Progress Energy

December 4, 2006 SGR06-0102

Chris Sward
Engineering Manager
Sargent & Lundy
55 East Monroe St.
Chicago, IL 60603

Subject: RB Pressure and Temperature - Loss of Decay Heat During Lowered Loop Operation Rev. 1

Chris,

The current PEF analysis of record for the subject event is acceptable for use as a design input for the evaluation of the capability of the liner plate and shell to withstand a loss of decay heat during lowered loop operation.

Specifically:

M-92-0041, Revision 2, page 14 of 16, Section 8.3 indicates the peak pressure to be 20.14 psia from an initial assumed RB pressure of 15 psia, yielding 5.14 psig as the applicable design input. The peak internal RB temperature is given as 173 degrees F.

Note: This letter may be used as a developmental reference in the calculation; however the design input remains the current analysis, M-92-0041, Revision 2.

S. P. Swenson
CR3 Major Projects
Mechanical Design Lead Engineer

D. L. Jopling
CR3 Major Projects
Supervisor

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0/90

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April 19, 2007 SGR07-0053

Chris Sward
Engineering Manager
SARGENT & LUNDY
55 East Monroe St.
Chicago, Il. 60603

Subject: Design Load Conditions

Chris,

When evaluating the effects of the TLD & HTS (both dead load & with lifted load) on the containment wall, do not include seismic, hurricane or tornado loads in your analysis. The TLD & HTS loads are to be combined with dead load, pre-stress and the operating temperature specified in PE Letter SGR07-0026, dated 2/14/07

John Holliday
Responsible Engineer for Containment Opening

Dan Jopling
CR3 SGR Supervisor

cc: Records Management

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February 14, 2007 SGR07-0026

Chris Sward
(Engineering Manager)
Sargent & Lundy
55, East Monroe St.
Chicago, IL 60603

Subject: Design Inputs for Containment Shell Analysis for Steam Generator Replacement

Chris,

The following Design Inputs are to be used in your evaluation of the containment shell where applicable:

A. Between cold shut down and defueled modes:

Inside Containment = 110°F (Note 1)
Outside Containment = 69°F (Note 2)
Soil = 74°F (Note 2)

B. Between defueled mode and full restoration of access opening:

Inside Containment = 90°F (Note 3)
Outside Containment = 69°F (Note 2)
Soil = 74°F (Note 2)

C. Actual strength of existing containment shell concrete is 6720 psi (Note 4)

D. When considering the TLD loads, consider additional load from the polar crane with a minimum spacing of 8 feet between the wheels of TLD and polar crane and a maximum of 60 kips lifted load by polar crane.

NOTES:

1. Refer to Gilbert Calculation 1.01.07, Page 6
2. Refer to attached information downloaded from the University of Florida's FAWN (Florida Automated Weather Network) website at http://fawn.ifas.ufl.edu/scripts/reportrequest.asp
3. Based on outage experience and also on the fact that during most of this time period the equipment hatch and access opening are open to outside ambient temperature of 69°F (Refer to B above).
4. Refer to Calculation S-00-0047, Rev.0

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Subject: Design Inputs for Containment Shell Analysis for Steam Generator Replacement
February 14, 2007
Page 2

John Holliday 2/14/07

John Holliday
Responsible Engineer for Containment Opening

K. Henshaw 2/14/07

Keith Henshaw (for Item #D)
Task Manager Rigging and Transport

Dan Jopling 2/14/07

Dan Jopling
CR3 SGR Supervisor

Attachment 1 - Florida Automated Weather Network

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Weather Information for Brooksville, Fl downloaded from the University of Florida at http://fawn.ifas.ufl.edu/scripts/reportrequest.asp

Year	Month	10m AVGt (C)	10m MINt (C)	10m MAXt (C)	-10cm AVGt (C)	-10cm MINt (C)	-10cm MAXt (C)
2003	1	10.59	-4.52	24.11	12.92	9.16	17.42
2003	2	15.76	1.57	28.56	16.31	11.93	20.87
2003	3	20.21	3.43	30.67	21.59	16.94	26.03
2003	4	20.32	0.14	30.85	23.31	15.98	28.57
2003	5	24.69	16.48	33.46	29.83	24.52	33.53
2003	6	25.23	19.89	33.58	30.04	24.79	35.11
2003	7	25.87	20.78	33.77	31.33	28.03	36.06
2003	8	25.63	20.8	33.02	30.56	27.6	34
2003	9	24.99	17.3	32.53	29.8	26.93	33.57
2003	10	22.39	10.83	31.34	25.89	21.03	29.21
2003	11	19.64	2.07	30.4	22.18	14.97	27.06
2003	12	13.03	-1.97	25.79	15.32	10.82	19.29

Year	Month	10m AVGt (F)	10m MINt (F)	10m MAXt (F)	-10cm AVGt (F)	-10cm MINt (F)	-10cm MAXt (F)
2003	1	51.062	23.864	75.398	55.256	48.488	63.356
2003	2	60.368	34.826	83.408	61.358	53.474	69.566
2003	3	68.378	38.174	87.206	70.862	62.492	78.854
2003	4	68.576	32.252	87.53	73.958	60.764	83.426
2003	5	76.442	61.664	92.228	85.694	76.136	92.354
2003	6	77.414	67.802	92.444	86.072	76.622	95.198
2003	7	78.566	69.404	92.786	88.394	82.454	96.908
2003	8	78.134	69.44	91.436	87.008	81.68	93.2
2003	9	76.982	63.14	90.554	85.64	80.474	92.426
2003	10	72.302	51.494	88.412	78.602	69.854	84.578
2003	11	67.352	35.726	86.72	71.924	58.946	80.708
2003	12	55.454	28.454	78.422	59.576	51.476	66.722
	AVERAGE	**69.2525**	**48.02**	**87.212**	**75.362**	**66.905**	**83.108**

Year	Month	10m AVGt (C)	10m MINt (C)	10m MAXt (C)	-10cm AVGt (C)	-10cm MINt (C)	-10cm MAXt (C)
2004	1	13.11	-2.38	26.88	14.99	11.56	19.36
2004	2	15.13	0.86	28.2	16.76	13.29	19.72
2004	3	18.21	2.91	28.7	18.96	15.39	21.76
2004	4	19.18	6.01	31.34	21.19	17.34	26.31
2004	5	24.1	11.71	33.18	27.2	22.38	31.73
2004	6	26.08	18.98	34.22	29.94	27.35	32.42
2004	7	26.34	20.98	34.28	30.17	27.69	32.57
2004	8	25.87	20.66	33.17	29.75	26.65	32.6
2004	9	25.69	18.72	33.15	28.12	25.12	32.29
2004	10	22.79	8.89	32.21	25.41	21.22	29.37
2004	11	19.11	6.53	30.2	21.27	17.6	25.58
2004	12	13.79	-1.14	28.24	16.45	12.02	21.52

Year	Month	10m AVGt (F)	10m MINt (F)	10m MAXt (F)	-10cm AVGt (F)	-10cm MINt (F)	-10cm MAXt (F)
2004	1	55.598	27.716	80.384	58.982	52.808	66.848
2004	2	59.234	33.548	82.76	62.168	55.922	67.496
2004	3	64.778	37.238	83.66	66.128	59.702	71.168
2004	4	66.524	42.818	88.412	70.142	63.212	79.358
2004	5	75.38	53.078	91.724	80.96	72.284	89.114
2004	6	78.944	66.164	93.596	85.892	81.23	90.356
2004	7	79.412	69.764	93.704	86.306	81.842	90.626
2004	8	78.566	69.188	91.706	85.55	79.97	90.68
2004	9	78.242	65.696	91.67	82.616	77.216	90.122
2004	10	73.022	48.002	89.978	77.738	70.196	84.866
2004	11	66.398	43.754	86.36	70.286	63.68	78.044
2004	12	56.822	29.948	82.832	61.61	53.636	70.736
	AVERAGE	**69.41**	**48.9095**	**88.0655**	**74.0315**	**67.6415**	**80.7845**

Year	Month	10m AVGt (C)	10m MINt (C)	10m MAXt (C)	-10cm AVGt (C)	-10cm MINt (C)	-10cm MAXt (C)
2005	1	15.03	-2.06	27.81	16	11.6	19.98
2005	2	15.64	2.09	25.84	16.62	13.23	19.75
2005	3	16.63	1.98	29.7	17.73	14.05	22
2005	4	18.73	6.4	30.31	20.43	17.22	22.89
2005	5	22.74	10.92	33.97	24.15	20.58	27.75
2005	6	25.41	20.23	32.72	27.57	24.84	30.21
2005	7	26.91	21.8	34.81	29.91	27.37	33.75
2005	8	26.97	21.65	34.47	31.14	28.23	34.59
2005	9	25.8	19.52	32.69	28.88	26.14	32.68
2005	10	22.02	5.02	31.53	25.39	18.68	29.91
2005	11	18.98	2.51	29	20.51	16.35	22.94
2005	12	12.75	0.51	25.71	15.52	11.86	18.93

Year	Month	10m AVGt (F)	10m MINt (F)	10m MAXt (F)	-10cm AVGt (F)	-10cm MINt (F)	-10cm MAXt (F)
2005	1	59.054	28.292	82.058	60.8	52.88	67.964
2005	2	60.152	35.762	78.512	61.916	55.814	67.55
2005	3	61.934	35.564	85.46	63.914	57.29	71.6
2005	4	65.714	43.52	86.558	68.774	62.996	73.202
2005	5	72.932	51.656	93.146	75.47	69.044	81.95
2005	6	77.738	68.414	90.896	81.626	76.712	86.378
2005	7	80.438	71.24	94.658	85.838	81.266	92.75
2005	8	80.546	70.97	94.046	88.052	82.814	94.262
2005	9	78.44	67.136	90.842	83.984	79.052	90.824
2005	10	71.636	41.036	88.754	77.702	65.624	85.838
2005	11	66.164	36.518	84.2	68.918	61.43	73.292
2005	12	54.95	32.918	78.278	59.936	53.348	66.074
	AVERAGE	**69.1415**	**48.5855**	**87.284**	**73.0775**	**66.5225**	**79.307**

Year	Month	10m AVGt (C)	10m MINt (C)	10m MAXt (C)	-10cm AVGt (C)	-10cm MINt (C)	-10cm MAXt (C)
2006	1	15.39	-0.75	27.01	15.68	12	19.18
2006	2	14.02	-4.77	27.78	15.24	9.76	19.95
2006	3	17.63	1.72	29.59	18.67	15.29	21.35
2006	4	21.34	7.47	31.87	22.05	18.95	25.12
2006	5	23.23	11.79	33.6	24.68	21.29	29.6
2006	6	25.78	16.73	35.03	27.98	25.92	31.11
2006	7	26.46	20.49	34.58	28.35	25.85	30.5
2006	8	26.5	20.61	35.33	28.76	26.69	31.46
2006	9	24.89	14.41	33.15	27.2	24.23	29.74
2006	10	21.56	6.26	31.63	24.05	20.05	26.68
2006	11	16.68	4.47	29.32	19.32	15.09	22.77
2006	12	17.56	2.67	28.14	18.79	15.41	22.3

Year	Month	10m AVGt (F)	10m MINt (F)	10m MAXt (F)	-10cm AVGt (F)	-10cm MINt (F)	-10cm MAXt (F)
2006	1	59.702	30.65	80.618	60.224	53.6	66.524
2006	2	57.236	23.414	82.004	59.432	49.568	67.91
2006	3	63.734	35.096	85.262	65.606	59.522	70.43
2006	4	70.412	45.446	89.366	71.69	66.11	77.216
2006	5	73.814	53.222	92.48	76.424	70.322	85.28
2006	6	78.404	62.114	95.054	82.364	78.656	87.998
2006	7	79.628	68.882	94.244	83.03	78.53	86.9
2006	8	79.7	69.098	95.594	83.768	80.042	88.628
2006	9	76.802	57.938	91.67	80.96	75.614	85.532
2006	10	70.808	43.268	88.934	75.29	68.09	80.024
2006	11	62.024	40.046	84.776	66.776	59.162	72.986
2006	12	63.608	36.806	82.652	65.822	59.738	72.14
	AVERAGE	**69.656**	**47.165**	**88.5545**	**72.6155**	**66.5795**	**78.464**

Progress Energy

July 25, 2006 SGR06-0051

Chris Sward
Engineering Manager
Sargent & Lundy
55 East Monroe St.
Chicago, IL 60603

Subject: Original Gilbert Design Analysis Calculations

Chris,

The original Gilbert design analysis calculations for the plant have been entered into CR-3 quality records. These calculations are the historical records for the design basis of the plant. As such, they can be referenced and used as design inputs by S&L. That being said, S&L will be expected to search the CR-3 calculation data base as needed to insure additional/revised design documentation has not been developed during the life of the plant.

The DBD's and EDBD's are quality records and can be referenced as design inputs.

The use of information provided in the FSAR for benchmarking the FEM model should be acceptable. The design inputs to the new containment model (dia., wall thickness, material, reinforcement, design pressures etc.) are developed from quality records including those discussed above. The benchmarking effort is directed at establishing modeling techniques and execution results are comparable to the 1970's vintage efforts.

D. L. Jopling
CR3 SGR, Supervisor

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Progress Energy

August 9, 2006 SGR06-0054

Chris Sward
Engineering Manager
Sargent & Lundy
55 East Monroe St.
Chicago, IL 60603

Subject: RB Pressure and Temperature

Chris,

The replacement of the CR-3 Once Through Steam Generators with new B & W Canada OTSG's is not expected to have an impact on the following containment items:

Design Basis Operating Temperature and Pressure
Design Basis Accident Pressure
Design Basis Accident Temperature"

A basic design criterion for the new replacement steam generators is that their installation and operation will not change the original plant design basis for operating and accident temperatures and pressures. The design basis values are the result of RCS flow rates and T-hot vs. T-Cold values. The replacement steam generators will not change those values.

D. L. Jopling
CR3 SGR, Supervisor

Robert Lemberger
Task Manager ROTSG
Design/Manufacture

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Precision Surveillance Corporation

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June 6, 2008

Progress Energy
Crystal River unit 3 SGR
Crystal River, FL

Attention: John Holliday

Dear John:

PSC has reviewed your request as to the length of time a tendon at Crystal River may be drained and left unfilled. The Viscosity grease is design to adhere to the wires up to temperature of 145 degree Fahrenheit. This allows for grease coverage to remain on the wire after bulk draining of tendons. This will provide projection for over a year if void is sealed. PSC has observed scrap tendons maintaining the grease coating for over two year exposed to the weather without corrosion occurring under the grease. The original requirement for a shop greased tendon was 90 days from place to stress and 30 days from stress to grease. (Allowing 120 days without grease) There were studies completed by the industry that set the partially drained tendon acceptable time before regreasing at one year. The studies were not published, but several plants adopted the one year window. (Byron & Braidwood, ANO)

Therefore, we recommend a six month window be allowed for tendons to be partially greased with protection from weather. (ie. Top caps on)

Sincerely,

Paul C. Smith

Paul C. Smith
President

PROGRESS ENERGY NUCLEAR

GENERATION GROUP

CR3-C-0002

SPECIFICATION SUB-TYPE: CIV

PRIORITY CODE: 3

SPECIFICATION

FOR

FORMWORK FOR THE RESTORATION OF THE SGR ACCESS OPENING

IN THE CONTAINMENT WALL

☐ BNP UNIT 1 & 2

☒ CR3 ☐HNP ☐RNP ☐ALL

REVISION: 0

QUALITY CLASS: Non-Safety Related

Prepared and Approved under EC 63016, Revision 5

LIST OF EFFECTIVE PAGES

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Pages i-iii.....Rev.0

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REVISION SUMMARY

Revision Number	Summary
0	Original Issue

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1.0 SCOPE

1.1 General

1.1.1 This specification covers the labor, materials and equipment necessary to provide formwork for concrete repair of the temporary construction opening created in the containment wall in support of the Crystal River Unit 3 steam generator replacement project. This specification also covers the labor, materials, and equipment necessary to provide separate formwork for protection of the containment opening in the event severe weather (hurricane). All items in this specification are classified as non-safety related and can be procured by normal commercial means.

1.1.2 Crystal River Unit 3 is scheduled to replace the existing Once-Through Steam Generators (OTSG) during refueling Outage 16 (RFO 16) in the fall of 2009. Replacement of the steam generators will require creation of an access opening through the containment shell to facilitate removal of the existing generators and installation of new ones. Formwork must be erected on the outside face of the containment wall to support placement of fresh concrete in the opening during restoration and a formwork to protect the containment opening during a severe weather.

1.1.3 The post tensioned reinforced concrete containment wall is 42 inches thick, lined with a 3/8" thick liner plate on the inside face. The temporary construction opening in the concrete wall will measure 25 feet wide on the outside face; 26 feet wide on the inside face, by 27 feet high on the outside face; 26'-3" high on the inside face. The grade elevation is at elevation 118'-6" and the bottom of the opening is at elevation 183'-0" on the outside face.

1.1.4 Formwork used to place the concrete in the opening shall be designed to satisfy the following requirements:

1.1.4.a Required to confine the newly placed concrete in the construction opening and shall have sufficient strength to withstand the hydraulic pressure head and pumping pressure developed during placement.

1.1.5 Formwork required to protect the containment opening shall be designed to satisfy the following requirements:

1.1.5.a In the event of a hurricane the formwork shall provide protection for the temporary access opening, thereby protecting the inside of the containment building from the affects of high winds and rain intrusion. The formwork must therefore be designed with the flexibility that it can be erected at ANY time during the steam generator outage. This requirement will require that any anchor

bolts required to anchor the formwork to the outside concrete face of the containment building, around the perimeter of the construction opening, must be installed pre-outage.

1.2 Work Included

1.2.1 The work shall include, but not necessarily be limited to, the following which shall be shown on the installation/erection drawings

1.2.2 Design of the formwork and the form ties, and anchor bolts including preparation of all shop and installation/erection drawings and supporting design calculations. These must be submitted to the Owner for review and approval prior to installation. The owner review and approval does not relieve the contractor of the responsibility for the design of the formwork.

1.2.3 Form ties must be sized by the contractor and a suitable connection detail recommended at the liner plate stiffener angles.

1.2.4 Provide an all-steel concrete formwork system that can accommodate the curved configuration of the CR3 containment building and produce a concrete surface finish that is comparable to the existing building. Form joint marks should require practically no finishing labor.

1.2.5 The formwork system must include pour door panels to provide unimpeded access so that concrete placement can be controlled and properly consolidated.

1.2.6 Forms shall be substantial and sufficiently tight to prevent leakage of mortar.

2.0 <u>CODES AND STANDARDS</u>

2.1 ACI – American Concrete Institute

2.1.1 ACI 318 - Building Code Requirements for Structural Concrete

2.1.2 ACI 304.2R – Placing concrete by Pumping Methods

2.1.3 ACI – 347R – Guide to Formwork for Concrete

3.0 <u>TECHNICAL REQUIREMENTS</u>

3.1 The work shall include, but not necessarily be limited to, the following which shall be shown on the installation/erection drawings:

3.1.1 The severe weather formwork will be anchored to the outside concrete face of the containment building, around the perimeter of the construction opening. This will require the use of drilled in concrete expansion anchors. The maximum anchor bolt hole depth into the concrete is 3 ½". This depth restriction is due to the presence of hoop tendons at a depth of approximately 7" from the concrete surface. The actual location and depth of the hoop tendons cannot be confirmed until after the construction opening has been created, therefore, the vendor may elect to incorporate flexibility into his design with regard to the location of anchor bolts which would allow for the design embedment. There is one layer of #8 vertical and horizontal rebar in the outside face of containment, the first layer (horizontal) is located 2 ¼" clear from the face of concrete. These anchors must be installed pre-outage. The design of the formwork must therefore be sufficiently flexible to ensure that the location of the pre-outage installed anchor bolt locations match the pre-drilled holes in the formwork. The use of slotted holes in these connections should be considered.

3.1.2 Outside radius of the containment building is 68'-6 3/8"

3.1.3 The maximum concrete pour rate is 4 feet per hour.

3.1.4 Weight of wet concrete shall be assumed as 150 pcf for calculation purposes.

3.1.5 Lateral pressure from the newly placed concrete shall be calculated per the requirements of ACI 347-04, Section 2.2 but shall not be less than 1305 psf.

3.1.6 The maximum vertical spacing of ties shall be 2'-6".

3.1.7 Ties may be attached (welded) to the existing vertical angle stiffeners (L3x2x1/4") that are welded to the concrete side of the liner plate. These angles are spaced horizontally at 18" center to center.

3.1.8 Form tie axial load is 6500 lbs.

3.1.9 Severe weather formwork must be designed to resist hurricane force winds with a basic velocity of 110 mph at 30' above grade.

3.1.10 The formwork must be sufficiently rigid to prevent movement, bulging, or sagging during concrete placement.

4.0 DOCUMENTATION REQUIREMENTS

4.1 All items in this specification are classified as non-safety related and can be procured by normal commercial means. Contractor is responsible for the preparation of all shop and installation/erection drawings and supporting design calculations. These must be

submitted to the Owner for review and approval prior to installation. The owner review and approval does not relieve the contractor of the responsibility for the design of the formwork.

5.0 SCHEDULE

Deliver installation drawings and calculations to Progress Energy.....11/19/2008

Owners review and comments.....11/20/08 thru 12/04/08

Incorporate owners comments.....12/05/08 thru 12/19/08

Final issue of drawings and calculations.....01/14/09

Deliver formwork to site.....07/2009

DKEYNO

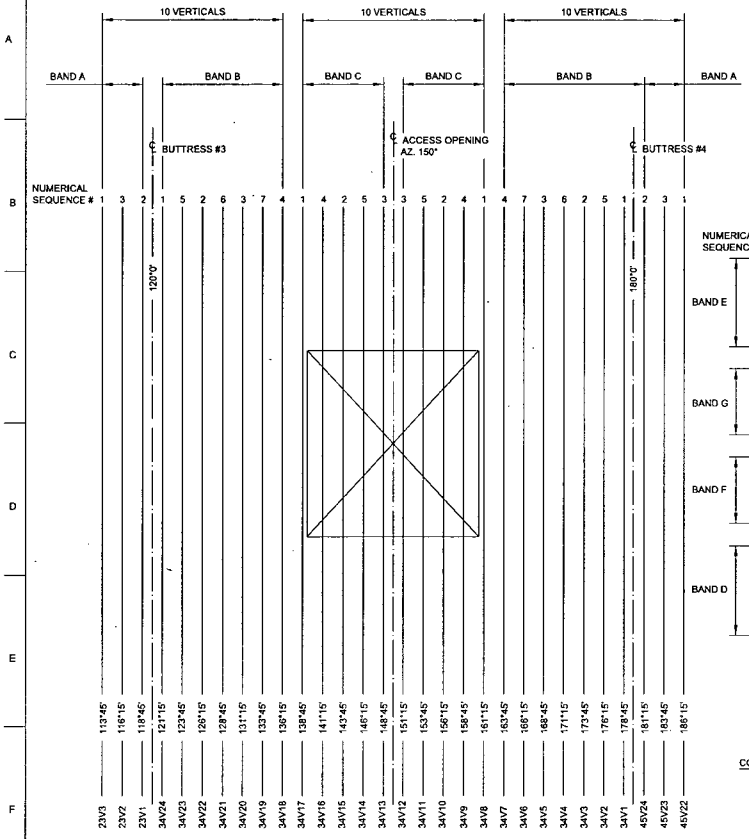
CALCULATED FORCE FOR ELONGATION MEASUREMENT & RETENSIONING 163 WIRE VERTICAL OR HOOP TENDON

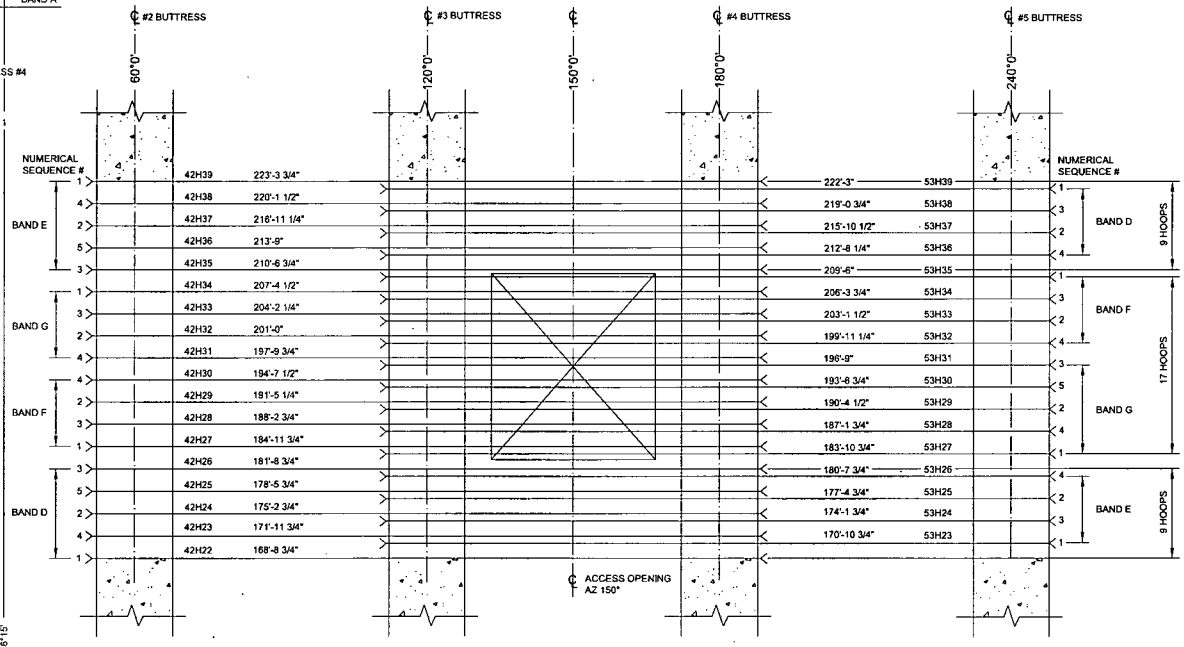
PTF = 350 KIPS

OSF (80% GUTS) = 1867 KIPS (11.46 KIPS FOR THE AMOUNT OF EFFECTIVE WIRES IN A TENDON)

LOF (70% GUTS +4% -2%) = 1633 TO 1727 KIPS

EC 63016R5





VERTICAL TENDON RE-TENSIONING SEQUENCE

VERTICAL TENDONS

V1. RETENSIONING VERTICAL AND HOOP TENDONS MAY START AT THE SAME TIME UNLESS NOTED OTHERWISE.

