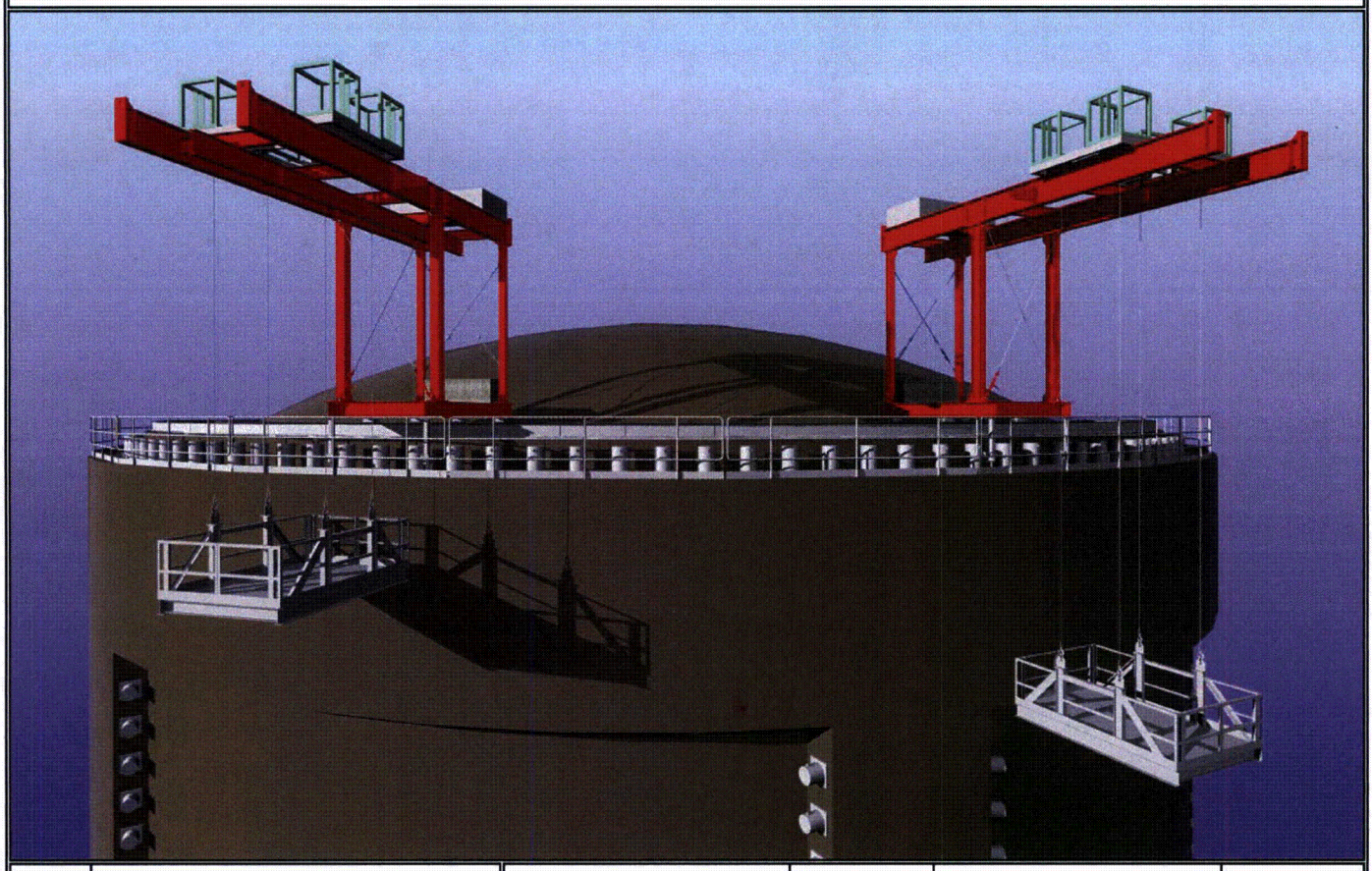
FM 8.4 Exhibit 1

DOCUMENT COVER SHEET

Document No: CR-1002-500

Title: PRE–SURVEILLANCE ENGINEERING PACKAGE



No.	Description	Prepared By	Date	Reviewed By	Date
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REVISIONS

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1.0 PURPOSE

1.1 SURVEILLANCE PURPOSE

1.1.1 The purpose of the Tendon Surveillance Program is to demonstrate the integrity of the containment post-tensioning system, including containment tendons, tendon end anchorage hardware; general and adjacent concrete integrity, and evaluation of the corrosion protective (grease) system. Individual inspections of selected tendons, as well as tendon wire and grease sample testing evaluate the overall integrity of the post-tensioning system.

1.2 DOCUMENT PURPOSE

1.2.1 The purpose of this document is to provide the engineering data and evaluations necessary to perform surveillance related activities. The scope of this document addresses:

1.2.1.1 The scope of work for the 8th period (30th Year) Tendon Surveillance

1.2.1.2 Predicted forces and normalization factors for selected scope tendons as well as the tendons adjacent to the ones selected. The predicted forces are used to accept as-found force levels if they are within the outlined acceptance criteria.

1.2.1.3 Tendon retensioning elongation tendon for all tendons scheduled to be detensioned for wire removal. The retension data is used to compare the elongation data obtained while restoring the tendon's force to the elongation that was observed while originally stressing the tendon in order to assure the force has been properly restored.

1.2.1.4 Grease void volumes for selected surveillance tendons and their respective adjacent tendons. The volumes allow IWL Level II Inspectors to document the percentage of the total void volume that is removed during inspection and replaced upon completion. This documentation is required per IWL-2526. If the absolute difference between the subject amounts exceeds 10% of the net duct volume, the Licensee shall report the conditions as required by 10CFR50.55a.

1.2.1.5 The design of the support frames and work platforms, which will be used to access hoop and dome tendons in order to assure their ability to withstand working and natural loadings.

1.2.1.5.1 The platform and the Upper Support Frame have been designed for both lateral and vertical loads by analyzing various loading conditions with RISA-3D Version 5.5. RISA-3D calculates both the force and stress in each individual member with respect to the member size designation. The entire system has been designed in accordance with AISC 9th Ed. ASD.

2.0 REFERENCES

2.1 REFERENCE DOCUMENTS

2.1.1 Crystal River Unit 3 Final Safety Analysis Report (FSAR), latest revision

2.1.2 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components", 1992 Edition, with 1992 Addenda.

2.1.3 NRC Regulatory Guide 1.35, Revision 3. Dated July 1990, "Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containment"

2.1.4 Code of Federal Regulation 10 CFR 50.55a

2.1.5 AISC Manual of Steel Construction – Allowable Stress Design, 9th Edition.

2.1.6 ASCE Standard SEI/ASCE 7-02 – Minimum Design Loads for Buildings and Other Structures, 2nd Edition.

2.1.7 ASME Standard A120.1-2001 – Safety Requirements for Powered Platforms for Building Maintenance

2.1.8 PSC Engineering Document E-GEN-500 – Rail Clamp Capacity Test

2.1.9 PSC Engineering Document CR-N991-100, "Predicted Base Forces For The 30th Year Containment IWL Inspection"

2.1.10 PSC Engineering Document CR-N1002-010, "SQ 11.1 Restressing"

2.1.11 PSC Engineering Document CR-N1002-010, "SQ 12.1 Grease Void Volumes"

2.1.12 PSC Engineering Document CR-N1002-100, "Upper Support Frame Set Position Design"

2.1.13 PSC Engineering Document CR-N1002-101, "Upper Support Frame Moving Position Design"

2.1.14 PSC Engineering Document CR-N1002-102, "Work Platform Design"

2.2 REFERENCE DRAWINGS

2.2.1 S – 425 – 001 IWE/IWL Inspection Concrete Layout 0° to 180°

2.2.2 S – 425 – 002 IWE/IWL Inspection Concrete Layout 180° to 360°

2.2.3 S – 425 – 003 IWE/IWL Inspection Exterior Dome Layout

2.2.4 S – 425 – 004 IWE/IWL Inspection Vertical Tendon Layout

2.2.5 S – 425 – 005 IWE/IWL Inspection Hoop Tendon "13" Layout

2.2.6 S – 425 – 006 IWE/IWL Inspection Hoop Tendon "42" Layout

2.2.7 S – 425 – 007 IWE/IWL Inspection Hoop Tendon "53" Layout

2.2.8 S – 425 – 008 IWE/IWL Inspection Hoop Tendon "64" Layout

2.2.9 S – 425 – 009 IWE/IWL Inspection Hoop Tendon "51" Layout

2.2.10 S – 425 – 0010 IWE/IWL Inspection Hoop Tendon "62" Layout

2.2.11 S – 425 – 0011 IWE/IWL Inspection Dome Tendons Layout – Plan

2.2.12 S – 425 – 0012 IWE/IWL Inspection Dome Tendons Layout – Elevation

2.2.13 S – 425 – 0020 IWE/IWL Inspection Tendon Detail

2.2.14 SC – 421 – 041 Reactor Building Ring Girder Concrete Outline – Plan and Sections

3.0 BACKGROUND

3.1 CONTAINMENT ARRANGEMENT

3.1.1 The Crystal River Unit 3 containment building is a post-tensioned and reinforced concrete structure comprised of a vertical cylinder with a hemispherical dome roof, and is supported on a conventional reinforced concrete foundation slab.

3.1.2 The containment structure post-tensioning system provides sufficient external pressure load on the containment structure to balance the internal pressure of the structure as well as the design basis accident internal containment pressure.

3.1.3 The containment post-tensioning system consists of:

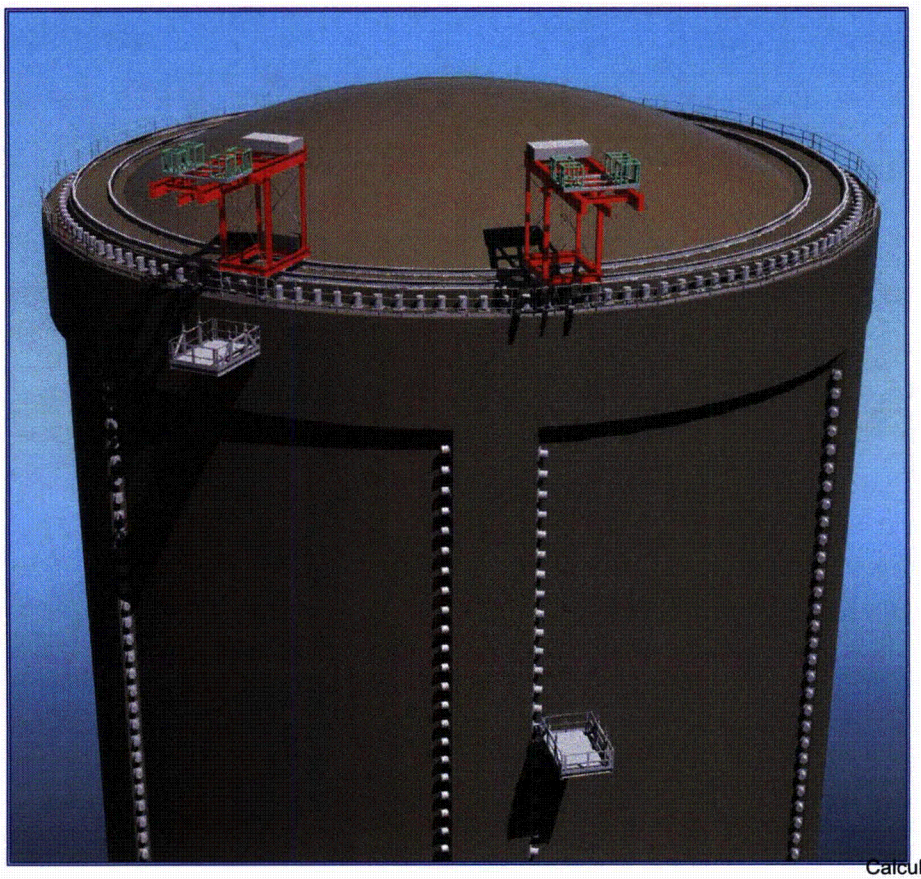
3.1.3.1 Approximately 144 vertical tendons in the cylinder wall anchored at the top surface of the ring girder and at the bottom of the base slab;

3.1.3.2 Approximately 282 hoop tendons in the cylinder wall anchored alternately at 120 degrees to each other. Each tendon encloses 120 degrees of arc and is anchored at two of the six vertical buttresses.

3.1.3.3 Three groups of 41 dome tendons (total 123 tendons) alternately oriented at 120 degrees to each other and anchored at the vertical face of the ring girder;

3.1.4 Each tendon consists of nominally 163 7mm diameter high strength low relaxation wires with buttonhead anchorages. The tendons are housed in individual spirally wrapped, corrugated, thin wall sheet metal sheathing connected to a steel bearing plate and trumplet at each end. The sheathing is cast into the containment structure concrete walls and dome. The tendons are capped at each anchorage with a sheathing filler cap and the tendon sheathing and caps are filled with corrosion preventing grease.

