** Numbers refer to document sections

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.3.1 Loading of Girders (Cont'd.)			
Lateral Forces*			
Due to Acceleration or deceleration: 2½% of the L.L. and the crane bridge	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B - Taken as 5% of live load and the crane bridge - meets CMAA
Wind Loading: 5 lbs. per sq. ft. on 1.6 times the projected area	2-1.3.1.b - Wind pressure of 30 psf.	3.1.2.b Wind load of 30 psf. acting on 1½ times the projected area - meets CMAA and ANSI	18B - Wind Pressure of 10 psf
Torsional Forces*			
Due to starting and stopping of bridge motor: Twisting Moment = 200% of Full load torque x gear ratio	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
Due to Overhanging Loads: Twisting Moment = Wt. of overhanging load x horizontal distance between c.g. of load & shear center of girder section	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
Due to eccentric lateral forces: Twisting Moment = Lat. Forces x vert. distance bet. center line of force & shear center of girder.	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
Combined Bending Stresses*			
Shall be taken as the larger of following:			
Sum of maximum stresses due to D.L., wt. of trolley, rated load and impact allowance	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
Sum of maximum stresses due to D.L., wt. of Trolley, rated load and lateral forces	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61	18B meets CMAA
Combined Shear Stresses*			
Sum of max. shear due to D.L., wt. of trolley, rated load, impact allowance and net twisting moment.	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	18B Meets CMAA
3.3.3 Design Limitations			
Welded box girders shall be fabricated of structural steel with continuous longitudinal weld of sufficient strength	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	18C meets CMAA plus weld stresses shall not exceed 20% of average ultimate strength of weld material

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.3.3 Design Limitations (Cont.)			
Proportions: Box Girder* $I/h \leq 25$ $I/b \leq 60$ $b/c \leq 60$ h/t: for no longitudinal stiffener, $h/t \leq 188$ or $81(k+1)\sqrt{\frac{17.6}{tc}}$ Whichever is smaller.	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	18C - I/h not listed $I/b \leq 55$ - meets CMAA b/c Meets CMAA h/t: for no longitudinal stiffener, $h/t \leq 240$ or $85(k+1)\sqrt{\frac{16000}{f_c}}$ Whichever is smaller.
for 1 longitudinal stiffener, $h/t \leq 376$ or $162\ (k+1)\sqrt{\frac{17.6}{tc}}$ Whichever is smaller.	2-1.4.2 requires CMAA, AISC or AISE	5.1.2 requires EOCI 61 and AISC	Not discussed
for 2 longitudinal stiffener, $h/t \leq 564$ or $243\ (k+1)\sqrt{\frac{17.6}{tc}}$ Whichever is smaller.	2-1.4.2 requires CMAA, AISC or AISE	5.1.2 requires EOCI 61 and AISC	Not discussed (See Note 7)
Longitudinal Stiffeners:*			
Provisions for minimum section properties of stiffener and its placement on the compression web	2-1.4.2 requires CMAA, AISC or AISE	5.1.2 requires EOCI 61 and AISC	Not discussed (See Note 3)
Basic Allowable Stresses*			
Tension 17.6 ksi	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	18C - Tension equal to 16 ksi - meets CMAA

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.3.3 Design Limitations (Cont.)			
Girder Allowable Stresses			
Compression ≤ 17.6 ksi for b/c < 38 for b/c > 38 reduce allowable compresive stress	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	18C - Compression equal to 16 ksi for b/c ≤ 41
Shear < 13.2 ksi	2-1.4.2 requires CMAA, AISC or AISE	5.1.2 requires EOCI 61 and AISC	18C - for b/c > 41 reduce top flange allowable compressive stresses as specified in EOCI
Bearing < 26.4 ksi on plates in contact	2-1.4.2 requires CMAA, AISC or AISE	5.1.2 requires EOCI 61 and AISC	Not discussed (See Note 2)
Allowable stress range for members and fasteners subjected to repeated loading shall not exceed allowable values specified in Table 3.3.3.1.3-1	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires EOCI 61 and AISC	Not discussed (See Note 7)
Diaphrams and Vertical Stiffeners*			
Maximum spacing between vertical web stiffeners = 350 t/$\sqrt{v}$ or 72 in. or depth of web whichever is greater	2-1.4.2 requires CMAA, AISC, or AISE	5.12 requires EOCI 61	18C Meets CMAA
All diaphragms shall bear against top cover plate and shall be welded to the web plates.	2-1.4.2 requires CMAA, AISC, or AISE	5.12 requires EOCI 61	18C Meets CMAA

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.3.3 Design Limitations (Cont.)			
Diaphrams and Vertical Stiffeners*			
Diaphragm plate thickness shall be sufficient to resist trolley wheel load in bearing at 26.4 ksi.	2-1.4.2 requires CMAA, AISC, or AISE	5.12 requires EOCI 61	18C Meets CMAA
Short diaphragms shall be placed between full depth diaphrams so that maximum bending stress in trolley rail to be $\leq$ 18 ksi.	2-1.4.2 requires CMAA, AISC, or AISE	5.12 requires EOCI 61	18C Meets CMAA
Deflection and Camber*			
Max. Vertical deflection shall not exceed .00125" per inch of span	2-1.4.2 requires CMAA, AISC, or AISE	3.4.5.a Deflection shall shall not exceed .001 in per inch of span	18C Meets CMAA
Girder shall be cambered an amount equal to D.L. deflection +½ x L.L. deflection	2-1.4.2 requires CMAA, AISC, or AISE	3.4.5.b Meets CMAA	18C Meets CMAA
3.4 Bridge End Trucks*			
Wheel base of end truck shall be 1/7 of the span or greater	2-1.4.2 requires CMAA, AISC, or AISE	4.1 Meets CMAA	19A Meets CMAA
Trucks may be of rotating axle or fixed axle type	2-1.4.2 requires CMAA, AISC, or AISE	4.2 Meets CMAA	19B Meets CMAA