V2. RETENSIONING TENDONS OUTSIDE THE OPENING (BANDS A AND B) MAY BEGIN AFTER THE CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF AT LEAST 5000 PSI WHICH IS TO BE VERIFIED BY CYLINDER TEST BREAKS.

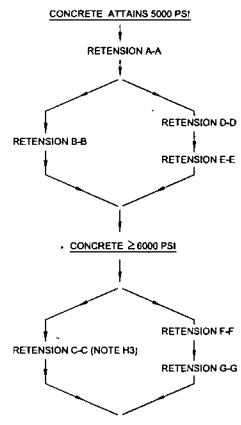
V3. TENSIONING TENDONS INSIDE THE OPENING (BANDS C) CANNOT BEGIN UNTIL BANDS A AND B HAVE BEEN RETENSIONED (SEE NOTE V5) AND THE REPLACEMENT CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF AT LEAST 6000 PSI WHICH IS TO BE VERIFIED BY CYLINDER TEST BREAKS.

V4. RETENSION SIMILAR BANDS CONCURRENTLY, I.E. START RETENSIONING BAND A @ BUTTRESS #3 AT THE SAME TIME AS BAND A @ BUTTRESS #4. HOWEVER, AS RETENSIONING PROGRESSES, IT IS ACCEPTABLE TO BE OUT-OF-SEQUENCE AS DESCRIBED IN NOTE V6.

V5. START RETENSIONING BAND A TENDONS FIRST IN THE NUMERICAL SEQUENCE NUMBERS SHOWN FOLLOWED BY BANDS B, AND FINALLY BANDS C.

V6. IT IS PREFERABLE THAT IDENTICAL SEQUENCE NUMBERED TENDONS IN A BAND ARE FULLY TENSIONED BEFORE PROGRESSING TO THE NEXT HIGHER SEQUENCE NUMBER. HOWEVER, IT IS ACCEPTABLE TO BE OUT-OF-SEQUENCE BY UP TO TWO TENDONS, E.G. AFTER COMPLETING BAND A ON BUTTRESS #4, IT IS ACCEPTABLE TO START RETENSIONING TENDON SEQUENCE NUMBER 1 IN BAND B @ BUTTRESS #4 WHILE THE LAGGING TENDON CREW @ BAND A, BUTTRESS #3 IS RETENSIONING TENDON SEQUENCE #2 OR #3.

V7. VERTICAL TENDON AZIMUTHS ARE FOR REFERENCE ONLY.



HOOP TENDON RE-TENSIONING SEQUENCE

HOOP TENDONS ONLY

H1. RETENSIONING VERTICAL AND HOOP TENDONS MAY START AT THE SAME TIME UNLESS NOTED OTHERWISE (SEE NOTE H2-B).

H2. RETENSIONING HOOP TENDONS OUTSIDE THE OPENING (BANDS D AND E), MAY BEGIN AFTER:

(A) THE CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF AT LEAST 5000 PSI (WHICH IS TO BE VERIFIED BY CYLINDER TEST BREAKS) AND

(B) VERTICAL BAND A HAS BEEN RETENSIONED

H3. HOOP BANDS D AND E MAY BE RETENSIONED IN PARALLEL WITH VERTICAL BANDS C AFTER THE CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF AT LEAST 6000 PSI WHICH IS TO BE VERIFIED BY CYLINDER TEST BREAKS.

H4. TENSIONING HOOP TENDONS INSIDE THE OPENING (BANDS F AND G) CANNOT BEGIN UNTIL HOOP BANDS D AND E HAVE BEEN RETENSIONED (SEE NOTE H6) AND THE REPLACEMENT CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF AT LEAST 6000 PSI WHICH IS TO BE VERIFIED BY CYLINDER TEST BREAKS.

H5. RETENSION SIMILAR BANDS CONCURRENTLY, I.E. START RETENSIONING BAND E ABOVE THE OPENING AT THE SAME TIME AS BAND E BELOW THE OPENING. HOWEVER, AS RENTENSIONING PROGRESSES, IT IS ACCEPTABLE TO BE OUT-OF-SEQUENCE BY UP TO TWO TENDONS (REFER TO NOTE H7 BELOW).

H6. START RETENSIONING BAND D TENDONS FIRST IN THE NUMERICAL SEQUENCE NUMBERS SHOWN FOLLOWED BY BANDS E, BANDS F AND FINALLY BANDS G.

H7. IT IS PREFERABLE THAT IDENTICAL SEQUENCE NUMBERED TENDONS ARE FULLY TENSIONED BEFORE PROGRESSING TO THE NEXT HIGHER SEQUENCE NUMBER. HOWEVER, IT IS ACCEPTABLE TO BE OUT-OF-SEQUENCE BY UP TO TWO TENDONS AS STATED NOTE H5. E.G. AFTER COMPLETING BAND D ABOVE THE OPENING, IT IS ACCEPTABLE TO START RETENSIONING TENDON SEQUENCE NUMBER 1 IN BAND E ABOVE THE OPENING WHILE THE LAGGING TENDON CREW @ BAND D BELOW THE OPENING IS STILL RETENSIONING TENDON SEQUENCE #4 OR #5.

H8. HOOP TENDON ELEVATIONS ARE FOR REFERENCE ONLY.

EC 63016
ATTACHMENT Z12R5

RESTORATION

FILE: L:\Shared\SGR AutoCAD\Crystal River Project\Ecs\63016\421-352.dwg

Progress Energy

SGR DESIGN ENGINEERING

CR3
CRYSTAL RIVER

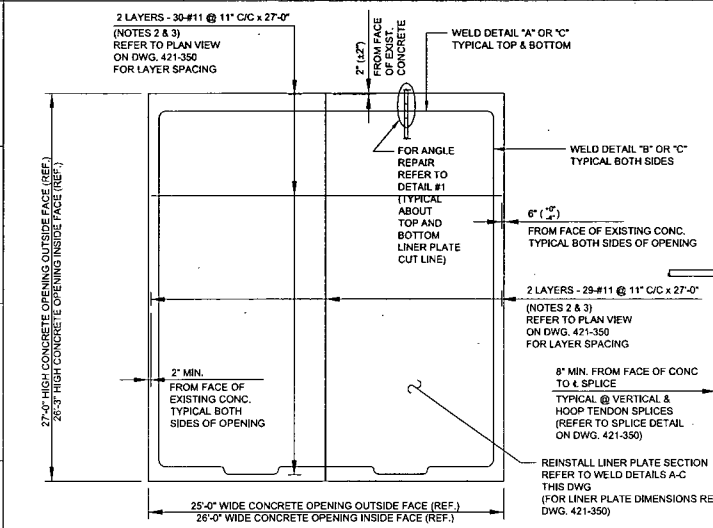
REACTOR BUILDING
TEMPORARY ACCESS OPENING FOR SGR RESTORATION
SHEET 3 OF 3

LPM		09/04/2008	NTS
DRAWN	CHKD.	APRVD.	DATE	SCALE
DESCP.	1 SHEET	DWG. 421-352	0 REV.

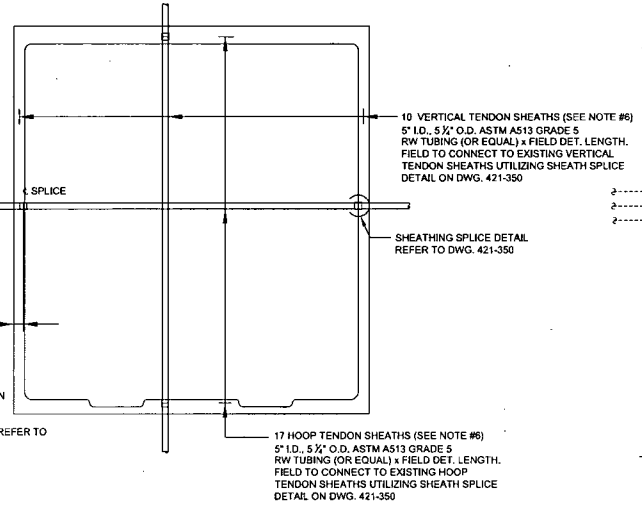
DTYPE DVLT

Attachment Z13R0 has been deleted. It originally contained Rev. 3 of the "Laboratory Testing Requirements for Concrete Proportioning". This document is now part of the "Specification for Concrete Work for Restoration of the SGR Opening in the Containment Shell" which is contained in Attachment Z25.

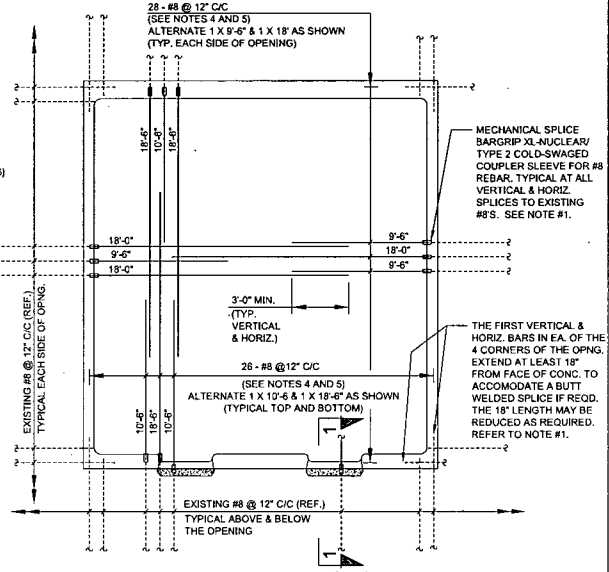
John Holliday 5/28/2009



RESTORATION STEP #1
ELEVATIONAL VIEW B-B
WELD LINER PLATE, STIFFENER ANGLES & INSTALL #11 REBAR CAGE
NTS



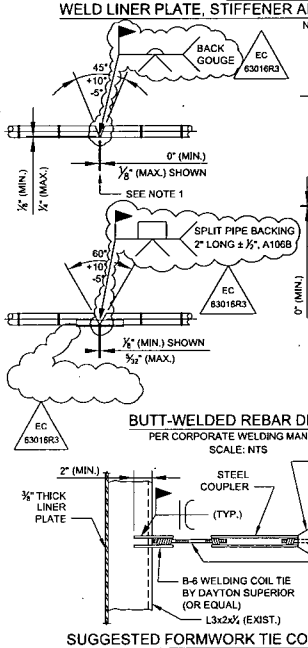
RESTORATION STEP #2
ELEVATIONAL VIEW B-B
INSTALL TENDON SHEATHS
NTS



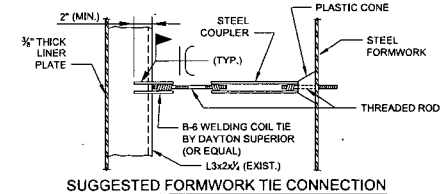
RESTORATION STEP #3
ELEVATIONAL VIEW B-B
INSTALL #8's
NTS

NOTES:

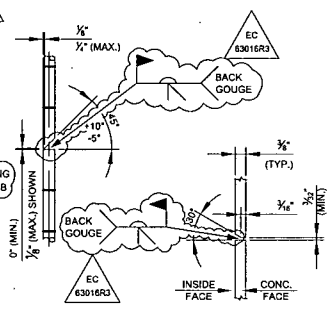
1. FIELD HAS THE OPTION OF EITHER USING A MECHANICAL COUPLER (BARGRIP-XL) OR BUTT-WELDED SPLICE (AS SHOWN ON THIS DRAWING).
2. HORIZONTAL AND VERTICAL SPACING OF #11 REBARS HAVE A TOLERANCE OF [$^{+0}_{-2}$].
3. THE LENGTHS SHOWN FOR THE VERTICAL AND HORIZONTAL #11 REBARS IS A MAXIMUM LENGTH AND WILL REQUIRE TRIMMING TO REDUCE LENGTH TO SUIT OPENING SIZE. TOTAL NUMBER OF BARS SHOWN MAY BE ADJUSTED TO SUIT AS-BUILT OPENING SIZE.
4. HORIZONTAL AND VERTICAL SPACING OF #8 REBARS HAS A TOLERANCE OF [±½"].
5. LENGTH OF BARS SHOWN ARE MINIMUM LENGHTS. EXCESS LENGTH MAY BE FIELD TRIMMED BUT MINIMUM SPLICE LENGTH OF 3'-0" MUST BE MAINTAINED. TOTAL NUMBER OF BARS SHOWN MAY BE ADJUSTED TO SUIT AS-BUILT OPENING SIZE.
6. TOTAL NUMBER OF VERTICAL AND HOOP TENDON SHEATHS MAY BE ADJUSTED TO SUIT AS-BUILT OPENING SIZE.



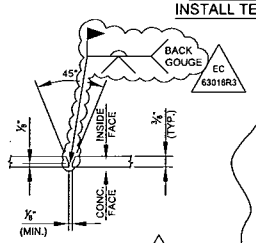
BUTT-WELDED REBAR DETAIL
PER CORPORATE WELDING MANUAL
SCALE: NTS



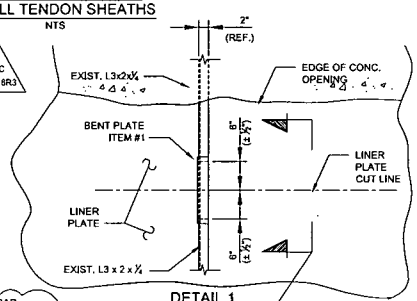
SUGGESTED FORMWORK TIE CONNECTION
SCALE: NTS



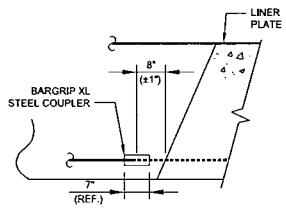
DETAIL "A"
HORIZONTAL



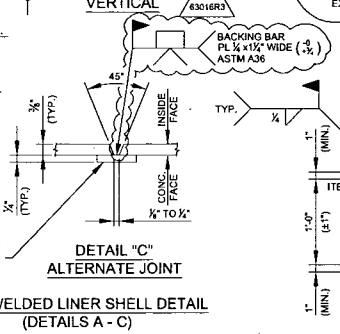
DETAIL "B"
VERTICAL



DETAIL 1
SCALE: 1" = 1'-0"

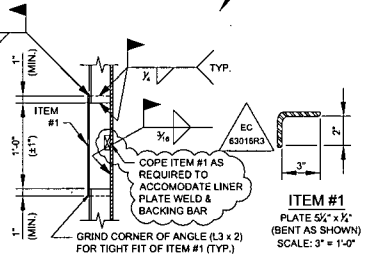


DETAIL 2
SCALE: ¾" = 1'-0"
(REF. DWG. 421-350)



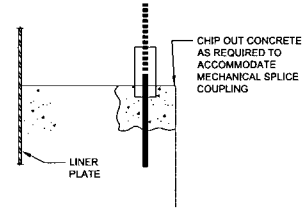
DETAIL "C"
ALTERNATE JOINT

BUTT-WELDED LINER SHELL DETAIL
(DETAILS A - C)
SCALE: 6" = 1'-0"



SCALE: 1½" = 1'-0"

ITEM #1
PLATE 5¼" x ¼"
(BENT AS SHOWN)
SCALE: 3" = 1'-0"



SECTION 1-1
SCALE: 1½" = 1'-0"
(TYPICAL @ BOTH LINER PLATE CUT-OUTS)
#11 REBARS & TENDON SHEATHS NOT SHOWN FOR CLARITY

EC 63016
ATTACHMENT Z11R3

RESTORATION

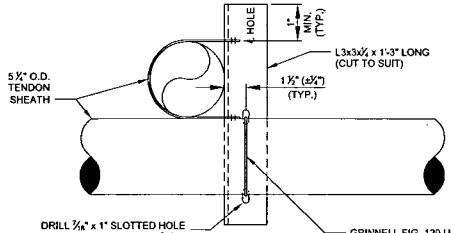
FILE: L:\Shared\SGR AutoCAD\Crystal River Project\EC's\63016\421-351.dwg

Progress Energy	SGR DESIGN ENGINEERING
	CR3 CRYSTAL RIVER
	REACTOR BUILDING TEMPORARY ACCESS OPENING FOR SGR RESTORATION SHEET 2 OF 3
LPM (DRAWN) / - (CHKD) / (APPVD) / 09/05/2008 (DATE) / AS NOTED (SCALE)	
(DISCP) / 1 (SHEET) / (DWG.)	421-351 / 0 (REV.)

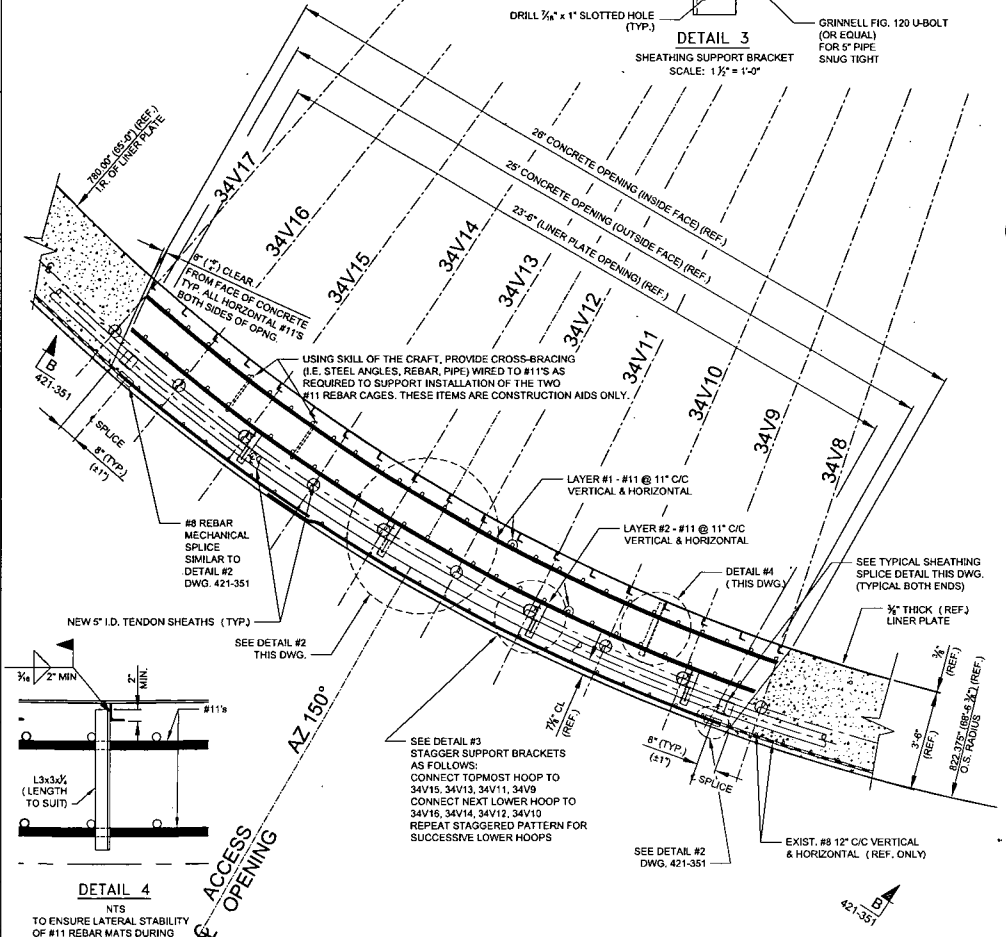
KEY NO.: DKEYNO

KEY NO.: DKEYNO

LEGEND:
I.R. = INSIDE RADIUS
O.S. = OUTSIDE
O.D. = DIAMETER
T.L. = TANGENT LINE

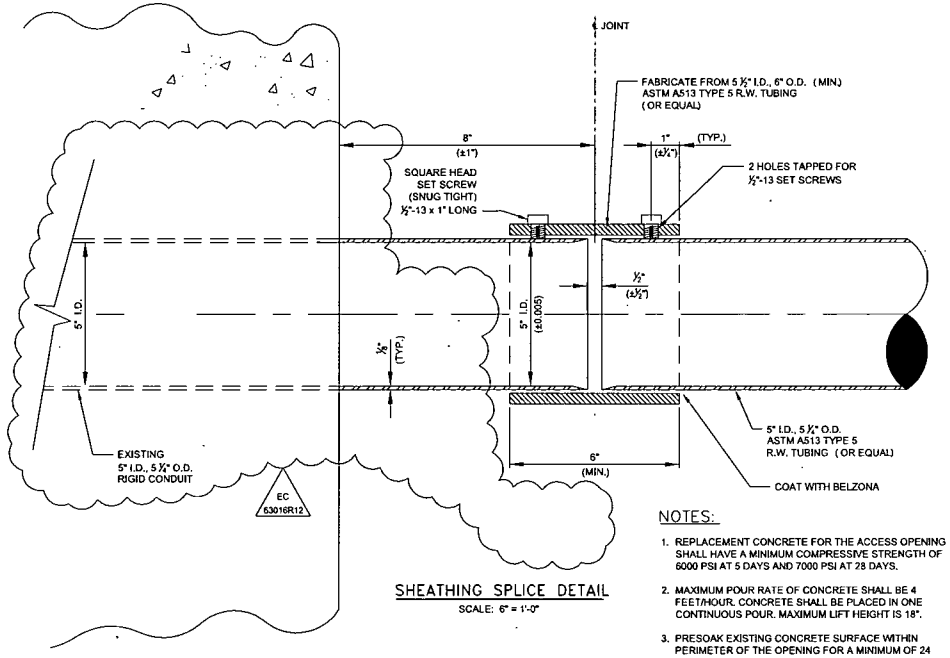


DETAIL 3
SHEATHING SUPPORT BRACKET
SCALE: 1 ½" = 1'-0"



PLAN VIEW OF OPENING
CONCRETE, REBAR & TENDON SHEATHING RESTORATION
SCALE: ⅛" = 1'-0"

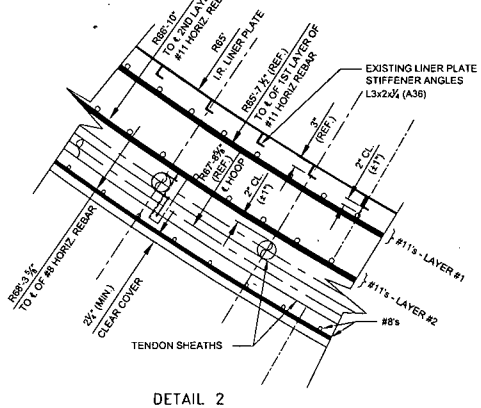
DETAIL 4
NTS
TO ENSURE LATERAL STABILITY OF #11 REBAR MATS DURING ERECTION & CONCRETE POUR, FIELD IS TO INSTALL ANGLES (AS SHOWN) AND TIE WIRE ANGLES TO #11s. CONSTRUCTION IS TO DETERMINE OPTIMAL LOCATIONS OF ANGLES.



SHEATHING SPLICE DETAIL
SCALE: 6" = 1'-0"

NOTES:

1. REPLACEMENT CONCRETE FOR THE ACCESS OPENING SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 6000 PSI AT 5 DAYS AND 7000 PSI AT 28 DAYS.
2. MAXIMUM POUR RATE OF CONCRETE SHALL BE 4 FEET/HOUR. CONCRETE SHALL BE PLACED IN ONE CONTINUOUS POUR. MAXIMUM LIFT HEIGHT IS 18".
3. PRESOAK EXISTING CONCRETE SURFACE WITHIN PERIMETER OF THE OPENING FOR A MINIMUM OF 24 HOURS PRIOR TO POURING NEW CONCRETE.
4. MINIMUM CONCRETE COVER TO THE #8 REBARS SHALL BE 2 ½". MINIMUM COVER TO A SPLICE COUPLER IS 1½".
5. FORMWORK SHALL BE INSTALLED PER VENDOR SUPPLIED DRAWINGS. MAXIMUM VERTICAL SPACING OF TIES SHALL BE 3'-0", MAXIMUM HORIZONTAL SPACING SHALL BE 1'-6".
6. REFER TO DRAWING 421-352 FOR TENDON RETENSIONING SEQUENCE. RETENSIONING CANNOT START UNTIL THE NEWLY PLACED CONCRETE HAS REACHED A MINIMUM COMPRESSIVE STRENGTH OF 5000 PSI. TENSIONING OF THE NEW REPLACEMENT TENDONS WITHIN THE OPENING CANNOT START UNTIL THE MINIMUM CONCRETE COMPRESSIVE STRENGTH IS 6000 PSI.
7. NEW STEEL REINFORCEMENT BARS SHALL CONFORM TO ASTM A615 GRADE 60.
8. MECHANICAL REBAR SPLICES FOR #8 REBAR SHALL BE BARGRIP XL - NUCLEAR/TYPE 2 SERIES, COLD SWAGED STEEL COUPLERS, MANUFACTURED BY BARSPLICE PRODUCTS, INC.



