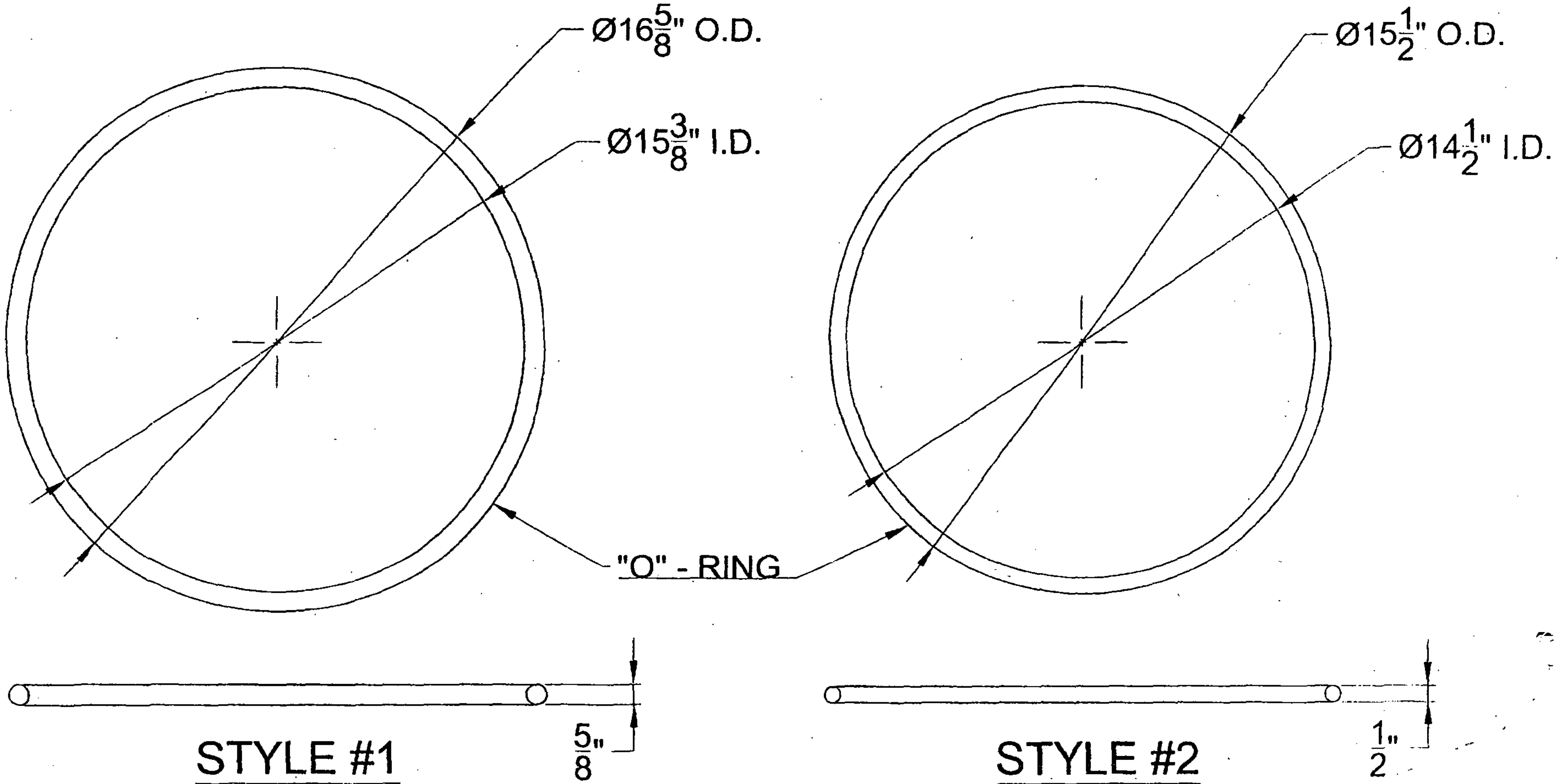

STYLE #1
LOWER VERTICAL

STYLE #2
HOOP, DOME &
UPPER VERTICAL

PSC
MASTER COPY
INITIAL cec DATE 7-3-07

MATERIAL: NEOPRENE OR NITRILE BASE RUBBER
60 - DUROMETER

REF: DRAWING 5EX7-003 A-09C Rev. A
DRAWING 5EX7-003 A-09D Rev. A

ATTACHMENT Z53R3

Sheet 1 of 1
Drawing No. CR-N1002-501
Current Revision Rev. 0
Project Name: CRYSTAL RIVER
Drawing Name: END CAP GASKETS

PSC
Precision Surveillance Corporation
3468 Watling St.
East Chicago, IN 46312
(219)397-5826 (P)
(219)397-5887 (F)

Date	Rev.	Description	Approved

Designed By: N/A N/A
Drawn By: BAG 07/03/2007
Checked/Approved By: CEC 07/03/2007

M:\NUCLEAR\N1002 Crystal River Surveillance 2007\CAD\Final\CR-N1002-501 Gaskets.dwg

Grace Construction Products

W.R. Grace & Co. – Conn.
1200 NW. 15th Avenue
Pompano Beach, FL 33069

T 954-974-6700
www.graceconstruction.com

1/26/2009

. Purchase order # 414289
Progress Energy Florida Inc.
15760 West Powerline Street
Crystal River , Florida 34428

Project Name: .
Product Selected: ADVA® Cast 575

This is to certify that the ADVA Cast 575, a High Range Water Reducer, as manufactured and supplied by Grace Construction Products, W.R. Grace & Co. – Conn., is formulated to comply with the Specifications for Chemical Admixtures for Concrete, ASTM: C494, Type F, AASHTO: M194, Type F and complies with the Specification for Chemical Admixtures for Use in Producing Flowing Concrete, ASTM C 1017.

ADVA Cast 575 does not contain calcium chloride or chloride containing compounds as a functional ingredient. Chloride ions may be present in trace amounts contributed from the process water used in manufacturing.

The foregoing is in addition to and not in substitution for our standard Conditions of Sale attached.

G. Terry Harris
South Eastern Region Manager

CONDITIONS

All orders are accepted and all sales are made subject only to the provisions of the written contract between us under which the order is placed, or if no such contract exists, subject only to the terms on the face hereof and to the following provisions.

1. Delivery and Freight: Risk of Loss. Title to and all risk of loss of all goods sold hereunder shall pass to Buyer upon delivery f.o.b. W. R. Grace & Co. s (Grace) plant to an agent of the Buyer including a common carrier, notwithstanding and pre-payment or allowance of freight by Grace. If Grace pays freight Grace shall have the right to select the carrier, routing and means of transportation, provided that Buyer may make an alternate selection and pay Grace s additional costs, if any.

2. Freight, Weights and Orders.

(a) Whenever Grace is to pay freight Grace shall have the right initially to designate routing and means of transportation. If Buyer requires a more expensive routing and/or means of transportation Buyer shall reimburse Grace for any extra cost involved. GRACE SHALL NOT BE LIABLE FOR ANY DELAY IN TRANSPORTATION HOWEVER OCCASIONED.

(b) Grace s invoice weights, volumes, sizes, and tares shall be treated as prima facie correct except that in case of bulk shipments by carload, tank car or otherwise carriers weights shall be accepted as conclusive.

(c) Buyer s orders are not binding upon Grace until accepted in writing by an authorized employee at Grace s offices.