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.4 Bridge End Trucks (Cont.)*			
Truck shall be constructed of structural steel providing a rigid structure with substantial guards provided in front of each outside wheel	2-1.4.2 requires CMAA, AISC, or AISE	4.3 Meets CMAA	19C Meets CMAA
Allowable vertical stresses w/o impact: Tension = 14.4 ksi Compression = 14.4 ksi Shear = 10.8 ksi	2-1.4.2 requires CMAA, AISC, or AISE	5.1.2 requires AISC	Not discussed
3.5 Footwalks and Handrails			
Handrail shall be at least 42 inches high and provided 2 with an intermediate railing	2-1.73 requires ANSI A12.1	5.1.2 requires EOCI 61 11.6 Meets CMAA	20A Meets CMAA
Footwalks shall be designed for a live load of 50 lbs. per sq. ft.	2-1.7.2 Meets CMAA	11.2 requires EOCI 61	Not discussed
Footwalk specified by mfr. and protected by toe-guard	2-1.7.1 and 2-1.7.2 specify additional requirements	11.6 Meets CMAA	20A meets CMAA
Allowable steel stresses: Tension = 20 ksi Compression = 20 ksi Shear = 13.0 ksi	Not Addressed	5.1.2 requires AISC	Not discussed

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.6 Operator's Cab			
Cab shall be adequately braced to prevent swaying or vibration and all bolts for supporting member connections should be in shear	2-1.5.2 Meets CMAA	5.1.2 requires AISC	Not discussed
Location of cab shall not interfere with the hook approach	2-1.5.1d Meets CMAA	5.1.2 requires EOCI 61	21A Meets CMAA
3.7 Trolley Frames			
Trolley frame shall be of rigid construction designed to transmit load to bridge rail w/o undue deflection	Not addressed	5.1.2 requires EOCI 61	22A Meets CMAA
Allowable vertical stresses w/o impact Tension = 14.4 ksi Compression = 14.4 ksi for b/c 38 Shear = 10.8 ksi	Not addressed	5.1.2 requires AISC	Not addressed
3.8 Rails			
Bridge rails shall conform to the cross sections and weights per yard specified on ASCE, ARA, AREA, and other Commercial standards	Not addressed	Not in scope of specification	Not required by specification

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
3.8 Rails (Cont.)			
Bridge rails shall be joined by standard joint bars or welded w/positive stops provided at the ends.	2-1.3.2 Meets CMAA	Not in scope of specification	Not required by specification
Bridge rails shall be securely fastened in place to maintain center distance of rails.	2-1.3.2 Meets CMAA	Not in scope of specification	Not required by specification
Bridge and Trolley rails should be in accordance with Table 4.11.3 for max. wheel load	2-1.3.2 Meets CMAA	8.4 Meets CMAA	8.4 Meets CMAA
3.9 Gantry Crane*			
Design of leg, end tie, strut and sill members shall conform to applicable sections of current edition of AISC Manual at a unit stress proportioned to that used for girder design.	Not addressed	5.1.2 requires AISC	Not required

* Indicates items verified by calculation

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.1 Load Block - Steel Construction	2-1.11.4 Meets CMAA. Adds - prevent rope chafing	12.6.1 requires EOCI 61 12.6.8 - Totally enclose block except for rope openings	23 - meets CMAA -chafing requirement not addressed
Hook - Rolled or Forged Steel Ball or Roller thrust bearing	2-1.11.4 Meets CMAA. Adds - Latches required at throat opening	12.6.1 requires EOCI 61 12.6.7 - Hook Material to be forged steel - design stress limited to 10000 psi. in stem 20000 psi in hook (combined tension and bending)	23 - meets CMAA - Latching Requirement not addressed (See Note 4)
4.2 Hoist Rope $\frac{\text{Capacity + Wgt. Bottom Block}}{\text{\# Parts of Rope}} \leq$ 20% Breaking Strength	2-1.11.2a meets CMAA	12.6.1 requires EOCI 61 12.6.6 - Safety factor to equal six (6) based on Yu with capacity load	24 $\frac{\text{Capacity}}{\text{\# Parts of Rope}} \leq$ 20% Rope Breaking Strength (See Note 5)
Cable Specified by Mfr.	2-1.11.2b, d, e, f, g meet CMAA	12.6.1 requires EOCI 61 12.6.6 - Standard diameter, extra flexible, improved plow steel (alloy steel on containment polar and spent fuel cask cranes), independent steel core.	24 - meets CMAA
4.3 Sheave			
Steel or A-48 Cl. 40 CI or equal per manufacturer	No requirement	12.6.1 requires EOCI 61	25 - meets CMAA
Pitch diameter of running sheaves: 24 x d(rope) when 6x37 or 30 x d(rope) when 6x19	No requirement	12.6.1 requires EOCI 61	25 - meets CMAA