FIGURE 1: TYPICAL SURVEILLANCE SETUP



3.1.5 Inspection Equipment

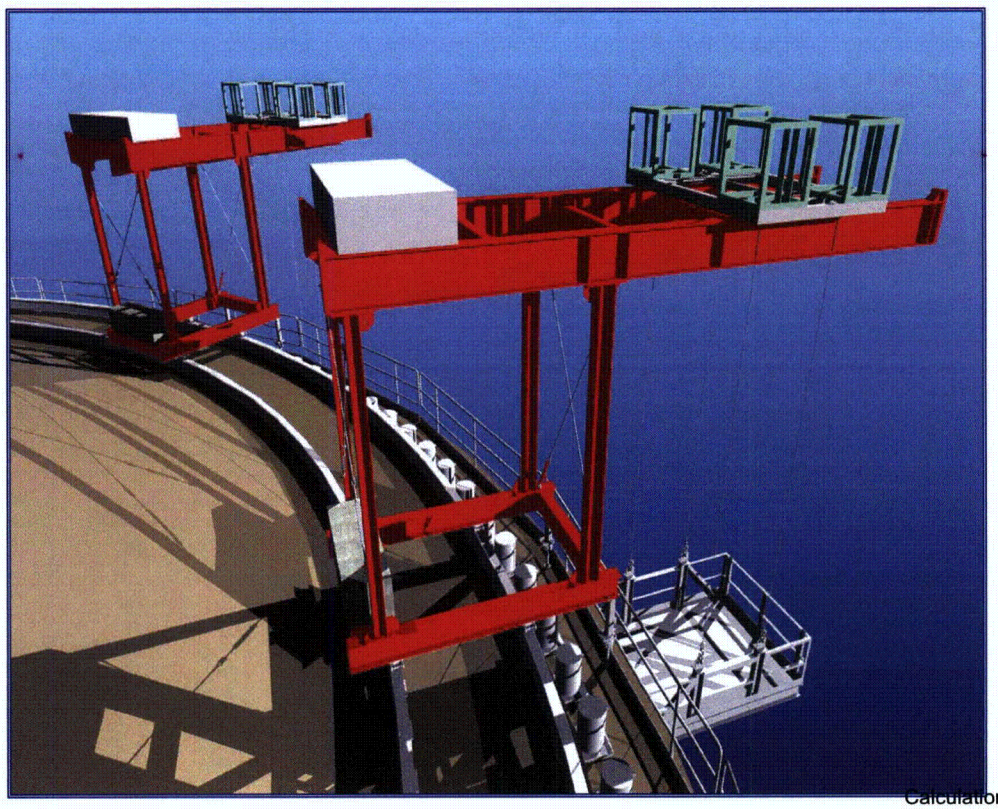
3.1.5.1 In order to perform the work required, PSC will supply the following equipment in order to perform the inspection activities. This list is for information only and equipment may be added or subtracted as needed.

1400 Ton Hydraulic Rams	Heise Digital Hydraulic Gauge	55 gallon empty drums
Jack Chairs	Misc. Electrical Transformers	110 volt electric cable
High Pressure Hydraulic Pumps	Tractel Motor Assemblies	480 volts electric cable
Jack chair extensions	2 Ga. OTC pump	Buttonhead puller
163 wire stressing adapters	Jib supports	Smooth wire puller
Pull rods with nuts	Hydraulic wire puller	Surveillance tool trailer
Inspection platforms (2)	1" diameter guide pins	Grease can plugs
Upper Support Frames (2)	1" diameter eye bolts	Graco grease pump
5 ton electric chain hoists (2)	Trolleys	Grease hose 1½" x 50'
Spider baskets/platforms	1½" diameter brass shut-off valves	55 gallon drum heater
Hydraulic hoses - 20' long	Shop and field pulling caps	Office Trailer
0-10000 psi Hydraulic Gauges	Anchorhead lifting ring	Mobile crane

3.1.6 Access Equipment

3.1.6.1 In order to access the hoop and dome tendons, two Upper Support Frames (hereafter referred to as USF) will be installed on the containment dome rails. Each USF will have a 5-Ton hoist running on a monorail to facilitate the positioning of the hydraulic stressing ram. A work platform will also be hung from each USF attached to four drive motors, which will raise and lower the platform into working position. The entire USF assembly will utilize rollers, which will allow it to travel circumferentially around the dome in order to access all selected tendons.

FIGURE 2: UPPER SUPPORT FRAMES INSTALLED ON CONTAINMENT DOME



3.1.6.2 The setup and design information for the Upper Support Frames and work platforms is included in section 8.0 of this document.

3.1.7 Stressing Equipment

3.1.7.1 In order to perform stressing activities on the selected tendons (i.e. monitoring tendon forces, detensioning, and retensioning) PSC will provide the required 1400-ton hydraulic ram setups. Each setup includes:

3.1.7.1.1 A calibrated hydraulic cylinder used for stressing, whose calibration is traceable to the National Institute of Standards and Technology (NIST).

3.1.7.1.2 A jack chair used to support the cylinder against the bearing plate as well as facilitate the removal and installation of stressing shims.

3.1.7.1.3 A pullrod/nut combination to convert the compressive force of the cylinder to a tensile force being applied to the tendon

3.1.7.1.4 A 163-wire stressing adapter to couple the pulling rod to each selected tendon's anchorhead.

3.1.7.1.5 A two stage high pressure hydraulic pump to power the cylinder

3.1.7.1.6 A calibrated field gauge for reading the pressure applied

3.1.7.2 Extreme caution shall be taken to ensure that the stressing adapter is fully engaged with the anchorhead in order to eliminate the potential for overstressing of the anchorhead threads.

4.0 SCOPE OF WORK

4.1 TENDON SELECTION REQUIREMENTS

4.1.1 The specific requirements for selection of the scope of work as well as specific requirements and acceptance criteria for the performance of the inspection for the 8th period (30th Year) Tendon Surveillance are defined by The Crystal River Technical Specifications, the Code of Federal Regulations 10 CFR 50.55a and ASME Section XI, Sub-Section IWL, define the specific requirements for selection of the inspection tendons.

4.2 TENDON SELECTION

4.2.1 Tendons were selected for the eighth surveillance period by Progress Energy Florida and distributed to Precision Surveillance Corporation. Tendons to be examined are selected on a random basis among the tendons that have not been examined during previous inspections, except for one tendon from each group, which is designated as the common tendon and is examined during each surveillance.

4.2.1.1 Eleven tendons were selected for this surveillance consisting of 5 hoop tendons, 3 vertical tendons, and 3 dome tendons. In addition to the eleven surveillance tendons, one tendon from each group (vertical, hoop, dome) was selected as an alternate. The alternate tendons will only be inspected in the event that one of the surveillance tendons is found to be inaccessible. Table 1 below lists the tendons selected for the current surveillance as well as the inspections that will be performed on each tendon.

4.2.2 In the event that the acceptance criteria are not met for a certain tendon, it may be necessary to inspect either one or both tendons adjacent to the selected tendon. The criteria and need for this inspection are outlined in the applicable governing codes (see references 2.1.2, 2.1.3, and 2.1.4) as well as the surveillance procedure. The adjacent tendons are listed in Table 2.

TABLE 1 : SCOPE OF WORK

CRYSTAL RIVER UNIT 3 – 30TH YEAR SURVEILLANCE SCOPE OF WORK												
		VISUAL					PHYSICAL					
TENDON	END	SQ6.0	SQ6.1	SQ7.0	SQ8.0	SQ8.3	SQ9.0	SQ10.2	SQ10.3	SQ11.0	SQ12.1	COMMENTS
12V01	D & G	●	●	●	●	●	●				●	COMMON, STEAM ZONE @ DOME
45V20	D & G	●	●	●	●	●	●				●	ORIGINAL SCOPE
61V17	D & G	●	●	●	●	●	●	●	●	●	●	DETENSION
34V17	D & G											ALTERNATE
13H36	BT. 1 & 3	●	●	●	●	●	●				●	
42H46	BT. 2 & 4	●	●	●	●	●	●				●	STEAM ZONE @ BT2
46H21	BT. 4 & 6	●	●	●	●	●	●				●	COMMON
51H34	BT. 5 & 1	●	●	●	●	●	●	●	●	●	●	DETENSION, STEAM ZONE @BT1
62H30	BT. 6 & 2	●	●	●	●	●	●				●	STEAM ZONE @BT 2
46H07	BT. 4 & 6											ALTERNATE
D129	BT. 3 & 5	●	●	●	●	●	●				●	STEAM ZONE @BT3
D212	BT. 1 & 3	●	●	●	●	●	●				●	COMMON
D238	BT. 4 & 6	●	●	●	●	●	●	●	●	●	●	DETENSION
D337	BT. 1 & 5											ALTERNATE

LEGEND

SQ 6.0 – GREASE CAP REMOVAL
SQ 6.1 – INSPECTION FOR WATER
SQ 7.0 – AQUIRE GREASE SAMPLES
SQ 8.0 – ANCHORAGE INSPECTION
SQ 8.3 – CONCRETE INSPECTION
SQ 9.0 – MONITOR TENDON FORCE
SQ 10.2 – TENDON WIRE INSPECTION
SQ 10.3 – TESTING TENDON WIRES
SQ 11.0 – RETENSION TENDONS
SQ 12.1 – GREASE REPLACEMENT

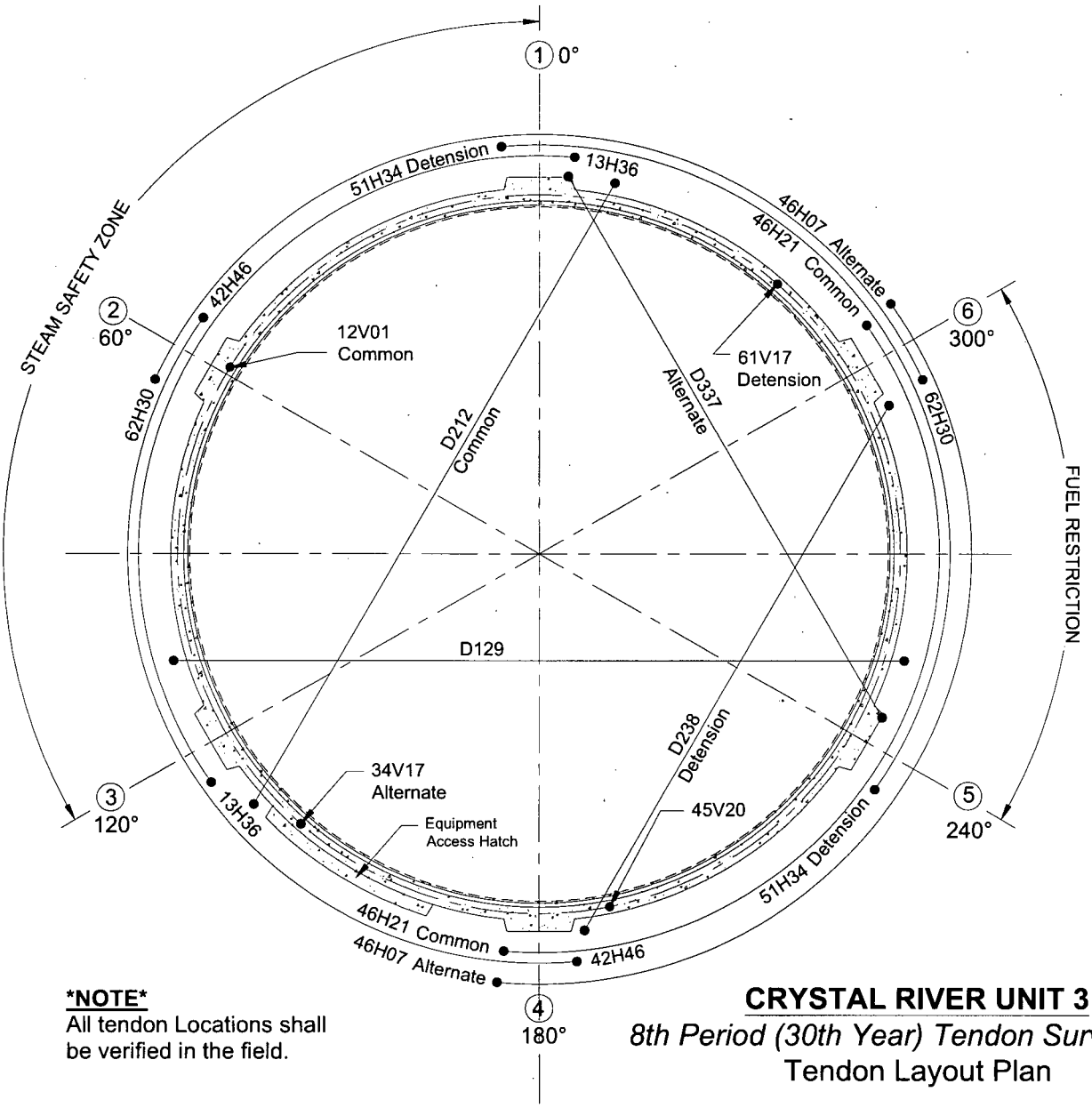
TABLE 2 : ADJACENT TENDONS

CRYSTAL RIVER UNIT 3 – 30TH YEAR SURVEILLANCE ADJACENT TENDONS						
TENDON	END	COMMENTS		TENDON	END	COMMENTS
61V24	D & G	ADJACENT		51H33	BT. 5 & 1	ADJACENT
12V02	D & G	ADJACENT		51H35	BT. 5 & 1	ADJACENT
45V19	D & G	ADJACENT		62H29	BT. 6 & 2	ADJACENT
45V21	D & G	ADJACENT		62H31	BT. 6 & 2	ADJACENT
61V16	D & G	ADJACENT		46H06	BT. 4 & 6	ADJACENT OF ALTERNATE
61V18	D & G	ADJACENT		46H08	BT. 4 & 6	ADJACENT OF ALTERNATE
34V16	D & G	ADJACENT		D128	BT. 3 & 5	ADJACENT
34V18	D & G	ADJACENT		D130	BT. 3 & 5	ADJACENT
13H35	BT. 1 & 3	ADJACENT		D211	BT. 1 & 3	ADJACENT
13H37	BT. 1 & 3	ADJACENT		D213	BT. 1 & 3	ADJACENT
42H45	BT. 2 & 4	ADJACENT		D237	BT. 4 & 6	ADJACENT
42H47	BT. 2 & 4	ADJACENT		D239	BT. 4 & 6	ADJACENT
46H20	BT. 4 & 6	ADJACENT		D336	BT. 1 & 5	ADJACENT
46H22	BT. 4 & 6	ADJACENT		D338	BT. 1 & 5	ADJACENT

4.3 TENDON LAYOUT

4.3.1 In order to properly locate the correct tendon in the field, layouts of the selected surveillance tendons as well as alternates have been performed. There is a plan and elevation view showing the tendons as well as surrounding buildings. The tendon layouts are shown below in Figures 3, 4 and 5.