DETAIL 2
SCALE: ¾" = 1'-0"

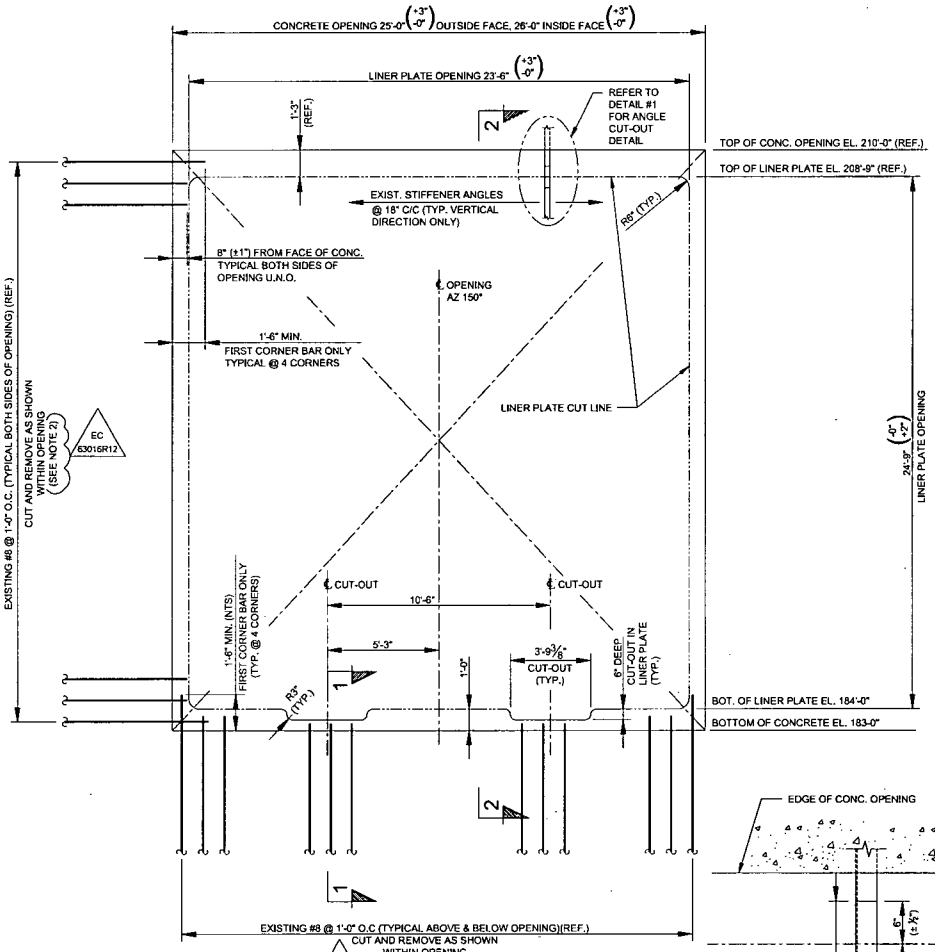
RESTORATION

EC 63016
ATTACHMENT Z10R12

FILE: L:\Shared\SGR AutoCAD\Crystal River Project\ECs\63016\421-350.dwg

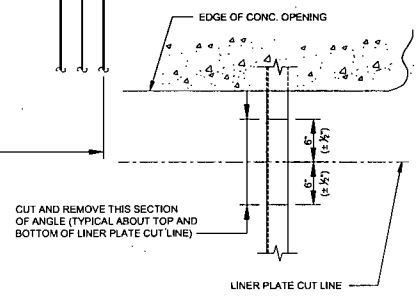
Progress Energy	SGR DESIGN ENGINEERING		
	CR3 CRYSTAL RIVER		
	REACTOR BUILDING TEMPORARY ACCESS OPENING FOR SGR RESTORATION SHEET 1 OF 3		
LPM DRAWN	CHKD.	APRVD.	09/05/2008 DATE	1/2"=1'-0" SCALE
DESCR.	1 SHEET	DWG.	421-350	0 REV.

KEY NO.: DKEYNO



ELEVATIONAL VIEW A-A

SCALE: 3/8" = 1'-0"



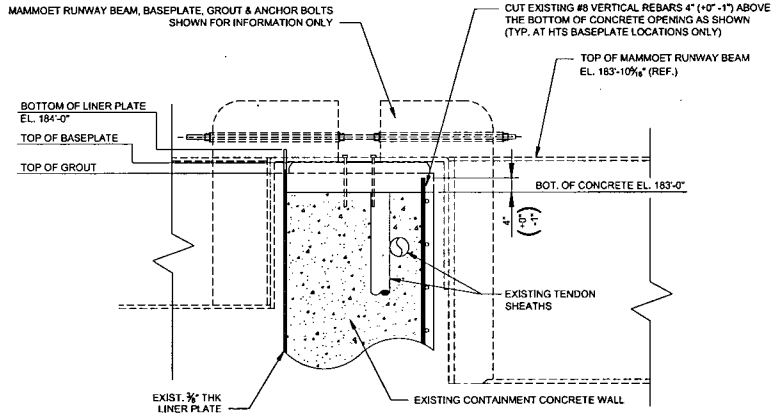
DETAIL #1

SCALE: 1 1/2" = 1'-0"

EC 63016R12

NOTES:

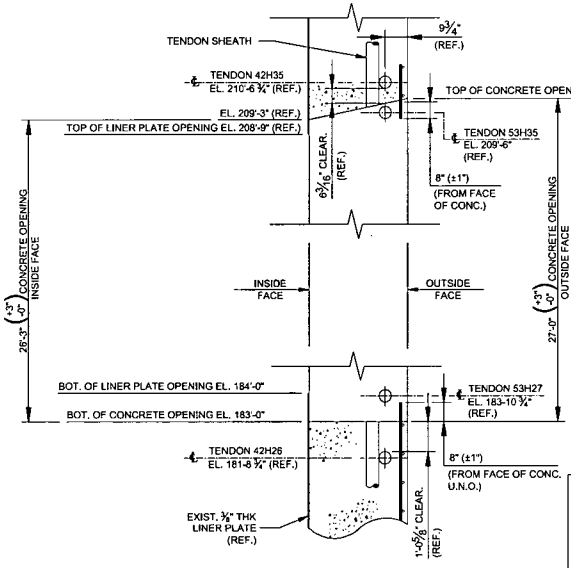
2. FIELD HAS THE OPTION OF NOT REMOVING REBAR WITHIN 8" OF EDGE OF THE OPENING.



SECTION 1-1

SCALE: 3/4" = 1'-0"

(TYPICAL @ BOTH LINER PLATE CUT-OUTS)



SECTION 2-2

SCALE: 1/2" = 1'-0"

(TYPICAL U.N.O.)

EC 63016
ATTACHMENT Z09R12

NOTES:

1. FOR LEGEND REFER TO DRAWING 421-348.

DEMOLITION

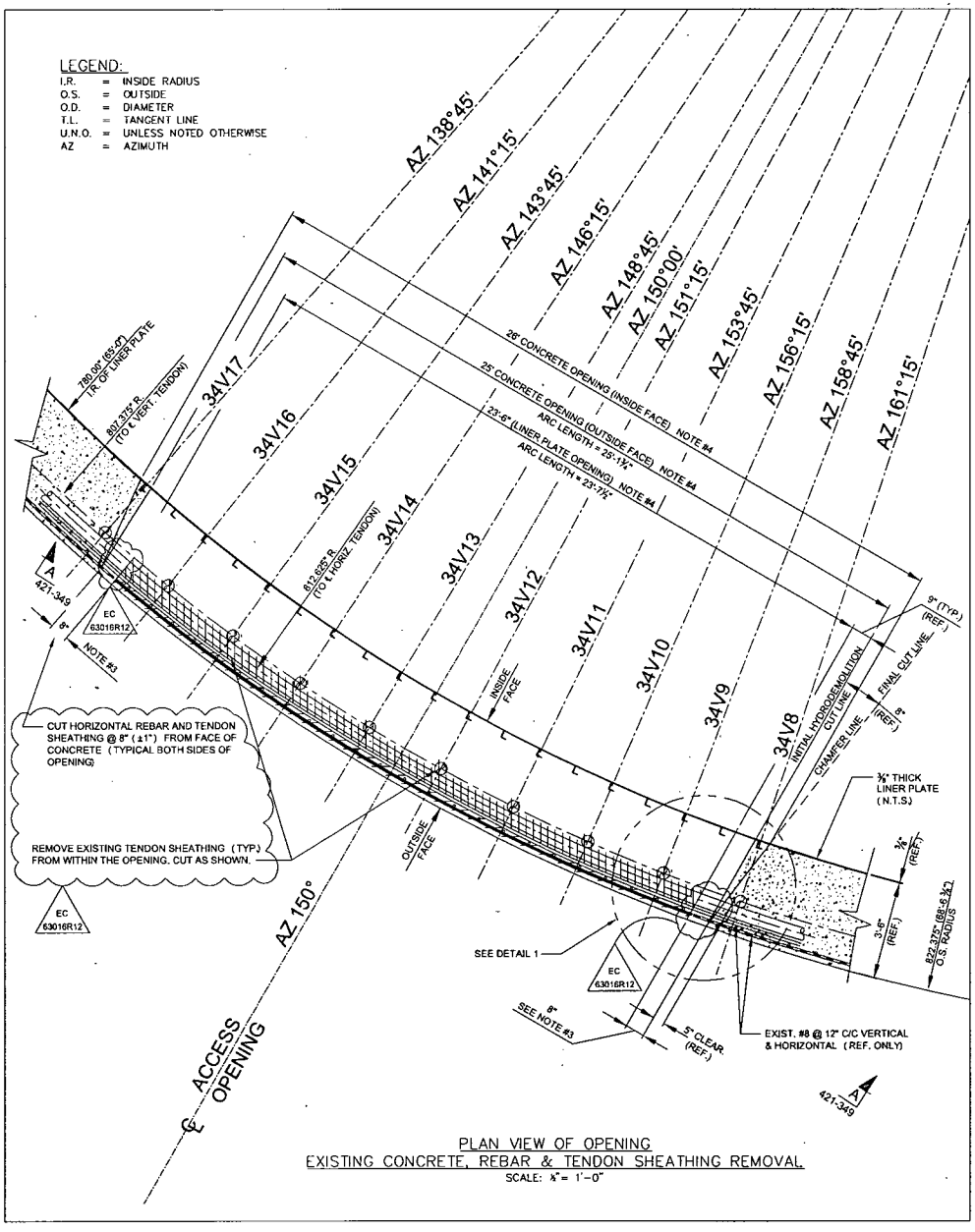
FILE: L:\Shared\SGR AutoCAD\Crystal River Project\ECs\63016\421-349.dwg

Progress Energy	SGR DESIGN ENGINEERING		
	CR3 CRYSTAL RIVER		
	REACTOR BUILDING TEMPORARY ACCESS OPENING FOR SGR DEMOLITION SHEET 2 OF 2		
LPM DRAWN / CHKD	APPRV.	08/27/2008 DATE	AS NOTED SCALE
DESCP / 1 SHEET	DWG.	421-349	0 REV.

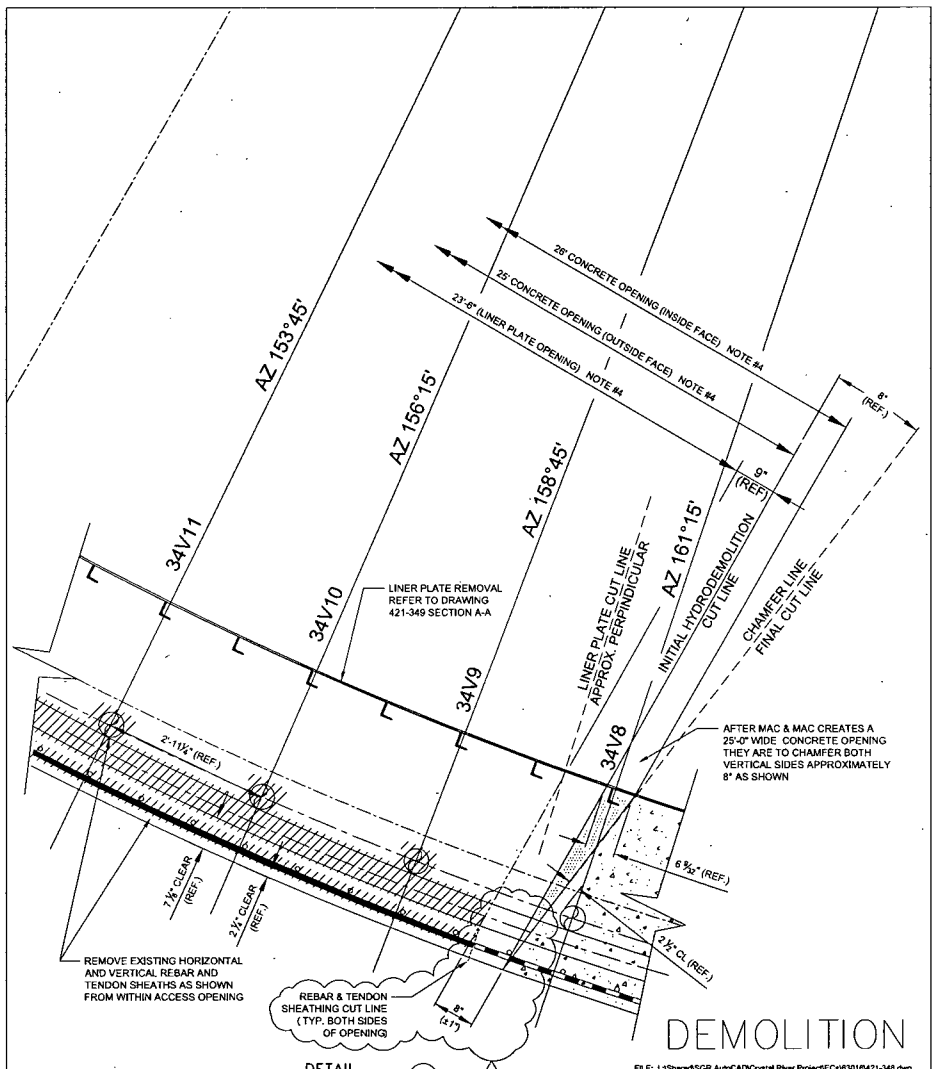
KEY NO.: DKEYNO

KEY NO.: DKEYNO

LEGEND:
I.R. = INSIDE RADIUS
O.S. = OUTSIDE
O.D. = DIAMETER
T.L. = TANGENT LINE
U.N.O. = UNLESS NOTED OTHERWISE
AZ = AZIMUTH



PLAN VIEW OF OPENING
EXISTING CONCRETE, REBAR & TENDON SHEATHING REMOVAL
SCALE: ¼" = 1'-0"



DETAIL 1
SCALE: 1" = 1'-0"

DEMOLITION

NOTES:
1. TENDON AZIMUTHS ARE FOR REFERENCE ONLY.
2. ALL RADII ARE FOR REFERENCE ONLY.
3. CUT HORIZONTAL REBAR AND TENDON SHEATHING AT 8" (±1") FROM FACE OF CONCRETE (TYPICAL BOTH SIDES OF OPENING).
4. TOLERANCE ON THIS DIMENSION IS (+3" / -0").

EC 63016R12

EC 63016
ATTACHMENT Z08R12

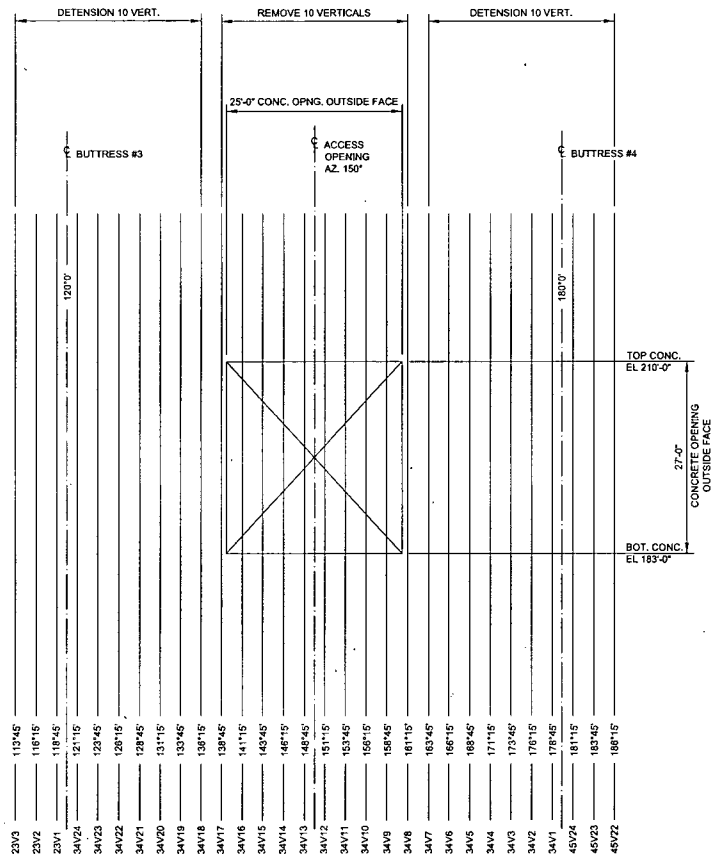
FILE: L:\Shared\SGR AutoCAD\Crystal River Project\ECs\63016\421-348.dwg

Progress Energy

SGR DESIGN ENGINEERING
CR3
CRYSTAL RIVER
REACTOR BUILDING
TEMPORARY ACCESS OPENING FOR SGR DEMOLITION
SHEET 1 OF 2

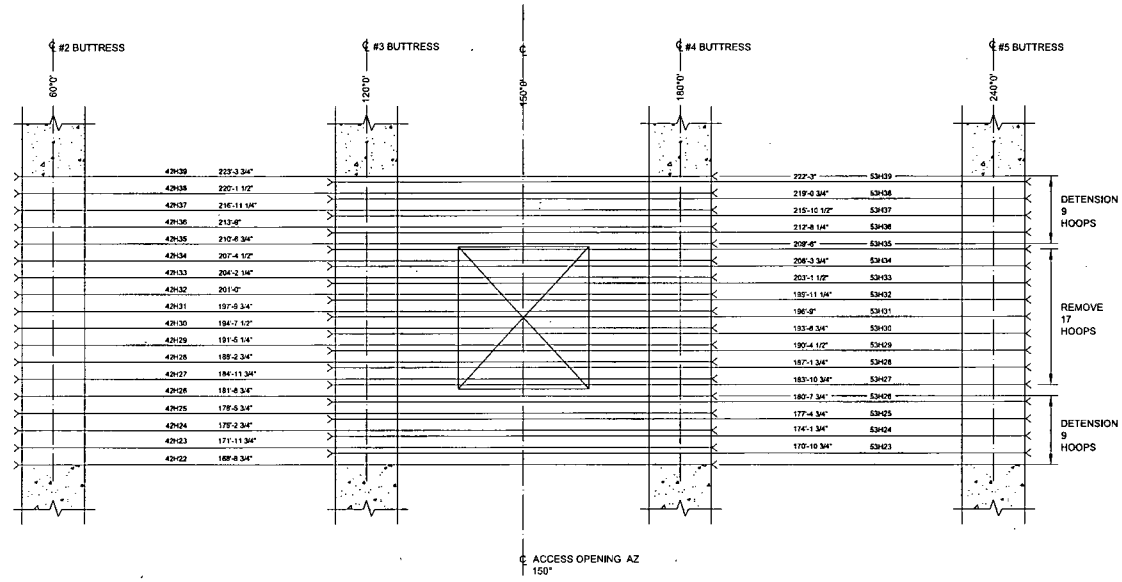
DRAWN	CHKD.	APRVD.	DATE	SCALE
JKO/LPM			09/05/2008	1/2"=1'-0"
DESCR.	SHEET 1	DWG. 421-348		REV. 0

KEY NO.: DKEYNO



VERTICAL TENDON POSITION

OUTSIDE VIEW
LINER PLATE NOT SHOWN FOR CLARITY
(REFER TO NOTE #1)



HORIZONTAL HOOP TENDON POSITION

OUTSIDE VIEW
LINER PLATE NOT SHOWN FOR CLARITY
(REFER TO NOTE #1)

EC 63016R3

EC 63016
ATTACHMENT Z07R3

NOTES:

1. FOR LOCATION AND DIMENSIONS OF LINER PLATE SECTION TO BE CUT AND REMOVED, REFER TO DRAWINGS 421-348 AND 421-349.
2. ALL DIMENSIONS, AZIMUTHS AND ELEVATIONS SHOWN ON THIS DRAWING ARE FOR REFERENCE ONLY.
3. REFER TO DRAWINGS 421-348 AND 421-349 FOR ACCESS OPENING DEMOLITION DETAILS.
4. REFER TO DRAWINGS 421-350, 421-351 AND 421-352 FOR ACCESS OPENING RESTORATION DETAILS.

FILE: L:\Shared\SGR AutoCAD\Crystal River Project\ECs\63016\421-347.dwg

Progress Energy	SGR DESIGN ENGINEERING
	CR3 CRYSTAL RIVER
	REACTOR BUILDING TEMPORARY ACCESS OPENING FOR SGR VERTICAL & HORIZONTAL TENDON POSITIONS

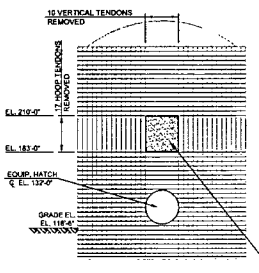
LPM			08/27/2008	NTS
DRAWN	CHKD.	APRVD.	DATE	SCALE
	1	421-347		0
DISCP.	SHEET	DWG.		REV.

DTYPE DVLT

KEY NO.: DKEYNO

MODE 5 THRU Rx DEFUEL
STAGE 1 PRESTRESS - LODHR ACCIDENT CONTROLS

HTS & TLD ARE NOT INSTALLED.



LEGEND:

DL= DEAD LOAD
W = WIND LOAD(HURRICANE)
W_w= TORNADO WIND
W_m= TORNADO GENERATED MISSLE
Pt = TORNADO DEPRESSURIZATION
RP1 = REDUCED PRESTRESS (STAGE 1)
RP2 = REDUCED PRESTRESS (STAGE 2)
Pa = ACCIDENT PRESSURE
Ta = ACCIDENT TEMPERATURE (NOTE #3)
To = OPERATING TEMPERATURE
HTS/TLD = REACTIONS FROM HTS/TLD/ POLAR CRANE DURING SG REPLACEMENT ACTIVITIES
HTS*= MISC. LOADS (AUX. CRANE)
OBE = OPERATING BASIS EARTHQUAKE
SSE = SAFE SHUTDOWN EARTHQUAKE = 2x OBE

CONCRETE REMOVED FROM ACCESS OPENING AND LINER PLATE EXPOSED.
STAGE 1 PRESTRESS = 10 VERTICAL AND 17 HOOP TENDONS REMOVED FROM OPENING.

NOTE: ONLY CONTROLLING LOAD CASES SHOWN (TYPICAL).

26a. (1.0+/- 0.05) DL+1.0 RP1 + 1.5 Pa + 1.0 Ta
27a/28a (1.0+/- 0.05) DL+1.0 RP1 +/- 1.25 OBE + 1.25 Pa + 1.0 Ta
29a/30a (1.0+/- 0.05) DL+1.0 RP1 +/- 1.25 W + 1.25 Pa + 1.0 Ta (NOTE #1)
31a/32a (1.0+/- 0.05) DL+1.0 RP1 +/- SSE + 1.0 Pa + 1.0 Ta
33a/34a (1.0+/- 0.05) DL+1.0 RP +/- 2.0 W + 1.0 Pa + 1.0 Ta (NOTE #1)

REFERENCE CALC. #S06-0005 & S06-0007

DL CONTAINMENT SELFWEIGHT + DEADWEIGHT OF POLAR CRANE OVER ACCESS OPENING.

RP1 EXISTING PRESTRESS IN CONTAINMENT SHELL MINUS 10 VERTICALS AND 17 HOOP TENDONS FROM OPENING. (STAGE 1 PRESTRESS).

RP2 N/A

Fo N/A

Fa N/A

Pa 5.14 psig (DUE TO LODHR)

Ta TEMP PROFILE THRU WALL IS BASED ON 69° OUTSIDE AND 110° INSIDE TEMP (SEE NOTE 3)
$T_{(MID\ PL)}$ = 173° F (DUE TO LODHR ACCIDENT)

To N/A (ACCIDENT LOAD CASE CONTROLS)

W 179 mph, 81.79 psf (HURRICANE)

W_{TW} N/A (NOTE #2)

W_{TM} N/A (NOTE #2)

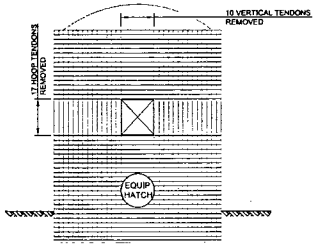
Pt N/A (NOTE #2)

E or E' $E_{(OBE)}$ = 0.05g, $E'_{(SSE)}$ = 0.1g (VERTICAL = 2/3 x E or 2/3 x E')

HTS/TLD N/A

HTS* N/A

DEFUELED
STAGE 1 PRESTRESS - HTS & TLD INSTALLED
LOADS FROM LIFTING SG's



CONCRETE AND LINER PLATE REMOVED FROM ACCESS OPENING.
STAGE 1 PRESTRESS = 10 VERTICAL AND 17 HOOP TENDONS REMOVED FROM OPENING.

35a 1.45 DL + 1.0 RP1 + 1.0 To + 1.7 HTS/TLD
35b 0.95 DL + 1.0 RP1 + 1.0 To + 1.7 HTS/TLD

REFERENCE CALC. #S06-0005

DL CONTAINMENT SELFWEIGHT + EQUIPMENT
(NOTE: DEADWEIGHT OF HTS/TLD & POLAR CRANE WITH 60 KIP LOAD IS INCLUDED IN THE LOAD IDENTIFYER 'HTS/TLD' - SEE BELOW).

RP1 EXISTING PRESTRESS IN CONTAINMENT SHELL MINUS 10 VERTICAL AND 17 HORIZONTAL TENDONS FROM OPENING. (STAGE 1 PRESTRESS)

RP2 N/A

Fo N/A

Fa N/A

Pa N/A

Ta N/A

To $T_{(OUTSIDE)}$ = 69° F $T_{(INSIDE)}$ = 90° F (WHILE DEFUELED)

W N/A (NOTE #5)

W_{TW} N/A (NOTE #2)

W_{TM} N/A (NOTE #2)

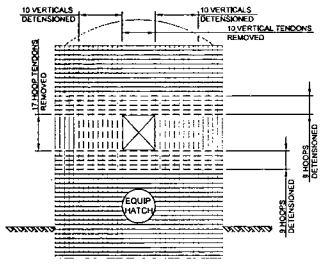
Pt N/A (NOTE #2)

E/E' N/A (NOTE #2)

HTS/TLD MAX REACTION FROM TLD BOGIES ON POLAR CRANE RAIL WHILE LIFTING SG. + MAX. REACTIONS FROM IHTS/OHTS WHILE MOVING SG's + DEADWEIGHT OF HTS/TLD AND POLAR CRANE WITH 60 KIP LOAD ADJANCENT TO ACCESS

HTS* N/A

DEFUELED
STAGE 2 PRESTRESS - HTS & TLD INSTALLED
MISC. LOADS ON HTS EXCLUDING SG's



CONCRETE & LINER PLATE REMOVED FROM ACCESS OPENING
STAGE 2 PRESTRESS =10 VERTICAL AND 17 HOOP TENDONS REMOVED FROM ACCESS OPENING AND AN ADDITIONAL 20 VERTICAL & 18 HOOP TENDONS DETENSIONED AROUND OPENING.