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.3 Sheave (Cont.)			
Pitch diameter of idler sheaves 0.5D of running sheaves	No requirement	12.6.1 requires EOCI 61	25 - meets CMAA
Deviation allowed on sheave dimensions based on clearances	No requirement	12.6.1 requires EOCI 61	25 - meets CMAA
No CMAA requirement	2-1.11.1a - smooth, close fitting grooves	not specified	not required by specification
No CMAA requirement	2-1.11.1b if rope unload - possible, guides to assure alignment on reloading	12.6.8 - totally enclosed block except for rope openings	not required by specification
No CMAA requirement	2-1.11.1c - bottom block guards to prevent fouling	12.6.8 - totally enclosed except for rope openings	not required by specification
No CMAA requirement	2-1.11.1.d - prevent rope chafing	not specified	not required by specification
No CMAA requirement	2.1.11.1f - means for lubricating running sheaves bearings	12.1.9 meets CMAA	30.D meets ANSI
4.4 Drum			
Steel or A-48 CL 40 CI or equal per mfr.	Not addressed	12.6.1 requires EOCI 61	26 - high grade cast iron
Withstand combined crushing and bending loads	Not addressed	12.6.1 requires EOCI 61	26 - withstand maximum bending and crushing loads (See Note 6)

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.4 Drum (Cont.)			
2 wraps of rope remaining at low point	Not Addressed	12.6.1 requires EOCI 61	26 - meets CMAA
No overlapping of rope at high point of hook	Not Addressed	12.6.1 requires EOCI 61	26 - meets CMAA
Grooves machined - right hand and left-hand	Not Addressed	12.6.1 requires EOCI 61	26 - meets CMAA
Groove Pitch 1.14 x d(rope) (use smaller or value) d(rope) + 1/8	Not Addressed	12.6.1 requires EOCI 61	Not addressed (See Note 6)
Minimum Groove Depth 3/8 x d(rope)	Not Addressed	12.6.1 requires EOCI 61	Not addressed (See Note 6)
Pitch Diameter 24x d(rope) for 6 x 37 or 30x d(rope) for 6 x 19	Not Addressed	12.6.1 requires EOCI 61	26- meets CMAA
4.5 Gearing			
Gears or Pinions of Steel or other suitable material	Not Addressed	12.2.1 - Rolled or cast steel gears - rolled or forged alloy steel pinions --meets CMAA	Not required by specification
H.P. Rating of Spur, helical, herring bone gears per AGMA stds.	Not Addressed	Not Addressed (See Note 6)	Not required by specification

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.5 Gearing (Cont.)			
Actual gearing HP = motor HP x S.F. for Class (crane)	Not Addressed	Not Addressed (See Note 6)	Not required by specification
Worm Gearing rating by by manufacturer	Not Addressed	Not Addressed, therefore specified by mfr - meets CMAA	Not required by specification
Type of Gearing Specified by manufacturer	Not Addressed	Not Addressed, therefore specified by mfr - meets CMAA	Not required by specification
Means of proper lubrication	Not Addressed	12.2.2 meets CMAA	Not required by specification
Gearing except final at drum/wheel run in oil or splashed	Not Addressed	12.2.2 meets CMAA	Not required by specification
All gearing not in boxes to be guarded with provisions for lubrication/ inspection	Not Addressed	12.2.2 meets CMAA	Not required by specification
4.6 Bearings			
Type specified by crane manufacturer	Not Addressed	12.1.8 meets CMAA	Not required by specication
Anti-friction bearing B-10 Life (3000 Hr)	Not Addressed	12.1.9 - Heavy Duty Roller Anti-Friction Bearing Required; minimum 5000 hour life	Not required by specification

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.6 Bearings (Cont.)			
Bronze sleeve bearings unit pressure of 1000 psi of projected area	Not Addressed	Not Addressed (See Note 6)	Not required by specification
Proper lube and housing design	2-1.11.1f meets CMAA	12.1.9 meets CMAA	Not required by specification
4.7 Brakes			
Bridge Motion			
Cab Control/Cab on Bridge Rating ≥ Bridge Motor	2-1.9.4 - stop bridge in distance (Ft) = 10% of rated full speed at rated load	12.5.1 requires EOCI 61	31. meets CMAA
Cab Control/Cab on Trolley* Rating ≥ 75% Bridge Motor	Same as "Cab on Bridge"	12.5.1 requires EOCI 61	31. 50% Bridge motor
Floor/Remote Control Rating ≥ 50% Bridge Motor	Same as "Cab on Bridge"	12.5.1 requires EOCI 61	31. meets CMAA
Trolley Motion			
Cab Control/Cab on Bridge Rating ≥ 50% Trolley Motor	2-1.9.6.b 50% Trolley Motor	12.5.1 requires EOCI 61	31. meets CMAA
Cab Control/Cab on Trolley* Rating ≥ Trolley Motor	Same as "Bridge Motion"	12.5.1 requires EOCI 61	31. meets CMAA
Floor/Remote Control Rating ≥ 50% Trolley Motor	Same as "Bridge Motion"	12.5.1 requires EOCI 61	31. meets CMAA

* No cabs located on trolleys

CMAA	ANSI B30.2	Specification C-42	EOCI 61
4.7 Brakes (Cont.)			
Hoist - Holding Brakes			
One required; application automatic on power loss; mounted on motor shaft or gear train shaft	2-1.9.1a and c meets CMAA	12.5.1 - require EOCI 61	31B meets CMAA
Rating (with respect to motor torque) 125% with other than mech. control brake 100% if mechanical control brake 100% each if two holding braces used	2-1.9.2a meets CMAA	12.5.1 - require EOCI 61	Not addressed (See Note 5)
Wear Adjustment	2-1.9.2d meets CMAA	12.5.4 - meets CMAA	Not addressed
Hoist - Control Brakes			
Control brake or suitable worm gear required	2-1.9.1b meets CMAA	12.5.1 requires EOCI 61	31B meets CMAA
Power or mechanical brakes to control speed	2-1.9.3d meets CMAA	12.5.1 requires EOCI 61	31B meets CMAA
	2-1.9.2e - wear surfaces free of defects	12.5.1 requires EOCI 61	Not addressed
	2-1.9.2b and 2-1.9.3b - adequate thermal capacity	12.5.1 requires EOCI 61	Not addressed