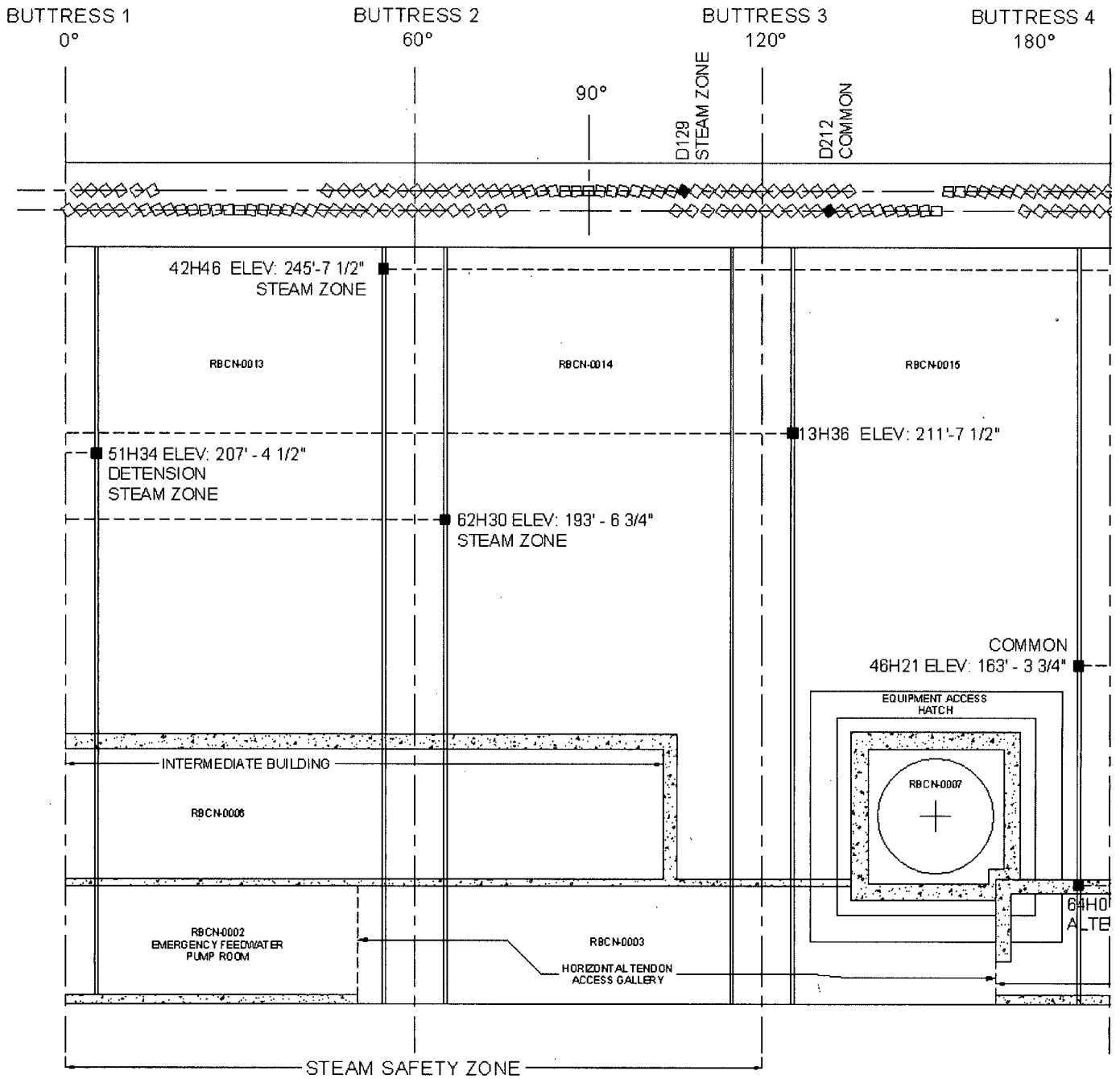
FIGURE 3: CR03 8TH PERIOD SURVEILLANCE – TENDON LAYOUT – PLAN



NOTE
All tendon Locations shall be verified in the field.

CRYSTAL RIVER UNIT 3
8th Period (30th Year) Tendon Surveillance
Tendon Layout Plan

FIGURE 4: CR03 8TH PERIOD SURVEILLANCE – TENDON LAYOUT – ELEVATION 0° TO 180°



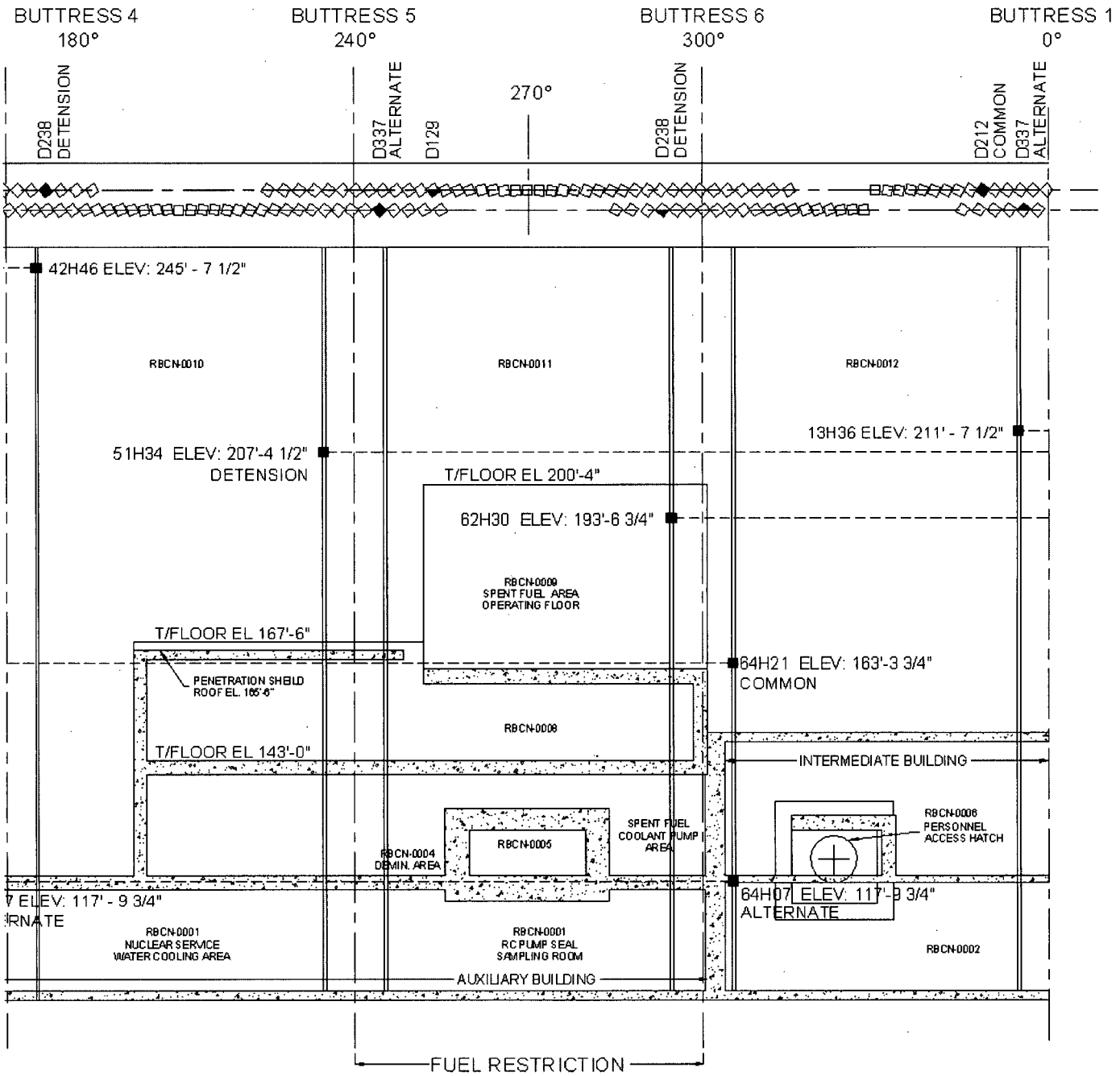
CRYSTAL RIVER UNIT 3

8th Period (30th Year) Tendon Surveillance

Tendon Layout Elevation - 0° to 180°

NOTE
All tendon Locations shall be verified in the field.

FIGURE 5: CR03 8TH PERIOD SURVEILLANCE – TENDON LAYOUT – ELEVATION 180° TO 360°



CRYSTAL RIVER UNIT 3

8th Period (30th Year) Tendon Surveillance

Tendon Layout Elevation - 180° to 360°

NOTE

All tendon Locations shall be verified in the field.

5.0 MONITOR TENDON FORCES

5.1 PERFORMING LIFT-OFF TESTING

5.1.1 In order to check the force being held by each of the selected surveillance tendons a Lift-off test will be performed. This process will be performed in accordance with the PSC supplied In-Service Inspection Procedure. A lift-off is achieved by transferring the tension on the tendon from its shim stack to the hydraulic ram. Once the tension has been transferred, the force is calculated from the internal pressure of the hydraulic ram. The steps involved in performing a liftoff are as follows:

5.1.1.1 The hydraulic pressure will be applied to the ram until lift-off is achieved.

5.1.1.2 After achieving lift-off 2 feeler gauges (0.030 inch) shall be inserted about 180 degrees apart, between the anchor head and the top shim.

5.1.1.3 The pressure will then be reduced to transfer the load back to the shim stack.

5.1.1.4 Pressure will be applied to the tendon until the feeler gauge can be pulled out with some effort.

5.1.1.5 These steps will then be repeated until three consecutive readings within the specified tolerance are achieved.

5.1.1.6 The pressure used to achieve liftoff is then converted to the force for that tendon using the hydraulic ram calibration data, which is traceable to NIST, and the normalization factor and compared to the predicted force for that tendon to verify acceptability.

5.1.2 The predicted forces and normalization factors for each surveillance tendon, as well as the tendons adjacent to it, have been calculated and included in Attachment C and are summarized below in Table 3.

TABLE 3 : SQ 9.1 – PREDICTED FORECS SUMMARY

CRYSTAL RIVER UNIT 3 – SQ 9.1 – PREDICTED FORECS SUMMARY									
TENDON	PREDICTED BASE (kips)	95% PREDICTED BASE (kips)	90% PREDICTED BASE (kips)	NORMALI-ZATION FACOTR	TENDON	PREDICTED BASE (kips)	95% PREDICTED BASE (kips)	90% PREDICTED BASE (kips)	NORMALI-ZATION FACOTR
61V24	1529	1452	1376	-14	13H35	1373	1304	1235	+56
12V01	1525	1449	1372	-9	13H36	1484	1410	1336	-56
12V02	1596	1516	1437	-80	13H37	1368	1299	1231	+61
45V19	1484	1409	1335	+31	62H29	1421	1350	1279	+7
45V20	1507	1432	1357	+7	62H30	1413	1342	1272	+14
45V21	1533	1456	1380	-19	62H31	1475	1401	1328	-46
61V16	1523	1447	1371	-8	D128	1268	1205	1141	+53
61V17	1498	1423	1348	+17	D129	1287	1223	1159	+34
61V18	1493	1418	1344	+21	D130	1261	1198	1135	+60
46H20	1467	1394	1321	-39	D211	1305	1239	1174	+18
46H21	1441	1369	1297	-12	D212	1305	1240	1175	+15
46H22	1486	1412	1337	-57	D213	1312	1246	1180	+10
51H33	1392	1323	1253	+36	D237	1426	1335	1283	-104
51H34	1487	1413	1339	-59	D238	1348	1281	1213	-26
51H35	1348	1281	1213	+79	D239	1409	1338	1268	-88
42H45	1473	1399	1325	-44					
42H46	1456	1383	1310	-28	= SURVEILLANCE TENDON				
42H47	1425	1354	1283	+3	= ADJACENT TENDON				

6.0 RETENSION TENDONS

6.1 DETENSIONING, WIRE REMOVAL, AND RETENSIONING OF TENDONS

6.1.1 One tendon out of each group (vertical, hoop, and dome) is selected to have a wire removed and tested. This process will be performed in accordance with the PSC supplied In-Service Inspection Procedure. In order for this to be accomplished the following will happen:

6.1.1.1 Liftoff-testing will be completed to ensure the tendon's force is at an acceptable level.

6.1.1.2 Once the liftoff has been completed, the force will be transferred to the hydraulic ram and all of the shims will be removed.

6.1.1.3 After the shims have been removed, the pressure will then be released from both ends of the tendon until there is no longer any force on it. This is the detensioning of the tendon.

6.1.1.4 While the tendon is in the detensioned state, a sample wire is removed and scheduled for physical testing as required by IWL-2523.

6.1.1.5 Once the wire has been removed, the tendon is then restored to an acceptable force by pressurizing the ram and replacing the stressing shims.

6.1.2 In order to perform an acceptable restressing operation, the following parameters must be calculated since the tendon has one less effective wire (because of the removed test wire).

6.1.2.1 The new Pre-Tension Force (PTF)

6.1.2.2 The new Overstress Force (OSF) which is 80% of the tendons Gross Ultimate Tensile Strength (GUTS)

6.1.2.3 The new elongations at each of the measurement stops and at OSF

6.1.3 All of the new restressing calculations are included in Attachment D and the parameters are summarized in Table 4 below.

TABLE 4 : SQ 11.1 – RESTRESSING DATA

CRYSTAL RIVER UNIT 3 – SQ 11.1 – RESTRESSING DATA								
TENDON	PREVIOUSLY		AT RETENSIONING					ORIGINAL ELONGATION (in.)
	ORIGINAL PTF (kips)	ORIGINAL OSF (kips)	NUMBER OF WIRES	NEW PTF (kips)	NEW OSF (kips)	600 (kips)	1200 (kips)	
61V17	357	1866	162	354	1855	1.92	6.62	11.75
			161	352	1843	1.95	6.68	
			160	350	1832	1.98	6.74	
51H34	362	1866	162	359	1855	1.65	5.76	10.25
			161	357	1843	1.67	5.81	
			160	355	1832	1.70	5.87	
D238	359	1866	162	357.1	1854.6	1.34	4.64	8.25
			161	354.9	1843.1	1.36	4.68	
			160	352.7	1831.7	1.38	4.73	

7.0 GREASE VOID VOLUMES

7.1 GREASE REPLACEMENT

7.1.1 Once all inspections have concluded, any sheathing filler (grease) that was lost during the inspections must be replaced. Throughout the inspection all grease that is removed is documented. The required methods of refilling, as well as the acceptance requirements for amount refilled, are dependent upon the percentage of the total void that is lost. In order to calculate this percentage, the grease void volume has been calculated for each selected surveillance tendon as well as both of its adjacent tendons. The grease void calculations are included in Attachment E and are summarized below in Table 5.