3. Examination, Suitability and Claims. Buyer shall examine and test each shipment of goods promptly upon delivery to Buyer and before any part of the goods has been changed from its original condition and Buyer hereby waives all claims for any cause after any part of the goods has been treated, processed or changed in any manner (except for reasonable test quantities). Buyer assumes sole responsibility for determining whether the goods are suitable for their contemplated use (whether or not such use is known to Grace). Buyer waives all claims of which Grace is not notified in writing within thirty (30) days after delivery of the goods or in respect of goods disposed of or returned without Grace s consent.

4. Warranties, Remedies and Limitations.

(a) Grace warrants to Buyer that at the time of delivery the goods sold hereunder will conform substantially to the description on the face hereof. Grace s liability and Buyer s remedy under this warranty are limited in Grace s discretion to replacement of goods returned to Grace which are shown to Grace s reasonable satisfaction to have been nonconforming or to refund of the purchase price, or, if not paid, to a credit in the amount of the purchase price. Transportation charges for the return of nonconforming goods to Grace and the risk of loss thereof will be borne by Grace only if returned in accordance with written instructions from Grace.

(b) Grace warrants that the goods will not in and of themselves infringe any patent of the United States or Canada. Grace s liability under this warranty is conditioned upon Buyer s giving prompt written notice of any claim of patent infringement made against Buyer, all information available to Buyer in respect of the claim, and Buyer s granting Grace exclusive control of its settlement and/or litigation. Grace may discontinue without liability delivery of the goods if in Grace s opinion their manufacture, sale or use would constitute patent infringement. If the use or resale of the goods is finally enjoined Grace shall at Grace s option (i) procure for Buyer the right to use or resell the goods previously delivered, (ii) replace such goods with equivalent noninfringing goods, (iii) modify them so they become noninfringing but equivalent, or (iv) refund the purchase price (less a reasonable allowance for use, damage and obsolescence). Grace makes no warranty against patent infringement resulting resulting from the manufacture, use or sale of the goods if made to Buyer s specifications or from use of the goods in combination with other matter or in the operation of any process, and if a claim, suit or action is based thereon Buyer shall defend, indemnity and save harmless Grace therefrom.

(c) Grace warrants to Buyer that it will convey goods sold hereunder. Grace s liability and Buyer s remedy under this warranty are limited to the removal of any title defect or, at the election of Grace, to the replacement of the goods or any part thereof which are defective in title; provided, however, that the rights and remedies of the parties with respect to patent infringement shall be limited to the provisions of paragraph (b) above.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES OF BUYER FOR ANY BREACH OF WARRANTY SHALL BE LIMITED TO THOSE PROVIDED HEREIN AND FOR DELAY OR NONDELIVERY WHICH IS NOT EXCUSABLE TO THE PURCHASE PRICE OF THE GOODS IN RESPECT OF WHICH THE DELAY OR NONDELIVERY IS CLAIMED TO THE EXCLUSION OF ANY AND ALL OTHER REMEDIES INCLUDING, WITHOUT LIMITATION, INCIDENTAL OR CONSEQUENTIAL DAMAGES, NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTIES, REMEDIES OR THIS LIMITATION WILL BE BINDING UPON GRACE UNLESS IN WRITING, SIGNED BY DULY AUTHORIZED OFFICER OF GRACE.

5. Prices, Credit and Payment.

(a) Buyer shall pay for goods, according to the terms of payment as specified on the face hereof or those terms specifically quoted to Buyer in writing. Pro rata payments shall become due as deliveries are made. Prices are subject to change without notice; however, on orders accepted for shipment within thirty (30) days, process in effect at the time of acceptance will apply unless shipment is delayed beyond thirty (30) days, in which event prices in effect at the time of shipment will apply.

(b) If Buyer shall fail to fulfill the terms of payment, or if Grace at any time shall have any doubt as to Buyer s financial responsibility, Grace without liability to Buyer may decline to make further shipments except against cash or satisfactory security.

(c) If Grace is prevented from revising prices or from continuing any price already in effect by any action of government or by compliance with any request of government, Grace may cancel this contract or any undelivered portion thereof without liability to Buyer upon written notice of such termination to Buyer.

6. Taxes, Duties and Excises. In the absence of satisfactory evidence of exemption supplied to Grace by Buyer, Buyer shall pay in addition to the price of the goods all taxes, duties, excises or other charges for which Grace may be responsible for collection or payment to any government (national, state, or local) upon, measured by or relating to the importation, exportation, production, or any phase or part of the production storage, sale, transportation and/or use of the goods identified on the face hereof.

7. Force Majeure.

(a) Buyer acknowledges that the goods called for hereunder are to be specially manufactured by Grace to fulfill this contract and delivery dates are based on the assumption that there will be no delay due to causes beyond the reasonable control of Grace.

(b) Grace shall not be charged with any liability for delay or nondelivery when due to delays of suppliers, production problems, acts of God or the public enemy, compliance with any applicable foreign or domestic court order or governmental regulation, order or request whether or not it proves to be invalid, fires, riots, labor disputes, unusually severe weather, or any other cause beyond the reasonable control of Grace. During the period when deliveries are affected by the matters identified in this paragraph, Grace may omit delivery during the period of continuance of such circumstances and the contract quantity shall be reduced by the quantity so omitted, but this contract shall remain otherwise in effect. Grace shall endeavor to allocate any available goods among all buyers including its own divisions, departments and affiliates in such manner as it considers fair.

8. Assignment and Nonwaiver.

(a) This contract is not assignable or transferable by Buyer whether voluntary or by operation of law in whole or in part, without the prior written consent of Grace.

(b) Grace s failure to insist upon strict performance of any provision hereof shall be deemed to be a waiver of Grace s rights or remedies or a waiver by Grace of any subsequent default by Buyer in the performance of or compliance with any terms hereof.

9. Separate Contract. Each delivery shall stand and may be recovered for as a separate and independent contract. If Buyer fails to fulfill the terms of order, purchase, or payment under this or any other contract with Grace, Grace without prejudice to other lawful remedies may at its option defer further shipments hereunder until such default is made good, treat such default as a breach of this entire contract or terminate this contract.

10. Compliance with Fair Labor Standards Act. Grace hereby certifies that all goods sold hereunder which are produced or manufactured in the United States of America are produced in compliance with Sections 6, 7, or 12 of the Fair Labor Standards Act of 1938, as amended (29 U.S. Code 201-219), or of any order of the Administrator issued under Section 14 of said Act. All requirements as to the certified contemplated in the October 26, 1949 amendment to the Fair Labor Standards Act of 1938 shall be considered as satisfied by this certification.

11. Royalties; Miscellaneous. The purchase of equipment from Grace confers no license, express or implied, under any patent. When goods identified on the face hereof include goods suitable for use according to Grace s patents, a royalty (amount obtainable upon request) is included in the purchase price. Goods identified on the face hereof may vary according to Grace s established limits, sizes and tolerances in effect at the time of delivery in respect of such goods. ANY ADVICE FURNISHED BUYER CONCERNING THE USE OF THE GOODS SHALL REPRESENT GRACE S BEST JUDGEMENT IN THE CIRCUMSTANCES BUT IS ACTED UPON AT BUYER S SOLE RISK.

12. Entire Contract and Construction.

(a) The contract between Buyer and Grace in respect of the goods identified on the face hereof consists in its entirety of the terms and conditions appearing on the face and back of this document in lieu of all others, and supersedes all previous communications, representations or agreements, either oral or written, between the parties hereto with respect to the subject matter hereof. No modification shall be effected by the acknowledgement or acceptance of Buyer s purchase order forms or other documents containing terms or conditions different from or in addition to those contained herein.