35c 1.45 DL + 1.0 RP2 + 1.0 To + 1.7 HTS*
35d 0.95 DL + 1.0 RP2 + 1.0 To +1.7 HTS*

REFERENCE CALC. #S06-0005

DL CONTAINMENT SELFWEIGHT ONLY.
(NOTE: DEADWEIGHT OF HTS/TLD & POLAR CRANE WITH 60 KIP LOAD IS INCLUDED IN THE LOAD IDENTIFYER HTS* - SEE BELOW)

RP1 N/A

RP2 EXISTING PRESTRESS IN CONTAINMENT SHELL MINUS 10 VERTICAL AND 17 HORIZONTAL TENDONS & AN ADDITIONAL 20 VERTICAL & 18 HORIZONTAL TENDONS DETENSIONED (STAGE 2 PRESTRESS)

Fo N/A

Fa N/A

Pa N/A

Ta N/A

To $T_{(OUTSIDE)}$ = 69° F $T_{(INSIDE)}$ = 90° F (WHILE DEFUELED)

W N/A (SEE NOTE #5)

W_{TW} N/A (NOTE #2)

W_{TM} N/A (NOTE #2)

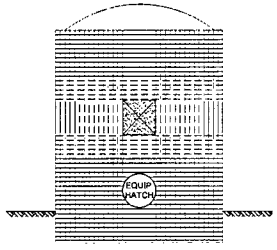
Pt N/A (NOTE #2)

E/E' (NOTE #2)

HTS/TLD N/A

HTS* 527.3 KIPS FROM AUXULARY CRANE ON IHTS + DEAD WT. OF HTS/TLD AND POLAR CRANE WITH 60 KIP LOAD

DEFUELED THRU REFUEL
STAGE 2 PRESTRESS - HTS/TLD DISASSEMBLED



CONCRETE REMOVED FROM ACCESS OPENING. LINER PLATE MAY OR MAY NOT HAVE BEEN REINSTALLED.
STAGE 2 PRESTRESS =10 VERTICAL AND 17 HOOP TENDONS REMOVED FROM ACCESS OPENING AND AN ADDITIONAL 20 VERTICAL AND 18 HOOP TENDONS DETENSIONED AROUND OPENING.

36/37 (1.0 ± 0.05) DL+1.0 RP2 ± SSE + 1.0 To
38/39 (1.0 ± 0.05) DL+1.0 RP2 ± 1.0 W_{TW} + 1.0 To
40/41 (1.0 ± 0.05) DL+1.0 RP2 ± 1.0 W_{TW} ± 0.5 Pt + 1.0 To

REFERENCE CALC. #S06-0005 & S06-0007

EC 63016R3

DURING REFUEL:
26A .95DL + 1.0 RP2 + 1.5Pa +1.0 Ta
26B .95DL + 1.0 RP2 + 1.5Pa +1.0 Ta + 1.7 HTS (60 klps)
26C .95DL + 1.0 RP2 + 1.5Pa +1.0 Ta + 1.7 HTS (350 klps)

REFERENCE CALC. #S09-0025

DL CONTAINMENT SELFWEIGHT + DEADWEIGHT OF HTS/TLD AND POLAR CRANE OVER ACCESS OPENING W/60 KIP LIFTED LOAD

RP1 N/A

RP2 EXISTING PRESTRESS IN CONTAINMENT SHELL MINUS 10 VERTICAL AND 17 HORIZONTAL TENDONS AND AN ADDITIONAL 20 VERTICAL AND 18 HORIZONTAL TENDONS DETENSIONED (STAGE 2 PRESTRESS)

Fo N/A

Fa N/A

Pa 1.4 psig (DUE TO LODHR ACCIDENT)

Ta TEMP PROFILE THRU WALL IS BASED ON 69° OUTSIDE AND 83° INSIDE TEMP (REF. M09-0031) - SEE NOTE 3
$T_{(MID\ PL)}$ = 114.7° F (DUE TO LODHR ACCIDENT)

To $T_{(OUTSIDE)}$ = 69° F $T_{(INSIDE)}$ = 90° F (WHILE DEFUELED)

W N/A (TORNADO WIND LOAD CONTROLS)

W_{TW} 212 mph, (NOTE #4)

W_{TM} N/A (NOTE #2)

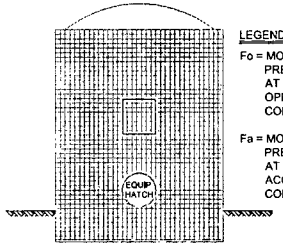
Pt 1.2 psi (NOTE #4)

E or E' $E_{(OBE)}$ = 0.05g, $E'_{(SSE)}$ = 0.1g (VERTICAL = 2/3 x E or 2/3 x E')

HTS POLAR CRANE WITH 60 klp LIFTED LOAD
POLAR CRANE WITH 350 klp LIFTED LOAD

HTS* N/A

FULLY RESTORED TO END OF LIFE



LEGEND:
Fo = MODIFIED PRESTRESS AT OPERATING CONDITIONS
Fa = MODIFIED PRESTRESS AT ACCIDENT CONDITIONS

CONTAINMENT SHELL FULLY RESTORED

21b/22b (1.0 ± 0.05) DL+Fo ± 1.0 W_{TW} + 1.0 Pt + To
23b/24b (1.0 ± 0.05) DL+Fo ± W_{TW} + 0.010 Pa + To
26b (1.0 ± 0.05) DL+Fa ± 1.5 Pa + Ta
27b/28b (1.0 ± 0.05) DL+Fa ± 1.25 OBE + 1.25 Pa + Ta
29b/30b (1.0 ± 0.05) DL+Fa ± 1.25 W + 1.25 Pa + Ta
LC 31b/32b (1.0 ± 0.05) DL+Fa ± SSE + Pa + Ta
LC 33b/34b (1.0 ± 0.05) DL+Fa ± 2W + Pa + Ta

REFERENCE CALC. #S06-0006

DL (CONTAINMENT STRUCTURE INCLUDING WEIGHT OF POLAR CRANE)

RP1 N/A

RP2 N/A

Fo MODIFIED PRESTRESS AT OPERATING CONDITIONS

Fa MODIFIED PRESTRESS AT ACCIDENT CONDITIONS

Pa 55 psig DESIGN BASIS PEAK ACCIDENT PRESSURE

Ta TEMP PROFILE THRU WALL IS BASED ON To (BELOW) (SEE NOTE 3)
$T_{(MID\ PL)}$ = 281° (PEAK ACCIDENT TEMP)

To REFER TO TABLE 6-3 OF CONTAINMENT DBD

W 179 mph, 81.79 psf

W_{TW} 300 mph, P=230 psf

W_{TM} N/A (PER FSAR)

Pt 3 psi

E or E' $E_{(OBE)}$ = 0.05g, $E'_{(SSE)}$ = 0.1g (VERTICAL= 2/3 x E or 2/3 x E')

HTS/TLD N/A

HTS* N/A

NOTES:

1. LOAD CASES 29a/30a & 33a/34a ARE ENVELOPED BY L.C's 27a/28a & 31a/32a
2. LOAD ELIMINATED BY RISK ASSESSMENT.
3. Ta INCLUDES THERMAL LOADS EXERTED ON CONCRETE WALL FROM RESTRAINED EXPANSION OF THE LINER PLATE (LINER PLATE @114.7°, 173° or 281°). THE TEMPERATURE PROFILE THRU CONCRETE WALL CONCURRENT WITH PEAK ACCIDENT PRESSURE WILL BE THE SAME AS THAT FOR OPERATING CONDITION. DURING ACCIDENT CONDITIONS THE LINER PLATE HEATS UP VERY QUICKLY, WHEREAS THE CONCRETE DOES NOT REALIZE MUCH CHANGE IN TEMPERATURE. EC 63016R3
4. ELIMINATED BY RISK ASSESSMENT. HOWEVER, TO NEGATE ANY I/I CONCERNS THE RB HAS CONSERVATIVELY BEEN ANALYSED FOR TORNADO LOADS BASED ON THE REQUIREMENTS OF REG. GUIDE 1.76, REV 1, NUREG/CR-4461, REV 2 & SRP 3.3.2.
5. THE OUTSIDE HTS WILL NOT BE USED TO LIFT THE STEAM GENERATORS WHEN WINDS IN EXCESS OF 30 MPH ARE FORECAST.

EC 63016
ATTACHMENT Z06R3

EC 63016R3

Progress Energy

SGR DESIGN ENGINEERING
CR3
CRYSTAL RIVER
REACTOR BUILDING
TEMPORARY ACCESS OPENING FOR SGR LOAD COMBINATIONS

421-348

Progress Energy

Radiological & Metallurgical Services
Harris Energy & Environmental Center
3932 New Hill – Holleman Road
New Hill, NC 27562-0327

fax

DR MOCCARI

To:	John Holiday	From:	Ahmad Moccari
Company:		Phone No.:	8-772-3438
Fax No.:	352-563-4365	Date:	1,25,08
Subject:	ARMCO-SSS100	Pages plus Cover:	3

Comments:

WORKS @ E&E CENTER

CHARLIE GRIFFIN (KAUFMAN) RICHMOND I
SPOKE TO DR MOCCARI.

ARMCO SSS-100 EQUIV TO ASTM A514

NGG Nuclear Generation Group

PC-GDF3G

Alloy DIGEST

Filing Code: SA-234
Steel-Alloy 63016

DECEMBER 1968

DATA ON WORLD WIDE METALS AND ALLOYS

Published by
Engineering Alloys Digest, Inc.
Upper Montclair, New Jersey

CONTAINMENT OPENING

ARMCO SSS-100

ARMCO SSS-100*
(Constructional Steel)

ARMCO SSS-100 is a quenched and tempered low-carbon, alloy constructional steel providing high strength, exceptional notch toughness, good weldability and improved atmospheric corrosion resistance along with good abrasion resistance.

*Trademark Armco Steel Corporation.

Composition:

Carbon	0.12–0.20
Manganese	0.40–0.70
Silicon	0.20–0.35
Chromium	0.20–0.35
Molybdenum	0.40–0.60
Titanium or V	0.04–0.10
Copper	0.20–0.40
Boron	0.0015–0.005
Iron	Remainder

(Vanadium may be substituted for all or part of titanium content.)

Physical Constants:

Density, lb/cu.in.	2.83
Thermal coef. expansion/°F (70-1200°F)	7.7×10^{-6}
Modulus of elasticity, psi	
in tension	29.50×10^6
in compression	30.86×10^6
Modulus of rigidity, psi	11.9×10^6
Poisson's ratio	0.292

PROPERTIES

Table 1 – TYPICAL MECHANICAL PROPERTIES – Plate

	Plate Thickness		
	3/16" to 2½" incl.	Over 2½" to 4" incl.	Over 4" to 6" incl.
Tensile strength, psi	115000-135000	105000-135000	105000-135000
Yield strength, psi (0.2%) (min.)	100000	90000	90000
Elongation, % in 2" (min.)	18	17	16
Reduction of area, % (min.)	50*	50	45
Brinell hardness	235-293	235-293	235-293
Shear strength, psi			
Long.	72700	72700	72700
Trans.	72500	72500	72500
Endurance strength, psi	64400-75600	58800-75600	58800-75600

*40% reduction of area for plates ¾" and less

Table 2 – JOMINEY HARDENABILITY
(Distance from quenched end in 1/16 inch)

"J" Distance	1	2	3	4	6	8	10	12	14	16	24	32
Rc max.	46.7	47.0	47.0	46.8	46.2	45.5	44.5	43.3	42.2	41.0	37.5	36.0
Rc min.	41.8	41.0	40.5	39.5	38.0	36.0	34.8	33.8	33.2	32.5	31.0	30.3

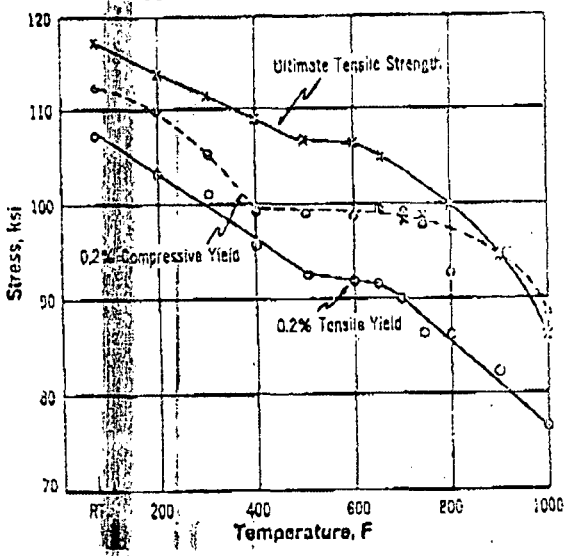
Table 3 – TYPICAL LOW TEMPERATURE PROPERTIES
(Specimens 0.250" diameter x 1" gage length)

Test Temperature °F	Orientation	Tensile Strength psi	Yield Strength psi (0.2%)	Elongation % in 1"	Reduction of Area %
RT	Long.	121800	113200	21.5	67.7
−20	Long.	127800	117200	21.0	67.9
−20	Trans.	129900	120000	19.0	58.3

Table 4 – TYPICAL TENSILE PROPERTIES
(Regular quality vs. Firebox quality plates)

Gage inches	Quality	Tensile Strength psi	Yield Strength psi (0.2%)	Elongation % in 2"	Reduction of Area %
¼	Reg.	129300	121000	24.0	58.9
	FBX	125000	116600	23.0	64.9
1½	Reg.	126800	118300	20.0	68.3
	FBX	121300	113800	20.0	68.1
2	Reg.	118800	112800	19.0	67.9
	FBX	116100	108500	18.0	64.0
4	Reg.	108000	94700	18.5	47.9
5	FBX	107100	93400	18.0	45.4
5¾	FBX	108700	95500	17.0	46.8

Typical Tensile and Compressive Yield Strength Data on 1" Thick Plate of SSS-100 at Elevated Temperatures



Heat Treatment:

The uniform high mechanical properties plates are secured through the following precise heat treatment: Austenitized at 1650-1700°F, quenched in agitated water, tempered at 1150-1250°F. (Heavy thickness above approximately 2½ inches require double heat treatment to secure optimum ductility and notch toughness.)

Machinability:

Machining characteristics are similar to quenched and tempered medium carbon steel of Rockwell C23-28 hardness. The steel can be machined with super-high-speed steel and sintered carbide tools. Medium to heavy duty equipment is preferred because the cutting pressures are higher than with conventional steels. Tools should be rigidly supported near the cutting edge. Use cutting speeds of 60-70 sfpm with high-speed steel tools and 150-200 sfpm with carbide tools for lathe turning. Grind high-speed steel lathe turning tools to 6-7 deg. front and side clearance, 15 deg. side rake, 7-12 deg. back rake, 10 deg. side cutting edge, 15 deg. back rake, 10 deg. side cutting edge, 15 deg. end cutting edge, and a nose radius of 1/16 inch. Grind carbide tools to 6 deg. front and side clearance, 6 deg. side cutting edge, 15 deg. end cutting edge and 1/64 in. nose radius. Feed rates of 0.0082-0.012 ipr are suggested. For finishing, reduce feed to 0.002 ipr and increase speed to 135-140 sfpm.

For drilling, use an included tip angle of 150 deg. and a 6 deg. cutting edge clearance. Speeds of 40-50 sfpm generally give satisfactory performance with feed rates of 0.006 to 0.012 ipr. Apply coolant as a mist spray.

Workability:

Forming may be accomplished at elevated temperatures up to 1400°F without impairment of strength or toughness.

Bend Test Properties

Thickness	Ratio of Bend Diameter to Specimen Thickness
To 1" incl.	2
Over 1" to 2½" incl.	3
Over 2½" to 4" incl.	4

Cold Forming Data for Plates

Thickness	Suggested Minimum Inside Radius
To 1" incl.	2T
Over 1" to 2½" incl.	3T
Over 2½" to 4" incl.	4T

Table 5 – CREEP PROPERTIES

Test Temperature °F	Stress, psi to Produce Minimum Creep Rate of 0.0001%/hour	0.00001%/hour
750	85000	75000
800	74000	63000
900	44000	27000
1000	13000	4200*

*Extrapolated

Table 6 – STRESS RUPTURE DATA

Test Temperature °F	Stress, psi to Produce Rupture in 100 hours	1,000 hours	10,000 hours
750	95000	90000	88000
800	87000	82000	78000
900	70000	60000	48000
1000	50000	37000	19000

Weldability:

Good weldability. Low-hydrogen welding conditions must be observed. Preheating of large sections or those under very high restraint may be necessary to prevent cracking, but temperatures should not exceed 500°F. Cooling of the base metal after welding must not be excessively slow because less-tough microstructures will be formed in the heat-affected zones. Stress relief heat treatments may be applied using temperatures as high as 1100°F without suffering loss of strength or toughness. When welding thicknesses of base metal less than about 1/2", the heat input for each pass should be reduced proportionately to ensure rapid cooling. Interpass temperature for multi-pass welding ordinarily should be held to approximately 300°F maximum, but may be adjusted upward for conditions of high restraint.

Corrosion Resistance:

ARMCO SSS-100 has 4 to 6 times the atmospheric corrosion resistance of carbon structural steel.

Specification Equivalents:

ASME Code Case 1298
ICC Code Case 1298
ASTM A514
ASTM A517
AMS 6386
MIL-S-13326A, Cl. 90

General Characteristics:

Sheffield SSS-100 provides high strength, exceptional notch toughness and good weldability through a full range of thicknesses. These qualities, plus excellent atmospheric corrosion resistance, are secured through a balanced alloy composition and an exacting quench and temper heat treatment. Plates are available in the following qualities: regular, flange, firebox and aircraft.

This steel was designed to provide both full strength and toughness in a weldment. Alloy composition assures that strength will be maintained adjacent to the welds. Balanced chemical composition promotes the formation of either a low carbon Martensite or a fine Bainite microstructure after heat treatment. For abrasion resistant purposes the alloy is produced to minimum hardness level of 321 Brinell.

At elevated temperatures SSS-100 steel has creep, stress rupture and short time elevated temperature strength at 900°F approximately three times that of structural carbon steel. Other attributes of this steel are its ability to remain ductile and tough at low temperatures in the presence of stress concentrations and to resist crack propagation.

Forms Available:

Plates, flat and round bars, blooms and billets.

Applications:

Railroad and mine cars, bus and trailer bodies, booms and derricks, transport tanks, bridges, buildings, pressure vessels.

Manufacturer:

Armco Steel Corporation
Houston, Texas

Print this page | Close window

Title: **THE DESIGN AND WELDING OF A RIGID FRAME BENT OF ASTM A 514 STEELS FOR A RAILROAD OVERPASS**

Accession Number: 00208872

Record Type: Component

Abstract: BEAUMONT, TEXAS, HAS LONG BEEN CONFRONTED WITH A CRITICAL PROBLEM OF TRAFFIC CONGESTION IN THE DOWNTOWN BUSINESS DISTRICT. FOUR MAJOR RAILROADS SERVE THE CITY AND ITS LARGE MARITIME PORT AND REFINERIES. A NETWORK OF MAIN LINES AND SPUR TRACKS IS CONCENTRATED WITHIN A TWO SQUARE MILE AREA OF THE DOWNTOWN AREA. A COMMERCIAL FIRM WAS GIVEN THE DESIGN PROBLEM OF RELOCATING RAILROAD TRACKS AND INSTALLING GRADE SEPARATIONS TO ALLEVIATE THE PROBLEM. ONE GRADE SEPARATION WAS A HEAVILY TRAVELED INTERSECTION WHERE THREE RAILROAD TRACKS CROSSED THE INTERSECTION AT A DIAGONAL. BECAUSE OF THE CITY'S LOW ELEVATION ABOVE SEA LEVEL, DEPTH OF DEPRESSED ROADWAYS MUST BE KEPT TO A MINIMUM. THE APPROACH GRADES OF THE RAILROAD TRACKS COULD NOT BE RAISED BEYOND ABOUT TWO FEET DUE TO AMOUNT OF RIGHT-OF-WAY REQUIRED. THE DESIGN ENGINEERS SOLVED THE PROBLEM OF INSTALLING A GRADE SEPARATION PROVIDING SUFFICIENT CLEARANCE WITH THE USE OF A RIGID FRAME BENT MADE OF A 514 STEELS. THE PAPER DISCUSSED THE ALTERNATES CONSIDERED FOR THE OVERPASS-UNDERPASS STRUCTURES AND THE ADVANTAGES GAINED IN USING THE RIGID FRAME BENT MADE OF A 514 STEELS. THE CHEMISTRY AND PHYSICAL PROPERTIES OF THE A 514 STEELS USED (ARMCO STEEL SSS 100 AND SSS 100A) ARE PRESENTED, ALONG WITH DATA ON FATIGUE STRENGTHS AND REPORTS OF WELDABILITY STUDIES. THE DETAILS OF WELD PROCEDURE QUALIFICATION CARRIED OUT BY THE FABRICATOR AND TEST RESULTS OBTAINED ON THE PLATES TO A MAXIMUM OF 3 1/2-IN. THICKNESS ARE REPORTED. PREHEAT CONSIDERATIONS ARE DISCUSSED. PROBLEMS CAUSED BY THE PRESENCE OF HYDROGEN ARE REVEALED WHEN INSUFFICIENT PREHEAT IS USED. THE SUCCESSFUL WELDING WHEN PROPER PROCEDURES ARE FOLLOWED OF THE SSS 100 AND SSS 100A STEELS IS SHOWN. ALL SHOP FABRICATION WAS FOLLOWED BY POST-WELD HEAT TREATMENT. THE HIGHLY RESTRAINED JOINTS AT THE KNEE OF THE RIGID FRAME BENT WERE WELDED WITH THREE WELDERS SIMULTANEOUSLY IN ORDER TO PREVENT RESTRAIN PROBLEMS. THE ERECTION OF THE RIGID FRAME BENT AND THE TWO CONTINUOUS SPANS SUPPORTED BY IT IS DESCRIBED. WELDING OPERATIONS WERE SUCCESSFUL DESPITE UNUSUALLY HEAVY RAINFALL IN THE WINTER. /AUTHOR/

Supplemental Notes: No 242, pp 67-83, 17 FIG, 3 TAB, 6 REF

TRIS Files: HRIS

Authors: Bridgefarmer, J E; Crick, H F; Hartzell, R L

Monograph Info: See related components

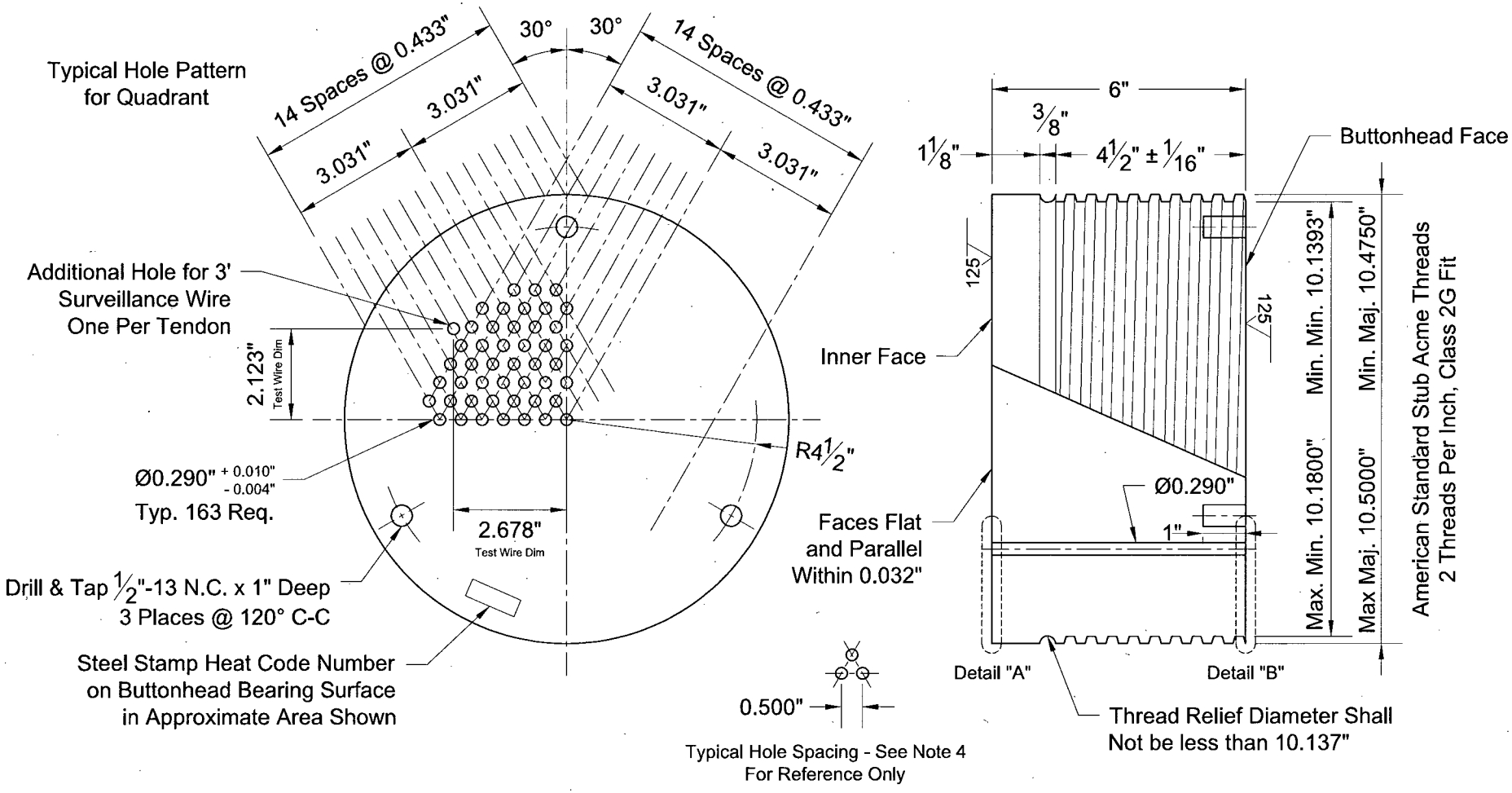
Availability:
- Transportation Research Board Business Office
  500 Fifth Street, NW
  Washington, DC 20001 USA
  Order URL: http://onlinepubs.trb.org/onlinepubs/out_of_print.htm