TABLE 5 : SQ 12.1 – GREASE VOID VOLUMES

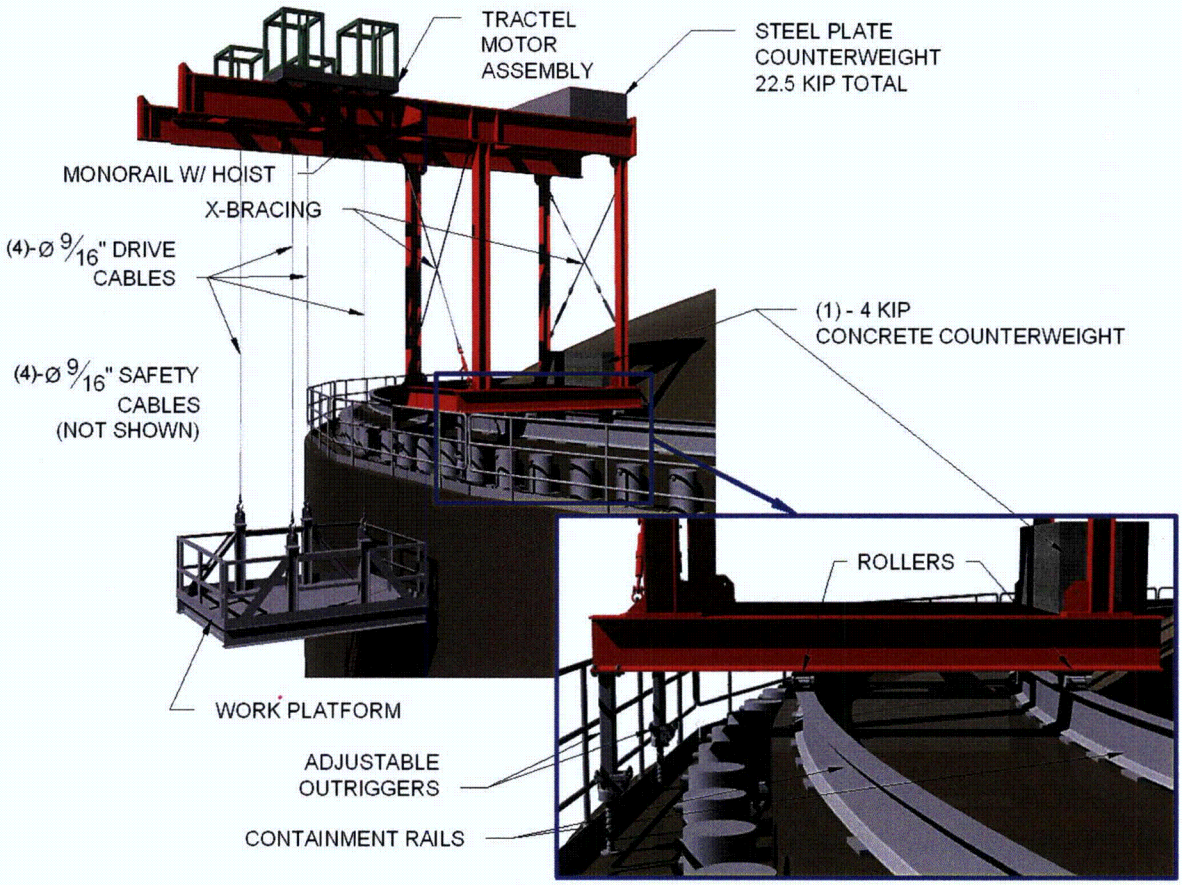
CRYSTAL RIVER UNIT 3 – SQ 12.1 – GREASE VOID VOLUMES								
TENDON	NET DUCT VOLUME (GALLONS)	10% DUCT VOLUME (GALLONS)	TENDON	NET DUCT VOLUME (GALLONS)	10% DUCT VOLUME (GALLONS)	TENDON	NET DUCT VOLUME (GALLONS)	10% DUCT VOLUME (GALLONS)
61V24	144.09	14.41	13H35	121.77	12.18	D128	118.31	11.83
12V01	143.97	14.40	13H36	121.67	12.17	D129	116.41	11.64
12V02	144.12	14.41	13H37	122.18	12.22	D130	116.12	11.61
45V19	144.51	14.45	42H45	121.40	12.14	D211	115.58	11.56
45V20	144.47	14.45	42H46	122.57	12.26	D212	115.99	11.60
45V21	144.05	14.40	42H47	121.84	12.18	D213	116.85	11.69
61V16	144.36	14.44	46H20	121.37	12.14	D237	104.93	10.49
61V17	144.74	14.47	46H21	122.06	12.21	D238	102.59	10.26
61V18	144.15	14.42	46H22	122.43	12.24	D239	100.43	10.04
34V16	145.50	14.55	51H33	121.94	12.19	D336	107.62	10.76
34V17	145.67	14.57	51H34	120.88	12.09	D337	106.08	10.61
34V18	144.97	14.50	51H35	122.21	12.22	D338	103.92	10.39
			62H29	121.93	12.19			
			62H30	121.75	12.17			
			62H31	122.13	12.21			
			46H06	122.00	12.20			
			46H07	121.18	12.12	= SURVEILLANCE TENDON		
			46H08	121.46	12.15	= ADJACENT TENDON		

8.0 UPPER SUPPORT FRAME & WORK PLATFORM DESIGN

8.1 EQUIPMENT ARRANGEMENT

8.1.1 The two Upper Support Frames (a.k.a. USF) will be installed on top of the containment rail system. The USF will support the work platform with four drive cables and four safety cables, as well as a hydraulic stressing ram hanging from a 5-Ton hoist. See Figures 6 and 7 below for the setup of components and dimensions respectively.

FIGURE 6: USF & WORK PLATFORM COMPONENT SETUP



8.1.2 The work platform will be raised/lowered by four Tractel 2050XE drive units. The Tractel units have a man-riding capacity of 4 kips each, for a total of 16 kips when using a single part line. The drive and safety cables (each a set of 4 cables) will consist of 9/16" diameter wire rope. The steel cable has a minimum breaking strength of 40 kips, for a total ultimate strength of 160 kips (for each set). This means in this configuration, the support cables have a safety factor of 10.

8.1.3 The Tractel drive units will be arranged on a separate assembly unit, which will attach to the top flanges of the USF. This allows for the placement of the basket in an optimal location for the work being performed. The entire assembly, including framing, drive units, and 200 feet of drive cables, weighs 4.4 kips.

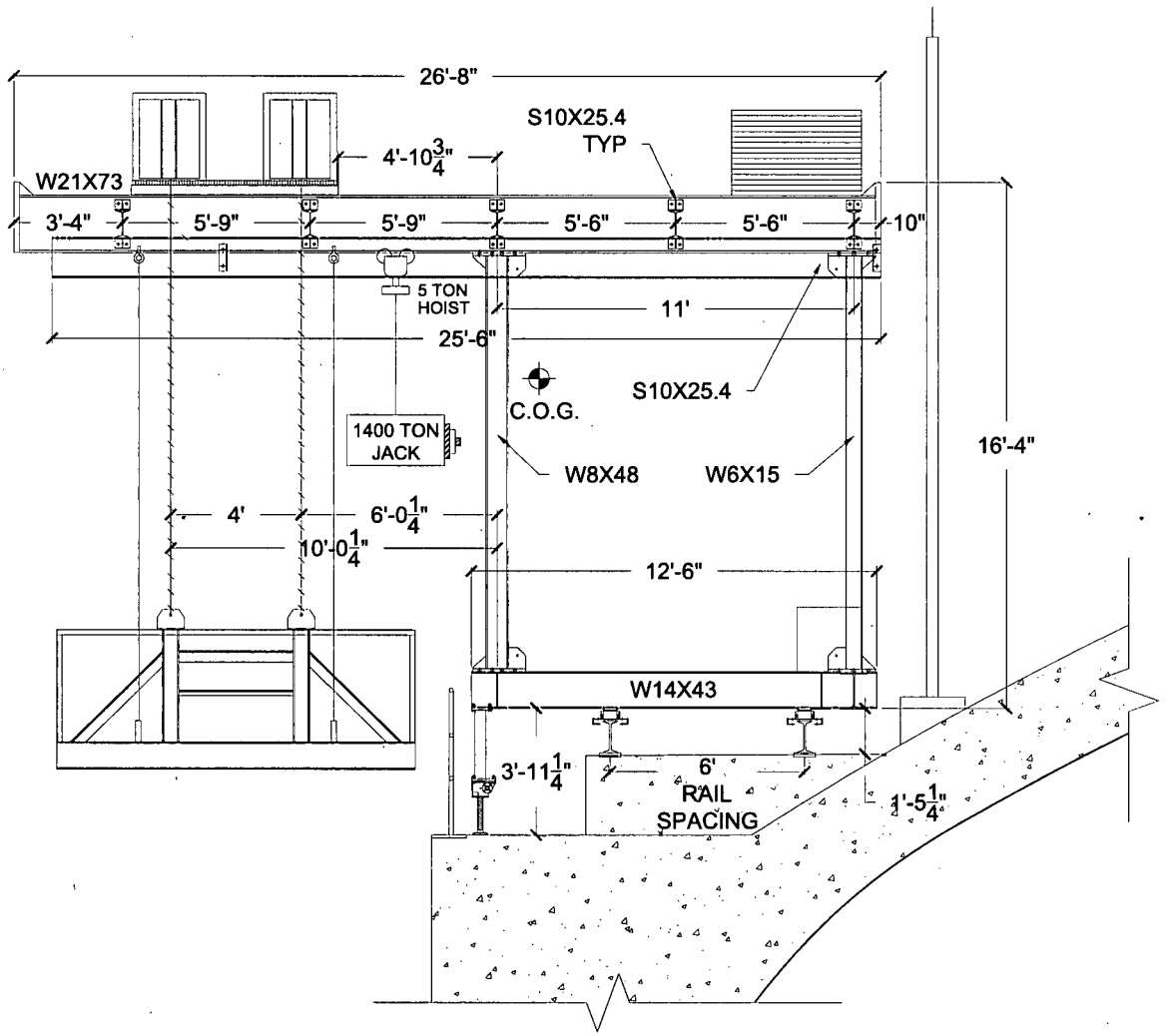
8.1.4 A spider basket may be hung from the USF to facilitate the transportation of personnel and material/tooling between the work platform and the containment dome or ground. The spider basket has a dead weight of 250 lbs. and a capacity of 1,000 lbs. This setup will exert a maximum of 1,250 lbs. of force on the USF when installed.

8.1.5 The hydraulic ram will be supported from a 5-ton capacity (10 kip working load) electric hoist. The hoist itself weighs 1.8 kips. In this configuration the maximum load the hoist could exert on the USF is 11.8 kips.

8.1.6 When the USF is in a set position (either working or storage) two outriggers at the outer edge of the USF will be lowered to the concrete to increase its support base width. These outriggers will consist of structural tube stub columns connected to worm gear screw jacks. The screw jacks will be outfitted with a standard hex bolt connection so that they can be raised and lowered using a standard ratchet or impact wrench. The screw jacks are model M15-U-T-12.0-L-B-TP made by T.K. Simplex, and have a working load capacity of 15-ton (30 kips).

8.1.7 The counterweight used for the system will be a combination of 22.5 kips of steel plate and 4 kip of concrete. Also, the platform will be tied down to the containment rails using PSC custom tie downs (Reference PSC Calculation E-GEN-500 – Rail Clamp Capacity Test). The tie downs are designed and tested for a maximum force of 40 kips each. The total hold-down force for this frame will be 106.5 kips {22.5+4+40+40 = 106.5 kips}.

FIGURE 7: USF DIMENSIONS



8.2 Design Loads

Table 6 :Usf Design Loads

CRYSTAL RIVER UNIT 3 – DETAILED WORK PLATFORM LOADS					
Load Description	**Class**	**Unit Weight**	**Quantity**	**Total Weight**	**Class Totals**
Platform Self-Weight	D.L.	3,850 lbs.	1	3,850 lbs.	3,850 lbs.
Personnel	L.L.	250 lbs.	4	1,000 lbs.	2,600 lbs.
New/Scrap Grease Drum	L.L.	500 lbs.	1	500 lbs.	
Shims	L.L.	100 lbs.	1	100 lbs.	
Tools	L.L.	250 lbs.	1	250 lbs.	
Hydraulic Jack Pump	L.L.	750 lbs.	1	750 lbs.	
				Total Work Platform Weight =	6,450 lbs.