(b) Acceptance or use by Buyer of any goods delivered hereunder shall be an acceptance of these as the only terms and conditions applying to the purchase and sale of said goods unless other terms and conditions be agreed to in writing signed by both parties specifically referring to this contract.

(c) This contract shall be interpreted in accordance with and the construction thereof shall be governed by the laws of the Commonwealth of Massachusetts. Captions as used in these terms and conditions are for convenience of reference only and shall not be deemed or construed as in any way limiting or extending the languages of the provisions to which such captions may refer.

8179 W. R. GRACE & CO.-CONN.

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: S&ME Water Testing Results **Revision 0 (8/31/09)**

The signature below of the Lead Reviewer records that:

- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

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

☐ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☐ **Special Engineering Review**________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature] Civil 09/03/09
Lead Reviewer **(print/sign)** **Discipline** **Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
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.

S&ME, INC. KNOXVILLE BRANCH

Water Testing

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208
Contract 373812

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

August 31, 2009

PREPARED BY: ____________________

REVIEWED BY: ____________________

QA BY: ____________________

APPROVED BY: ____________________

All work contained in this report was conducted in accordance with the requirements of the referenced procurement documents and the S&ME, Inc., Knoxville Branch Quality Assurance Manual, Volume I, Revision 4, dated December 5, 2003.

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

BACKGROUND

S&ME, Inc. (S&ME) has completed the first round of water testing. The testing was performed as outlined in Contract 373812, Change Order No. 5 and S&ME Proposal dated June 9, 2009. The testing was performed under our 10CFR50 Appendix B Program.

RECEIPT INSPECTION

One sample consisting of four, one-gallon containers of water was received by S&ME personnel on July, 15, 2009. The sample was received and inspected in accordance with S&ME Quality Assurance Procedure (QAP) 10.1 "Quality Inspection". The water sample was identified as "plant water". For tracking purposes, S&ME assigned I.D. number 09-003C-001 to the sample. The item received was documented on the Receipt Inspection Report No. QA-INSP-09-003C in accordance with S&ME Quality Assurance Procedure (QAP) 10.1, "Quality Inspection".

SCOPE

The testing included water testing as outlined in Table 1 (Concrete Performance Requirements) and Table 2 (Optional Chemical Limits) of ASTM C 1602-06.

RESULTS

A Certified Materials Test Report (CMTR) for the water sample testing is attached

S&ME Certified Materials Testing Summary Water Testing

Client:	Progress Energy	Material:	Batch Plant Water
Project:	Crystal River	Source:	Batch Plant
S&ME Project No.:	1439-08-208	Quantity:	Four 1-gallon containers
Contract/P.O. No.:	373812	Date Received:	July 15, 2009
		S&ME Log No.:	09-003C-001

Physical Property	Test Methods	Potable Water (Control batch)	Batch Plant Water	Percent/Deviation of Control	ASTM C 1602-06 Specification
Compressive Strength, min % control at 7-days	ASTM C 31-08a ASTM C 39-05$^{\epsilon 1}$	6,420-psi (avg. of 3 cylinders)	6,830-psi (avg. of three cylinders)	106.4 %	90% minimum
Time of Set, Deviation from control, h:min	ASTM C 403-08	Initial Set 4:00 (avg. of three specimens)	Initial Set 4:00 (avg. of three specimens)	0:00	From 1:00 early to 1:30 later
		Final Set 5:05 (avg. of three specimens)	Final Set 5:05 (avg. of three specimens)	0:00	

Chemical Property Maximum concentration in combined mixing water, ppm	Test Methods	Result Batchplant Water	ASTM C 1602-06 Specification
Chloride as Cl-, ppm	ASTM C 114-09	12 ppm	500 ppm maximum (in prestressed concrete, bridge decks, or otherwise designated) 1000 ppm maximum (other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms)
Sulfate as SO_4, ppm	ASTM C 114-09	10 ppm	3000 ppm maximum
Alkalies as (Na_2O + 0.658 K_2O), ppm	ASTM C 114-09	63 ppm	600 ppm maximum
Total Solids by Mass, ppm	ASTM C 1603-05a	209 ppm	50000 ppm maximum

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: AUG 3 1 2009

Quality Assurance Manager-Nuclear Projects

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Concrete Mix Water Test Plan **Revision 0**

The signature below of the Lead Reviewer records that:

- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**__________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature] Civil 08/10/09
Lead Reviewer **(print/sign)** **Discipline** **Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
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.

EGR-NGGC-0003	Rev. 10	

June 9, 2009

Progress Energy Florida, Inc.
15760 W. Powerline Street (SA2C)
Crystal River, Florida 34428-6708

Attention: Ms. Debbie Hanna

Reference: **Proposal for Testing Services-Water Testing**
Progress Energy Crystal River Nuclear Plant Unit 3
Steam Generator Replacement Restoration of the Containment Opening
Crystal River, Florida
S&ME Project No. 1439-08-208
Contract 373812

Dear Ms. Hanna:

S&ME, Inc. (S&ME) appreciates the opportunity to submit this proposal for testing services for the Crystal River Nuclear Plant Unit 3 Steam Generator Replacement Restoration of the Containment Opening Project. Our understanding of the work is based on an e-mail from Ms. Amy Justice on June 3, 2009 and on telephone conversations with John Holliday of Progress Energy (Progress).

BACKGROUND/SCOPE OF SERVICES

Our services will be in support of the closure of the construction opening created to remove and replace the existing steam generators. This scope will include water testing as outlined in Table 1 (Concrete Performance Requirements) and Table 2 (Optional Chemical Limits) of ASTM C 1602. You indicated that three samples of water and three samples of ice would be provided for testing. It is our understanding, based on conversations with Mr. Holliday that the samples may come in three different shipments, one shipment immediately, and the subsequent samples at approximate three month intervals.

CLIENT RESPONSIBILITIES

It is anticipated that Progress will provide the samples of water and/or ice to our laboratory. We anticipate that the testing will require approximately 4 gallons per sample. If additional material is required, Progress would be notified.

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

REPORTING/DELIVERABLES

The testing will be performed under our 10CFR50 Appendix B Program. Certified Materials Test Reports (CMTR's) will be issued as requested to document the testing.

SCHEDULE AND FEE

It is anticipated that S&ME can perform each round of testing within 3 to 4 weeks from receipt of the samples and execution of an amendment to the contract authorizing the work. An expedited turnaround may be possible depending on when the samples are received. We have included an Opinion of Probable Cost (OPC) for this testing based on the quantities provided in the request and the 3 to 4 week turnaround time. Since the quantity of tests may vary, we propose to perform the testing on a unit rate basis based upon the actual number of units performed.

CONTRACTUAL ARRANGEMENTS

This project will be conducted in accordance with existing Contract No. 373812 between PROGRESS ENERGY SERVICE COMPANY, LLC, not in its individual capacity, but solely as an agent for PROGRESS ENERGY FLORIDA, INC. and S&ME, Inc. We understand that PROGRESS ENERGY will issue an amendment to this contract. The amendment will constitute authorization to proceed and upon receipt, we will initiate our services.

CLOSURE

This proposal is valid for a period of 90 days from the submittal date of this proposal. We look forward to being of service to you on this project. If you have any questions, please do not hesitate to contact us.

Sincerely,
S&ME, Inc.