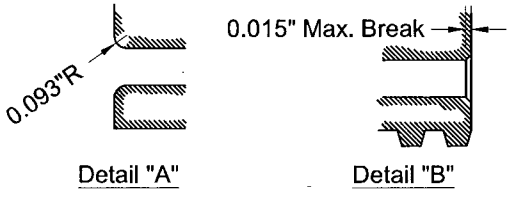
Publication Date: 1968

Serial: Highway Research Record
Issue Number: 242
Publisher: Highway Research Board

Index Terms: Bents; Chemical properties; Continuous girder bridges; Depressed highways; Frames; Grade separations; High strength steel; Metal heating; Overpasses; Physical properties; Railroad tracks; Relocation (Facilities); Stiffness; Traffic congestion; Welding; Heat treatment; Relocation; Weldability; Rigid frames

Subject Areas: H25: STRUCTURES DESIGN AND PERFORMANCE





Owner Approval			
This drawing has been approved by use by Progress Energy Florida by the individual listed below for use on the Crystal River Unit 3 Steam Generator Replacement Project			
Signature		Date	

Notes

1. Bottom Vertical Washers Unthreaded
2. Material: ASTM A514 - Type Q
3. Reference Dwg: Prescon Drawing 5EX7-003 Sheet A8 Rev 3
4. All holes' locations to be within ±0.010" of true position on Buttonhead Face and ±0.035" on Inner Face

Sheet 1 of 1

Drawing No. CR-N1009-502

Current Revision Rev. 1

Project Name

Crystal River

Unit 3 Steam Generator Replacement Project

Drawing Name

163 Wire Stressing Washer

Scale: NTS

PSC
Precision Surveillance Corporation
3468 Watling Street
East Chicago, IN 46312
http://www.psctendon.com
Phone: (219) 397-5826
Fax: (219) 397-5867
Email: info@psctendon.com

Revisions			
Date	Rev.	Description	Approved
01/09/08	0	ISSUED FOR OWNER APPROVAL	CEC
01/28/08	1	DELETE SSS-100 FROM NOTE 2	CEC

Designed By: N/A N/A

Drawn By: BAG 01/28/2008

Checked/Approved By: CEC 01/28/2008

M:\...\N1009 Crystal River SGR Material\CAD\CR-N1009-502 163 Wire Stressing Washer Rev1.dwg

I.1 Design Verification

Design Verification Review	X	Engineering Review		Owner's Review	
Design Review	X	Scope of Review			
Alternate Calculation		EC 63016 Rev.5			
Qualification Testing					
Special Engineering Review					
Reviewer		Discipline		Date	
Casaba Ranganath		Civil/Structural		7/27/09	

Item	Comment	Resolution
1	File A00: A.3 Revision Summary-Revision 5: a) Pages Added: 1) Mark up Drawing S-502-036, File C03. 2) Attachment Z60 to Z62. b) Pages Revised: 1) Revise page numbers as marked. 2) B00, B.6.5-p, page 43-45 should be B.6.5-i, Page 44-45. 3) B00, B.6.5-p, page 64: Calculation S08-0025 should be S09-0025. 4) B00: After Z51 add Z58 Page 13, Section 9.2: Bullet 1 revised to show the revised vertical tendons to be removed and the removal process.	Incorporated comments
2	D00: Section D.2.2.5 Re-Install Tendon Gallery Access Cover: Change this section to D.2.2.6 and change ½" diameter hole under Option 1 line 1 to 5/8" diameter hole.	Incorporated
3	D.2.2.1-2b, 2c,2e,2f, Pages 8 and 9: Should be revised to delete removal of three vertical tendons pre-outage.	Incorporated
4	Attachment Z60: Change VT-1 to visual examination.	Changed to VT-1C.....this reference was added just to clarify to QC what is required.
5	ADL: Add drawing S-502-036.	Done.

Note: The Lead Reviewer signature on the EC DV milestone panel signifies that a lead review has been performed in accordance with EGR-NGGC-0003 and that errors/deficiencies (for all reviews performed) have been resolved and included in the EC package.

FINAL DRB COMMENTS

- Review spacing of the liner plate angle stiffeners and determine if they will impact welding backing plate. *Have no way of knowing where the angles actually are until they are exposed during hydrodemolition. Liner plate cut location will be adjusted in the field to account for angle location. Have added note to installation instructions.*

- Evaluate the need for contingency planning for breach of containment should the liner plate be punctured after hydrodemolition and prior to completion of defueling. *I have discussed this with Bechtel and the conclusion is that we can use Belzona and a section of thin steel to patch any holes. Have added note to installation instructions.*

- Add a sketch to the EC (perhaps in the installation instructions) to provide buttress numbering information. *Have added Attachment Z32.*

- Review the laydown needs for Mac & Mac versus ILRT needs assessing timing (assign to J. Whisler, this does not need to be included in the EC package).

- Add the requirement for a fire barrier breach permit when the liner plate is cut, based on CP-137, in the installation instructions. *Have added to EC including installation instructions.*

- Evaluate the need for retention of waste water while being piped from the hydrodemolition equipment to the settling ponds. *This is being handled by the Containment Opening Task manager through Work Order Task 1165094-Task 03.*

- Determine if rigging, fit up and welding fixtures on the inside of the liner plate must be removed down to base metal. If not establish the acceptance criteria for accepting any portion of the fixture or weld left in place. *Per Jim Terry the fit-up devices will be removed from the inside face of containment.*

Record of Concurrent Review

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Howard T. Hill	Civil	14 Aug 08
Concurrent Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1	Page 4, 3rd line from the bottom – Based on dimensions given, concrete opening extends 9" beyond the liner on each side and an average of 13.5" top and bottom, not 18" all around as stated.	Revised to "approximately 12"" (Note that sides are sloping and dimension varies from 9" to approximately 16".
2	Page 5, 3rd full paragraph (middle of page) – The new No. 11 reinforcing should be mentioned here.	Added sentence.
3	A.5.1-Task #1, Activity 3 – (Editorial) 'requirements' is not an activity. Subject of the sentence should be 'storing'.	Deleted "requirements"
4	A.5.1-Task #1, Activity 12 – Change 'from within' to 'to create".	Done
5	A.5.1.2 – In the 3rd paragraph, identify S&ME as the contracted concrete laboratory (here instead of the 4th paragraph).	Done
6	A.5.1.2 – Poisson's ratio should be determined by the lab and listed as a required parameter here and elsewhere in the EC.	Poisson's ratio was not in the labs scope of work.
7	A.5.1.6 – The paragraph at the bottom of p. 9 suggests that vertical tendons are drained by removing end caps. Primary draining is through the end cap fitting provided for fill / drain / vent. End cap can be removed when CPM flow stops (reduced to a dribble).	Revised accordingly.

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Item No.	Deficiency	Resolution
8	A.5.1.11 – (Editorial) In the 5th line of the 2nd paragraph on p. 13, change 'tugger's' to 'tuggers".	DONE
9	A.5.1.12 – The Davis Besse containment is a steel pressure vessel. Hydrodemolition, if used, was used to create the opening through the Shield Building, not the 'containment shell' (see 5th line of the paragraph above the list of plants on p. 14).	Davis-Besse removed from list.
10	A.5.1.12 – The description in the paragraph below the list of plants on p. 14 would benefit with reference to a sketch or drawing showing the arrangement of the nozzle heads and supporting framework.	Added reference to G05 for details of frame. Nozzle heads are proprietary information and no drawings are available.
11	A.5.1.12 – The description in the paragraph starting at the bottom of p.. 14 would benefit with reference to a sketch or drawing showing the nozzle paths.	No drawings are available
12	A.5.2.7 – In the 4th line of the final paragraph on p.20, replace 'VT-1' with 'detailed' per 02 Addendum change to IWL-4220(c).	Done
13	A.5.2.10 – In the 5th line from the bottom of p. 22, change 'VT-1' to 'detailed'.	Done

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Item No.	Deficiency	Resolution
14	A.5.2.10 – The examinations described in the penultimate paragraph will require access to the space between the liner and outer form. Verify that there is access, either sufficient room for examiners to work between the forms or closely spaced access door in the outer form to permit a proper examination from the outside.	Formwork will be designed to provide adequate access.
15	A.5.2.11 – Change reference to VTMA 02850-001 (3 places).	PSCs manual is not going to be made into a CR3 vendor manual. VTMA 02850-001 has been deleted.
16	A.5.2.13 – Reference should be to a pressure test as required by IWL-5000 to demonstrate the structural integrity of the restoration work, not to an ILRT. The ILRT is not required by Section XI, which does not specify the type of test used to verify leak tight integrity of the liner weld; a Type B test is sufficient.	Revised accordingly.
17	P. 26, AIMS ID #573 – the 2nd paragraph refers to a 'finding'. The subsequent paragraph describes the access opening but does not indicate that there are 'findings' associated with it.	"Finding" removed from sentence.
18	P. 26, AIMS ID #573 – In re the Conclusion Statement, see Comment No. 1.	Revised to approximately 12".
19	P. 27, AIMS ID #573 – In re the Conclusion Statement, opening dimensions should be consistent throughout the EC. See p. 5.	Revised to show opening size on outside face of containment, as shown on page 5.

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Item No.	Deficiency	Resolution
20	P. 27, AIMS ID #574 – See Comment No. 17 in re 'finding'.	"Finding" removed from sentence.
21	P. 27, AIMS ID #574 – In re the Conclusion Statement, if the No. 8 bars are to be lap spliced, loss of material is not a concern.	The concern is the loss of material at the bar projecting from the concrete. If too much is removed the remaining length may not be sufficient to make the mechanical splice which would require additional chipping around the bar.
22	AIMS ID #574 - See Comment No. 17 in re 'finding'.	"Finding" removed from sentence.
23	AIMS ID #650 – The first sentence under Activity/Subject should read '....short and long end caps...' rather than '...short and tall hats...'. The 2nd sentence could be reworded.	This is copied and pasted directly from the AIMS data base.
24	B.3, Reference 1.8 – Other references to Section III, division 2 cite the 2001 Edition with Addenda through 2003.	Reference deleted
25	B.4.5 – In the 1st line of the 3rd paragraph, delete the word 'liner' before 'exposed'.	Done
26	B.4.6 and Elsewhere – Considering the cost of new corrosion protection medium and the added cost of disposing of the old, it may be worth considering reusing that which drains from vertical tendons (perhaps 50 drums @ ~$1,000 for new material + disposal cost).	Per Precision Surveillance Corporation, every SGR they have worked on replaced the old grease with new grease. Need to take a representative sample of the grease for testing, which cannot be done until all the grease has been drained out of the tendon, which would have to be done during the outage. Results of testing may not be acceptable for old grease and then we would have to purchase new safety related grease during the outage.

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Item No.	Deficiency	Resolution
27	B.4.8 – The 2nd line at the top of p. 14 refers to meeting or exceeding the listed requirements. There is no clear definition as to what constitutes meeting or exceeding a particular slump, cement type or Poisson's ratio.	Added requirements.
28	B.4.8 – The Original Materials list on p. 14 includes tendon sheathing and other items that are not safety related. These should probably be identified as such.	Section B.6.8 specifies quality level.
29	B.4.20 – Expand the final sentence of the 1st paragraph (top of p. 19) to include examinations of the new concrete surface and the inside face of the restored section of liner (not just the welds).	Revised accordingly.
30	B.4.22 – Change the 2nd sentence to a positive action statement such as 'Personnel performing these activities will be trained and qualified.	Done.
31	B.4.24 – The tendon corrosion protection medium (grease) is a flammable petroleum product.	Noted accordingly.
32	B.4.28 – In re the statement in the final full sentence on p. 21, PSC does not provide services to San Onofre and, therefore, not to all post-tensioned containments in the US.	Changed to "majority' of plants
33	B.5.4 – Responsibilities for future actions should be assigned to organizational entities, not named individuals.	Removed name.

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Item No.	Deficiency	Resolution
34	B.6.1, Bulleted List – Is LOCA pressure not 54.2 psig and design pressure 55 psig? Makes a difference since LOCA pressure, P_a, is test pressure for both the IWL-5000 test and the ILRT.	Added sentence clarifying that DBA pressure is 54.2 psi
35	B.6.1 – In the 2nd line of the 1st paragraph following the bulleted list on p. 24, change 'Precast' to 'Prestressed'.	Changed
36	B.6.1 – The 5th line of the final paragraph uses the term 'code compliant'. Identify the applicable code(s).	Revised to reference the acceptance criteria listed in the DBD and the FSAR.
37	B.6.3 – The meaning of the discussions in the 2nd and 3rd paragraphs is not clear.	Clarified description.
38	B.6.4 – Clarify the directions of the pressures shown in the 1st bulleted line. 55 psig (or 50.6 psig P_a) is a positive internal pressure that is unsigned. Tornado pressure (a drop below atmospheric) should be equivalent to a positive internal pressure but is shown with a minus sign. Does spray actuation generate internal vacuum or a positive internal pressure?	Revised as noted. Spray actuation generates an internal vacuum inside containment (Refer t FSAR Section 5.2.1.2.7).

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Item No.	Deficiency	Resolution
39	B.6.4 – The 2nd bulleted line indicates that the LODHR calculation was done for a pressure of 5.14 psig. Is this correct? Wasn't the analysis done for a pressure of 8 psig? The LODHR pressure appears in many places in the EC. The question of 5.14 psig vs. 8 psig should be addressed where LODHR pressure is first mentioned.	5.14 psig is correct. Added and explanation in 6.4.
40	B.6.4 – The 3rd bulleted line mentions a maximum suction force of -6 psig. Is this only a design value or is it associated with a plant condition or event? Also, since suction increases compression in the structure, it is not enveloped by the design pressure of 55 psig. Suction (vacuum) increases compressive stress in the concrete and it must be shown (easily done) that combined dead load, pre-stress and suction pressure do not result in compressive stress in excess of ACI and / or ASME allowables.	Due to accidental actuation of building spay throughout the range of normal operating pressures (Ref. FSAR 5.2.1.2.7). Revised wording to explain pressure load is a suction force on the liner.
41	B.6.5-c – Does tornado wind load (as opposed to pressure drop in the eye) apply during the SGR outage?	Tornado wind and pressure drop are evaluated. Refer to B.6.5-f

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Item No.	Deficiency	Resolution
42	B.6.5-d(i) – There are a few minor numerical errors in the bulleted list which should be corrected for document quality purposes. GUTS = 9.723 x 240 = 2,333.5 0.8 GUTS = 1,866.8 0.7 GUTS = 1,633.4 The above can be rounded to the nearest whole number or, down for conservatism.	Extracted directly from the containment DBD (Ref. 2.1).
43	B.6.5-d(i) – For clarity, the minimum required pre-stressing force in a tendon should be identified as either end anchorage force, mean (along the length) force or minimum (near the center of a hoop) force. End anchorage force is preferred since this is determined by direct measurement; but, verify with the analyst.	Extracted directly from the containment DBD (Ref. 2.1). Added "mean anchorage force"
44	B.6.5-d(ii) – The final sentence of the 1st paragraph states that expected pre-stress at the time of replacement is based on average effective pre-stress considering all losses including friction. This needs to be explained since it relates back to the item discussed in Comment No. 43.	Deleted reference to friction. Added description concerning friction.

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Item No.	Deficiency	Resolution
45	B.6.5-d(ii) – Are the projected tendon forces shown in this paragraph based on design calculations or extrapolation of trends determined using surveillance results (could be a large difference). The EC should be clear as to which. The bulleted items indicated that design calculation values are used.	Based on design calculations.
46	B.6.5-d(ii) – The bulleted sentences should explain the significance of the parenthetical (kip / ft) values. Also, the 164.75 ksi hoop stress needs an explanation (it is not 70% GUTS, which is 0.7 x 240 = 168 ksi).	Added sentence clarifying the meaning of kip/ft. Add clarification that the 164.75 ksi is the average tendon stress.
47	B.6.5-d(ii) – The expression, 'pressure load = tendon force (kip / ft) / radius' in the final paragraph at the top of p. 29 is not quite correct. The equivalent pressure load (considering a uniform stress along the length of a hoop tendon; i.e. no variations due to friction) is tendon force /(tendon spacing x radius). If the equivalent pressure is applied to the outside of the model, the correct radius to use in the expression is the reactor building outside radius.	The GTSTRUDL input file contains the appropriate area based on tendon spacing. Refer to Section 4.2.3.2 of Calculation S06-0004.

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Item No.	Deficiency	Resolution
48	B.6.5-d(iii) – The odd hoop lock-off stress (164.75 ksi) needs explanation. Also, in the last paragraph under the 1st primary bullet (arrowhead), the pressure load expression needs to be changed per Comment No. 47.	Refer to Item 46 Refer to Item 47
49	B.6.5-g, 1st Bullet – Is the LODHR calculation pressure 5.14 psig or 8 psig?	It is 5.14 psig. Refer to item 39
50	B.6.5-i – The thermal load discussion is difficult to follow. Is the present degree of detail necessary to the EC? Can the discussion be shortened and summarized?	The intent here is to provide enough information that a structural engineer with containment analysis experience will, after reviewing these sections, have a clear overview of the methodology used in the evaluations.
51	B.6.5-i – Following the 2nd bullet (arrowhead) on p. 33 and elsewhere, what is 'axial temperature'? should this be 'axial temperature gradient'?	Added in parenthesis : average cross-sectional)
52	B.6.5-i – The final sentence on p. 33 states that treating actual temperature distribution as linear is conservative. Explain why.	Revised to state that the temperature profile was considered linear.
53	B.6.5-i – The 2nd sentence on p.34 refers to 'proprietary' computer programs. What is the significance of 'proprietary'? Are these unique programs recognized in the industry? If so, possibly identify by name.	Removed "proprietary"

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Item No.	Deficiency	Resolution
54	B.6.5-i – The paragraph below the bulleted list on p. 34 states that heat transfer characteristics are evaluated. Aren't the characteristics fixed (diffusivity, conductivity, capacity, etc.) and used to calculate temperature distribution which is, in turn, evaluated?	Revised wording accordingly.
55	B.6.5-i – In the 6th line above the bottom of p. 34, what does 'Change in axial concrete temperature' mean? Does this refer to a time dependent change in gradient or to the change in temperature along an axis (radial or vertical)? Also (here and elsewhere), does axial refer to a direction parallel to the reactor building center line? If so, it might be better to use the term 'meridional' or 'vertical'. (In a plan view, axial would generally be considered radial as opposed to circumferential)	Added "average cross-sectional"
56	B.6.5-i – The 1st line at the top of p. 35 notes that concrete has a smaller expansion coefficient than steel. Values used in the analysis rather than qualitative comparison should be given here.	Added values.
57	B.6.5-i – Comments Nos. 54-56 apply to various lines on p. 35.	Done.

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Item No.	Deficiency	Resolution
58	B.6.5-j – The NOTE at the end of this section references 2 LODHR pressures. Which is considered to govern the opening analysis and why? Is the LODHR pressure an FSAR value? If so, which number is in the FSAR?	It is not an FSAR value. The containment shell was evaluated for 5.14psi. The liner plate was conservatively evaluated for 5.14 and 8 psi.
59	B.6.5-k – The discussion is difficult to follow. Par. 1. Refers to the TLD. Par. 2. Refers to the auxiliary crane. Are these the same item, separate items or is one part of the other?	Added an explanation of what the auxiliary crane is, i.e. The auxiliary crane is a pedestal crane mounted on a skid that transverses the HTS and supports the erection and dismantling of the TLD.
60	B.6.5-l – The discussion in the 2nd paragraph could use added description of the lifting system. Does the TLD bear on the rotating polar crane girders or only on the fixed circular rail?	Clarified sentence.
61	B.6.5-l – The material presented in Pars. 1., 2. & 3. seems very detailed. Is this necessary to the EC? Can it be summarized?	Refer to item 50
62	B.6.5-m – The 4th and 5th lines of the final paragraph refer to 'column strength interaction diagrams'. What are these and how are these used in the analysis?	Defined per ACI 318.
62	B.6.5-o – The final sentence of the 1st paragraph should be rewritten to eliminate use of the word 'we'.	Reworded
63	B.6.5-o – The two equations beginning with 'S = 0.75 x' require some explanation.	Revised as discussed.

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Howard T. Hill	Civil	14 Aug 08
Concurrent Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
64	B.6.5-p – Revise the final sentence of the 3rd paragraph to clarify whether: The results of STRUDL analysis matched the manual calculation results reasonably well. The results of the initial design basis calculations did not match the manual calculation results as well. or The results of STRUDL analysis matched the manual calculation results reasonably well. However, the results of the STRUDL analysis did not match the results of the initial design basis calculations very well. Suggest splitting into two sentences. The first stating that results were compared and the second stating that (think this is the correct correct choice): 'Results of the manual calculations were a better match to those of the GESTRUDL analysis than to those of the design basis calculations.' The STRUDL analysis is considered to be the more exact. Therefore, manual calculations should match reasonably well in regular (PR/t) areas of the wall.	Revised accordingly.

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Howard T. Hill	Civil	14 Aug 08
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Item No.	Deficiency	Resolution

FORM EGR-NGGC-0003-3-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

ATTACHMENT 3
Sheet 1 of 1

Record of Concurrent Review

Document Engineering Change 000006301 / E.1 **Revision** 0

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Howard T. Hill Civil 25 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
1	p. 1 / Item 2 / Test Procedure – In the 1st and 2nd lines, delete 'of actual production splices'. No production splices will be tested.	Done
2	p. 1 / Item 2 / Acceptance Criteria – there will be about 100 mechanical splices. Maximum number of sister splices tested will be about 9. Need to address this in the Acceptance Criteria discussion since the 100% ultimate criterion applies to 15 tests.	Revised to 9 splices
3	p. 3 / Item 1 / Design Input – It should be noted that liner pre-service exam is done following restoration of the coating.	Done
4	p. 3 / Item 2 / Design Input – Note that a pre-service examination of the new concrete is to be done per IWL-2230 following the pressure test.	Done
5	p. 3 / Item 2 / Design Input – In the final paragraph, change '(IX)' to lower case '(ix)'.	Done
6	p. 3 / Item 4 / Design Input – Change 'protective' to 'protected'.	Done

Document Engineering Change 000006301 / E.1 **Revision** 0

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Howard T. Hill Civil 25 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
7	Add requirement for quality checks of field button heading (per PSC Manual procedure). Checks include go-no go diameter measurements, eccentricity measurements and visual and measurement of splits.	Done

FORM EGR-NGGC-0003-3-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

ATTACHMENT 3
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Record of Concurrent Review

Document EC 000063016, Part C **Revision** 0

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Howard T. Hill — Civil — 16 Aug 08
Concurrent Reviewer (print/sign) — **Discipline** — **Date**

Item No.	Deficiency	Resolution
1	D.1.1 / Item 21 – Re-installation of corrosion protection medium (re-greasing) can be done anytime up to 30 days following Mode 2 entry.	Done.
2	D.2.1 / Item 2 / 6th Bullet – Clarify that no platform will be lowered to a roof location between Buttresses 1 & 3 or, alternatively, that platform can be remotely controlled during lowering.	Done.
3	D.2.1 / Item 3 / 5th Bullet – Doesn't sound correct that venting of radioactive material 'into' the RB is handled in accordance with the ODCM. Should this paragraph refer to venting 'from' the RB?	Revised to "from".
4	D.2.1 / Item 3 / 7th Bullet – (Editorial) Change 'Ph' to 'pH'.	Done.
5	D.2.1 / Item 3 / 11th Bullet – Cite reference for sump pump head & delivery or specify here.	The hydrodemolition contractor (Mac and Mac) will pump 300 gpm thru their hydrodemolition nozzles (Ref. Attachment Z24). Therefore, the temporary sump pump in the gallery has been sized for the worst case of 300 gpm.
6	D.2.1 / Item 4 – Add new bulleted item: • Notify Security prior to cutting liner.	Done.

Document EC 0000063016, Part C **Revision 0**

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Howard T. Hill Civil 16 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
7	D.2.2.1 / Item 2a – (Editorial) – In the 1st line, change 'degreased' to 'degrease'.	Done.
8	D.2.2.1 / Item 2b – As it is easily done prior to the outage start, consider requiring examinations of all (including those to be removed) vertical tendon end anchorages. This will significantly expand the plant OE data base.	Per discussion with the CR3 IWE/IWL engineer (Rick Portmann) I have added the following sentence to the work instructions "However, craft personnel are to look at the tendon assembly after cleaning and prior to cutting the buttonheads for removal and note any obvious deficiencies that may question the integrity of the tendon assembly. Any questionable deficiencies should be referred to the IWE/IWL Responsible Engineer".
9	D.2.2.1 / Item 2h – If intended, specify re-installation of the regular end caps (as written, the sentence could refer to a temporary protective cover) at both ends of the hoops and the upper ends of the verticals. If the hoop end caps have low point drains, these can be left open to drain water during hydro-demolition.	Reworded.
10	D.2.2.1 / Item 4f – (Editorial) In the 1st line, change 'install' to 'installed'.	Done
11	D.2.2.1 / Item 4i – Per discussion, consider changing 2,000 to 3,000 (generally accepted value for full strength concrete).	Done.

Document EC 0000063016, Part C **Revision** 0

☐ **Design Verification Review** ☒ **Engineering Review** ☐ **Owner's Review**

☐ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☐ **Special Engineering Review**_____

Howard T. Hill Civil 16 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
12	D.2.2.1 / Item 5b – Isn't the requirement 'at least 72 hours after placement and when strength is at least 5,000 psi'?	No. Only that the concrete has reached 5000 psi
13	D.2.2.2 / Item 1b – (Editorial) After 'chipping platform', delete 'will be installed'.	Done
14	D.2.2.2 / Item 1h – See Comment No. 5.	Refer to Item #5 resolution.
15	D.2.2.2 / Item 2b – Hoop tendon ends should already be covered with the regular end caps. Vent through low point drains if these exist. Otherwise loosen bolts and insert a spacer (thick washer) on the lowest bolt or lower 2 bolts to create a small gap at the bottom for drainage.	Reworded
16	D.2.2.2 / Item 2d – Need a second stop (or stops) in hydro-demolition work to remove tendon sheathing.	Done
17	D2.2.3 / Item 2d – It seems that the 2nd option is preferred from a cost and schedule standpoint. Is there a reason to mention the 1st (grind and examine / test and, repair if grinding is overdone).	The SGR project manager requires that the attachments on the inside of containment are removed.
18	D2.2.3 / Item 2d – Following the 2nd bullet, should 'above' be replaced by 'from the surface of'?	Changed accordingly.
19	D2.2.3 / Item 2f – Specify required tests and inspections here or cite a reference for this information.	Requirements are specified in E00.