CMAA	ANSI	Specification	EOCI
4.8 Bridge Drives			
If ≥ 8 wheels then 25% driven	Not Addressed	Not Addressed	Not required by specification
Meet CMAA drive arrangement	Not Addressed	12.1.10 meets CMAA	Not required by specification
4.9 Shafts			
With Gears			
Machined at bearing and gear fits	Not Addressed	Not Addressed (See Note 6)	Not required by specification
Meet spacing requirment	Not Addressed	Not Addressed (See Note 6)	Not required by specification
Without Gears			
Commercial Grade	Not Addressed	Not Addressed - meets CMAA	Not required by specification
All			
Torsional deflection	Not Addressed	Not Addressed (See Note 6)	Not required by specification
4.10 Couplings			
Cross shaft couplings shall be steel or A-48-64 CI or equal as specified by manufacturer	Not Addressed	Not Addressed so specified by manufacturer - meets CMAA	Not required by specification
Couplings to be compression, sleeve, or flange type	Not Addressed	12.3 meets CMAA	Not required by specification

CMAA	ANSI	Specification	EOCI
4.10 Couplings (Cont.)			
Flexible couplings to be manufacturer's standard	Not Addressed	12.3 meets CMAA	Not required by specification
Coupling required at each end of truck and each side of motor gear reducer	Not Addressed	12.3 meets CMAA	Not required by specification
Motor couplings by manufacturer	Not Addressed	12.3 meets CMAA	Not required by specification
4.11 Wheels			
Double flanged with treads or equal	Not Addressed	12.1.8 meets CMAA	Not required by specification
Bridge wheels straight or tapered tread with large diameter to span center	Not Addressed	12.1.8 meets CMAA	Not required by specification
Trolley wheels straight tread	Not Addressed	Not Addressed	Not required by specification
Drive wheels matched pairs	Not Addressed	Not Addressed	Not required by specification
Flangeless wheels per manufacturer	Not Addressed	12.1.8 not applicable	Not required by specification
Rolled or forged steel or acceptable CI	Not Addressed	12.1.8 meets CMAA	Not required by specification
No undue wear	Not Addressed	12.1.8 per EOCI 61	meets CMAA

CMAA	ANSI	Specification	EOCI
4.11 Wheels (Cont.)			
Wheel loads	Not Addressed	12.1.8 per EOCI 61	meets CMAA
Flange to rail head clearance	Not Addressed	Not Addressed	Not required by specification
Taper tread for bridge clearance	Not Addressed	Not Addressed	Not required by specification
Rotating wheels may be press fit, key fit or both	Not Addressed	12.1.4 meets CMAA	Not required by specification
All hubs should be thick enough for keys	Not Addressed	Not Addressed	Not required by specification
4.12 Bumpers and Stops			
Bridge			
Provide except if bridge not operated near ends of travel	2-1.8.2 meets CMAA	12.1.7 meets CMAA	Not required by specification
Stop bridge at less than 3 ft/s/s at 20% speed; at 40% speed capable of stopping crane	2-1.8.2 meets CMAA	Not Addressed	Not required by specification
No direct shear on bolts	2-1.8.2 meets CMAA	Not Addressed	Not required by specification
Rigidly mounted	2-1.8.2 meets CMAA	Not Addressed	Not required by specification

CMAA	ANSI	Specification	EOCI
4.12 Bumpers (Cont.)			
No damage to parts with full compression of bumper	Not Addressed	Not Addressed	Not required by specification
Bumper height by manufacturer	Not Addressed	Not Addressed so meets CMAA	Not required by specification
Purchaser to provide runway stops with sufficient attachment	Not Addressed	Not Addressed	Not required by specification
Runway stops should not engage wheel tread	Not Addressed	Not Addressed	Not required by specification
Trolley			
Provide except if trolley not operated near ends of travel	2-1.8.3 meets CMAA	12.1.7 meets CMAA	Not required by specification
Stop trolley (without load) at less than 4.7 ft/s/s at 1/3 rated speed	2-1.8.3 meets CMAA	Not Addressed	Not required by specification
Bumpers to be rigidly mounted	2-1.8.1 meets CMAA	Not Addressed	Not required by specification
Bolts not to be in shear	2-1.8.3 meets CMAA	Not Addressed	Not required by specification
Provide trolley stops at end of travel	2-1.8.1 meets CMAA	12.1.7 meets CMAA	Not required by specification
Not Addressed in CMAA	2-1.8.3 Stops to stop trolley from 50% rated speed	Not Addressed	Not required by specification

CMAA	ANSI B30.2	Specification C-42
5.1 General		
Comply with Art. 610 of N.E.C. (Cranes and Hoists)	2-1.10.1 meets CMAA	5.1.4 requires NEMA, ASA, NEC and Nat. Board of Fire Underwriters
5.2 Motors, AC and DC		
30 Minute basis minimum with temperature rise per NEMA	Not addressed	105.7 of CC-100 Attachment to Spec. meets CMAA
Anti-friction bearings required	Not addressed	13.2.2 meets CMAA
A.C. Wound rotor motor - NEMA or mfgr. standard motor secondary data	Not addressed	13.2.1 meets CMAA
Capable of + 10% rated voltage	Not addressed	105.8 of CC-100 Attachment to Spec. requires only +10%
Minimum motor time rating/ Insul. Class (T., Bldg. Main Cr) 30 min/ CLB (Mag. control, mech. brk.) (others) 30 min./ CLB (Mag. elect. cont. brk)	Not addressed	105.7 of CC-100 Attachment to Spec. meets CMAA
Squirrel cage shall be NEMA D unless otherwise specified by crane mfgr.	Not addressed	13.2.1 - All motors wound rotor induction
Rated voltage per code (CMAA)	Not addressed	105.8 of CC-100 Attachment to Spec. requires only + 10%