CRYSTAL RIVER UNIT 3 – DESIGN LOADS USED IN THE WORK PLATFORM ANALYSIS					
Load Description	**Class**	**Load Magnitude**	**Quantity of Loads Applied in RISA**	**Magnitude of Loads Applied in RISA**	**Comments**
Platform Live Load	L.L.	2.6 kips	80 sq. ft.	0.033 ksf	
Hydraulic Pump	L.L.	0.75 kips	1	0.75 kips	
Miscellaneous Live Load	L.L.	0.5 kips	80 sq. ft.	0.006 ksf	
5:1 Platform Live Load	L.L.	13.0 kips	80 sq. ft.	0.163 ksf	

CRYSTAL RIVER UNIT 3 – DESIGN LOADS USED IN THE UPPER SUPPORT FRAME ANALYSIS					
Load Description	**Class**	**Load Magnitude**	**Quantity of Loads Applied in RISA**	**Magnitude of Loads Applied in RISA**	**Comments**
Platform Dead	D.L.	3.85 kips	4	0.96 kips	
Platform Live	L.L.	2.6 kips	4	0.65 kips	
Tractel Support Basket	D.L.	4.4 kips	4	1.1 kips	
Trolley/Hoist	L.L.	11.8 kips	1	11.8 kips	
Steel Counterweight	D.L.	22.5 kips	8.0 ft.	2.813 kip/ft	
Concrete Counterweight	D.L.	4.0 kips	2	2.0 kips	
30mph Wind X-Dir ($W_{//30}$)	W.L.	1.79 kips	64.78 ft.	0.028 kip/ft	
30mph Wind Z-Dir ($W_{\perp 30}$)	W.L.	1.54 kips	40.44 ft.	0.038 kip/ft	
150mph Wind X-Dir ($W_{//150}$)	W.L.	18.19 kips	64.78 ft.	0.281 kip/ft	
150mph Wind Z-Dir ($W_{\perp 150}$)	W.L.	12.22 kips	40.44 ft.	0.302 kip/ft	
DBE Earthquake (EL_X)	E.L.	6.75 kips	53.34 ft.	0.127 kip/ft	
DBE Earthquake (EL_Y)	E.L.	1.78 kips	90.84 ft.	0.020 kip/ft	
DBE Earthquake (EL_Z)	E.L.	6.75 kips	37.5 ft.	0.180 kip/ft	
MHE Earthquake (EL_X)	E.L.	17.38 kips	53.34 ft.	0.326 kip/ft	
MHE Earthquake (EL_Y)	E.L.	5.3 kips	90.84 ft.	0.058 kip/ft	
MHE Earthquake (EL_Z)	E.L.	17.38 kips	37.5 ft.	0.463 kip/ft	

8.3 LATERAL LOADS

8.3.1 Two percent (2%) of Operating Weight:

$$[(10^K + 6.45^K + 11.8^K + 26.5^K)*0.02] = \mathbf{1.10^K} \text{ (Conservative)}$$

USF	Platform	Hoist	Counterweight
DL	DL+LL		

8.3.2 Wind Loading

8.3.2.1 The wind loading for the USF has been calculated in two directions for two different wind speeds. The first wind speed is 30 mph and the second is 150 mph. The 30mph condition is evaluated under working conditions, while the 150mph condition is evaluated when the platform is secured and uninhabited. The wind loads are applied perpendicular to containment (along the radius) and parallel to the containment building (tangent to the circle) in order to ensure the structure's ability to withstand these forces, and the tie-down system's ability to secure the USF on top of the containment building. 2% of the operating weight is also included in the wind load calculation to account for any accidental impact loading. The variables and dimensions used for calculating the design wind loads are tabulated in Tables 7 and 8 below, respectively.

TABLE 7 :WIND LOADING VARIABLES

Description	Variable	Value
Basic Wind speed	V	30 / 150 mph
Wind Directionality Factor	K_d	1.0
Importance Factor	I	1.15
Exposure Category	-	D
Building Height	z	195'
Velocity Pressure Coefficient	K_z	1.61
Topographic Factor	K_{zt}	1.0
Gust Effect Factor	G	0.8
Enclosure Classification	-	OPEN
Internal Pressure Coefficient	GC_{pi}	0.0
External Pressure Coefficient	C_f	1.6

TABLE 8 :WIND LOADING DIMENSIONS

Physical Dimensions		
Dimension	Parallel to Containment	Perpendicular to Containment
Projected Area (A_f)	125.26 sq. ft.	81.48 sq. ft.
Length that Wind Load is Applied in RISA (L_w)	64.78 ft.	40.44 ft.
* Areas and Lengths calculated from AutoCAD		

8.3.2.2 30mph condition:

8.3.2.2.1 Velocity Pressure Calculation:

$$q_z = 0.00256 K_z K_{zt} K_d V^2 I$$

$$q_{z30} = 0.00256(1.61)(1.0)(1.0)(30)^2(1.15) = \mathbf{4.27}\ \mathbf{lb/ft^2}$$

8.3.2.2.2 Design Wind load parallel to containment ($W_{//30}$):

$$F = q_z G C_f A_f$$

$$F_{//30} = (4.27)(0.8)(1.6)(125.26) = 684.6lb. = 0.6846^K + 1.10^K = \mathbf{1.79}^K$$

Distributed Load Applied in RISA: $W_{//30} = \dfrac{F}{L_W} = \dfrac{1.79}{64.78} = \mathbf{0.028}\ \mathbf{k/ft}$

8.3.2.2.3 Design Wind load perpendicular to containment ($W_{\perp 30}$):

$$F = q_z G C_f A_f$$

$$F_{\perp 30} = (4.27)(0.8)(1.6)(81.48) = 445.3lb. = 0.4453^k + 1.10^K = \mathbf{1.54}^K$$

Distributed Load Applied in RISA: $W_{\perp 30} = \dfrac{F}{L_W} = \dfrac{1.54}{40.44} = \mathbf{0.038}\ \mathbf{k/ft}$

8.3.2.3 150mph condition:

8.3.2.3.1 Velocity Pressure Calculation:

$$q_z = 0.00256 K_z K_{zt} K_d V^2 I$$

$$q_{z150} = 0.00256(1.61)(1.0)(1.0)(150)^2(1.15) = \mathbf{106.6}\,\mathbf{lb/ft^2}$$

8.3.2.3.2 Design Wind load parallel to containment ($\boldsymbol{W_{//150}}$):

$$F = q_z G C_f A_f$$

$$F_{//150} = (106.6)(0.8)(1.6)(125.26) = 17{,}091\,lb. = 17.09^K + 1.10^K = \mathbf{18.19}^K$$

Distributed Load Applied in RISA: $W_{//150} = \dfrac{F}{L_W} = \dfrac{18.19}{64.78} = \mathbf{0.281}\,\mathbf{k/ft}$

8.3.2.3.3 Design Wind load perpendicular to containment ($\boldsymbol{W_{\perp 150}}$):

$$F = q_z G C_f A_f$$

$$F_{\perp 150} = (106.6)(0.8)(1.6)(81.48) = 11{,}118\,lb. = 11.12^K + 1.10^K = \mathbf{12.22}^K$$

Distributed Load Applied in RISA: $W_{\perp 150} = \dfrac{F}{L_W} = \dfrac{12.22}{40.44} = \mathbf{0.302}\,\mathbf{k/ft}$

8.3.3 Seismic Loading:

8.3.3.1 The seismic loading conditions have been calculated using peak spectral accelerations from previous experience in designing the upper support frames to determine the representative static loads. The load combinations consist of a static distributed load being applied to the top story of the frame in each of the three ordinate directions. Static loadings have been calculated for two different accelerations, a Design Basis Earthquake (DBE) and a Maximum Hypothetical Earthquake (MHE). The DBE condition is evaluated under working conditions, while the MHE is only evaluated when the USF is secured and the platform uninhabited. The seismic loads considered are extremely conservative considering the required acceleration of 0.05g required by Reference 2.1.6. The dead loads and dimensions used for calculating the design seismic loads are tabulated in Tables 9 and 10 below, respectively.

TABLE 9 :SEISMIC DEAD LOADS

DEAD LOADS USED TO CALCULATE HORIZONTAL AND VERTICAL SEISMIC FORCES	
USF Dead	10.0^K
Counterweight	26.5^K
Tractel Support	4.4^K
Total D.L.	40.9^K

TABLE 10 :SEISMIC DIMENSIONS

LENGTH THAT SEISMIC LOAD IS APPLIED IN RISA (L_{EQ})	
X-DIRECTION	53.34 ft.
Y-DIRECTION	90.84 ft.
Z-DIRECTION	37.5 ft.
* Lengths calculated from AutoCAD	

8.3.3.2 The frequency and period of the USF are calculated below.

$$\text{Maximum Fundamental Period}, T = T_a \cdot C_V = C_T \cdot h_n^{3/4} \cdot C_V = 0.03 \cdot (14)^{3/4} \cdot 1.7 = 0.37$$

$$\text{Frame Frequency}, f = \frac{1}{T} = \frac{1}{0.37} = 2.71 \Rightarrow use\ \mathbf{3.0} \therefore \mathbf{Conservative}$$

8.3.3.3 Peak spectral accelerations are listed below. ∴ **Conservative (Reference 2.1.6)**

Horizontal DBE = $0.33g$ Vertical DBE = $\frac{2}{3} \cdot 0.13g = 0.087g$

Horizontal MHE = $0.85g$ Vertical MHE = $\frac{2}{3} \cdot 0.39g = 0.259g$

8.3.3.4 DBE Seismic Forces are calculated below.

$$EL_X = \frac{1}{2} \cdot 0.33 \cdot (10 + 26.5 + 4.4) = 6.75^K$$
$$EL_Y = \frac{1}{2} \cdot 0.087 \cdot (10 + 26.5 + 4.4) = 1.78^K$$
$$EL_Z = \frac{1}{2} \cdot 0.33 \cdot (10 + 26.5 + 4.4) = 6.75^K$$

8.3.3.5 MHE Seismic Forces are calculated below.

$$EL_X = \frac{1}{2} \cdot 0.85 \cdot (10 + 26.5 + 4.4) = 17.38^K$$
$$EL_Y = \frac{1}{2} \cdot 0.259 \cdot (10 + 26.5 + 4.4) = 5.30^K$$
$$EL_Z = \frac{1}{2} \cdot 0.85 \cdot (10 + 26.5 + 4.4) = 17.38^K$$

8.4 FRAME ANALYSIS

8.4.1 Member Design:

8.4.1.1 All of the members have been designed for both lateral and vertical loads by analyzing various loading conditions with RISA-3D Version 5.5. RISA-3D calculates the stresses in each member, with respect to the member size and designation, and checks them against the allowable stresses defined in the applicable code. All of the members for the USF and work platform have been designed in accordance with AISC 9th Edition ASD [Reference 2.1.5] and ASME A120.1-2001 [Reference 2.1.7].

8.4.1.2 Section 3.3.4.1 of ASME A120.1-2001 states "At no time shall the rated load be placed in its most outboard position without a system stability factor of 4." In the RISA-3D analysis, the AISC standard uses 60% of yield to determine the member's allowable stress. Therefore, in order to meet the previously stated requirement, PSC is using a load factor of 2.4 (4 x 60% = 2.4) to reach the 4 to 1 rating. (i.e., rated hoist load x 2.4/60% = rated hoist load x 4) for the overload calculation of the outrigger beams.

8.4.1.3 In the USF analysis, two separate models were evaluated. The first model, which includes "set position" in the title, is indicative of the setup the USF will have when in a stationary working position, as well as when stored while not in use. The second model represents the "moving position" in which the front outriggers have been lifted to facilitate the movement of the platform to a new working position. Because of the very limited amount of time the USF will spend in the moving position, the extreme lateral loading cases (150mph & MHE) are not considered for that model.

8.4.1.3.1 In the analysis of the set position, sixteen different load combinations have been evaluated and they are detailed, along with the analysis in Attachment F. The model configuration, applied loads with corresponding code checks and reactions, and a tabulation of the envelope solution are also included in Attachment F. All of the load combinations have been considered, and the worst case code check for each member is displayed in the envelope solution. The allowable stress increase of 1/3 for lateral loading conditions have been applied to the appropriate load combinations. All of the member's stresses, code checks and boundary condition reactions are acceptable.

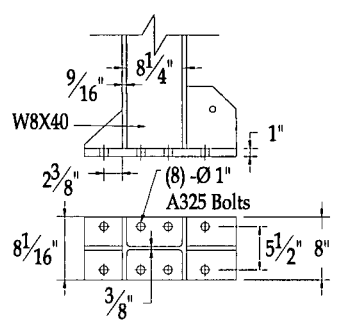
8.4.1.3.2 In the analysis of the moving position, nine different load combinations have been evaluated and they are detailed, along with the analysis in Attachment G. The model configuration, applied loads with corresponding code checks and reactions, and a tabulation of the envelope solution are also included in Attachment G. All of the load combinations have been considered, and the worst-case code check for each member is displayed in the envelope solution. The allowable stress increase of 1/3 for lateral loading conditions have been applied to the appropriate load combinations. All of the member's stresses, code checks and boundary condition reactions are acceptable.

8.4.1.3.3 In the work platform analysis, two load combinations were analyzed: the working load and dead load plus five times the live load. All lateral loading on the platform itself is negligible due to the pendulum effect of hanging from cables. The model configuration, applied loads with corresponding code checks and reactions, and a tabulation of the load combinations' solution are included in Attachment H. All of the members' stresses, code checks and boundary condition reactions are acceptable.

8.4.2 Connections:

8.4.2.1 Column Connections (Reference 2.1.5 – ASD 9th Ed, Pgs. 4-116 to 4-122)

FIGURE 8: COLUMN CONNECTION



Maximum Forces: *Shear* = -11.4^K, *Moment* = $20.22^{K\text{-}ft}$

Check Bolt Capacity: $F_f = \dfrac{M}{(d - t_{fb})} = \dfrac{20.22 \cdot 12}{(8.25 - 0.5625)} = 31.56^K$

4 ∅ 1" *A325 Bolts* = $4(34.6^K) = 138.4^K > 31.56^K$

∴**ACCEPTABLE**

Check remaining Shear Bolts: 4 ∅ 1" *A325 Bolts* = $4(16.5^K) = 66.0^K > 11.4^K$ *max*

∴**ACCEPTABLE**

Check Flange to Plate Weld: $D_{req'd} = \dfrac{31.56}{[2(8.0625 + 0.5625) - 0.375]0.928} = 2.02$

Existing ¼" welds, D = 4 > 2.02 ∴**ACCEPTABLE**

Check End Plate: $P_e = 2.375 - \dfrac{1.0}{4} - 0.707(.1875) = 1.99in.$

$C_a = 1.13$ *for* $F_y = 36ksi$

$C_b = \sqrt{\dfrac{8.0625}{8}} = 1.00$

$\dfrac{A_f}{A_w} = \dfrac{8.0625 \cdot .5625}{[8.25 - (2 \cdot 0.5625)] \cdot 0.375} = 1.70$

$\dfrac{P_e}{d_b} = \dfrac{1.99}{1.0} = 1.99$

$\alpha_m = 1.13 \cdot 1.00 \cdot (1.70)^{1/3} \cdot (1.99)^{1/4} = 1.602$

$M_e = 1.602 \cdot 31.56 \cdot (1.99/4) = 25.2kip - in$

Req'd Plate Thickness: $t_p = \sqrt{\dfrac{6 \cdot 25.2}{27 \cdot 8}} = 0.837in < 1.0\ in$ existing ∴**ACCEPTABLE**

Check Web to Plate Weld: *Required weld to develop maximum web tension stress* (F_y = 21.6 *ksi*)

$D_{req'd} = \dfrac{21.6 \cdot 0.375}{2 \cdot 0.928} = 4.36 < 6$, existing 3/8" weld ∴**ACCEPTABLE**

Beam Stiffeners: ½" stiffeners welded to both flanges and web with 3/16" weld both sides are **ACCEPTABLE** by engineering judgment

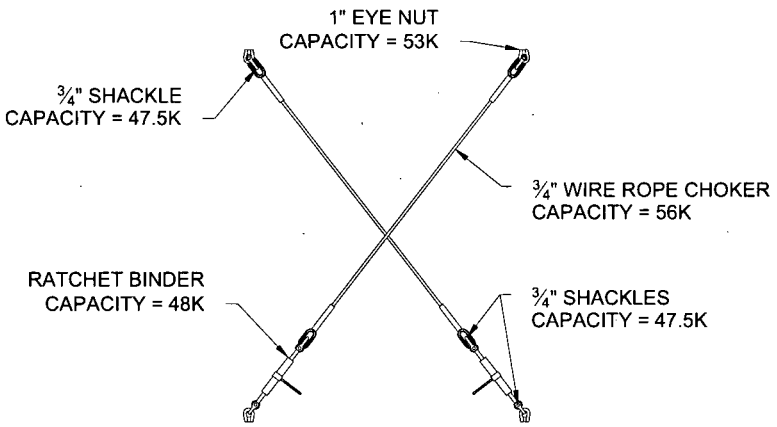
8.4.2.2 All other framing:

Minimum of (4) – ∅ 3/4" *Bolts*
Shear Capacity of ∅ 3/4" *A325 Bolt* = $9.3^K \rightarrow 4(9.3^K) = 37.2^K$
Tensile Capacity of ∅ 3/4" *A325 Bolt* = $19.4^K \rightarrow 4(19.4^K) = 77.6^K$
∴ **ACCEPTABLE** by *engineering judgment.*

8.4.3 X-Bracing:

8.4.3.1 The X-bracing is made up of several rigging components, which have an ultimate capacity able to withstand the maximum forces generated in the bracing due to all the lateral loading conditions. Below, Figure 9 depicts the typical bracing setup, with the ultimate capacities of each component listed. In the design below, the ultimate capacity of the system has been taken as 47.5 kip, because that is the capacity of the weakest link.