Document EC 0000063016, Part C **Revision 0**

☐ **Design Verification Review** ☒ **Engineering Review** ☐ **Owner's Review**

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Howard T. Hill — Civil — 16 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
20	New Section above D.2.2.4 – Need an item to cover preparation (roughening and cleaning) of the concrete surface. New item can be D.2.2.4 if current D.2.2.4 and D.2.2.5 are renumbered D.2.2.5 and D.2.2.6, respectively.	Added section D.2.2.4-c
21	D.2.2.4 / D.2.2.5 – Outline numbering of subordinate items needs correction.	Done.
22	D.2.2.4 / Item 6 (needs to be renumbered as item 2) – Add a requirement to examine No. 8 reinforcing stubs following liner reinstallation. Stubs to be examined per IWL-4220(c) and repaired, if necessary, per IWL-4230.	Done.
23	D.2.2.4 / Item 6h (needs to be renumbered as item 2d) – Add a requirement to secure the No. 11 mats in position as shown on Dwgs. 421-350, -351. These drawings should be modified to show methods (s) of attaching mats to fixed items (liner stiffeners close to the opening edge and / or No. 8 stubs close to the concrete face (before or after splicing depending on length of stub, need for access to splice, etc.).	Added instructions and also added detail to drawing 421-350.
24	D.2.2.5 – Add a new item identifying the activity to remove formwork (need to specify minimum time following placement and minimum strength) and grout form tie holes.	Added new section. However, have referred to concrete spec CR3-C-0003 for details addressing formwork removal.

Document EC 0000063016, Part C **Revision 0**

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Howard T. Hill — Civil — 16 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
25	D.2.3 / Item 1a – See Comment No. 8	Refer to resolution of Item #8
26	D.2.3 / Item 3a – Delete reference to IWL; does not apply to the liner.	Done
27	D.2.3 / Item 4a – (Editorial) Add '0003' following 'CR3-'.	Done
28	D.2.3 / Item 5a – Delete the word 'production' from the 2nd sentence and replace the 3rd sentence with the following. 'Due to the limited length of the No. 8 reinforcing stubs it is not possible to cut out and test production splices. Therefore, all tests will be on sister splices. Since production splices cannot be tested, overall testing frequency is increased beyond that required by ASME Section III, CC-4333.5.' Continue with the existing 4th and subsequent sentences.	Done.
29	D.2.3 / Item 5 – Add a new item 5c to cover welded splices.	Done
30	D.2.3 / Item 6a – (Editorial) Relocate 'ASME Section XI, Article IWL-5000' to precede 'SP-178'	Done

Document EC 0000063016, Part C **Revision 0**

☐ **Design Verification Review** ☒ **Engineering Review** ☐ **Owner's Review**

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Howard T. Hill — Civil — 16 Aug 08
Concurrent Reviewer (print/sign) — **Discipline** — **Date**

Item No.	Deficiency	Resolution
31	D.2.3 / Item 6b – Add the following final sentence. 'The final examination will satisfy the requirements of ASME Section XI, Par. IWL-2230 for preservice examination of repair / replacement activities.'	Done
32	D.4 / Line 2 – Will the No. 8 bars be factory bent to the specified radius?	Yes
33	D.4 / Line 6 – What is 'plane' steel?	Removed
34	D.4 / Line 7 – Reconcile dimensions of adapter shown on Dwg. 421-350 with those described on Line 7. The adapter shown on the drawing is swaged to an O.D of 4-7/8".	Done.
35	D.4 / Line 8 – Delete the word 'diameter' since bolts designed for a 5" diameter round may not fit a 5" pipe or a 5-1/4" round. For completeness, add nuts and washers to the material requirement.	Done
36	D.4 / Lines 12 & 13 – Delete periods after 'I' and 'D' and add 'No.' after 'D' to avoid suggestion that an inside diameter is involved.	Done

Document EC 000063016, Part C **Revision 0**

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Howard T. Hill — Civil — 16 Aug 08
Concurrent Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution
37	D.4 / Line 14 – (Observation) If information serves, the 2090 P-4 may cost ~$20 / gallon. Possibly consider reuse.	No re-use
38	D.4 / line 35 – 585 gallons seems an odd quantity. Suggest considering changing to '600'.	Already procured.
39	D.4 / line 36 – Probably better to specify a volume quantity rather than 'kit' (which could be quite small). Need enough to seal 162 joints plus wastage. Probably want to allow over ½ pint per joint, say 1 pint with wastage. Total for 162 joints would then be ~20 gal.	Added.
40	D.4 / Bottom of p. 17 – Delete Weld-Crete line.	Done.

FORM EGR-NGGC-0003-3-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

Crystal River Unit 3 Steam Generator Replacement Project
Review of Creep Effects on Behavior of Restored Containment Structure

Executive Summary

A steam generator replacement outage is planned for Crystal River Unit 3 during the fall of year 2009. A temporary construction opening is needed in the unit's six-buttress post-tensioned containment structure to facilitate the movement of old/new steam generators out of/into the containment structure. Prior to concrete removal, the post-tensioning tendons passing through the planned opening will be detensioned and removed; additionally, vertical and hoop tendons in the immediate vicinity of the opening will be detensioned to minimize the residual prestress level within the opening. After completion of the steam generator replacement operations, the construction opening will be restored by placing new concrete, whose mix will be designed and tested to achieve better creep and shrinkage properties than those of the existing concrete.

The necessary structural analyses are being performed by Sargent & Lundy (S&L) to verify that the interim and restored configurations of the containment structure will continue to meet the plant's licensing commitments (e.g., accident pressure/temperature, safe shutdown earthquake loads, etc). Of particular concern is the subject of differential creep effects on the stiffnesses of new and old concrete. Prof. Domingo Carreira, S&L's consultant, has prepared a white paper (Ref. 1) to address this subject, including suggested remedies. Progress Energy has asked Bechtel to perform an independent review of the paper and provide the following evaluations:

- Appropriateness of using a creep-adjusted moduli for the new and existing concrete for determining the relative distribution of prestress forces between the new concrete in the restored region and the existing concrete, which surrounds it.
- Efficacy of additional reinforcement to address the impacts of creep in the new concrete.
- Relative merits of other suggested measures for offsetting the undesirable creep effects.

This paper provides Bechtel's evaluation of the above issues. Bechtel concludes that while the relative distribution of prestress load is indeed dependent on creep-adjusted moduli, there is also sufficient statistical uncertainty in the actual values of the moduli such that the problem requires a parametric treatment. Our main observations are as follows:

- The new concrete mix should use high quality aggregates (imported, if necessary) to ensure high modulus and elasticity and low creep.
- Additional rebar in new concrete should not be sized for the sole purpose of matching the creep-adjusted stiffnesses of new and old concrete. Additional rebar will likely be necessary to resist the bending moments in the patch area; its benefit toward improving the new concrete stiffness should be addressed by considering high, low, and median values of the creep-related parameters for new and old concrete.
- Tendon retensioning should progress from the far region toward the restored region; this will ensure that the new concrete strength will exceed 6,000-psi when prestressed.
- Shrinkage compensating cement should not be used in the new concrete mix.

Background

Crystal River Unit 3 is a six-buttress post-tensioned containment structure designed to resist 55-psi accident pressure. The containment wall is post-tensioned with vertical and horizontal tendons and the dome is post-tensioned using a three-way post-tensioning system. The inside surface of the containment structure is lined with a carbon steel liner plate to ensure a high degree of leak tightness during operating and accident conditions. The liner plate is 3/8-inch thick for the cylinder and dome, and ¼-inch thick for the base. The cylinder portion has an inside diameter of 130-feet, wall thickness of 3.5-feet, and a height of 157-feet from the top of the foundation mat to the spring line. A ring girder is provided at the cylinder-dome transition. The shallow dome roof has a large radius of 110-feet, a transition radius of 20.5-feet, and a thickness of 3-feet. A temporary construction opening will be made in the containment wall to facilitate the movement of old and new steam generators out of and into the containment.

The creation and restoration of a containment opening poses the following challenges:

- Residual compressive stresses within the planned opening, resulting from deadweight and remaining prestress load (after removal/detensioning of the proximate tendons), are permanently redistributed once the opening is created. This makes it difficult to restore the original prestress levels in the restored region (i.e., the "patch") upon retensioning of the removed/detensioned tendons. On the other hand, the surrounding concrete benefits due to slightly increased compressive stresses.
- The creep is high in new concrete (due to its young age) compared to the surrounding old concrete. Difference in the values of creep-adjusted moduli of elasticity for new and existing concrete has a bearing on how the applied prestress load is shared among the two. While new the concrete benefits from lower creep mix design and higher initial strength, it may have a slightly lower creep-adjusted modulus (and hence stiffness) relative to the old concrete. This can result in a somewhat higher proportion of the prestress load being transferred to the old concrete, leaving the new concrete at potentially further disadvantage in terms of its ability to resist the design loads.
- Retensioning forces, which act asymmetrically in both hoop and vertical directions, produce small circumferential and meridional bending moments in the restored region and possibly in the region immediately surrounding it. These need to be resisted in addition to the typical membrane forces produced by accident pressure load and/or earthquake. The old concrete is better situated to resist these moments because it has slightly higher compressive stresses (compared to the original unbreached state), whereas the restored area is at some disadvantage because of lower compressive stress levels. This is typically overcome by providing additional (new) rebar on the inside face of the containment structure within the restored region; such rebar is also helpful in improving the new concrete stiffness.

The above disadvantages for new concrete need to be juxtaposed against the following benefits:

- Superior mix design should result in high early strength, low shrinkage and low creep coefficient; this reduces creep losses and increases the creep-adjusted modulus of elasticity. In terms of creep losses, the new concrete benefits on two accounts: superior

mix design and small expanse of the affected area relative to the total length of hoop/vertical tendons.

- Due to its age at the time of retensioning, the old concrete incurs less creep losses during the remainder of plant service life.
- Retensioned old tendons and new tendons (if used to replace the old ones) typically have better relaxation characteristics than before, resulting in smaller relaxation losses.
- The new concrete has higher strength at the (beginning and) end-of-life; it can thus resist higher membrane forces and moments than the surrounding concrete.
- Using the maximum permitted lockoff force, the retensioned tendons are able to impart higher prestress load into the affected region than before; additionally, the end-of-life prestress loads in the affected region is higher than before (i.e., if the containment was not breached and restored) because the tendon lift-off loads are higher for the retensioned tendons (due to higher lockoff force and smaller number of remaining years to end-of-life).

Because of the interplay between the undesirable factors listed under "challenges" and the offsetting factors listed under "benefits" above, it follows that mere restoration of prestress levels within the patch area does not necessarily guarantee that the restored structure will be able to resist the design loads without any problems. Also, the inherent uncertainty in the properties of new and old concrete (e.g., creep-adjusted modulus, age-adjusted modulus, etc) requires that the necessary analyses should be performed considering a range of values (i.e., low, median, and high values).

Other important considerations pertain to concrete placement activities. Precautions need to be taken to ensure that there is no gap left between the new concrete in the patch area and the old concrete which surrounds it. Various factors such as concrete pour rate, use of low shrinkage cement, profile of opening edges, and techniques for placement of the final few feet height, etc, are important in this regard.

Discussion

The following discussion is organized similar to the layout of Section 5 in Prof. Carreira's report (Ref. 1). Bechtel's observations and opinions relative to each subsection therein are presented below:

- New Concrete with High Modulus of Elasticity: Bechtel agrees that the new concrete mix design should employ aggregates with high modulus of elasticity. This will assure that the actual modulus of new concrete is high. If necessary, such aggregate should be imported.
- New Concrete with Low Creep and Low Shrinkage: This is typically a consequence of having a concrete with high modulus. Concrete constituents should be selected to assure low creep and low shrinkage.
- Use of Reinforcing Bars to Reduce Prestress Loss from Creep: Reinforcing bars in new concrete aid in improving its stiffness compared to that of the surrounding old concrete,

thus facilitating an equitable distribution of the prestress load among the two. While this benefit is incontrovertible, Bechtel believes that Prof. Carreira's report (including the supporting calculations presented in Attachment 3 to the report) places undue reliance on this approach. Uncertainties with regard to the validity of the ACI 209 equations and variability of the parameters therein (e.g., E_{ci}, υ_t, X, etc) mean that the results should only be considered indicative and that a range of parameter values should be considered to develop confidence concerning efficacy of this approach (alternatively, one may simply consider a ±20% variation in the resulting concrete stiffnesses relative to the "ideal" values).

More importantly, as discussed in the Background section earlier, matching the creep-adjusted stiffnesses of the two concretes does not necessarily assure continued structural integrity of the restored structure. We recommend that the new rebar in the restored region should be primarily sized to resist the small bending moments in that region and the adequacy of restoration should be assessed against the actual demands in terms of membrane forces and moments.

- Detensioning and Retensioning of Additional Tendons: Ideally, it is better to detension as many tendons as possible to bring the containment structure to as much of a stress-free state as possible (recall that the residual stresses prior to concrete removal are forever redistributed to the existing concrete surrounding the opening). However, these activities have a direct schedule impact and an optimal decision needs to be arrived at by trial and error to ensure that the chosen scheme will still assure continued adequacy of the restored structure. Based on Bechtel's past experience in these types of projects, S&L's preliminary decision to remove/detension 30 vertical tendons and 35 hoop tendons appears to be in the right ballpark.

- Elimination of Gaps between Replacement and Existing Concretes: Bechtel is in agreement with Prof. Carreira's recommendations concerning formwork, and concrete surface preparation. We also concur with his recommendations concerning use of cooler aggregate, and ice, if necessary, to minimize shrinkage in case of concrete placement during warm weather.

  We are concerned that a lapse of 30-minutes between placements of successive 12-inch lifts may be too long, risking a cold joint. The interval should be based on initial set characteristics of the concrete mix; it appears that 30-minutes may be too long for a high strength mix with rapid strength gain properties.

  Bechtel recommends against the use of shrinkage compensating cement in the new concrete mix. Our experience is mixed in this regard and an application of such importance should involve proven and widely accepted practices; it should not be experimented with. Creep properties of such concrete, which involves use of Type K cement (ASTM C-845), are not well documented, and this cement material is not allowed in ASME Section III Division 2 Subsubarticle CC-2221.1. Our experience is that the use of drypack for placement of the last few feet height of concrete pour can be sufficiently effective in eliminating a gap at the top; the profile of the top edge should be flaring up going away from the containment centerline to ensure best placement.

- Further Retensioning of Tendons after Post-Tensioning Restoration: This option should be used only if it becomes necessary; i.e., if the subsequent tendon surveillance of the

affected tendons reveals a problem. The retensioned tendons will have new lift-off curves that will be used for subsequent surveillances; the lift-off curves should be developed using the expected loss characteristics during the remaining plant life. Retensioning prior to end of outage could be beneficial, as illustrated in Figure 10 of Prof. Carreira's report; however, this will have adverse impact on the outage schedule. It is worth noting in this regard that the new concrete may be more than several days old by the time it starts experiencing significant prestress loads. This is because the retensioning sequence should start from the farthest tendons toward the ones within the opening. Additionally, the prestress level induced by tendon retensioning will be a smaller percentage of the then ultimate strength of the new concrete such that the corresponding E_{ci} value used in the creep equations is likely underestimated. A higher E_{ci} value for new concrete will help bring parity between its stiffness and that of the surrounding old concrete.

- Preplaced Aggreate Concrete: Bechtel believes that use of this approach is unnecessary. Conventional concrete placement practices have been found to be effective when restoring containment construction openings.

In Section 6 of Prof. Carreira's report, a concern has been raised that radial stirrups may be needed to prevent delamination of new concrete due to the radial stresses associated with tensioning of the hoop tendons. We believe that this assessment should be based on the exected minimum shear strength of the new concrete at the time of retensioning vis-à-vis the radial (compressive) stress exerted by tendon retensioning. Our previous experience indicates that delamination should not be a concern and hence the stirrups are unnecessary.

Summary

The following observations are most important in our opinion:

- The adequacy of the restored structure should be based on actual demand for membrane forces and moments; because of permanent changes and stress redistributions, a mere restoration of prestress levels to original values provides no guarantee that the restored structure will continue to be adequate for the design loads. Available margins in the existing design should provide a cushion against the deleterious effects associated with creation/restoration of construction opening and detensioning/retensioning of tendons.
- Several factors such as creep properties of new concrete, relaxation characteristics of new or retensioned tendons, etc, help offset the deleterious effects of 'opening creation/restoration and tendon detensioning/retensioning.
- Addition of new rebar should not be relied upon as a foolproof means for equal distribution of prestress load into the new and surrounding old concrete. The inherent uncertainties in determination of the concrete moduli necessitate that this problem be evaluated using a parametric approach (considering high/median/low values for the respective stiffnesses) to demonstrate that the restored structure will continue to meet the licensing commitments. More importantly, an equal sharing of the prestress load may be unnecessary for assuring structural integrity and it does not necessarily guarantee adequacy of the restored structure.

- The new rebar should be fundamentally sized to resist the incidental bending moments within the restored region; it is believed that this quantity of rebar alone may be sufficient to assure adequate structural integrity.
- Unproven techniques/materials such as preplaced aggregate and shrinkage compensating cement should not be used for this application; proven conventional techniques and materials have been found satisfactory for ensuring quality concrete placement.

References

1. "Effect of Concrete Creep on Replacement Concrete for Restoration of Steam Generator Access Opening", by Prof. Domingo J. Carreira, prepared for Progress Energy Crystal River Unit 3, February 15, 2007.
2. ACI 209R-92 (Reapproved 1997), "Prediction of Creep, Shrinkage and Temperature Effects in Concrete Structures", American Concrete Institute.
3. NRC Inspection Manual Inspection Procedure 50001 "Steam Generator Replacement Inspection", September 6, 2000 (see Appendix B).
4. ASME Section XI Articles IWA-4000 and IWL 4000, American Society of Mechanical Engineers.
5. ASME Section III Division 2 Article CC-2000, American Society of Mechanical Engineers.

Progress Energy

memo

Date: 08/05/08 SGR00-0084

To: Required Quorum Members:
Dave Jones
Mike Siapno
Chris Howell
Al Koralewski
Ricky Curry
Sam Franks
Sid Powell
Ron Johnson
Bob Gartner
Scott Kujak
Joe Lese
Rick Portmann
Marty Wolf
Jon Burchett

From: Magdy Bishara 8/6/08

Subject: Final Design Review Board (DRB) for EC 63016

The Steam Generator Replacement Project will be holding a Final Design Review Board (DRB) on 08/26/08 at 15:00 in the SGR War Room (Northeast corner of the 2nd floor SAB). A DRB is required for EC 63016. EC files will be available in Passport in the respective EC folder no later than one week prior to the meeting.

If you are an addressee, your sub-group's participation in the DRB is considered to be necessary to assure the various aspects of this EC are fully considered and addressed. Please plan on attending or have your representative attend. You or your representative's attendance is required as a quorum member. Quorum DRB members must review the package prior to the meeting and be prepared to participate in the DRB. If quorum members fail to attend the meeting or are not prepared for the meeting, the meeting will be cancelled. Charge any time required for preparation, review and meetings to 20041923.

If, after a review of the package, you conclude your sub-group will not significantly contribute to the DRB, inform Magdy Bishara via e-mail. Magdy can then remove your name from the quorum. This notification must be a minimum of 24 hours prior to the DRB.

The purpose of this meeting is to discuss design details for the proposed creation and restoration of a temporary access opening in the post tensioned reinforced concrete cylindrical wall and steel liner plate of the containment shell. This temporary access opening will facilitate moving the old steam generators out of containment and the new replacement steam generators into containment.

Progress Energy Florida, Inc.

If you are CC'd, this invitation is for information only. Your attendance is at your discretion.

CC:

Bishara, Magdy (Supt, Maj Pro)
Swenson, Scott (Lead Mech Eng)
Larramore, Mark (ANII)
Rigsby, Mark (Supt, RP)
Rass, Ken (Sr Ops Spec)
Neil Keeney (RP)
Brewer, Bill (Mgr, Maint)
Donovan, Mike (Supt, Materials)
Foster, Berry (Supt, Systems Eng'g.)
Kibler, Robin (Task Manager - Facilities)
Pepin, Rick (Supt, Maintenance)
Dyer, John (TM – Health & Safety)
Curham, Jack (Fire Protection)
Mueller, John (Coatings)
Mayes, David (Welding Engineer)
Whisler, Jeff (Bechtel Engineer)
Jopling, Dan (Eng Supv, Civil Lead)
Mills, Doug (Lead Occ Health & Safety)
Byers John (Proj Task Mgr)
Widener, Matt (Supt, Security)
Whetzel, Jim (Scheduling)
Mike Teller (Design Engineering Scheduler)
Hendricks, Chris (Supv, Materials)
Pinner, Rudy (Science Lab)
Wilson, Ken (PE & Reg Affairs)
Terry, Jim (Maj Pro, Project Mgr)
Wilson, Ivan (Outage & Scheduling)
Nielson, Bill (QA/QC)
Thompson, Rocky (Chemistry)
Harmon, Andy (Procurement)
Finnell, Jeff (Materials Engineer)
Fletcher, Dick (Bechtel Engineer)

Progress Energy Florida, Inc.

From: Holliday, John
To: Stephenson, John D. - (CR3); Lenoir, Vincent; Howell, Chris; Jones, David (CR3); Franks, Sam; Koralewski, Alvin; Mayes, David; Curry, Ricky; Whetzel, James L; Karrh, Charles; Dyer, John; Johnson, Ron; Gartner Jr, Robert H; Pandya, Dhiren; Burchett, Jon; Hanna, Deborah A; Santonastaso, Louis J; Curham, John J.; Mueller, John; Finnell, Jeffrey L.; Kujak, Scott; Young, Kenneth G; Brinkman, Scott; Kish, Charles J.; Thompson, Rocky H; Pinner, Rudolph W.; Portmann, Rick; Medley, Ralph; Siapno, Michael M.; Powell, Sid; Ranganath, Casaba;
cc: Bishara, Magdy M.; Jopling, Daniel L.;
Subject: EC 63016 Containment Opening - Final Departmental Reviews
Date: Monday, August 11, 2008 4:38:07 PM
Attachments: EC Final REVIEW.DOC
0000063016R000.lnk

Gentlemen,

This is your Final Review of EC 63016 for your approval via the appropriate Passport Milestone.
If you have comments, please document on the EC Final Review Comment form (copy attached for your convenience) and return to me for resolution no later than 8/19/08.
If you have no comments, please sign the Milestone.
Sign the EC milestone in the appropriate block as shown below.

http://webs:80/PJPROD1007/pjserv/servlet/com.iint.pjserv.servlets.PJBrowserServices?ConfigSection=V10+PRODUCTN&PanelID=TIME100&PanelKeyData=0000063016000&ShortCut=Y

Config. Mgmt.: L. Santonastaso
Lead Design Verifyer: Casaba Ranganath
Fire Protection : Jack Curham
System Eng 1 (MX): Scott Kujak
Emerg. Planning: John Stephenson
Coatings: John Mueller
Mech Maint. : Chris Howell
Planner: Ralph Medley
Operations: Dave Jones

Materials Engineer: Jeff Finnell
ISI Review: Rick Portmann
IWE/IWL: Review: Rick Portmann
Chemistry: Rocky Thompson/Rudy Pinner
Installer: Sam Franks
Security: Al Koralewski
Welding Engr.: David Mayes
ALARA: Mike Siapno
Radiation Control: Kenny Young
Procurement Engr.: Ricky Curry
Safe Shutdown: Charlie Kish
PSA: Scott Brinkman
Reg Affairs: Sid Powell

Other 1: D. Pandya (Chiefs Group)
Other 2: Charlie Karrh (Mechanical Design Verification)
Other 3: Vince Lenoir (Electrical Design Verification)
Other 4: Jim Whetzel (SGR Scheduing)
Other 5: John Dyer (SGR Proj. Move In / Move Out Task Manager)
Other 6: Jon Burchett (SGR Proj. Containment Opening Task Manager)
Other 7: Bob Gartner (SGR Proj. Health & Safety)
Other 8: Ron Johnson (SGR Proj. Environmental)
Other 9: Debbie Hanna (Contract Services)

Design Review Board Final Approval By Quorum Members EC 63016 Containment Opening Date 8/26/2008			
Name	Organization	Signature	Phone
Dave Jones	Operations		1507
Michael Siapno	Radiation Protection		1039
Al Koralewski	Security		4248
~~Chris Howell~~ Kevin Farris	Maintenance		7946
Rick Curry	Nuc Eng & Services		x4215
Sam Franks	Maj. Proj – Bechtel		1027
Sid Powell	Licensing		
Ron Johnson	Project Environmental		
Bob Gartner	Project health and Safety		2212
~~Scott Kujak~~	~~Misc. Struct. System Engineer~~	Waiver approved by Magdy Bishara. Refer to Attachment Z31	
Joe Lese	Design Engineering		
Rick Portmann	Containment IWE/IWL		
Marty Wolf	Testing/Operations		
Jon Burchett	Task Manager		