John B. Pearson
Materials Engineer

Randy G. Martin
Branch Manager

Reviewed by Michael R. Stomer, Vice President

Attachments: Opinion of Probable Cost

Opinion of Probable Cost

Progress Energy Crystal River Nuclear Plant Unit 3

Steam Generator Replacement Restoration of The Containment Opening Project

Water Testing Services

S&ME Project 1439-08-208

SERVICE	UNITS		UNIT COST	EXTENSION	TOTALS
Water Testing					
Chloride Content	6 tests	at	$185.00 /test	$1,110.00	
Sulfate as SO4	6 tests	at	$660.00 /test	$3,960.00	
Alkalies	6 tests	at	$535.00 /test	$3,210.00	
Total Solids	6 tests	at	$520.00 /test	$3,120.00	
Compressive Strength Comparision	6 tests	at	$1,500.00 /test	$9,000.00	
Time of Set Comparison	6 tests	at	$1,850.00 /test	$11,100.00	
			Estimated Cost		**$31,500.00**

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Additional Admixture Test Report **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review** ____________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature]	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
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.

EGR-NGGC-0003	Rev. 10	

S&ME, INC. KNOXVILLE BRANCH

Celebrating 35 Years
1973 ◦ 2008

TEST REPORT
TESTING OF ADDITIONAL ADMIXTURES

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

January 30, 2009

PREPARED BY: ____________________

REVIEWED BY: ____________________

QA BY: ____________________

APPROVED BY: ____________________

All work contained in this report was conducted in accordance with the requirements of the referenced procurement documents and the S&ME, Inc., Knoxville Branch Quality Assurance Manual, Volume I, Revision 4, dated December 5, 2003.

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

SCOPE

S&ME, Inc. (S&ME) and our subcontractor CTLGroup (CTL) have completed the testing of the additional admixtures that were provided to our laboratory. The admixture testing was performed as outlined in Contract 373812, Laboratory Testing Requirements for Concrete Proportioning Revision 3, and the Phase I Test Plan Rev. 0 dated July 3, 2008.

RECEIPT INSPECTION

Materials received for testing were inspected and documented in accordance with S&ME Quality Assurance Procedure (QAP) 10.1, "Quality Inspection". The following table provides information on the items received.

Material	Quantity	Date Received	Inspection Report	S&ME Sampl I.D.
Recover Hydration Stabilizer	2 3.5-gal. buckets	1-08-09	QA-INSP-09-004	09-004-001
ADVA Cast 575 HRWR	2 3.5-gal. buckets	1-15-09	QA-INSP-09-012	09-012-001

TEST RESULTS

Certified Materials Test Reports (CMTRs) are included for each admixture.

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Recover Hydration Stabilizer
Project:	Crystal River	Source:	W.R. Grace, Zellwood, FL
S&ME Project No.:	1439-08-208	Quantity:	Two 3.5-gallon buckets
Contract/P.O. No.:	373812	Date Received :	January 8, 2009
		S&ME Log No.:	09-004-001

Chemical Property	Test Designation	Results	Requirement (Laboratory Testing Requirements For Concrete Proportioning, Rev. 3)
Chloride Content	ASTM C 114-06	0.075%	1 % by volume

Note 1 Chloride was determined by a potentiometric titration according to ASTM C 114-06 Section 19, with the following exceptions to Section 19.5.1: 2 g of liquid admixture was used instead of a 5 g of sample, 50 mL of water was used instead of 75 mL, 3 mL of dilute nitric acid was used instead of 25 mL and the text "breaking up any lumps with a glass rod. If the smell of hydrogen sulfide is strongly evident at this point, add 3 mL of hydrogen peroxide (30% solution)" was ignored as it only pertains to cementitious materials.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: JAN 30 2009
Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

Certified Materials Test Report

Client:	Progress Energy	Material:	ADVA Cast 575 HRWR
Project:	Crystal River	Source:	W.R. Grace, Lithonia, GA
S&ME Project No.:	1439-08-208	Quantity:	Two 3.5-gallon buckets
Contract/P.O. No.:	373812	Date Received :	January 15, 2009
		S&ME Log No.:	09-012-001

Chemical Property	Test Designation	Results	Requirement (Laboratory Testing Requirements For Concrete Proportioning, Rev. 3)
Chloride Content	ASTM C 114-06	0.003%	1 % by volume

Note 1 Chloride was determined by a potentiometric titration according to ASTM C 114-06 Section 19, with the following exceptions to Section 19.5.1: 2 g of liquid admixture was used instead of a 5 g of sample, 50 mL of water was used instead of 75 mL, 3 mL of dilute nitric acid was used instead of 25 mL and the text "breaking up any lumps with a glass rod. If the smell of hydrogen sulfide is strongly evident at this point, add 3 mL of hydrogen peroxide (30% solution)" was ignored as it only pertains to cementitious materials.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: JAN 30 2009

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

B.1 Design Specification

The details of the design change are specified below:

B.2 Scope Description

The scope of this engineering change is to provide documentation to support the:

Creation and Restoration of a Temporary Construction Opening in the RB Containment Shell to Facilitate the Removal of the Old Steam Generators and Installation of Replacement Steam Generators.

To facilitate the transportation of the old steam generators out of containment and the transportation of the new, replacement steam generators into containment a temporary access opening will be created in the containment wall and steel liner plate directly above the existing 22'-7 ½" diameter equipment hatch, located at the 150 degree azimuth. This opening will be a penetration through the post tensioned reinforced concrete cylindrical wall and steel liner plate of the containment. Creation of the temporary access opening may start during Modes 1 thru 4 with the placement of the tendon work platforms and support frames on the roof of the RB After entering Mode 5 10 vertical and 17 hoop tendons will be detensioned and removed, followed by the hydrodemolition of the concrete within the boundaries of the opening. After the Unit is defueled (No Mode) the exposed liner plate will be cut and removed, thus creating the access opening.

Creation and restoration of the access opening will require the removal and reinstallation of the concrete, rebar, tendons, tendon sheaths and liner plate within the boundaries of the opening and detensioning and retensioning of selected vertical and horizontal tendons adjacent to the opening. Additionally, a new reinforcing cage comprising of 2 layers of #11 rebars at 11" center to center spacing, in both the hoop and vertical directions will be installed in the opening. These new rebars are not spliced to any existing reinforcing bars that may be protruding from the sides of the opening.

During the SGR outage the creation and restoration of the containment access opening results in several unique interim structural configurations of the containment shell. Each of these unique structural configurations, the applicable loads, load combinations and acceptance criteria have been evaluated by S&L in calculations S06-0002 thru S06-0007 (Refs. 5.7 thru 5.12), S07-0003 (Ref. 5.25), and S09-0025 (Ref. 5.30).

A complete description of each activity within the scope of this EC associated with the creation and restoration of the containment opening and associated inspection and testing requirements is contained in Section A.5 of this EC.

B.2.1 Impacted Structure, System, or Component (SSC) Description:

The creation of the temporary construction opening will affect the containment wall, vertical and horizontal tendons and tendon sheaths within the boundaries of the opening, selected vertical and horizontal tendons immediately adjacent to the opening, concrete within the opening that has to be removed and replaced, steel reinforcing bars within the opening that have to be removed and reinstalled, and a section of the steel liner plate.