CMAA	ANSI B30.2	Specification C-42
5.3 Motor Brake, AC and DC		
No added requirement over Mechanical	Agrees CMAA	12.5 meets CMAA
5.4 Controllers, AC and DC		
Control Systems		
Hoist control - plain reversing for use with mechanical brake	Not addressed	All brakes electrical
Mag. Control		
Contactors sufficient for start, stop, acceleration, reverse	Not addressed	13.4.7 and 13.4.8 meets CMAA
Minimum contactor as in CMAA table or as specified by mfgr.	Not addressed	By manufacturer - meets CMAA
Minimum contactor size shall be NEMA 1(AC) or NEMA 2 with next size main line contactor (DC)	Not addressed	5.1.4 requires NEMA, ASA, and NEC
Minimum number contactors for wound rotor and DC motors per table	Not addressed	5.1.4 requires NEMA, ASA, and NEC
Multi-motor drive contactors per section 5.4.5.7	Not addressed	5.1.4 requires NEMA, ASA, and NEC
Static Controls	Not addressed	13.4.7 and 13.4.8 require magnetic controls, therefore not required

CMAA	ANSI B30.2	Specification C-42
5.4 Controllers, AC and DC (Cont.)		
Control Panels to be enclosed	2-1.10.1 meets CMAA	13.4.11 and 13.4.13 meets CMAA
5.5 Resistors		
Resistors not in permanent sections - thermal capacity Class 150	Not addressed	13.4.18 meets CMAA (Class 92 in permanent sections)
Resistors on elect. braking system on hoists w/o mechanical load brakes Class 160	Not addressed	13.4.18 meets CMAA (Class 92 in permanent sections)
Proper first point stalled torque	Not addressed	13.4.7 and 13.4.8 meets CMAA
Adequate ventilation; installation to withstand vibration	2-1.10.4 meets CMAA	13.4.8 meets CMAA
	2-1.10.4 prevent loss of broken parts	13.4.18 meets CMAA
	2-1.10.5 if resistors enclosed, install to prevent combustible material accumulation	13.4.18 meets CMAA
5.6 Protection		
Lockable motor rated disconnect in leads from main runway conductors	2-1.10.5 lockable, accessible disconnect required. No rating indicated	13.4.7 meets CMAA

CMAA	ANSI B30.2	Specification C-42
5.6 Protection (Cont.)		
If no spring-return/momentary contact pushbuttons - motor disconnect from line or loss of power; no restart w/o reset	2-1.10.3A meets CMAA	13.4.2 and 13.4.4 require spring-return pushbuttons
Under voltage protection, if required	2-10.5 meets CMAA	13.4.17 meets CMAA
Disconnect's continuous 8 hr. current rating to be 50% of combined short time motor full load currents and 75% of sum of short time full load currents of motors required for single load crane	Not addressed	5.1.4 requires NEMA, ASA, and NEC
Overload relays provided on two phases on AC or one inverse time element overload provided on DC	2-1.10.1 per NEC Article 610	13.4.17 meets CMAA
Line contactor w/each motor control of DC cab oper. cranes	2-1.10.5b meets CMAA	13.4.17 meets CMAA
On radio control, loss of signal to stop crane	2-1.10.3j meets CMAA	13.4.5 and 13.4.6 meet CMAA
On automatic cranes, motion to fail safe	2-1.10.3i meets CMAA	Not applicable
Elect. safety features per ANSI B30.2	As discussed in this listing	As discussed in this listing

CMAA	ANSI B30.2	Specification C-42
5.7 Cab Master Switches		
Arrangement per CMAA sketch Sketch 5.7 indicates client preference is governing	2-1.10.3e requires arrangement per figures 2 & 3 which agree with CMAA arrangements	13.4.2 and 13.4.4 meet CMAA and intent of figures
5.8 Floor Operated Pendant Push button Stations		
Pushbutton arrangement in specified order	2-1.10.3k meet CMAA	Not discussed
Stop pushbuttons to be red	Not discussed	Not discussed
Grounding conductor between station and crane	2-1.10.1e meets CMAA	5.1.4 requires CMAA, ASA, and NEC
Conductor strain relief	2-1.10.1d meets CMAA	5.1.4 requires CMAA, ASA, and NEC
P.B. spring return to off	2-1.10.3g+h meet CMAA	13.42 meets CMAA
Max. voltage in pendant = 150VAC or 300VDC	2-1.10.1c meets CMAA	5.1.4 requires CMAA, ASA, and NEC
5.9 Hoist Limit Switch		
Restrict up movement by power removal and by applying holding brake	2-1.10.5d meets CMAA	13.4.10 requires switch to interrupt hoist power, EOCI 61 requires holding brake application on hoist power interrupt - meets CMAA
Interruption shall not restrict lowering	2-1.10.5d meets CMAA	13.4.10 meets CMAA
Lowering resets limit switch	Not addressed	13.4.10 meets CMAA
No CMAA requirement	2-10.5e recommends lower travel limit switch	13.4.10 meets ANSI