EC Approval

EC 63016

QUORUM MEMBERS 8/26/2008

Dp Jones

Samuel Franks

Neil Kenney

Rick D. Curry

Ken Farris

Jim Burchett

Matt Wolf

Jon C. Lee

Rick R

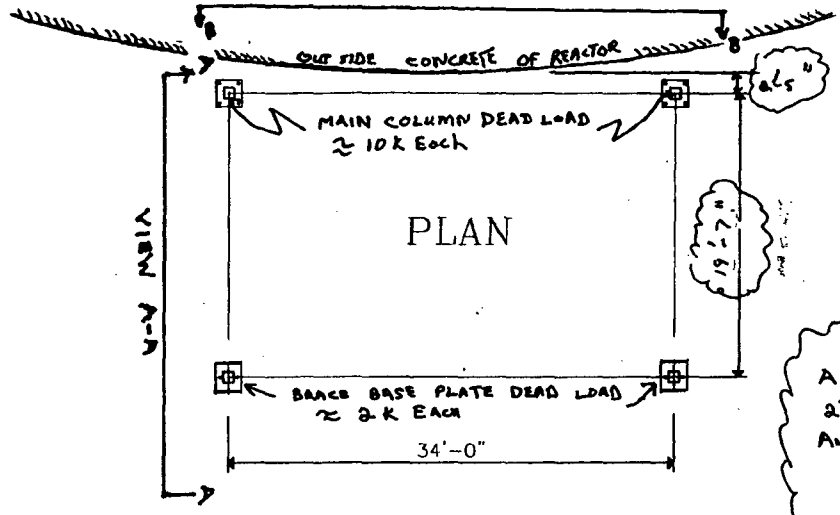
Lil Powell

Robert H Dantzler

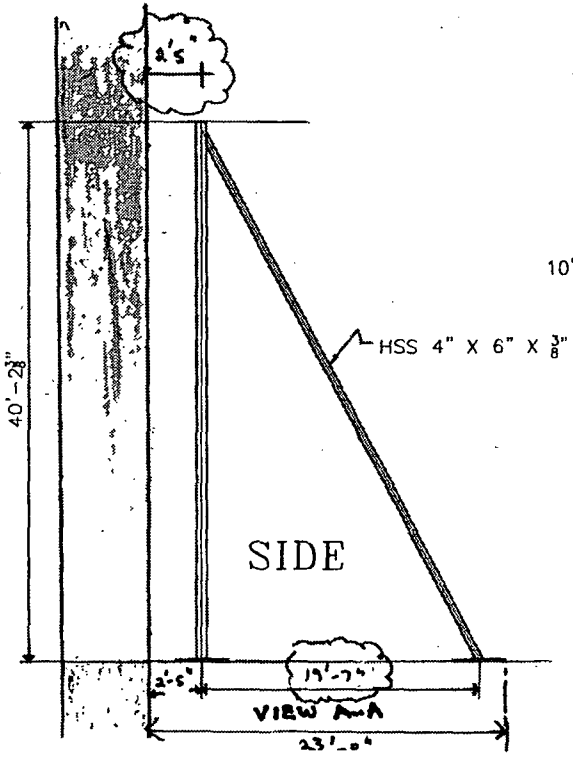
Final Design Review Board
EC 63016
Containment Opening
Date 8/26/2008

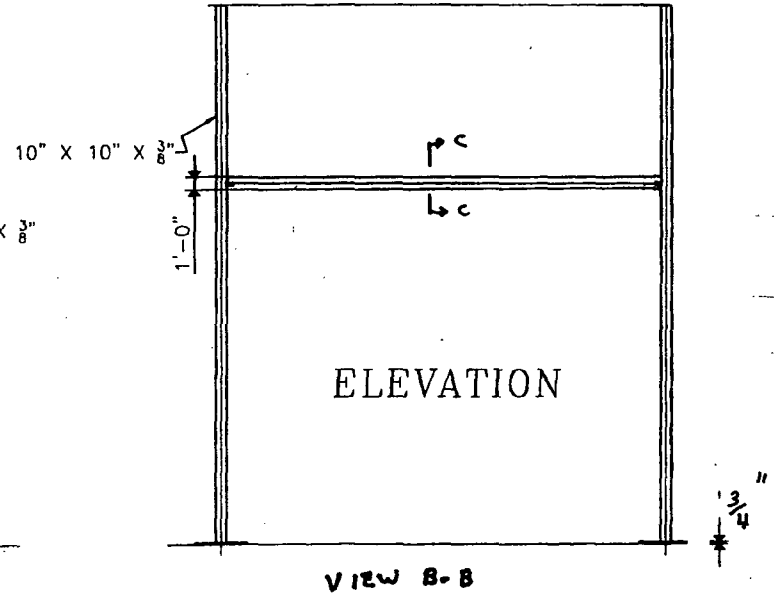
Non-Quorum Members

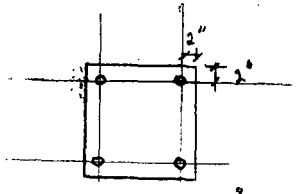
Name	Organization	Signature	Phone
MAGDY BISHARA	NPC/ENG	Magdy Bishara	7415
M.R. Fletcher	BECHTEL	M.R. Fletcher	1011
RALPH MEDLEY	BECHTEL	Ralph Medley	1019
WILSON W POPPELL	BECHTEL	Wilson W. Poppell	1031
Whisler, Jeffrey	Bechtel	Jeffrey E. Whisler	1018
Jim Whetzel	SCHEDULING	Jim Whetzel	4184
KEVIN FARRIS	CN-3 MAINT	Kevin Farris	7946
WILLIAM NIELSEN	NPC/SGRP	W. Nielsen	4121
PAUL J BENJAMIN	SECURITY	Perry Bryan	4203



ALL BASE PLATES
2'-0" SQUARE 3/4" PLATE
ANCHOR BOLT HOLES
7/8" Ø
SET 2" FROM EDGE
OF PLATE.
ALL ANCHOR BOLTS 3/4" Ø





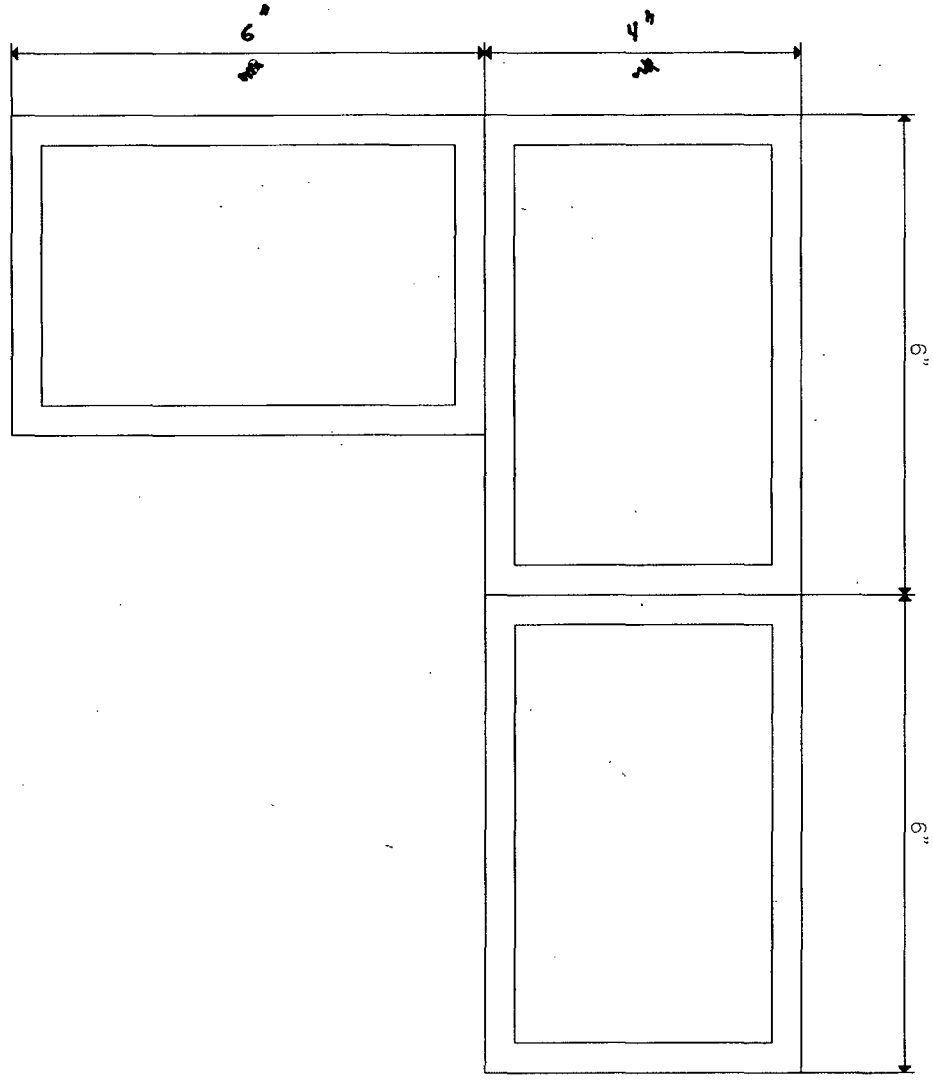


7/8" Ø holes
4 each base plates

Preliminary
Sept 14, 06
Revised
Sept 19/06

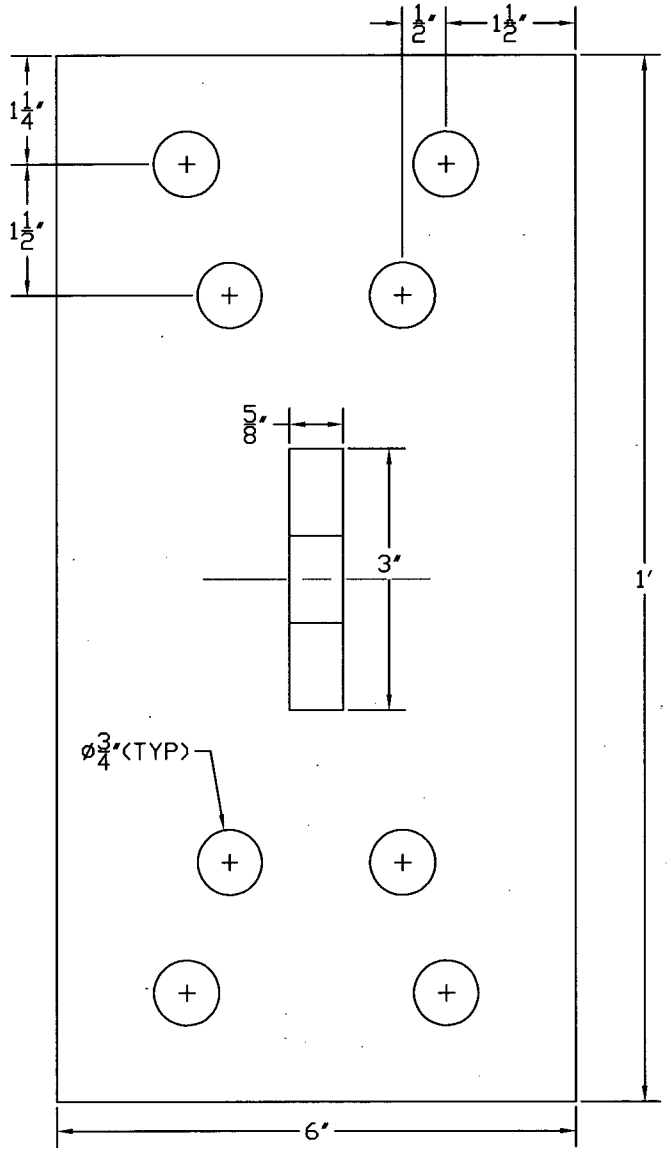
R2

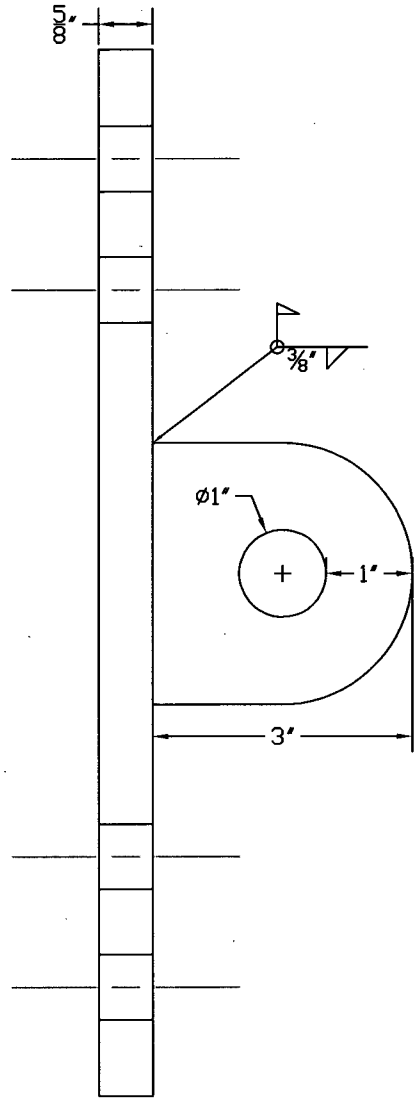
Top of Beam.



Section C-C

Preliminary
Sept 14, 01





WO #1165094
EC #63016

HYDRO DEMO TOWER SUPPORTS - WALL BRACKETS (2 TYP)

WALL BRACKETS TO BE PLACED approx. 40'-0" UP FROM CHIPPING PLATFORM, approx. 5'-0" OUTSIDE THE OPENING, BOTH SIDES

BRACKETS TO BE FASTENED WITH 5/8" X 6" HILTI ANCHORS, EMBEDMENT DEPTH 4"

NOTE: 8 BOLT HOLES SUPPLIED TO AVOID REBAR. ONLY 2 BOLTS TOP AND BOTTOM EACH, 4 BOLTS TOTAL REQUIRED.

DATE	REV	DESCRIPTION	DRWN	CKD	PFE	PE
9/22/2009	0	DETAIL	TDV			

CRYSTAL RIVER UNIT 3
STEAM GENERATOR
REPLACEMENT PROJECT

TITLE:
SGR - DETAIL
HYDRO DEMO TOWER SUPPORTS
WALL BRACKET

WO No. 1165094 | SCALE: N/A
EC No. 63016 | SHEET 1 OF 1

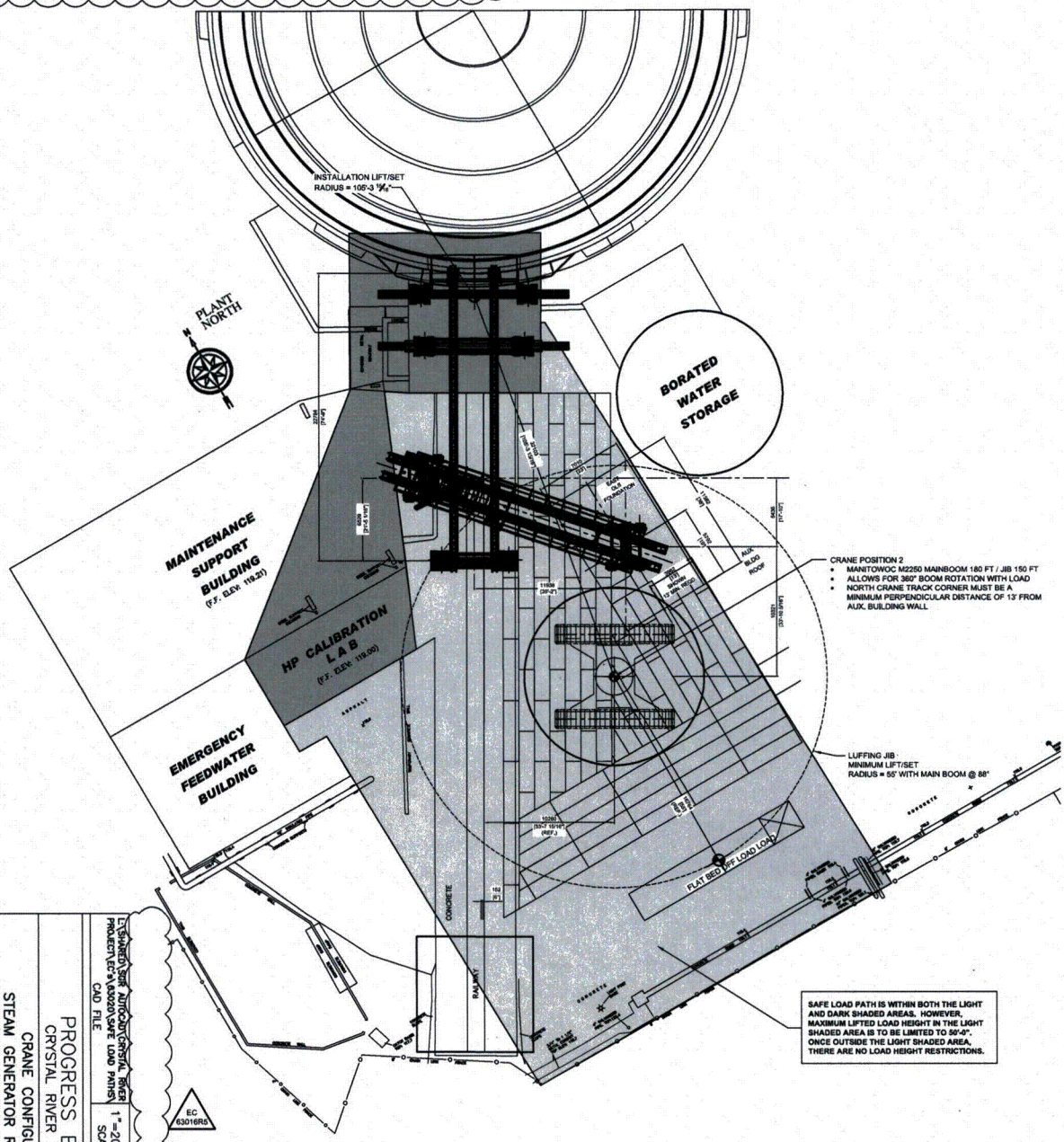
CRANE LIFT CHART	
LIFT DESCRIPTION	REMOVE AND INSTALL THE LINER PLATE
CRANE POSITION	2
JIB USED	LUFFING JIB @ 88° MAIN BOOM ANGLE
ESTIMATED WEIGHT	10,000# + 16,000# HOOK + 5,000# RIGGING = 31,000#
MINIMUM LIFT RADIUS	55', CAPACITY = 84,700#, WT = 31,000# 31,000/84,700 = 36.6% OF CHART
INSTALLATION LIFT/SET RADIUS	105'-3 1/16", CAPACITY @ 110' = 49,500#, WT = 31,000# 31,000/49,500 = 62.6% OF CHART

EC 63016R5

NOTE:
BLOCK AND WIRE ROPE DEDUCTION WHEN USING THE LUFFING JIB IS 16,000 LBS IF THE MAIN BLOCK IS LOWERED AND TIED BACK TO THE CRANE (WORST CASE). DEDUCTION FOR BLOCK AND WIRE ROPE IS ONLY 12,700 LBS FOR LUFFING JIB USE WHEN MAIN BLOCK IS RAN UP TO WITHIN 15' OF TIP OF HEAD SECTION OF THE MAIN BOOM.

NOTES:

1. THIS LIFT FROM CRANE POSITION 2 WILL REMOVE AND INSTALL THE LINER PLATE.
2. FLAGMAN SHALL BE IN SIGHT OF BOTH THE LOAD AND CRANE BOOM AT ALL TIMES.
3. AREAS WHERE LIFTS ARE BEING PERFORMED SHALL BE CONTROLLED BY FLAGMEN.
4. LOAD BLOCK AND RIGGING IS CONSIDERED A PORTION OF THE LIFTED LOAD, AND WEIGHT OF THESE ITEMS MUST BE ADDED TO LIFTED LOAD IN REVIEW OF LOAD CHART ALLOWABLES.
5. SAFE LOAD PATH IS WITHIN BOTH THE LIGHT AND DARK SHADED AREAS. SAFE LOAD PATH IS SELECTED TO AVOID CARRYING LOADS OVER THE AUXILIARY BUILDING, EMERGENCY FEEDWATER BUILDING OR BORATED WATER STORAGE TANK. DO NOT CARRY LOADS OVER THESE AREAS WITHOUT ENGINEERING APPROVAL.
6. LINER PLATE CONSERVATIVELY SHOWN AS PLACED AT END OF OUTSIDE HATCH TRANSFER SYSTEM .



EC 63016R5

EC 63016
ATTACHMENT G02R5

EC 63016R5

L:\SHARED\SHF\AUTOCAD\CRYSTAL RIVER PROJECT\EC's\63020\SAFE LOAD PATHS\ CAD FILE	
1"=20'-0" SCALE	LPM DRAWN
09-04-08 DATE	

PROGRESS ENERGY
CRYSTAL RIVER UNIT #3
CRANE CONFIGURATION
STEAM GENERATOR REPLACEMENT
REMOVE AND INSTALL LINER PLATE

SKETCH NO.	SHEET	REV
63016-SK-S002	1	0

CRANE LIFT CHART	
LIFT DESCRIPTION	INSTALL CONCRETE FORMS FOR CONCRETE PLACEMENT - USE 32,000#
CRANE POSITION	2
JIB USED	LUFFING JIB @ 83° MAIN BOOM ANGLE
ESTIMATED WEIGHT	PLACEMENT USE 32,000#, WEIGHT OF CONCRETE INSIDE THE FORM NOT CONSIDERED IN THIS LIFT EVALUATION 32,000# + 16,000# HOOK + 4,000# RIGGING = 52,000#
MINIMUM LIFT RADIUS	80', CAPACITY = 85,400#, WT = 52,000# 52,000/85,400 = 60.9% OF CHART
INSTALLATION LIFT/SET RADIUS	110', CAPACITY = 62,300#, WT = 52,000# 52,000/62,300 = 83.4% OF CHART

NOTE:
BLOCK AND WIRE ROPE DEDUCTION WHEN USING THE LUFFING JIB IS 16,000 LBS IF THE MAIN BLOCK IS LOWERED AND TIED BACK TO THE CRANE (WORST CASE). DEDUCTION FOR BLOCK AND WIRE ROPE IS ONLY 12,700 LBS FOR LUFFING JIB USE WHEN MAIN BLOCK IS RAN UP TO WITHIN 15' OF TIP OF HEAD SECTION OF THE MAIN BOOM.

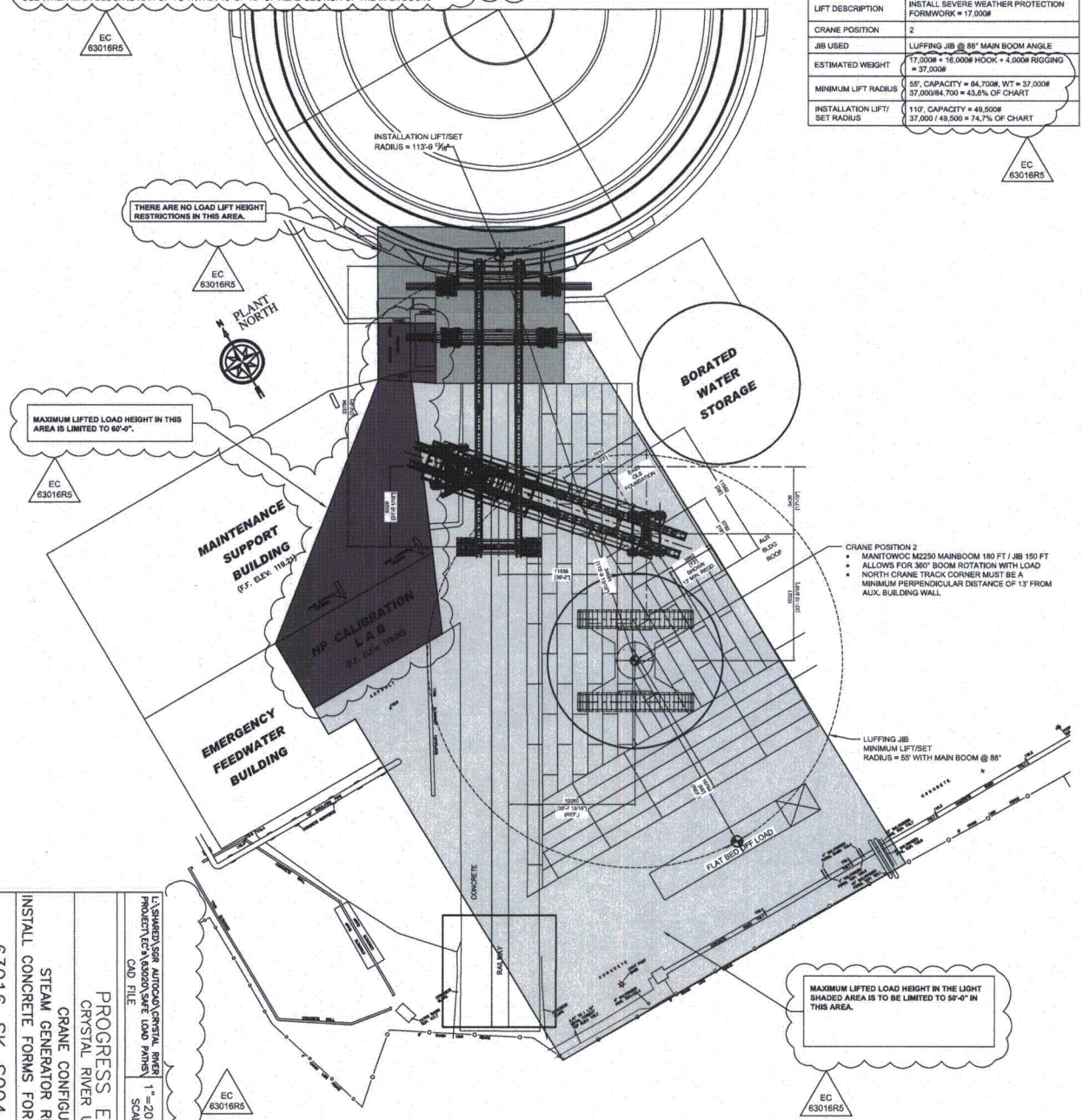
EC 63016R5

NOTES:

1. THIS LIFT FROM CRANE POSITION 2 WILL INSTALL CONCRETE FORMS FOR CONCRETE PLACEMENT..
2. FLAGMAN SHALL BE IN SIGHT OF BOTH THE LOAD AND CRANE BOOM AT ALL TIMES.
3. AREAS WHERE LIFTS ARE BEING PERFORMED SHALL BE CONTROLLED BY FLAGMEN.
4. LOAD BLOCK AND RIGGING IS CONSIDERED A PORTION OF THE LIFTED LOAD, AND WEIGHT OF THESE ITEMS MUST BE ADDED TO LIFTED LOAD IN REVIEW OF LOAD CHART ALLOWABLES.
5. SAFE LOAD PATH IS WITHIN BOTH THE LIGHT AND DARK SHADED AREAS. SAFE LOAD PATH IS SELECTED TO AVOID CARRYING LOADS OVER THE AUXILIARY BUILDING, EMERGENCY FEEDWATER BUILDING OR BORATED WATER STORAGE TANK. DO NOT CARRY LOADS OVER THESE AREAS WITHOUT ENGINEERING APPROVAL.