Tendons in the Opening - identification Numbers

34V8 thru 34V17 (10 verticals)

53H27 thru 53H35 and 42H27 thru 42H34 (17 hoops)

Tendons adjacent to the Opening -Detensioned & then re-tensioned per the requirements of this EC:

45V22 thru 45V24 and 34V1 thru 34V7 (10 verticals)

34V18 thru 34V24 and 23V1 thru 23V3 (10 verticals)

42H22 thru 42H26 and 53H23 thru 53H26 (9 hoops)

42H35 thru 42H39 and 53H36 thru 53H39 (9 hoops)

There are no other SSC's directly or indirectly affected by this EC.

Refer to Sections A-4 and A-5 of this EC for formal problem and solution statements.

B.3 References:

1.0 Industry Standards:

1.1. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, as contained in the Ninth Edition of the AISC Manual of Steel Construction.

1.2. ACI 318-63, Building Code Requirements for Structural Concrete and Commentary

1.3. ACI 209R-92 (Re-approved 1997), "Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures".

1.4. ACI 347-04, Guide to Formwork for Concrete.

1.5. ACI 349-01, Code Requirements for Nuclear Safety Related Concrete Structures

1.6. NUREG-0612, Control of Heavy Loads at Nuclear Power Plants

1.7. ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWA, IWE, and IWL of the 2001 edition through the 2003 Addenda, as amended by 10CFR50.55a.

1.8. ASME Boiler and Pressure Vessel Code, Section III, Division 2, Code for Concrete Containments, 2001 edition through the 2003 Addenda.

1.9. ANSI N45.2.2-1972, Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.

1.10. ANSI N45.2.11-1974, Quality Assurance Requirements for the Design of Nuclear Power Plants

1.11. ASA N 6.2-1965, Safety Standard for Design, Fabrication and Maintenance of Steel Containment Structures for Stationary Nuclear Power Reactors.

1.12. ASTM A421-65 and 98a, Standard Specification for Uncoated Stress-Relieved Wire for Pre-stressed Concrete.

1.13. ASTM A514-00a, High Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.

1.14. ASTM A513-69 and 06, Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

1.15. ASME Boiler & Pressure Vessel Code, Section VIII, Unfired Pressure Vessels, 1965 Ed.

1.16. ASME Boiler & Pressure Vessel Code, Section III, Nuclear Vessels, 1965 Ed.

1.17. ASME Boiler and Pressure Vessel Code, Section III, Division 2, Appendix F, Rules for Evaluation of Service Loadings with Level D Service Limits, 1995 Ed.

1.18. ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NE, 1995 Ed.

1.19. ASTM C1602-05, Specification for Mixing Water used in the Production of Hydraulic Cement Concrete.

2.0 <u>Design Basis Documents:</u>

2.1. Design Basis Document for the Containment, Revision 6 (Tab 1/1)

2.2. Design Basis Document for Major Class I Structures, Revision 4 (Tab 1/3)

3.0 <u>Specifications:</u>

3.1 SP-5209, Revision 0, CR-3 Seismic Qualification.

3.2 CPL-XXXX-W-005, Revision 11, Nuclear Power Plant Protective Coatings.

3.3 CPL-XXXX-W-006, Revision 8, Nuclear Power Plant Protective Coatings Procurement.

3.4 Gilbert Associates Inc, (GAI) Specification SP-5569, Furnishing and Delivering of Structural Concrete, Dated 6/23/1971

3.5 GAI Specification SP-5618, Placement of Structural Concrete, Dated 4/14/1972

3.6 CR3-C-0002, Revision 1, Formwork for the Restoration of the SGR Access Opening in the Containment Wall.

3.7 CR3-C-0003, Revision 0, Concrete Work for the Restoration of the SGR Opening in the Containment Wall.

3.8 RO 3040, Requirement Outline, Pre-stressing System Tendon Conduit, Date 06/12/1970

3.9 SP-5583, Dated 09/18/1968, Specification, Tendon and Associated Conduit, RB.

3.10 GAI Specification SP-5844, Dated 10/21/1970, Specification, Installation of Pre-stressing System Tendon Conduit and Embedded anchorage.

3.11 GAI Specification SP-5646, Fabrication and Delivery of Reinforcing Steel, Dated 04/25/1969

3.12 GAI Specification SP-5566, RB Liner and Penetrations and Personnel Access Locks, Dated 3/18/1981

4.0 Drawings:

4.1 SC-421-001, Revision 4, RB Tendon Access Gallery – Plan, Sections and Details

4.2 SC-421-031, Revision 4, RB Exterior Wall – Concrete Outline

4.3 SC-421-032, Revision 8, RB Stretch-Out of Exterior Wall Buttress #2, #3, #4 and #5

4.4 SC-421-033, Revision 8, RB Stretch-Out of Exterior Wall Buttress #5, #6, #1 and #2

4.5 SC-421-036, Revision 10, RB Exterior Wall – Sections and Details

4.6 SC-421-039, Revision 5, RB Exterior Wall – Equipment Access Opening Reinforcement Details.

4.7 SC-421-041, Revision 5, RB Ring Girder – Concrete Outline – Plan And Sections

4.8 SC-421-043, Revision 7, RB Equipment Access Shield Structure

4.9 5EX7-003-A-01, Revision 3, (Dwg key #S-000031)–Prescon Corp tendon fabrication

4.10 5EX7-003-A-02, Revision 0, (Dwg key #S-000032)

4.11 5EX7-003-A-03, Revision 5, (Dwg key #S-000195)

4.12 5EX7-003-A-04, Revision 5, (Dwg key #S-001527)

4.13 5EX7-003-A-07, Revision 2, (Dwg key #S-001528)

4.14 5EX7-003-A-08, Revision 3, (Dwg key #S-001529)

4.15 5EX7-003-A-09, Revision 5, (Dwg key #S-001530)

4.16 5EX7-003-A-09A, Revision 5, (Dwg key #S-001531)

4.17 5EX7-003-A-09C, Revision A, (Dwg key #S-001532)

4.18 5EX7-003-A-09D, Revision 1, (Dwg key #S-001533)

4.19 5EX7-003-P-16, Revision 1, (Dwg key #S-001569)

4.20 5EX7-003-P-19, Revision 0, (Dwg key #S-001572)

4.21 5EX7-003-P-22, Revision 1, (Dwg key #S-001575)

4.22 5EX7-003-P-28, Revision 1, (Dwg key #S-001581)

4.23 Chicago Bridge & Iron #68-3871-8, Revision 2 (Dwg key #S302)-Shell Plate Details.

4.24 Chicago Bridge & Iron #68-3871-11, Revision 5 (Dwg key #S305) Shell Details.

4.25 Chicago Bridge & Iron #68-3871-17, Revision 3 (Dwg key #S311) - Shell Stretchout and Plate Details.

4.26 Mammoet #HTS02-1/1, Revision 06, Detail Hook Construction Hatch.

4.27 421-346, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Load Combinations.

4.28 421-347, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Vertical & Horizontal Tendon Positions.