CMAA	ANSI B30.2	Specification C-42
5.10 Installation		
Protection of operator from live parts	2-1.10.2 meets CMAA	5.14 specifies installation per NEMA, ASA, NEC and National Board of Fire Underwriters. 13.3.3 meets CMAA
Elect. equipment accessible and protected from environs	2-1.10.2 meets CMAA	13.3.3, 13.4.2, 13.4.9, 13.4.10, 13.4.11, 13.4.12, 13.4.14, and 13.4.18 meet CMAA
Heat Shields as required by Purchaser	Not addressed	As required above
5.11 Bridge Conductors		
Manufacturer to determine type of conductor	2-1.10.2 requires type to prevent personnel contact	13.3.1 meets CMAA 13.3.3 meets ANSI
5.12 Runway Conductors		
Furnished and installed by purchaser	Not addressed	3.0 meets CMAA
Specification of crane to identify type of conductor to be used	Not addressed	13.3.4 bidders to recommend containment crane conductor arrangement

CMAA	ANSI B30.2	Specification C-42
5.12 Runway Conductors (Cont.)		
No CMAA requirement	2.10.6 requires open type installation to prevent personnel contact	
5.13 Voltage Drops		
Purchaser to specify actual voltage available at supply taps	2-1.10.1 requires NEC	13.1 meets CMAA
With associated voltage through equipment, motors shall operate as required. Consider all associated motors running and crane handling rated load	2-1.10.1 requires NEC	105.8 of CC-100 attachment to spec specifies + 10;-0% of full voltage for motor design. Motor operating combinations Not discussed

MAJOR PLANT CRANE REVIEW

Notes

1. Impact allowances used in calculation are as follows. Designs were found to be acceptable based on these values:

Polar Crane	- 15% of rated capacity
Turbine Bldg. Main Crane	- 15% of rated capacity
Turbine Bldg. Aux. Crane	- 15% of rated capacity
Intake Structure Crane	- 15% of rated capacity
Spent Fuel Crane	- 15% of rated capacity

2. Polar Crane short stiffener bearing stress exceeds CMAA requirement of 26.4 ksi. Further analysis indicates that this will not impair overall crane performance i.e., box girder is not adversely affected.

3. In all cranes, longitudinal stiffeners are placed lower than CMAA requires. In addition, the moment of inertia of these stiffners does not meet CMAA requirements in three cases. This reduces the allowable web plate compressive stress. Calculations indicate that stress values are within the limits of the reduced allowables. In addition, the effectiveness of the longitudinal stiffeners is judged to be acceptable for continued operation.

4. Drawing review indicates latches supplied on all hooks.

5. Calculations indicate rope safety factors meet CMAA requirement.

6. Insufficient data available on drawings to allow evaluation of this item. Vendor data not obtained - reference Conference Notes 769.

7. Calculations indicate all cranes meet CMAA.

8. All cranes furnished by Whiting Corporation.

9. This review was based solely on purchase documents, approved drawings, and various correspondence. Equipment condition was assumed to be as originally furnished. No physical inspections were performed to further verify existing conditions.

REVIEW OF SPECIAL LIFTING DEVICES

AGAINST ANSI N14.6

Compliance Status of Neutron Shield Lift Rig

Assembly	Part	Stress Design Factor (See Note 4) Max Tensile Stress w/yield	w/ult.	Max Shear Stress w/yield	w/ult.	Comments (See Note 2)
Lift Assembly	Eyebar	3	5.85	19.8	38.5	S
	Spreader Bar	6.65	12.94	-	-	S
	Weld Connection	-	-	36	70.5	S

Compliance Status of Closure Head Lift Rig

Assembly	Part	Stress Design Factor (See Note 4) Max Tensile Stress w/yield	w/ult.	Max Shear Stress w/yield	w/ult.	Comments (See Note 2)
Lifting Eye Assembly	Eyebar	6.46	12.56	5.45	10.6	S
	Shank	3.33	5.36	5.05	9.82	S
	Pin	-	-	13.5	16.1	S
	Lug	6.04	11.75	6.04	11.75	S
Lifting Rod Assembly	Pin	-	-	16.6	20.1	S
	Clevis	4.72	8.2	5.03	9.8	S
	Lifting Rod	12.6	14	-	-	S
Link Assembly	Recessed Pin	-	-	23.5	28.5	S
	Clevis	10.34	33.02	10.34	20.1	S
	Strut	4.97	9.65	-	-	S
	Lower Lift Lug	6.27	12.2	6.27	12.2	S
	Pin	11.3	13.7	23.5	28.5	S
Connection to Reactor Head	Bolt	10.2	11.4	-	-	S
	Internal Threads	-	-	20.15	32.2	S
	Shroud Flange	-	-	42.03	81.73	S
	Lift Lug	-	-	20.15	32.2	S
Closure Stud Tensioner System:						
Pipe Girder Assembly	Pipe	3.04	6.09	35	70	S
	Lug	-	-	9.23	17.95	S
	Upper Pin	-	-	19.1	19.1	S
	Hoist Hanger	10.3	20	25.7	50	S
	Hoist Bracket	-	-	8.8	17.07	S

Compliance Status of Closure Head Lift Rig (Cont.)

Stress Design Factor (See Note 4)

Assembly	Part	Max Tensile Stress w/yield	Max Tensile Stress w/ult.	Max Shear Stress w/yield	Max Shear Stress w/ult.	Comments (See Note 2)
Box Girder Assembly	Bolt	5.15	5.15	-	-	S
	Int. Threads	-	-	4.56	8.86	S
	Support Beam	4.38	8.52	-	-	S

Compliance Status of Upper Guide Structure Lift Rig

Stress Design Factor (See Note 4)

Assembly	Part	Max Tensile Stress w/yield	Max Tensile Stress w/ult.	Max Shear Stress w/yield	Max Shear Stress w/ult.	Comments (See Note 2)
Wrench Assembly	Pick-up Bolt	5.10	5.71	-	-	S
	Bolt Threads	-	-	41.5	46.3	S
Column Assembly	Round Tube	6.23	15.6	-	-	S
Spreader Assembly	Channel	3.02	7.55	-	-	S
Tie Rod Assembly*	Upper Yoke	9.12	22.8	-	-	S
	Pin	9.2	10.3	-	-	S
	Tie Rod	6.12	6.8	-	-	S
	Block	8.74	21.9	-	-	S