FIGURE 9: X-BRACING SYSTEM



SYSTEM ULTIMATE CAPACITY = **47.5K**

8.4.3.2 The maximum force the X-Bracing (members M17, M18, M19, M20) will have to sustain as calculated by the envelope solution of the set position is as follows:

Maximum Tensile Force = $38.257^K < 47.5^K$ ∴ **ACCEPTABLE**

8.4.4 Tie-Downs:

8.4.4.1 The back end of each frame will be tied down to the containment building rails in two places (one each side) using PSC's rail clamp system, or a system that is similar. The total capacity as defined in Reference 2.1.8 is 40 kip for each tie down. A system that is used in lieu of the system in Reference 2.1.8 will be designed and tested acceptably to withstand 40 kip as well.

8.4.4.2 The maximum downward reaction vector the rear tie down locations (Nodes N30 and N31 for the set position, and Nodes N32 and N33 for the moving position) will have to sustain is determined by reviewing the resulting reactions from each load combination solution. Tables 11 and 12 below summarize the vertical reaction vectors for all load cases in each model. The maximum downward reactions come from Load combination LC16 from the set position calculation. The PSC tie down system is more than capable of withstanding the required – 5.5 kip of hold down force.

TABLE 11 : USF VERTICAL REACTIONS – SET POSITION

USF VERTICAL REACTIONS – SET POSITION					
Load Combination		Vertical Reaction (kips)			
Number	Description	Joint N30	Joint N31	Joint N34	Joint N35
LC 2	DL	10.90	10.90	11.00	11.00
LC 3	DL+LL+Hoist In	14.30	14.30	14.80	14.80
LC 4	DL+LL+Hoist Out	4.70	4.60	24.40	24.40
LC 5	4:1 Equivalent	1.60	1.60	31.40	31.40
LC 6	DL+LL+WLX30	5.30	4.00	25.90	23.00
LC 7	DL+LL-WLX30	4.00	5.30	23.00	25.90
LC 8	DL+LL+WLZ30	4.10	4.10	25.00	25.00
LC 9	DL+LL-WLZ30	5.20	5.20	23.90	23.90
LC 10	DL+LL+WLX150	20.80	9.80	27.80	-2.50
LC 11	DL+LL-WLX150	9.80	20.90	-3.20	28.10
LC 12	DL+LL+WLZ150	11.00	11.00	16.80	16.80
LC 13	DL+LL-WLZ150	19.60	19.60	8.20	8.20
LC 14	DL+LL+DBE(X)+DBE(Y)+DBE(Z)	1.40	-1.80	39.60	17.20
LC 15	DL+LL-DBE(X)-DBE(Y)-DBE(Z)	7.90	11.10	9.30	31.70
LC 16	DL+LL+MHE(X)+MHE(Y)+MHE(Z)	2.40	-5.50	49.70	-8.10
LC 17	DL+LL-MHE(X)-MHE(Y)-MHE(Z)	-5.80	2.10	-2.50	55.30

TABLE 12 : USF VERTICAL REACTIONS – MOVING POSITION

USF VERTICAL REACTIONS – MOVING POSITION					
Load Combination		Vertical Reaction (kips)			
Number	Description	Joint N30	Joint N31	Joint N32	Joint N33
LC 2	DL	17.90	17.90	4.00	4.00
LC 3	DL+LL+Hoist In	24.00	24.00	5.00	5.00
LC 4	4:1 Equivalent	35.40	35.40	-2.50	-2.50
LC 5	DL+LL+WLX30	25.80	22.30	5.30	4.70
LC 6	DL+LL-WLX30	22.30	25.80	4.70	5.30
LC 7	DL+LL+WLZ30	24.90	24.90	4.10	4.10
LC 8	DL+LL-WLZ30	23.20	23.20	5.90	5.90
LC 9	DL+LL+DBE(X)+DBE(Y)+DBE(Z)	44.10	16.80	-3.10	-1.50
LC 10	DL+LL-DBE(X)-DBE(Y)-DBE(Z)	4.00	31.30	13.20	11.40

8.4.4.3 In addition to the rear tie downs, during the periods where the USF is left unattended for extended periods of time (i.e. overnight) the front columns (Nodes N32 and N33) will be secured to the front containment rail using rigging components similar to the X-bracing that have a minimum ultimate capacity of 25 kip. By reviewing the lateral reactions at Nodes N32 and N33 for all load combinations, the maximum reaction vector comes from Load combinations LC16 and LC17 from the set position calculation. Table 13 below summarizes the lateral reactions from all of the load combinations in the set position model. The maximum lateral reaction magnitude of 20.42 kip will be adequately resisted by the rigging components.

TABLE 13 : USF LATERAL REACTIONS – SET POSITION

USF LATERAL REACTIONs – SET POSITION							
Load Combination		Lateral Reactions (kips)					
		Joint N32			Joint N33		
Number	Description	X Dir.	Z Dir.	Lateral Reaction Magnitude	X Dir	Z Dir.	Lateral Reaction Magnitude
LC 2	DL	0.00	0.00	0.00	0.00	0.00	0.00
LC 3	DL+LL+Hoist In	0.00	0.00	0.00	0.00	0.00	0.00
LC 4	DL+LL+Hoist Out	0.00	0.00	0.00	0.00	0.00	0.00
LC 5	4:1 Equivalent	0.00	0.00	0.00	0.00	0.00	0.00
LC 6	DL+LL+WLX30	-0.10	0.10	0.14	-1.10	-0.10	1.10
LC 7	DL+LL-WLX30	1.40	-0.10	1.40	3.00	0.10	3.00
LC 8	DL+LL+WLZ30	0.00	-0.40	0.40	0.00	-0.40	0.40
LC 9	DL+LL-WLZ30	0.00	0.70	0.70	0.00	0.70	0.70
LC 10	DL+LL+WLX150	-0.90	1.00	1.35	10.30	-1.00	10.35
LC 11	DL+LL-WLX150	14.40	-1.10	14.44	2.60	1.10	2.82
LC 12	DL+LL+WLZ150	0.00	-2.90	2.90	0.00	-2.90	2.90
LC 13	DL+LL-WLZ150	0.00	5.80	5.80	0.00	5.80	5.80
LC 14	DL+LL+DBE(X)+DBE(Y)+DBE(Z)	-0.10	-2.20	2.20	6.70	-4.30	7.96
LC 15	DL+LL-DBE(X)-DBE(Y)-DBE(Z)	6.70	2.20	7.05	0.10	4.30	4.30
LC 16	DL+LL+MHE(X)+MHE(Y)+MHE(Z)	-0.20	-5.80	5.80	17.20	-11.00	20.42
LC 17	DL+LL-MHE(X)-MHE(Y)-MHE(Z)	17.20	-11.00	20.42	0.20	-5.70	5.70

8.4.5 Overturning Stability:

8.4.5.1 Stability factors have been calculated for three different load combinations on the USF. When in the set position, the stability factors were calculated for the working load condition as well as to check for the acceptance of the ANSI 4:1 overturning requirement. For the moving position, the frame is checked for the worst case loading while moving to ensure its stability. The stability factor is the ratio of the negative moment (overturning) to the positive moment (tie-downs/counterweight). Figures 10 and 11 depict the locations of each force, and Tables 14 through 16 calculate the stability factor for each load condition.

FIGURE 10: SET POSITION OVERTURNING STABILITY

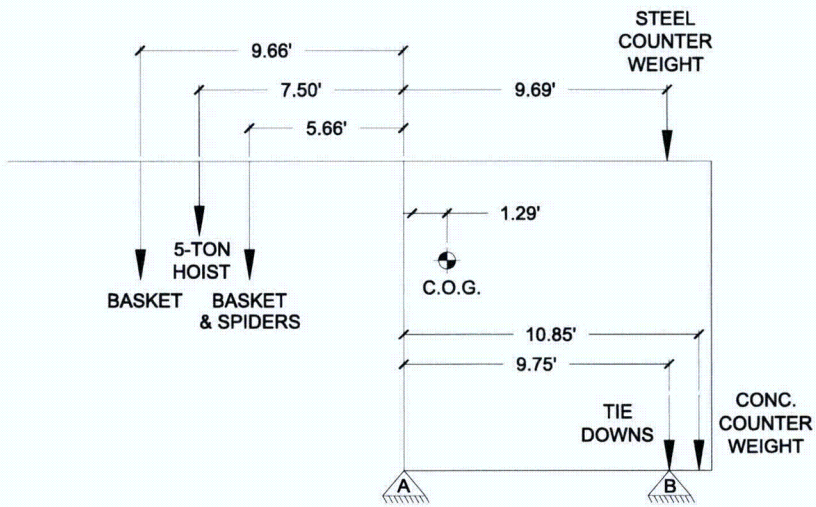


TABLE 14 : USF LATERAL REACTIONS – SET POSITION

Set Position - Working Load :
Hoist all at working Position, Basket Fully Loaded, Spider Loaded, Counterweights installed
No Tie-Downs

Negative Moment

Frame Weight		Hoist	
Force	Location	Force	Location
		11.8 K	7.5 ft.

Basket		Spider Baskets	
Force	Location	Force	Location
2.71 K	5.66 ft.	1.25 K	6.00 ft.
2.71 K	5.66 ft.		
2.71 K	9.66 ft.		
2.71 K	9.66 ft.		

Positive Moment

Frame Weight		Hoist	
Force	Location	Force	Location
10.0 K	1.29 ft.		

Counterweight		Tie Down	
Force	Location	Force	Location
22.5 K	9.69 ft.		
4.0 K	10.85 ft.		

Safety Factor

Negative Moment =	-179.06 K-ft
Positive Moment =	274.28 K-ft
Total Down Force =	60.39 K
Reaction at "A" =	50.37 K
Reaction at "B" =	10.02 K
Saftey Factor	1.53

TABLE 15 : USF LATERAL REACTIONS – SET POSITION

Set Position - ANSI A120.1-2001 4:1 Stability Factor
Hoist all the way out, Basket Fully Loaded, Counterweights installed, Spider Loaded, Tie-Downs Installed

Negative Moment

Frame Weight		Hoist	
Force	Location	Force	Location
		11.8 K	7.5 ft.

Basket		Spider Baskets	
Force	Location	Force	Location
2.71 K	5.66 ft.	1.25 K	6.00 ft.
2.71 K	5.66 ft.		
2.71 K	9.66 ft.		
2.71 K	9.66 ft.		

Positive Moment

Frame Weight		Hoist	
Force	Location	Force	Location
10.0 K	1.29 ft.		

Counterweight		Tie Down	
Force	Location	Force	Location
22.5 K	9.69 ft.	25.0 K	9.75 ft.
4.0 K	10.85 ft.	25.0 K	9.75 ft.

Safety Factor

Negative Moment =	-179.06 K-ft
Positive Moment =	761.78 K-ft
Total Down Force =	110.39 K
Reaction at "A" =	49.05 K
Reaction at "B" =	61.34 K
Saftey Factor	4.25

FIGURE 11: MOVING POSITION OVERTURNING STABILITY

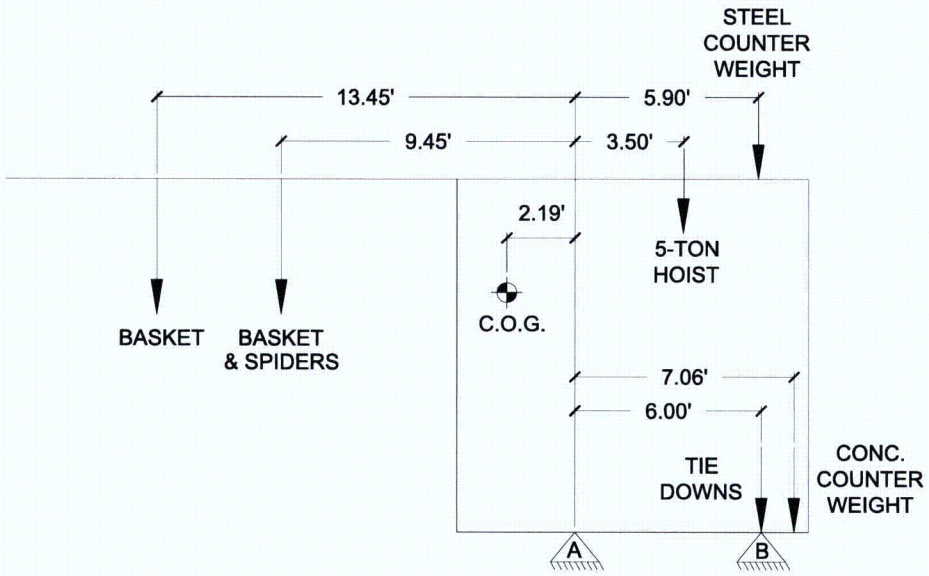


TABLE 16 : USF LATERAL REACTIONS – SET POSITION

Moving Position - Transit Load:
Basket Fully Loaded, Counterweights installed
NO tie downs or Hoist

Negative Moment

Frame Weight		Hoist	
Force	Location	Force	Location
10.0 K	2.14 ft.		