4.29 421-348, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Demolition Sheet 1 of 2

4.30 421-349, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Demolition Sheet 2 of 2

4.31 421-350, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 1 of 3

4.32 421-351, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 2 of 3

4.33 421-352, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 3 of 3

4.34 S-502-036, Revision 2, Miscellaneous Security Barriers (tendon access hatch cover).

5.0 Calculations:

5.1 F 99-0004, Revision 4, CR-3 Time to Boil, Time to 200 degrees F, Time to Saturate and Time to Uncover.

5.2 M-92-0041, Revision 2, RB Pressurization – Loss of Decay Heat during Lowered Loop Operation.

5.3 M 89-0016, Revision 0, Loss of Decay Heat Removal While the RCS is in a Reduced Inventory Condition.

5.4 S-91-0007, Revision 3, Equipment Hatch Bolts Required for Loss of Decay Heat Removal during Lowered Loop Operation.

5.5 S80-0002, Revision 0, "Required Minimum Average Tendon Force".

5.6 S95-0082, Revision 3, "6th Tendon Surveillance – Generation of Tendon Force Curves".

5.7 S06-0002, Revision 1, "Containment Shell Analysis for Steam Generator Replacement – Design Criteria".

5.8 S06-0003, Revision 0, "Containment Shell Analysis for Steam Generator Replacement – Benchmarking".

5.9 S06-0004, Revision 0, "Containment Shell Analysis for Steam Generator Replacement – Properties of New Concrete for Access Opening and Number of Hoop and Vertical Tendons to be De-tensioned".

5.10 S06-0005, Revision 0, "Containment Shell Analysis for Steam Generator Replacement – Shell Evaluation during Replacement Activities".

5.11 S06-0006, Revision1, "Containment Shell Analysis for Steam Generator Replacement – Evaluation of Restored Shell".

5.12 S06-0007, Revision2, "Liner Evaluation for Steam Generator Replacement".

5.13 S06-0008, Revision 0, "SGR – "Mammoet Computation Base".

5.14 S06-0009, Revision 0, "SGR – "Mammoet TLD Loads on Polar Crane Rail".

5.15 Spare

5.16 S06-0011, Revision0, "SGR – Mammoet OLS Foundations".

5.17 S06-0013, Revision2, "SGR – Mammoet HTS Foundations"

5.18 S06-0026, Revision 1, "Steam Generator Replacement – IHTS and TLD Loads on D-rings and Containment wall".

5.19 1.01.3 "Reactor Building – Outside Shell – Mat Design Loadings", 01/01/1975 (RMS Record No. 000000002888202).

5.20 1.01.4 "Reactor Building – Outside Shell – Cylindrical Wall (Book II)", 01/01/1975 (RMS Record No. 000000002894487).

5.21 1.01.7 "Reactor Building – Outside Shell – Reactor Building Design - Pre-stressing (Book II)", 01/01/1975 (RMS Record No.000000002894495).

5.22 1.01.9 "Reactor Building – Outside Shell – Reactor Building Design – Polar Crane Bracket and Girder (Book II)", 01/01/1975 (RMS Record No.000000002894426).

5.23 1.01.19, "Reactor Building – Outside Shell – FSAR – Input Data Calculations Book III)," 01/01/1975 (RMS Record No. 000000002894578).

5.24 25th Year Physical Surveillance of Unit 3 Containment Building Post Tensioning at the Crystal River Nuclear Plant by Precision Surveillance Corp., 2001

5.25 S07-0003, Revision 0, "Containment Shell Analysis for SGR – Predicted Tendon Forces for ISI".

5.26 Deleted

5.27 S08-0021, Revision 0, Design of Concrete Formwork for restoration of SGR access opening. (Note: This calculation number has been reserved in Passport; issue date is being tracked by AR 293932).

5.28 S08-0005, Revision 0, Steam Generator Replacement, Load Drop Analysis

5.29 M09-0031, Revision 0, CR3 Loss of DH Removal Containment response – 133' RV Water Level

5.30 S09-0025, Revision 0, Containment Shell Analysis for Steam Generator Replacement – Evaluation for Refueling prior to Restoration of Access Opening.