*This item transferable to the Core Support Barrel Lift Rig

Compliance Status of Instrumentation Plate Hoist Assembly

Stress Design Factor (See Note 6)

Assembly	Part	Max Tensile Stress w/yield	Max Tensile Stress w/ult.	Max Shear Stress w/yield	Max Shear Stress w/ult.	Comments (See Note 2)
Sling Assembly	Link	-	-	4.3	10.76	S
	Slings	-	2.46	-	-	ANSI B30.9 Recommended a F.S. of 5
	Bar	-	-	22.6	56.6	S
Pick-up Assembly	Pick-up Bolt	5.03	5.62	-	-	S
	Tube	9.1	22.7	-	-	S
	Bar	3.66	9.16	-	-	S

Compliance Status of Filter Cask Lift Rig

Stress Design Factor (See Note 6)

Assembly	Part	Max Tensile Stress w/yield	w/ult.	Max Shear Stress w/yield	w/ult.	Comments (See Note 2)
Lifting Eye Assembly	Lifting Shackle	-	3.65	-	-	N
	Plate	3.18	6.18	17.14	33.33	S
	Tube	19.6	38	-	-	S
Spreader Beam		8.91	17.3	-	-	S
Lift Lug		7.35	14.3	-	-	S

Compliance Status of Reactor Seal Ring Lift Rig

Stress Design Factor (See Note 6)

Assembly	Part	Max Tensile Stress w/yield	Max Tensile Stress w/ult.	Max Shear Stress w/yield	Max Shear Stress w/ult.	Comments (See Note 2)
Spreader Beam Assembly	Spreader Beam	N/A	N/A	-	-	N, A
	Eyebar	16.63	32.33	-	-	S
	Bolt	-	-	60	77.8	S
	Weld Connection	-	-	5.53	10.7	S
Lower Leg	Single Rope	-	6.88	-	-	Complies with ANSI B30.9
	Bridle Sling	-	5.56	-	-	Complies with ANSI B30.9

Compliance Status of Core Support Barrel Lift Rig

Stress Design Factor (See Note 4)

Assembly	Part	Max Tensile Stress w/yield	Max Tensile Stress w/ult.	Max Shear Stress w/yield	Max Shear Stress w/ult.	Comments (See Note 2)
Wrench Assembly	Pick-up Bolt	3.86	4.3	-	-	N
	Bolt Threads	-	-	15.93	17.8	S
Column Assembly	Round Tube	2.6	6.53	-	-	N
Spreader Assembly	Channel	4.2	10.52	-	-	S
Lifting Shackle	Pin	-	-	5.52	6.17	S
	Shackle Plate	6.03	15.08	-	-	S
	Shank	10.91	27.3	-	-	S
	Lug	6.5	15.15	-	-	S
Tie Rod Assembly*	Upper Yoke	4.07	10.17	-	-	S
	Pin	4.13	4.62	-	-	N
	Tie Rod	2.72	3.04	-	-	N
	Block	3.9	9.74	-	-	S

Note: Evaluation of this rig not required under NUREG as lift of the Core Support Barrel is performed with fuel removed from vessel. Review performed for information only.

*This item transferable to the Upper Guide Structure Lift Rig.

Review of Special Lifting Devices

Against ANSI N14.6

Notes:

1. Evaluations were based on latest design drawings and original equipment condition.

2. Under comments heading the following symbols are used:

   * S = Meets ANSI N14.6 Section 5.3.2.1.1
     N = Does not meet ANSI N14.6 as underlined, but satisfactory for continued use
   N/A = ANSI N14.6 Not applicable

3. The following dynamic load factors are included in the tabulated results:

A.	Closure Head Lift Rig	- 0.5
B.	Upper Guide Structure Lift Rig	- 0.3
C.	ICI Plate Hoist Assembly	- 0.3
D.	Filter Cask Lift Rig	- 0.3
E.	Seal Ring Lift Rig	- 0.3
F.	Core Support Barrel Lift Rig	- 0.3

4. Stress design factor required is a minimum of 3 for yield and 5 for ultimate. Evaluation criteria for all devices is based on normal design as the crane design is not based on single-failure-proof criteria.

Review of Plant Monorail
vs. ANSI B30.11

(Specifications M-391 and M-395)

Monorails

ANSI B30.11		Specifications
11-1.3	General Construction	
11-1.3.1	Crane Runways and Monorail Tracks	
	a. Designed to withstand loads and forces from cranes and carriers.*	Specs meet ANSI
	b. Free from detrimental vibrations.	Not specified
	c. Splices at surface and sides of load carrying flange.	Not specified
	d. Track spaced to be compatible with crane span and design.	Not specified
	e. Provide stops at ends of carrier travel and at open ends of track. Stops designed to resist impact of carrier or crane at full load traveling at normal walking speed or at 50% load at full speed, if powered.	Specs require stops to be provided to withstand full load at of 20% of rated speed (20% of 40 f.p.m. - 8 f.p.m.)
	Track Supports	
	a. Track fastened to supporting structure.	Specs meet ANSI
	b. Track support and fastening devices designed for carrier or crane loads and forces.	Specs meet ANSI
	c. Consider unequal loads in multiple rod hangers.	Specifications require suitable support
	d. Provide restraint against lateral and longitudinal movement.	Specifications require suitable support
	e. If track suspended from hanger rods provide lock nuts.	Not specified

*Verified by calculation

11-1.3.1 Track Supports (Cont.)

f. Track and supports should meet AISC or ANSI B30.11, 1973.