Basket		Spider Baskets	
Force	Location	Force	Location
2.71 K	9.45 ft.	1.25 K	9.45 ft.
2.71 K	9.45 ft.		
2.71 K	13.45 ft.		
2.71 K	13.45 ft.		

Positive Moment

Frame Weight		Hoist	
Force	Location	Force	Location
		9.7 K	3.5 ft.

Counterweight		Tie Down	
Force	Location	Force	Location
22.5 K	5.90 ft.	5.0 K	6.0 ft.
4.0 K	7.06 ft.	5.0 K	6.0 ft.

Safety Factor

Negative Moment =	-157.83 K-ft
Positive Moment =	254.87 K-ft
Total Down Force =	68.29 K
Reaction at "A" =	58.08 K
Reaction at "B" =	10.21 K
Saftey Factor	1.61

ATTACHMENT A – ASME SECTION XI, 1992 EDITION WITH 1992 ADDENDA

SUBSECTION IWL
REQUIREMENTS FOR CLASS CC CONCRETE COMPONENTS OF LIGHT-WATER COOLED PLANTS

ARTICLE IWL-1000
SCOPE AND RESPONSIBILITY

IWL-1100 SCOPE

(a) This Subsection provides the rules and requirements for preservice examination, inservice inspection and repair of the reinforced concrete and the post-tensioning systems of Class CC components, herein referred to as concrete containments as defined by CC-1000.

(b) The rules and requirements of this Subsection do not apply to the following:

(1) steel portions not backed by concrete;

(2) shell metallic liners;

(3) penetration liners extending the containment liner through the surrounding shell concrete.

IWL-1200 ITEMS SUBJECT TO EXAMINATION

IWL-1210 EXAMINATION REQUIREMENTS

The examination requirements of this Subsection shall apply to concrete containments.

IWL-1220 ITEMS EXEMPT FROM EXAMINATION

The following items are exempt from the examination requirements of IWL-2000:

(a) tendon end anchorages that are inaccessible, subject to the requirements of IWL-2521.1;

(b) portions of the concrete surface that are covered by the liner, foundation material, or backfill, or are otherwise obstructed by adjacent structures, components, parts, or appurtenances.

ARTICLE IWL-2000
EXAMINATION AND INSPECTION

IWL-2100 INSPECTION

Examinations shall be verified by an Inspector.

IWL-2200 PRESERVICE EXAMINATION

Preservice examination shall be performed in accordance with the requirements of IWL-2500.

IWL-2210 EXAMINATION SCHEDULE

Preservice examination shall be completed prior to initial plant startup.

IWL-2220 EXAMINATION REQUIREMENTS

IWL-2220.1 Concrete

(a) Preservice examination shall be performed in accordance with IWL-2510.

(b) The preservice examination shall be performed following completion of the containment Structural Integrity Test.

IWL-2220.2 Unbonded Post-Tensioning Systems. The following information shall be documented in the preservice examination records. This information may be extracted from construction records.

(a) Date on which each tendon was tensioned.

(b) Initial seating force in each tendon.

(c) For each tendon anchorage, the location of all missing or broken wires or stands and unseated wires.

(d) For each tendon anchorage, the location of all missing or detached buttonheads or missing wedges.

(e) The product designation for the corrosion protection medium used to fill the tendon duct.

IWL-2230 PRESERVICE EXAMINATION OF REPAIRS AND MODIFICATIONS

(a) When a concrete containment or a portion thereof is repaired or modified during the service lifetime of a plant, the preservice examination requirements shall be met for the repair or modification.

(b) When the repair or modification is performed while the plant is not in service, the preservice examination shall be performed prior to resumption of service.

(c) When the repair or modification is performed while the plant is in service, the preservice examination may be deferred to the next scheduled outage.

IWL-2300 VISUAL EXAMINATION, PERSONNEL QUALIFICATION, AND RESPONSIBLE ENGINEER A92

IWL-2310 VISUAL EXAMINATION AND PERSONNEL QUALIFICATION

(a) VT-1C visual examinations are conducted to determine concrete deterioration and distress for suspect areas detected by VT-3C, and conditions (e.g., cracks, wear, or corrosion) of tendon anchorage and wires or strands. Minimum illumination, maximum direct examination distance, and maximum procedure demonstration lower case character height shall be as specified in IWA-2210 for VT-1 visual examination.

(b) VT-3C visual examinations are conducted to determine the general structural condition of concrete surfaces of containments by identifying areas of concrete deterioration and distress, such as defined in ACI 201.1 R-68. The minimum illumination, maximum direct examination distance, and maximum procedure demonstration lower case character height shall be as specified in IWA-2210 for VT-3 visual examination.

(c) The Owner's written practice shall define qualification requirements for concrete examination personnel in accordance with IWA-2300. Limited certification in accordance with IWA-2350 may be used for examiners limited to concrete.

IWL-2320 RESPONSIBLE ENGINEER

The Responsible Engineer shall be a Registered Professional Engineer experienced in evaluating the in-service condition of structural concrete. The Responsible Engineer shall have knowledge of the design and Construction Codes and other criteria used in design and construction of concrete containments in nuclear power plants.

The Responsible Engineer shall be responsible for the following:

(a) development of plans and procedures for examination of concrete surfaces;

(b) approval, instruction, and training of concrete examination personnel;

(c) evaluation of examination results;

(d) preparation of repair procedures;

(e) submittal of report to the Owner documenting results of examinations and repairs.

IWL-2400 INSERVICE INSPECTION SCHEDULE

IWL-2410 CONCRETE

(a) Concrete shall be examined in accordance with IWL-2510 at 1, 3, and 5 years following the completion of the containment Structural Integrity Test CC-6000 and every 5 years thereafter.

(b) The 1, 3, and 5 year examinations shall commence not more than 6 months prior to the specified dates and shall be completed not more than 6 months after such dates. If plant operating conditions are such that examination of portions of the concrete cannot be completed within this stated time interval, examination of those portions may be deferred until the next regularly scheduled plant outage.

(c) The 10 year and subsequent examinations shall commence not more than 1 year prior to the specified dates and shall be completed not more than 1 year after such dates.

IWL-2420 UNBONDED POST-TENSIONING SYSTEMS

(a) Unbonded post-tensioning systems shall be examined in accordance with IWL-2520 at 1, 3, and 5 years following the completion of the containment Structural Integrity Test and every 5 years thereafter.

(b) The 1, 3, and 5 year examinations shall com-

mence not more than 6 months prior to the specified dates and shall be completed not more than 6 months after such dates. If plant operating conditions are such that examination of portions of the post-tensioning system cannot be completed within this stated time interval, examination of those portions may be deferred until the next regularly scheduled plant outage.

(c) The 10 year and subsequent examinations shall commence not more than 1 year prior to the specified dates and shall be completed not more than 1 year after such dates.

IWL-2421 Sites With Two Plants

(a) For sites with two plants, the examination requirements for the concrete containments may be modified if both containments utilize the same prestressing system and are essentially identical in design, if post-tensioning operations for the two containments were completed not more than 2 years apart, and if both containments are similarly exposed to or protected from the outside environment.

(b) When the conditions of IWL-2421(a) are met, the inspection dates and examination requirements may be as follows.

(1) For the containment with the first Structural Integrity Test, all examinations required by IWL-2500 shall be performed at 1, 3, 10, 20, and 30 years. Only the examinations required by IWL-2524 and IWL-2525 need be performed at 5, 15, 25, and 35 years.

(2) For the containment with the second Structural Integrity Test, all examinations required by IWL-2500 shall be performed at 1, 5, 15, 25, and 35 years. Only the examinations required by IWL-2524 and IWL-2525 need be performed at 3, 10, 20, and 30 years.

IWL-2500 EXAMINATION REQUIREMENTS

Examination shall be performed in accordance with the requirements of Table IWL-2500-1.

A92 **IWL-2510 EXAMINATION OF CONCRETE**

(1) Concrete surface areas, including coated areas, except those exempted by IWL-1200(b), shall be VT-3C visual examined for evidence of conditions indicative of damage or degradation, such as defined in ACI 201.1 R-68, in accordance with IWL-2310(b). Selected areas, such as those that indicate suspect conditions, shall receive a VT-1C examination in accordance with IWL-2310(a).

(b) The examination shall be performed by, or under the direction of, the Responsible Engineer.

(c) Visual examinations may be performed from floors, roofs, platforms, walkways, ladders, ground surface, or other permanent vantage points, unless temporary close-in access is required by the inspection plan.

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IWL-2520 EXAMINATION OF UNBONDED POST-TENSIONING SYSTEMS

IWL-2521 Tendon Selection

(a) Tendons to be examined during an inspection shall be selected on a random basis except as noted in IWL-2521(b) and (c). The population from which the random sample is drawn shall consist of all tendons which have not been examined during earlier inspections. The number of tendons to be examined during an inspection shall be as specified in Table IWL-2521-1.

(b) One tendon of each type (as defined in Table IWL-2521-1) shall be selected from the first year inspection sample and designated as a common tendon. Each common tendon shall be examined during each inspection. A common tendon shall not be detensioned unless required by IWL-3300. If a common tendon is detensioned, another common tendon of the same type shall be selected from the first year inspection sample.

(c) If a containment with a stranded post-tensioning system is constructed with a predesignated number of detensionable tendons, one tendon of each type shall be selected from among those which are detensionable. The remaining tendons shall be selected from among those which cannot be detensioned.

IWL-2521.1 Exemptions. The following requirements shall apply to tendon anchorages that are not accessible for examination because of safety or radiological hazards or because of structural obstructions.

(a) After the process of randomly selecting tendons to be examined, any inaccessible tendons shall be designated as exempt and removed from the sample.

(b) Substitute tendons shall be selected for all tendons designated as exempt. Each substitute tendon shall be selected so that it is located as close as possible to

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TABLE IWL-2500-1
EXAMINATION CATEGORIES

EXAMINATION CATEGORY L-A, CONCRETE							
Item No.	Parts Examined	Test or Examination Requirement	Test or Examination Method	Acceptance Standard	Extent of Examination	Frequency of Examination	Deferral of Examination
L1.10	Concrete Surface						
L1.11	All Areas	IWL-2510	Visual, VT-3C	IWL-3210	IWL-2510	IWL-2410	NA
L1.12	Suspect Areas	IWL-2510	Visual, VT-1C	IWL-3210	IWL-2510	IWL-2410	NA

EXAMINATION CATEGORY L-B, UNBONDED POST-TENSIONING SYSTEM							
Item No.	Parts Examined	Test or Examination Requirement	Test or Examination Method	Acceptance Standard	Extent of Examination	Frequency of Examination	Deferral of Examination
L2.10	Tendon	IWL-2522	IWL-2522	IWL-3221.1	IWL-2521	IWL-2420	NA
L2.20	Wire or Strand	IWL-2523	IWL-2523.2	IWL-3221.2	IWL-2523.1	IWL-2420	NA
L2.30	Anchorage Hardware and Surrounding Concrete	IWL-2524	Visual, VT-1 and VT-1C	IWL-3221.3	IWL-2524.1	IWL-2420	NA
L2.40	Corrosion Protection Medium	IWL-2525	IWL-2525.2(a)	IWL-3221.4	IWL-2525.1(a)	IWL-2420	NA
L2.50	Free Water	IWL-2525	IWL-2525.2(b)		IWL-2525.1(b)	IWL-2420	NA

TABLE IWL-2521-1
NUMBER OF TENDONS FOR EXAMINATION

Inspection Period	Percentage[1,2] of all Tendons of Each Type[3]	Required Minimum[1] Number of Each Type	Maximum Required Number of Each Type
1st year	4	4	10
3rd year	4	4	10
5th year	4	4	10
10th year	2	3	5
15th year	2	3	5
20th year	2	3	5
25th year	2	3	5
30th year	2	3	5
35th year	2	3	5

NOTES:
(1) Fractional tendon numbers shall be rounded to the next higher integer. Actual number examined shall not be less than the minimum required number and need not be more than the maximum required number.
(2) The reduced sample size listed for the 10th year and subsequent inspections is applicable only if the acceptance criteria of IWL-3221.1 are met during each of the earlier inspections.
(3) A tendon type is defined by its geometry and position in the containment; e.g., hoop, vertical, dome, helical, and inverted U.

the exempted tendon, and shall be examined in accordance with IWL-2520.

(c) Each exempted tendon shall be examined in accordance with IWL-2524 and IWL-2525 to the extent that the end anchorages of the exempt tendon are accessible either during operation or at an outage.

IWL-2522 Tendon Force Measurements

(a) The prestressing force in all inspection sample tendons shall be measured by lift-off or an equivalent test.

(b) Equipment used to measure tendon force shall be calibrated in accordance with a calibration procedure prior to the first tendon force measurement and following the final tendon force measurement of the inspection period. Accuracy of the calibration shall be within 1.5% of the specified minimum ultimate strength of the tendon. If the post-test calibration differs from the pretest calibration by more than the specified accuracy tolerance, the results of the examination shall be evaluated.

IWL-2523 Tendon Wire and Strand Sample Examination and Testing

IWL-2523.1 Tendon Detensioning and Sample Removal. One sample tendon of each type shall be completely detensioned. A single wire or strand shall be removed from each detensioned tendon.

IWL-2523.2 Sample Examination and Testing

(a) Each removed wire or strand shall be examined over its entire length for corrosion and mechanical damage. The examination shall determine the location of most severe corrosion, if any. Strand wires shall be examined for wedge slippage marks.