6.0 <u>Nuclear Generating Group (NGG) Procedures:</u>

6.1 EGR-NGGC-0003, Revision 10, Design Review Requirements.

6.2 EGR-NGGC-0005, Revision 27, Engineering Change.

6.3 EGR-NGGC-0007, Revision 9, Maintenance of Design Documentation.

6.4 EGR-NGGC-0011 Revision 11, Engineering Product Quality.

6.5 Spare

6.6 NGGM-PM-0003 Revision 82, Corporate Welding Manual.

6.7 MNT-NGGC-0004 Revision 9, Scaffolding Control.

6.8 MNT-NGGC-0005 Revision 3, Control of Rigging and Temporary Loads.

6.9 MNT-NGGC-0009 Revision 5, Application of Protective Coatings.

6.10 FIR-NGGC-0003, Revision 2, Hot Work Permit.

6.11 FIR-NGGC-0004, Revision 2, Determination of Combustible Loading and Equipment Fire Severity.

6.12 MCP-NGGC-0401, Revision 23, Material Acquisition (Procurement, Receiving, and Shipping).

6.13 MCP-NGGC-0402, Rev. 17, Material Management (Storage, Issue & Maintenance).

6.14 MNT-NGGC-0003, Revision 11, Radiation Shielding Use.

6.15 MNT-NGGC-0007, Revision 6, Foreign Material Exclusion Program.

6.16 NGGM-PM-0011, Revision 59, Nuclear NDE Manual.

6.17 NUA-NGGC-1530, Revision 13, Quality Assurance Hold Point Procedure.

6.18 REG-NGGC-0010, Revision 11, 10CFR 50.59 and Selected Regulatory Reviews.

6.19 SAF-NGGC-2172, Revision 9, Industrial Safety.

6.20 SAF-NGGC-2174, Revision 5, Confined Space Entry Procedure.

6.21 SEC-NGGC-2166, Revision 3, Site Access Controls.

6.22 CHE-NGGC-0045, Revision 13, NGG Chemical Control Program.

6.23 EGR-NGGC-0020, Revision 2, Preparation and Control of Specifications.

6.24 EGR-NGGC-0015, Revision 3, Containment Inspection Program.

6.25 EGR-NGGC-0352, Revision 5, Baseplate Design

7.0 Plant Procedures:

7.1 CP-341, Revision 4, Containment Penetration Control.

7.2 SP-182, Revision 16, Reactor Building Structural Integrity Tendon Surveillance Program.

7.3 AI-504, Revision 27, Guidelines for Cold Shutdown and Refueling.

7.4 Environmental Qualification Plant Profile Document (EQPPD), Revision 14.

7.5 MP-114, Revision 25, Removal and Installation of RB Equipment Hatches.

7.6 FP-203, Revision 52, Defueling and Refueling Operations.

7.7 AP-404, Revision 12, Loss of Decay Heat Removal.

7.8 OP-209, Revision 121, Plant Cool-down.

7.9 AI-2200, Revision 11, Guidelines for Handling, Use and Control of Transient Combustibles.

7.10 MNT-NGGC-0021, Revision 0, Lifting and Rigging Practices and Equipment.

7.11 AI-1801, Revision 15, Heat Stress Management.

7.12 AI-1803, Revision 21, Safety Standards for Ladders & Scaffolds.

7.13 AI-1816, Revision2, Industrial Safety Signs and Tags.

7.14 AI-2205E, Revision 0, Pre-Fire Plan, Reactor Building

7.15 AI-2210, Revision 11, Fire watch Program

7.16 CP-216, Revision 7, Preparation of an FSAR Change Package.

7.17 AI-550, Revision 5, Infrequently Performed Tests or Evolutions.

7.18 EM-220, Revision 36, Violent Weather

7.19 CP-137, Revision 20, Fire and HELB Barrier Breaches

7.20 NUA-NGGC-1530, Revision 13, Quality Assurance Hold Point Procedure

7.21 MP-804, Revision 10, Concrete Anchor Bolt Installation

7.22 EVC-SUBS-00107, Revision 01, Waste Vendor Program

7.23 AI-505, Revision 21, Conduct of Operations During Abnormal and Emergency Events

7.24 SP-178, Revision 30, Containment Leakage Test-Type "A" Including Liner Plate

7.25 AI-2200, Revision 11, Guidelines for handling Use and Control of Transient Combustibles.

7.26 Station Fire Protection Plan (FPP, Revision 25)

7.27 SGR-012, Revision 0, Regulatory Selection Process for SGR Activities.

7.28 AI-1820, Revision 2, Hazardous and Non-Hazardous Waste Management

7.29 EVC-SUBS-00008, Revision 5, DOT Hazardous Materials

7.30 EVC-SUBS-00016, Revision 7, Hazardous Waste Management

8.0 <u>Plant Change Documents:</u>

8.1 EC 63022R0, Steam Generator Rigging and Transport.

8.2 EC 70377R0, Temporary Power Outside Containment for SGR.

8.3 EC 61170R0, Methodology Study – SG Transport Through Containment

8.4 EC-ED 0068398R0, NUREG-0612 Justification for Tendon Testing Over Spent Fuel Pool.

8.5 EC 63020R0, SGR Outside Erection Crane and Inside Auxiliary Crane.

8.6 EC ED 0070586R0, SGRP RB Opening Liner Plate Owner Reconciliation.

8.7 EC ED 0059400R0, Identify the Source and Limitations for Crystal River South (CRS) Water Supply and Discharge for OTSG RFO-16.

8.8 EC 63021, Temporary Manlift to the RB Roof.

8.9 EC 64487, Remove the Need to Install Missile Shields Over the SF Pool

8.10 EC 70443, Steam generator Replacement project Reconciliation

8.11 SGR Containment Liner Plate IWE Repair/Replacement Plan (Contained in Attachment Z57)

Deleted: 0000063016R7

8.12 SGR Containment IWL Repair/Replacement Plan (Contained in Attachment Z58).

9.0 Regulatory Documents:

9.1 FSAR, Revision 31cc

9.2 Regulatory Guide 1.76, Revision 1 "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants".

9.3 NUREG/CR-4461, Revision 2 "Tornado Climatology of the Contiguous USA".

9.4 NUREG-0800 SRP 3.3.2, Revision 3, "Tornado Loadings".

9.5 Improved Technical Specifications (Through Amendment 229 and Improved Technical Specifications Bases Revision 73).

9.6 NUREG-1488, Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear power Plant Sites East of the Rocky Mountains.

9.7 NUREG-1742, Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program' prepared by the NRC Office of Nuclear Regulatory Research, April 2002

10.0 Other References

10.1 Progress Energy Letter No. SGR07-0026, dated February 14, 2007, Subject: Design Inputs for Containment Shell Analysis for Steam Generator Replacement (Refer to Attachment Z16).

10.2 Progress Energy Letter No. SGR07-0053, dated April 19, 2007, Subject: Design Load Combinations (Refer to Attachment Z16).

10.3 Progress Energy Letter No. SGR06-0102, dated Dec. 4, 2006, Subject: RB Pressure and Temperature – Loss of Decay Heat During Lowered Loop Operation (Refer to Attachment Z16).

10.4 Tajeda-Dominguez, F, et al, Formwork Pressure of Self-Consolidating Concrete in Tall Wall Field Applications, Transportation Research Board Annual Meeting, Washington, DC (Refer to Calculation S06-0007).

10.5 AR 282349, 10CFR50.59 Evaluation for EC 63016

10.6 AR 284485, Risk Assessment for EC 63016.

10.7 AR 285181, PSC Calculation for tendon work platforms and upper support frames

10.8 AR 285173, PSC Post Tensioning System Field and Quality Control Procedure Manual".

10.9 AR 277358, Develop & Submit Code Relief Request for Alternative Tendon Testing

10.10 Mac and Mac Hydrodemolition Work Instructions, Rev 0. (Refer to Attachment Z24)

10.11 Industrial Waste Water Permit (FLA016960) for CR3, issue date: 1/9/2007, expiration date: 1/8/2012

10.11 Offsite Dose Calculation Manual, Rev. 030, dated 04/10/2007

10.12 Georgia Technical Research Corporation GT STRUDL Version 27.

10.13 AR 289322 assigned to David Mayes, SGR welding engineer to develop a new welding procedure for welding rebar applicable to the containment opening. Due date is 4/1/2009.

10.14 AR 289302 to track post job critique for EC 63016.

10.15 AR 290111 tracks completion of concrete tests for access opening replacement concrete (due summer 2009) and subsequent incorporation of concrete proportions into spec and issue of specification (CR3-C-0003).

10.16 BPI-GRIP Systems Splicing Manual (SM01) contained in Attachment Z26.

10.17 Precision Surveillance Corporation (PSC) Manual "Post Tensioning System Field and Quality Control Procedure Manual", Revision 0, contained in Attachment Z23

10.18 AR 292005 to track issue of Containment Opening RP Task Plan.

10.19 Work Order Task 1165094-Task-03, Water supply and disposal for concrete removal.

10.20 AR 291833 tracks that the containment IWE/IWL Program Manager reviews EC 63016 for its impact on SP-182 (Tendon Surveillance Procedure) and revise and issue SP-182 accordingly prior to EC Closure.

10.21 AR 292126 tracks issue date of concrete specification CR3-C-0003.

10.22 AR 292151 initiated to track that the containment opening Task Manager is responsible for identifying the source, method of delivery and disposal of the water required for hydrodemolition.

10.23 Work Order Task 1165094-Task-03. Details for supply and disposal of the water for concrete hydrodemolition.

10.24 AR 292500 initiated to track that Calculation S08-0020 is issued prior to EC closeout (Note: This AR was prematurely closed out and has been replaced with AR 293703).

10.25 AR 292796 has been initiated to track that the IWE/IWL RE reviews and approvals EC 63016.

10.26 EVC-SUBS-00107, Revision 1, Progress Energy Waste Vendor Program.

10.27 Precision Surveillance Corporation (PSC) Tendon Tensile Test Results for the new replacement tendons, Revision 0 (Refer to Attachment Z20).

10.28 AR 293703 has been initiated to track the completion and issue date for calculation S08-0020 (Refer to Section B.5 "Caveats Outstanding)

10.29 AR 293932 has been initiated to track issue date for concrete formwork Calculation S08-0021 and associated drawings.

10.30 PEERE 987, Plant Equipment Equivalency Replacement Evaluation.

10.31 Progress Energy Letter No. SGR 06-0054 form D.L. Jopling and R. Lemberger to Chris Sward, Subject: RB Pressure and Temperature dated August 9, 2006.

10.32 AR 295907 has been initiated to track the post-job-briefing

10.33 REG AR 350195, Screen for EC 63016 including Transition Plan

B.4 Design Inputs

Following is a list of applicable *design inputs* specified to meet the requirements of ANSI N45.2.11. (See EGR-NGGC-0005, Attachment 2, for details).