Specifications issued prior to 1973 - require commercial practice.

Welded Construction

Welding should meet ANSI D14.1-70 or D1.1-80

Specs require Commercial practice - Weld inspections per ASME Section IX

11-1.4 Track Switches, Openers, and Interlocks

Switches

Specs require commercial practice

a. Construct to maintain alignment Locate control within reach of operator.

b. Provide integral stops.

c. Provide means of preventing carrier from running of movable track when not engaged.

d. Provide means to hold movable track stationary.

e. Provide electric baffle if cab control or auto dispatch carriers.

Openers

Specs require commercial practice

Provide stops at open ends of track.

Interlocks

Specs require commercial practice

a. Interlocks shall remain in alignment during use.

b. Stops shall be provided integral with the interlock mechanism.

11-1.5	Vertical Drop of Lift Sections (Applicable to M-391 only)	4.7 requires latest codes and manufacturers standard
	a. Sections shall remain in alignment during use.	4.7 meets ANSI
	b. Provide means to prevent carrier from leaving end of section when not in alignment with stationary tracks.	4.7 meets ANSI
	c. Provide stops at open ends.	4.7 requires stops or safety forks
	d. Provide carrier baffle if cab control or auto dispatch carrier	Not applicable
11-1.6	Cabs	Not applicable
11-1.7	Guards and Lugs	
	Guards for Hoisting Ropes	
	1. Provide guards where rope fouling possible.	Specs require commercial practice
	2. Provide guard if rope can contact conductors.	Specs require commercial practice
	Lugs	
	Provide means to limit end truck drop height. Locate on both sides of track.	Specs require commercial practice
11-1.8	Brakes	
	Hoisting Brakes	
	Brakes shall meet ANSI B30.11	Not specified
	Brakes for bridge and carrier travel (cab operated).	Not applicable

11-1.8 Brakes (Cont.)

Brakes for power operated bridges and carriers (floor and remote operated) - if provided.	Specs require commercial practice
1. Brakes shall stop carrier or bridge within distance equal to 10% of rated load speed when traveling at full speed and load with power off.	Specs require commercial practice
2. Parking brakes shall not prohibit use of drift point.	Specs require commercial practice
3. Provide adequate thermal capacity	Specs require commercial practice

Brake Application

Travel brake not required if brakes meet stopping criteria above. Provide travel brake otherwise.	Specs require commercial practice

11-1.9 Electrical Equipment

General

a. Wiring shall meet NEC Article 610.	Specs require commercial practice
b. Control voltage shall not to exceed 600VAC or VDC.	Specs require commercial practice
c. Voltage at pendant station not to exceed 150 VAC or 300 VDC.	Specs require commercial practice
d. Use strain protection on multiple conductor cable at pendant.	Specs require commercial practice
e. Prevent electrical shock at pendant station.	Specs require commercial practice

11-1.9 Electrical Equipment (Cont.)

Equipment		
a.	Prevent inadvertant contact with live parts.	Specs require commercial practice
b.	Protect live parts from grease, oil, dirt, and moisture.	Specs require commercial practice
c.	Prevent guard deformation near live parts.	Specs require commercial practice
Controls - Floor Operated (other N/A)		
a.	Controllers, if rope operated shall return to "off" automatically on release.	Specs require Pendant control
b.	On release, pushbuttons shall return to "off".	Specs require commercial practice
c.	Meet specified pendant arrangement.	Specs require commercial practice
Resistors		
a.	Support to minimize vibration.	Specs require commercial practice
b.	Prevent release of broken parts.	Specs require commercial practice
c.	Enclosures, if provided, shall prevent combustible material accumulation.	Specs require commercial practice
Switches		
a.	Power shall be switch or circuit breaker controlled and shall be accessible.	Specs require commercial practice

11-1.9	Electrical Equipment (Cont.)		
	b.	Conductor leads shall have a switch or circuit breaker capable of being locked open. Mount on bridge.	Specs require commercial practice
	c.	Provide disconnect for above either non-conductive rope or under voltage trip switch or main line contactor.	Specs require commercial practice
	d.	Hoist over travel per ANSI B30.16	Specs require commercial practice
	Conductors		
		Prevent inadvertant contact by personnel.	Specs require Commercial practice
11-1.10	Hoist		
		Hoist to meet ANSI B30.16	Capacity per Monorail Manufacturer's Association Standard - otherwise commercial practice

EVALUATION OF MONORAILS AND UNDERHUNG CRANES

	Monorail	S.F. Over Ult. Strength	Acceptability For Operation (Yes or No)
1.	6-T Jib Crane for Transfer Carriage	8.54	Y
2.	10-T Monorail in Switchgear Room	4.41	Y
3.	5-T Machine Shop Crane	4.38	Y
4.	Main Steam Room Monorails	3.08	Y
5.	Diesel Generator Room 10-T Monorail	3.75	Y
6.	15-T Monorail (Equip. Hatch)	2.41	N
7.	7½-T Filter Cask Monorail	3.8	Y

Notes:

1. Items 2 through 7 have been deleted from NUREG-0612 scope under Phase II (9 month submittal).
2. Items 1 through 5 were purchased under M-395. Items 6 and 7 were purchased under M-391.
3. M-395 requires structural design per EOCI.
4. The above safety factors (S.F.) were determined including a 15% impact factor.
5. Acceptability for operation is based on design S.F. equaling or exceeding 3.0.
6. The above monorails were evaluated during the Phase I review. This in not intended to be a complete listing of plant monorails and underhung cranes.
7. The review reflected in these tables was limited during the course of the Phase I submittal preparation to the above calculations and review of the standards.