(b) Tension tests shall be performed on each removed wire or strand: one at each end, one at mid-length, and one in the location of the most corroded area, if any. The following information shall be obtained from each test:

(1) yield strength
(2) ultimate tensile strength
(3) elongation

IWL-2523.3 Retensioning. Tendons that have been detensioned shall be retensioned to at least the force predicted for the tendon at the time of the test. However, the retensioning force shall not exceed 70% of the specified minimum ultimate tensile strength of the tendon based on the number of effective wires or strands in the tendon at the time of retensioning.

IWL-2524 Examination of Tendon Anchorage Areas

IWL-2524.1 Visual Examination. A VT-1 visual examination in accordance with IWA-2411 shall be performed on the tendon anchorage hardware, including bearing plates, anchorheads, wedges, buttonheads, shims, and the concrete extending outward a distance of 2 ft from the edge of the bearing plate. The following shall be documented:

(a) concrete cracks having widths greater than 0.01 in.;

(b) corrosion, broken or protruding wires, missing buttonheads, broken strands, and cracks in tendon anchorage hardware;

(c) broken wires or strands, protruding wires and detached buttonheads following retensioning of tendons which have been detensioned.

IWL-2524.2 Free Water Documentation. The quantity of free water contained in the anchorage end cap as well as any which drains from the tendon during the examination process shall be documented.

IWL-2525 Examination of Corrosion Protection Medium and Free Water

IWL-2525.1 Samples

(a) Samples of the corrosion protection medium shall

TABLE IWL-2525-1
CORROSION PROTECTION MEDIUM ANALYSIS

Characteristic	Test Method	Acceptance Limit
Water content	ASTM D 95	In course of preparation
Water soluble chlorides	ASTM D 512 [Note (1)]	10 ppm maximum
Water soluble nitrates	ASTM D 992 [Note (1)]	10 ppm maximum
Water soluble sulfides	APHA 427 [Note (1)] (Methylene blue)	10 ppm maximum
Reserve alkalinity (Base number)	ASTM D 974 Modified [Note (2)]	[Note (3)]

NOTES:

(1) *Water Soluble Ion Tests.* The inside (bottom and sides) of a one (1) liter beaker, approx. OD 105 mm, height 145 mm, is thoroughly coated with 100 ±10 grams of the sample. The coated beaker is filled with approximately 900 ml of distilled water and heated in an oven at a controlled temperature of 100°F (37.8°C) ±2°F for 4 hours. The water extraction is tested by the noted test procedures for the appropriate water soluble ions. Results are reported as PPM in the extracted water.

(2) *ASTM D 974 Modified.* Place 10 g of sample in a 500 ml Erlenmeyer flask. Add 10 cc isopropyl alcohol and 5 cc toluene. Heat until sample goes into solution. Add 90 cc distilled water and 20 cc $1N H_2SO_4$. Place solution on a steam bath for ½ hour. Stir well. Add a few drops of indicator (1% phenolphthalein) and titrate with 1N NaOH until the lower layer just turns pink. If acid or base solutions are not exactly 1N, the exact normalities should be used when calculating the base number. The Total Base Number (TBN), expressed as milligrams of KOH per gram of sample, is calculated as follows:

$$TBN = \frac{[(20)(N_A) - (B)(N_B)]\,56.1}{W}$$

where

B = milliliters NaOH
N_A = normality of H_2SO_4 solution
N_B = normality of NaOH solution
W = weight of sample in grams

(3) The base number shall be at least 50% of the as-installed value, unless the as-installed value is 5 or less, in which case the base number shall be no less than zero. If the tendon duct is filled with a mixture of materials having various as-installed base numbers, the lowest number shall govern acceptance.

be taken from each end of each tendon examined. Free water shall not be included in the samples.

(b) Samples of free water shall be taken where water is present in quantities sufficient for laboratory analysis.

IWL-2525.2 Sample Analysis

(a) Corrosion protection medium samples shall be thoroughly mixed and analyzed for reserve alkalinity, water content, and concentrations of water soluble chlorides, nitrates, and sulfides. Analyses shall be performed in accordance with the procedures specified in Table IWL-2525-1.

(b) Free water samples shall be analyzed to determine pH.

IWL-2526 Removal and Replacement of Corrosion Protection Medium

The amount of corrosion protection medium removed at each anchorage shall be measured and the total amount removed from each tendon (two anchorages) shall be recorded. The total amount replaced in each tendon shall be recorded and differences between amount removed and amount replaced shall be documented.

ARTICLE IWL-3000
ACCEPTANCE STANDARDS

IWL-3100 PRESERVICE EXAMINATION

IWL-3110 CONCRETE SURFACE CONDITION

IWL-3111 Acceptance by Examination

The condition of the surface is acceptable if the Responsible Engineer determines that there is no evidence of damage or degradation sufficient to warrant further evaluation or repair.

IWL-3112 Acceptance by Evaluation

Items with examination results that do not meet the acceptance standards of IWL-3111 shall be evaluated as required by IWL-3300.

IWL-3113 Acceptance by Repair

Repairs required to reestablish acceptability of an item shall be completed as required by IWL-3300. Acceptable completion of the repair shall constitute acceptability of the item.

IWL-3120 UNBONDED POST-TENSIONING SYSTEM

The condition of the unbonded post-tensioning system is acceptable if it met the requirements of the construction specification at the time of installation.

IWL-3200 INSERVICE EXAMINATION

IWL-3210 CONCRETE SURFACE CONDITION

IWL-3211 Acceptance by Examination

The condition of the concrete surface is acceptable if the Responsible Engineer determines that there is no evidence of damage or degradation sufficient to warrant further evaluation or repair.

IWL-3212 Acceptance by Evaluation

Items with examination results that do not meet the acceptance standards of IWL-3211 shall be evaluated as required by IWL-3300.

IWL-3213 Acceptance by Repair

Repairs to reestablish the acceptability of an item shall be completed as required by IWL-3300. Acceptable completion of the repair shall constitute acceptability of the item.

IWL-3220 UNBONDED POST-TENSIONING SYSTEMS

IWL-3221 Acceptance by Examination

IWL-3221.1 Tendon Force. Tendon forces are acceptable if:

(a) the average of all measured tendon forces, including those measured in IWL-3221.1(b)(2), for each type of tendon is equal to or greater than the minimum required prestress specified at the anchorage for that type of tendon;

(b) the measured force in each individual tendon is not less than 95% of the predicted force unless the following conditions are satisfied:

(1) the measured force in not more than one tendon is between 90% and 95% of the predicted force;

(2) the measured forces in two tendons located adjacent to the tendon in IWL-3221.1(b)(1) are not less than 95% of the predicted forces; and

(3) the measured forces in all the remaining sample tendons are not less than 95% of the predicted force.

IWL-3221.2 Tendon Wire or Strand Samples. The condition of wire or strand samples is acceptable if:

(a) samples are free of physical damage;

(b) sample ultimate tensile strength and elongation e not less than minimum specified values.

IWL-3221.3 Tendon Anchorage Areas. The condition of tendon anchorage areas is acceptable if:

(a) there is no evidence of cracking in anchor heads, shims, or bearing plates;

(b) there is no evidence of active corrosion;

(c) broken or unseated wires, broken strands, and detached buttonheads were documented and accepted during a preservice examination or during a previous inservice examination;

(d) cracks in the concrete adjacent to the bearing plates do not exceed 0.01 in. in width.

IWL-3221.4 Corrosion Protection Medium. Corrosion protection medium is acceptable when the reserve alkalinity, water content, and soluble ion concentrations of all samples are within the limits specified in Table IWL-2525-1.

IWL-3222 Acceptance by Evaluation

Items with examination results that do not meet the acceptance standards of IWL-3221 shall be evaluated as required by IWL-3300.

IWL-3223 Acceptance by Repair or Replacement

Repairs or replacements to reestablish acceptability the condition of an item shall be completed as re- red by IWL-3300. Acceptable completion of the repair or replacement shall constitute acceptability of the item.

IWL-3300 EVALUATION

IWL-3310 EVALUATION REPORT

Items with examination results that do not meet the acceptance standards of IWL-3100 or IWL-3200 shall be evaluated by the Owner. The Owner shall be responsible for preparation of an Engineering Evaluation Report stating the following:

(a) the cause of the condition which does not meet the acceptance standards;

(b) the acceptability of the concrete containment without repair of the item;

(c) whether or not repair or replacement is required and, if required, the extent, method, and completion date for the repair or replacement;

(d) extent, nature, and frequency of additional examinations.

IWL-3320 REVIEW BY AUTHORITIES

The Engineering Evaluation Report shall be subject to review by the regulatory and enforcement authorities having jurisdiction at the plant site.

ARTICLE IWL-4000
REPAIR PROCEDURES

IWL-4100 GENERAL

IWL-4110 SCOPE

This Article provides rules and requirements for repair of concrete containments.

IWL-4120 REPAIR/REPLACEMENT PROGRAM

(a) Repairs shall be performed in accordance with the Repair/Replacement Program required by IWA-4140.

(b) Repairs shall be completed in accordance with the Repair Plan of IWL-4200.

(c) The Repair/Replacement Program shall address concrete material control.

IWL-4200 REPAIR PLAN

The Repair Plan shall be developed under the direction of a Responsible Engineer (IWL-2500).

IWL-4210 CONCRETE REPAIR

(a) The Repair Plan shall specify requirements for removal of defective material.

(b) The affected area shall be visually examined to assure proper surface preparation of concrete and reinforcing steel prior to placement of repair material.

(c) When removal of defective material exposes reinforcing steel, the reinforcing steel shall receive a VT-1 visual examination. Reinforcing steel is acceptable when the Responsible Engineer determines that there is no evidence of damage or degradation sufficient to warrant further evaluation or repair. When required, reinforcing steel shall be repaired in accordance with IWL-4220. Repair of exposed-end anchors of the post-tensioning system shall be in accordance with IWL-4230.

(d) Repair material shall be chemically, mechanically, and physically compatible with existing concrete.

(e) When detensioning of prestressing tendons is required for repair of the concrete surface adjacent to the tendon, the Repair Plan shall require the following:

(1) selection of repair material to minimize stress and strain incompatibilities between repair material and existing concrete;

(2) procedures for application of repair material;

(3) procedures for detensioning and retensioning of prestressing tendons.

(f) The Repair Plan shall specify requirements for in-process sampling and testing of repair material.

IWL-4220 REPAIR OF REINFORCING STEEL

Damaged reinforcing steel shall be repaired by any method permitted in the original Construction Code or in Section III, Division 2, with or without removal of the damaged reinforcing steel.

IWL-4230 REPAIR OF THE POST-TENSIONING SYSTEM

(a) Weld repair of bearing plates and shim plates of the post-tensioning system shall meet the applicable requirements of IWA-4000. The corrosion protection medium shall be restored following the repair.

(b) Procedures for detensioning and retensioning of prestressing tendons shall be specified in the Repair Plan.

IWL-4300 EXAMINATION

The repaired area shall be examined in accordance with IWL-2000 to establish a new preservice record and shall meet the acceptance standards of IWL-3000.

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ARTICLE IWL-5000
SYSTEM PRESSURE TESTS

IWL-5100 SCOPE

This Article provides requirements for pressure testing concrete containments following repair or replacement.

IWL-5200 SYSTEM TEST REQUIREMENTS

IWL-5210 GENERAL

A containment pressure test shall be performed following repair or replacement unless any of the following conditions exist:

(a) The Engineering Evaluation Report (IWL-3310) demonstrates that the structural integrity of containment in the existing unrepaired condition has not been reduced below that required by the original design criteria.

(b) The repair or replacement affects only the cover concrete external to the outermost layer of structural reinforcing steel or post-tensioning tendons.

(c) The repair or replacement involves only exchange of post-tensioning tendons, tendon anchorage hardware, shims, or corrosion protection medium.

IWL-5220 TEST PRESSURE

The pressure test shall be conducted at the design basis accident pressure, P_a.

IWL-5230 LEAKAGE TEST

If the repair or replacement penetrated the containment metallic liner, or otherwise breached containment leak-tight integrity, a leakage rate test shall be conducted as required by IWE-5000.

IWL-5240 SCHEDULE OF PRESSURE TEST

If the repair or replacement is performed with the plant shutdown, the pressure test shall be conducted prior to resumption of operation. If the repair or replacement is performed with the plant in operation, the pressure test may be deferred until the next scheduled integrated leak-rate test.

IWL-5250 TEST PROCEDURE AND EXAMINATIONS

The pressure test shall be conducted in accordance with a detailed procedure prepared under the direction of the Responsible Engineer. The surface of all containment concrete placed during repair or replacement operations shall be examined by VT-1 examination prior to start of pressurization, at test pressure, and following completion of depressurization. Extended surface examinations, additional examinations during pressurization, other examinations, and measurements of structural response to pressure shall be conducted as specified by the Responsible Engineer.

IWL-5260 CORRECTIVE MEASURES

If the surface examinations of IWL-5250 cannot satisfy the requirements specified by the Responsible Engineer, the area shall be examined to the extent necessary to establish requirements for corrective action. Repairs shall be performed in accordance with IWL-4000, and pressure testing shall be repeated in accordance with IWL-5200, prior to returning the containment to service.

IWL-5300 REPORT

A pressure test report shall be prepared under the direction of the Responsible Engineer. This report may be an addition to a previously-prepared Engineering Evaluation Report (IWL-3310). The report shall describe pressure test procedures and examination results and shall state whether or not the repair or replacement is acceptable. If the repair or replacement is not acceptable, the report shall specify corrective measures.

ARTICLE IWL-7000
REPLACEMENTS

IWL-7100 GENERAL REQUIREMENTS

IWL-7110 SCOPE

(a) This Article provides rules and requirements for reinstallation and replacement of post-tensioning system items for concrete containments.

(b) Grease caps and installation screws are exempt from the requirements of this Article.

IWL-7120 REPLACEMENT PROGRAM

The following items, as applicable, shall be contained in the Replacement Plan:

(a) requirements for removal of items that are to be replaced;

(b) surface preparation required prior to installation of replacement items;

(c) examinations required prior to installation of replacement items;

(d) detensioning and retensioning requirements for tendons affected by installation of replacement items;

(e) requirements and procedures applicable to installation of replacement items;

(f) in-process sampling and testing requirements to be performed during installation of replacement items.