CRANE LIFT CHART	
LIFT DESCRIPTION	INSTALL SEVERE WEATHER PROTECTION FORMWORK = 17,000#
CRANE POSITION	2
JIB USED	LUFFING JIB @ 88° MAIN BOOM ANGLE
ESTIMATED WEIGHT	17,000# + 16,000# HOOK + 4,000# RIGGING = 37,000#
MINIMUM LIFT RADIUS	55', CAPACITY = 84,700#, WT = 37,000# 37,000/84,700 = 43.6% OF CHART
INSTALLATION LIFT/ SET RADIUS	110', CAPACITY = 49,500# 37,000 / 49,500 = 74.7% OF CHART

EC 63016R5



EC 63016
ATTACHMENT G04R5

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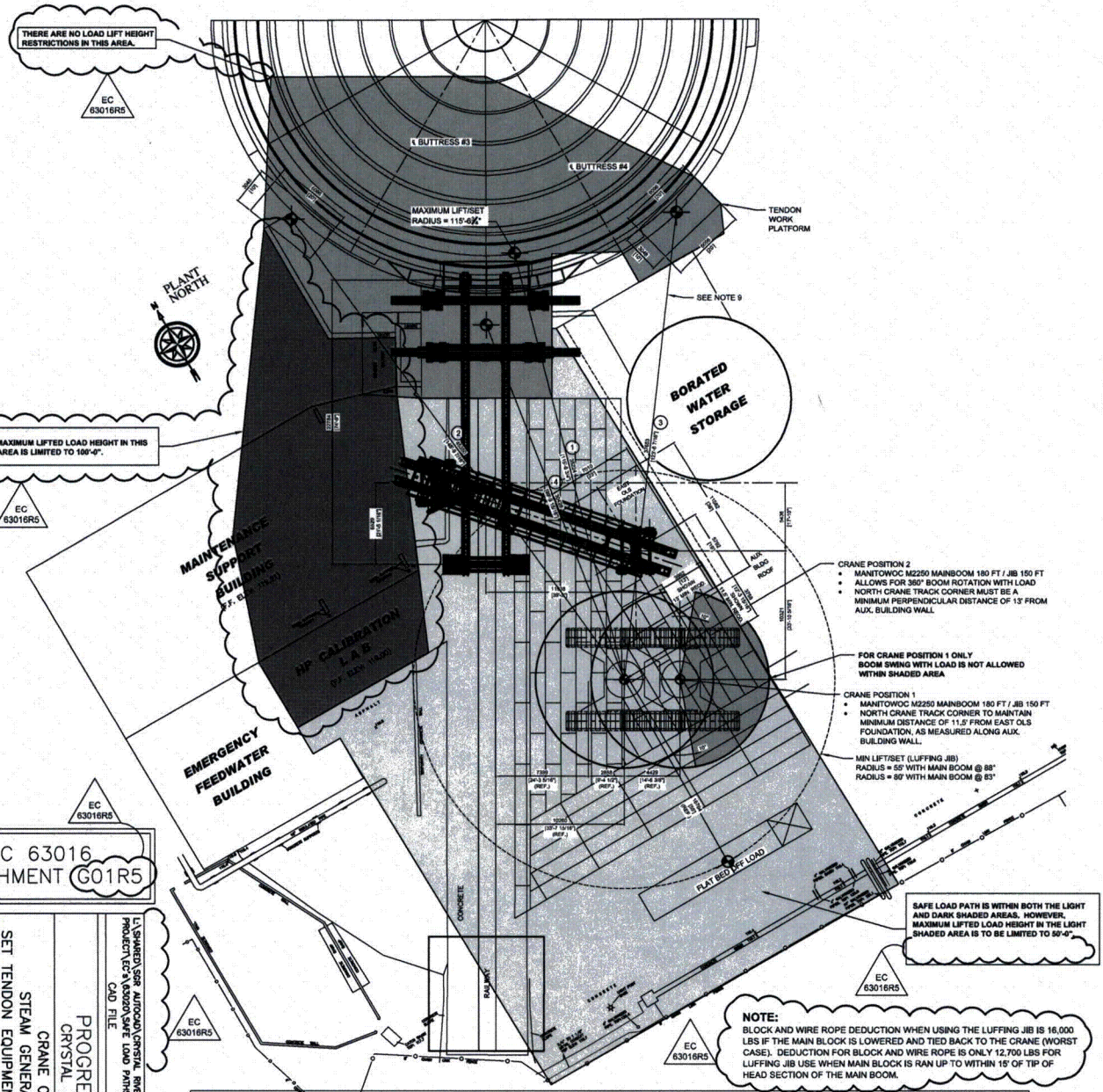
1"=20'-0" SCALE	LPM DRAWN	09-04-08 DATE

PROGRESS ENERGY
CRYSTAL RIVER UNIT #3
CRANE CONFIGURATION
STEAM GENERATOR REPLACEMENT
INSTALL CONCRETE FORMS FOR CONCRETE PLACEMENT

SKETCH NO. 63016-SK-S004 | SHEET 1 | REV 0

NOTES:

1. THIS LIFT FROM CRANE POSITION 2 OR CRANE POSITION 1 WILL INSTALL AND REMOVE TENDON EQUIPMENT ON TOP OF THE REACTOR BUILDING.
2. FLAGMAN SHALL BE IN SIGHT OF BOTH THE LOAD AND CRANE BOOM AT ALL TIMES.
3. AREAS WHERE LIFTS ARE BEING PERFORMED SHALL BE CONTROLLED BY FLAGMEN.
4. LOAD BLOCK AND RIGGING IS CONSIDERED A PORTION OF THE LIFTED LOAD AND WEIGHT OF THESE ITEMS MUST BE ADDED TO LIFTED LOAD IN REVIEW OF LOAD CHART ALLOWABLES
5. SAFE LOAD PATH IS WITHIN BOTH THE LIGHT AND DARK SHADED AREAS. MAXIMUM LIFTED LOAD HEIGHT IN THE LIGHT SHADED AREA IS TO BE LIMITED TO 50'-0". ONCE OUTSIDE THE LIGHT SHADED AREA THERE ARE NO LOAD HEIGHT RESTRICTIONS. SAFE LOAD PATH IS SELECTED TO AVOID CARRYING LOADS OVER THE AUXILIARY BUILDING, EMERGENCY FEEDWATER BUILDING OR BORATED WATER STORAGE TANK. DO NOT CARRY LOADS OVER THESE AREAS WITHOUT ENGINEERING APPROVAL
6. DURING TENDON EQUIPMENT INSTALLATION, AFTER LIFT OF TENDON EQUIPMENT FROM TRAILER AND MOVEMENT BEYOND EMERGENCY FEEDWATER BUILDING, CHANGE MAIN BOOM ANGLE FROM 88° TO 83° PRIOR TO EXTENDING LUFFING JIB (INCREASES CAPACITY/LOWERS % OF CHART).
7. WHEN REMOVING EQUIPMENT, PLACE MAIN BOOM AT 83° FOR INITIAL LIFT. AFTER INITIAL LIFT, THEN RAISE LUFFING JIB TO MINIMIZE RADIUS. THEN RAISE MAIN BOOM TO 88° TO AVOID PASSING LOAD OVER EMERGENCY FEEDWATER BUILDING.
8. IN CRANE POSITION 1, BOOM MAY NOT GO BEYOND 10° PAST PERPENDICULAR IN THE DIRECTION OF THE AUX. BUILDING WITH A LOAD ON EITHER HOOK.
9. BOOM CAN PASS OVER BORATED WATER STORAGE TANK PER MAINTENANCE RISK ASSESSMENT DURING MODES 5 THRU 6.



NOTE:
BLOCK AND WIRE ROPE DEDUCTION WHEN USING THE LUFFING JIB IS 16,000 LBS IF THE MAIN BLOCK IS LOWERED AND TIED BACK TO THE CRANE (WORST CASE). DEDUCTION FOR BLOCK AND WIRE ROPE IS ONLY 12,700 LBS FOR LUFFING JIB USE WHEN MAIN BLOCK IS RAN UP TO WITHIN 15' OF TIP OF HEAD SECTION OF THE MAIN BOOM.

INSTALLATION LIFT/SET RADIUS CHART

TARGET #	LIFT DESCRIPTION	CRANE POSITION	RADIUS TO TRAILER	RADIUS TO INSTALL POSITION	WEIGHT	HOOK & WIRE ROPE WEIGHT	RIGGING WEIGHT	TOTAL WEIGHT	BOOM USED	CAPACITY FOR WORST CASE RADIUS	% OF CHART
1 & 4	• SET TENDON EQUIPMENT INCLUDING UPPER SUPPORT FRAMES ON REACTOR BUILDING ROOF ABOVE EQUIPMENT HATCH (ANY MODE). • SET TENDON WORK PLATFORMS ON CHIPPING PLATFORM OR ON TOP OF EQUIPMENT HATCH SHIELD STRUCTURE ROOF.	2 OR 1 *	55'	115'-6 1/4"	20,000	16,000	4,000	40,000	LUFFING JIB WITH MAIN BOOM ANGLE VARYING, SEE NOTES 6 & 7	*53,700 @ 120'	74.5%
2 & 3	MOVE TENDON EQUIP. & TENDONS TO & FROM WORK PLATFORM @ BUTTRESS #3 OR BUTTRESS #4 (MODES 5, 6 OR DEFUELED ONLY).	2 OR 1*	55'	148'-9 1/16"	10,000	16,000	4,000	30,000	LUFFING JIB WITH MAIN BOOM ANGLE VARYING, SEE NOTES 6 & 7	*36,700 @ 150'	81.7%

EC 63016R5

* FINAL WEIGHTS AND RADIUS TO BE DETERMINED BY RIGGING SUPERINTENDENT/CREW IN ACCORDANCE WITH AI-650.

* CRANE POSITION 1 MAY BE USED AS LONG AS LIFTS REMAIN WITHIN CRANE CHART ALLOWABLES. SEE NOTE 8.

* CAPACITY BASED ON MAIN BOOM AT 83° FOR CRANE POSITION 2 .

PROGRESS ENERGY
CRYSTAL RIVER UNIT #3
CRANE CONFIGURATION
STEAM GENERATOR REPLACEMENT
SET TENDON EQUIPMENT ON REACTOR BLDG ROOF

63016-SK-S001

SKETCH NO. | SHEET 1 | REV 0

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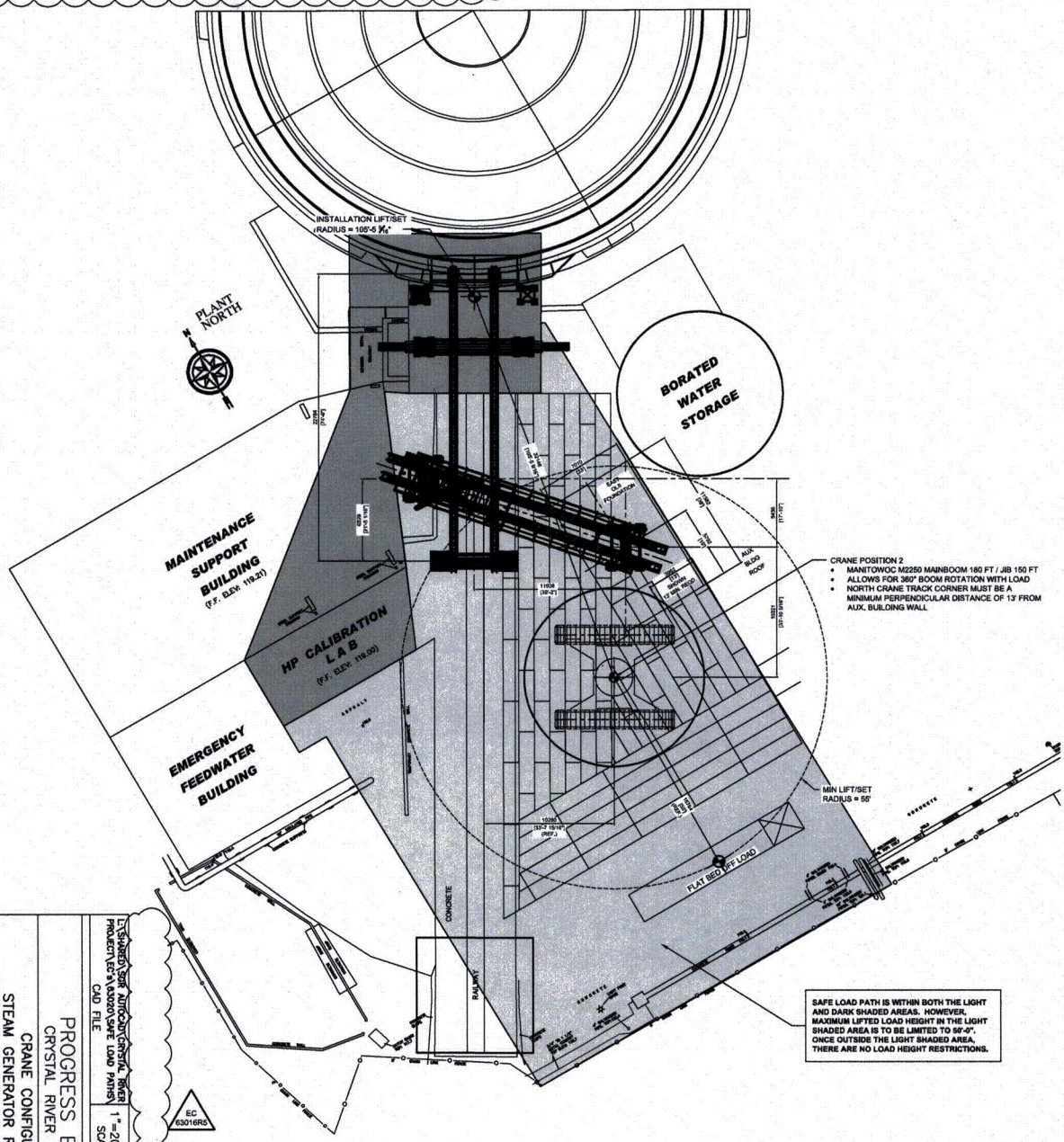
CRANE LIFT CHART	
LIFT DESCRIPTION	INSTALL REBAR MAT FOR REPAIRING THE CONTAINMENT WALL
CRANE POSITION	2
JIB USED	LUFFING JIB @ 88° MAIN BOOM ANGLE
ESTIMATED WEIGHT	7,500# + 16,000 BLOCK/LINE + 4,000# RIGGING = 27,500#
MINIMUM LIFT RADIUS	55', CAPACITY = 84,700#, WT = 27,500# 27,500/84,700 = 32.4% OF CHART
INSTALLATION LIFT/SET RADIUS	105'-5 $\frac{3}{16}$", CAPACITY @ 110' = 49,500#, WT = 27,500# 27,500/49,500 = 55.5% OF CHART

EC 63016R5

NOTE:
BLOCK AND WIRE ROPE DEDUCTION WHEN USING THE LUFFING JIB IS 16,000 LBS IF THE MAIN BLOCK IS LOWERED AND TIED BACK TO THE CRANE (WORST CASE). DEDUCTION FOR BLOCK AND WIRE ROPE IS ONLY 12,700 LBS FOR LUFFING JIB USE WHEN MAIN BLOCK IS RAN UP TO WITHIN 15' OF TIP OF HEAD SECTION OF THE MAIN BOOM.

NOTES:

1. THIS LIFT FROM CRANE POSITION 2 WILL INSTALL REBAR MAT FOR REPAIRING THE CONTAINMENT WALL.
2. FLAGMAN SHALL BE IN SIGHT OF BOTH THE LOAD AND CRANE BOOM AT ALL TIMES.
3. AREAS WHERE LIFTS ARE BEING PERFORMED SHALL BE CONTROLLED BY FLAGMEN.
4. LOAD BLOCK AND RIGGING IS CONSIDERED A PORTION OF THE LIFTED LOAD, AND WEIGHT OF THESE ITEMS MUST BE ADDED TO LIFTED LOAD IN REVIEW OF LOAD CHART ALLOWABLES.
5. SAFE LOAD PATH IS WITHIN BOTH THE LIGHT AND DARK SHADED AREAS. SAFE LOAD PATH IS SELECTED TO AVOID CARRYING LOADS OVER THE AUXILIARY BUILDING, EMERGENCY FEEDWATER BUILDING OR BORATED WATER STORAGE TANK. DO NOT CARRY LOADS OVER THESE AREAS WITHOUT ENGINEERING APPROVAL.
6. REBAR MAT SHOWN AS PLACED AT END OF OUTSIDE HATCH TRANSFER SYSTEM.



EC 63016
ATTACHMENT G03R5

EC 63016R5

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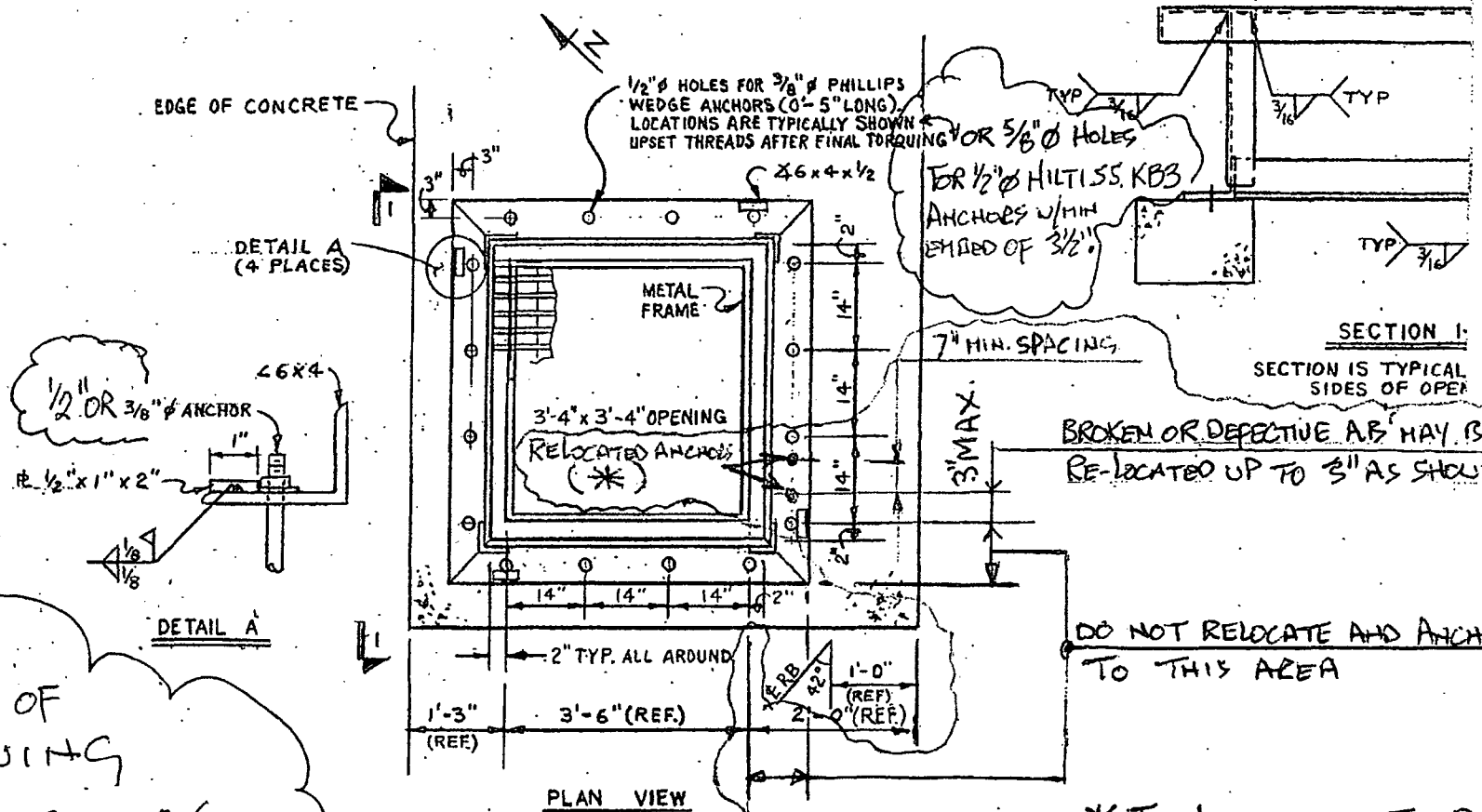
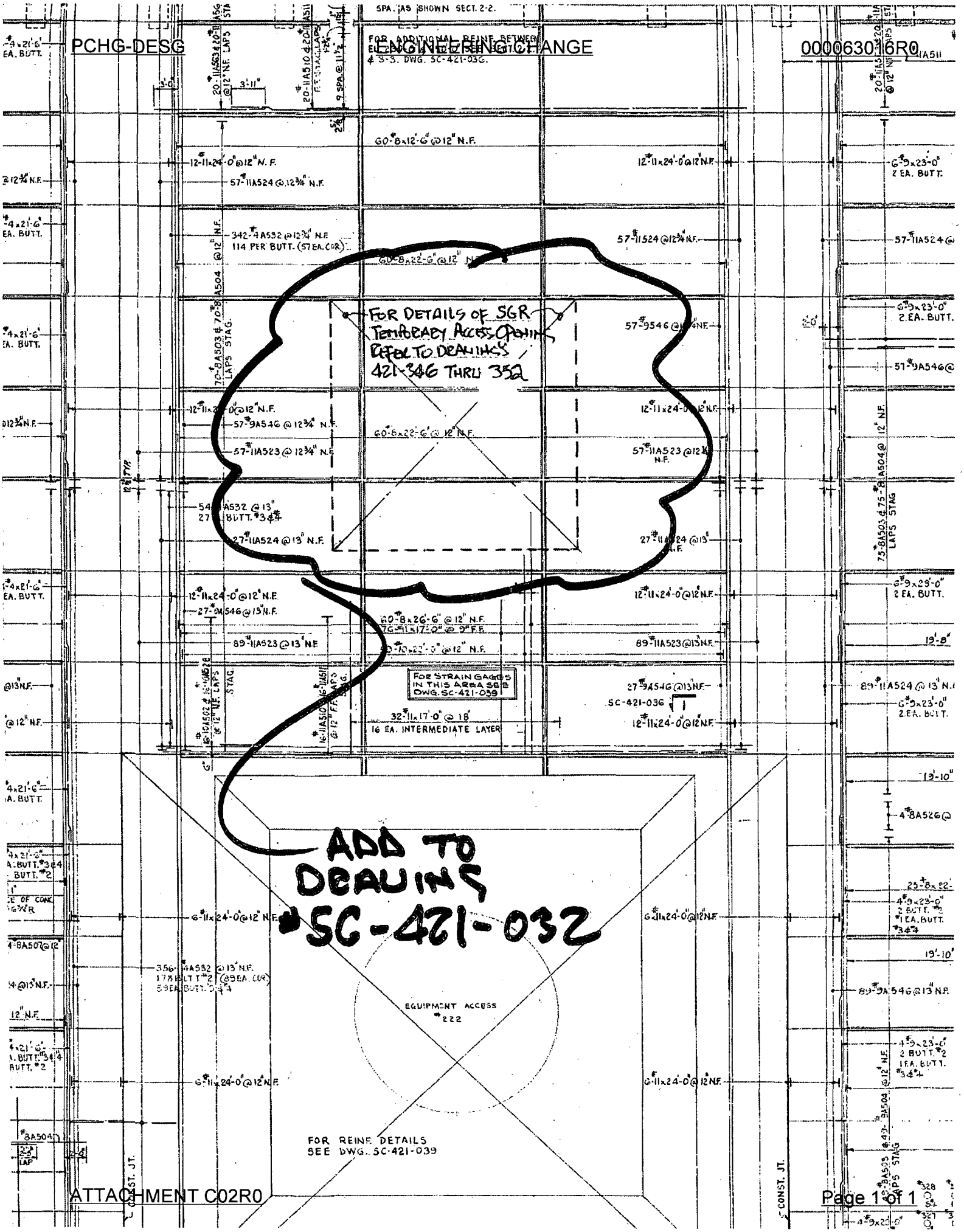
1"=20'-0" SCALE	LPM DRAWN
09-04-08 DATE	

PROGRESS ENERGY
CRYSTAL RIVER UNIT #3
CRANE CONFIGURATION
STEAM GENERATOR REPLACEMENT
INSTALL REBAR MAT FOR REPAIRING CTMT WALL

SKETCH NO.	SHEET	REV
63016-SK-S003	1	0

NOTE: BROKEN OR DEFECTIVE 3/8"Ø PHILLIPS WEDGE ANCHORS MAY BE REPLACED WITH 1/2"Ø SS HILTI KB3's W/ MIN. EMBED OF 3 1/2". ALTERNATIVELY, ANCHOR BOLT LOCATION MAY BE MOVED AS SHOWN BELOW




FOR DETAILS OF SGR TEMPORARY ACCESS OPENING REFER TO DRAWINGS 421-346 THRU 352
ADD TO DRAWING SC-421-032
FOR STRAIN GAGES IN THIS AREA SEE DWG. SC-421-039
SC-421-036
EQUIPMENT ACCESS #222
FOR REINF DETAILS SEE DWG. SC-421-039
60-#8x12'-6" @12" N.F.
60-#8x22'-6" @12" N.F.
60-#8x26'-6" @12" N.F.
12-#11x24'-0" @12" N.F.
57-#11A524 @12¾" N.F.
57-#9A546 @12¾" N.F.
57-#11A523 @12¾" N.F.
27-#11A524 @13" N.F.
27-#9A546 @13" N.F.
89-#11A523 @13" N.F.
89-#9A546 @13" N.F.
32-#11x17'-0" @18"
16 EA. INTERMEDIATE LAYER
CONST. JT.