1. Basic Functions of Each Structure, System and Component:

Reactor Building Containment Structure:

The containment is a Class I Structure as described in the FSAR Sections 5.1.1.1 and 5.2.1 and the Design Basis Document for the Containment, (Tab 1/1). The primary function of the reactor containment building and its steel liner is to house the primary nuclear system and to provide biological shielding from the fission products that could become airborne under accident conditions. Its failure could result in the uncontrollable release of radioactivity and its integrity is vital for the safe shutdown and isolation of the reactor. Containment integrity is required in Modes 1, 2, 3, and 4, Ref. 9.5 (TS 3.6). There are no Technical Specification (TS) Limiting Conditions for Operation (LCOs) for containment integrity during Modes 5, 6 and defueled (TS 3.6.1), however, Improved Tech Specs require containment closure during Mode 6 to mitigate accident consequences as follows:

- 3.9.3 LCO requires containment closure during Mode 6 to mitigate the dose consequences of a fuel handling accident involving recently irradiated fuel. Containment closure is not required when handling fuel that has not been recently irradiated.

- 3.9.4 Action A.4 requires containment closure during Mode 6 to mitigate the dose consequences for loss of decay heat removal.
- 3.9.5 Action B.3 also requires containment closure during Mode 6 to mitigate the dose consequences for loss of decay heat removal.

AI-504, Guidelines for Cold Shutdown and Refueling (Ref. 7.3), identifies the requirements for plant safety function availability based on defined Shutdown Conditions 1 through 6. The Shutdown Condition numbers denote the lowest to highest shutdown risk classifications for loss of decay heat removal capability. Containment closure is one of the safety functions, and the requirements vary according to the shutdown risk. Containment closure is required in conditions 2 through 6. AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending (defueling).

During Modes 5 and 6 ascending (refueling) AI-504 (Refer to Enclosure 9 for specific requirements for refueling during the SGR outage) still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig.

The function of the containment building cannot be changed or degraded as a result of the creation and restoration of the containment access opening.

Basis: Design Basis Document for the Containment (Tab 1/1),
G/C Inc. Specifications SP-5569 and SP-5618,
Improved Technical Specifications Sections 3.6 and 3.9.
AP-404
AI-504 and AI-505

2. **Performance Requirements such as Capacity, Rating, and System Output:**

The reactor containment building is a Class I Structure designed as a passive barrier that is required to maintain its structural integrity during a design basis accident and for all normal and accident load cases and load combination. It was designed for an internal pressure of 55 psig and a temperature of 281 degrees F (accident condition); an internal pressure (external pressure drop) of 3 psig during a tornado; and an external pressure (internal pressure drop) of 2.5 psig during normal operation of the plant. Due consideration was given to the dead load, live load, temperature gradients, and effects of penetrations at accident and working conditions.

Basis: Design Basis Document for the Containment, (Tab 1/1)
FSAR, Section 5.2.1

3. **Codes, Standards, and Regulatory Requirements:**

The post tensioned, reinforced concrete reactor containment building is designated as a Class I Structure (FSAR Section 5.1.1.1 and Ref. 2.1) and by definition is therefore nuclear safety-related. Its design and construction predated the establishment of a concrete pressure vessel code. The primary design code for the concrete, tendons and steel reinforcement was ACI 318-

63, Parts IV-B and Part V. The tendons conformed to the applicable portions of ASTM A421-65 for low relaxation wire (FSAR Section 5.2.2.3.2). The liner plate conformed in all respects to the applicable Sections of ASA N 6.2-1965 "Safety Standard for Design, Fabrication and Maintenance of Steel Containment Structures for Stationary Nuclear Power Reactors".

Basis: Design Basis Document for the Containment DBD11, (Tab 1/1)
G/C Inc. Specifications SP-5569 and SP-5618
FSAR Section 5.0

4. **Design Conditions such as Pressure, Temperature, Fluid Chemistry and Voltage:**

Pressures:
Normal Operation: +1 to -1 psig
Accident pressure inside containment resulting from worst case LOCA: 55 psig
Accidental RB Spray Actuation: -2.5 psig on interior of containment
Total suction pressure (suction on interior of containment: -6.0 psig)
Tornado differential pressure (suction on outside of containment): -3 psig

Temperatures:
Operating temperature inside containment: 90 to 110 degrees F.
Operating temperature outside containment: 25 to 100 degrees F.
Accident temperature: 281 degrees F.

Basis: Design Basis Document for the Containment, (Tab 1/1)
FSAR Section 5.2

5. **Loads such as Seismic, Wind, Thermal, and Dynamic:**

Loads to be considered in verifying the structural integrity of the containment building during the SGR outage include both forces resulting from natural phenomena such as earthquake, tornado, wind, and hurricane in addition to those resulting from design basis accident conditions, material dead and live loads and forces resulting from tendon stressing. The dead weight of the polar crane, inside and outside horizontal transfer system, the temporary lifting device, weight of steam generators, auxiliary crane and fresh poured concrete will be included in the evaluation of the containment building.

The upper support frames (USFs) that support the tendon work platforms will be placed on the containment roof pre-outage and must be designed for dead, live, hurricane wind and seismic loads. The primary consideration for the work platforms (& the USFs) is seismic II/I concerns, particularly when they are initially placed on the RB roof during Modes 1 thru 4.
The exposed liner plate must be verified for pressure and temperature resulting from a LODHR accident and the pressure resulting from the placement of wet concrete in the opening, i.e. liner plate acts as formwork for the interior face of the containment wall.

Basis: Design Basis Document for the Containment, (Tab 1/1),
ACI 318-63, Parts IV-B and Part V

S06-0026, SGR– IHTS and TLD Loads on D-rings and Containment wall.
1.01.3 Reactor Building – Outside Shell – Mat Design Loadings", 01/01/1975
1.01.4 "Reactor Building – Outside Shell – Cylindrical Wall (Book II)", 01/01/1975.
1.01.7 "Reactor Building – Outside Shell – Reactor Building Design - Pre-stressing (Book II)", 01/01/1975.
1.01.9 "Reactor Building – Outside Shell – Reactor Building Design – Polar Crane Bracket and Girder (Book II)", 01/01/1975.
1.01.19, "Reactor Building – Outside Shell – FSAR – Input Data Calculations Book III)," 01/01/1975.

6. **Environmental Conditions:**

Water requirements:
Creation of the temporary access opening will require large amounts of clean water that must be delivered to the hydrodemolition equipment. Water specimens must be obtained to verify baseline chemical and radiological testing of the water prior to the start of hydrodemolition. The resulting waste water and concrete debris that are generated must be disposed of in an environmentally acceptable manner. Other waste that will be generated will include (but not limited too) used tendon grease, anchorage components, scrapped tendons, tendon sheaths and rebar.

Waste water disposal requirements:
The current plan is to discharge this water into the Crystal River South percolating ponds (Refer to Section B.6.12 for chemical testing requirements).

Samples for radiological testing and analysis will be taken at the collection bins and tested at the on-site RP/Chemistry laboratory in accordance with existing site procedures. Discharge of the water and rubble may continue uninterrupted while samples are being tested and analyzed. Specific details on radiological sampling and analysis of the waste generated during hydrodemolition will be addressed by SGR RP in the Containment Opening RP Task Plan (issue date tracked by NTM AR 292005) and the associated work package.

The containment opening task manager is responsible for water delivery, storage and the means of piping it to and from the containment and is outside the scope of this EC. He is also responsible for determining if the settling ponds have adequate storage for the expected 2 million gallons of waste water. The details for supply and disposal of the water for concrete hydrodemolition will be included and approved per Work Order Task 1165094-Task-03. Additionally, AR 00292151 has been assigned to the containment task manager to ensure he develops all these activities and adds them to the Work Order.

Tendon grease disposal:
It is estimated that approximately (by the tendon contractor, i.e., PSC) 200 drums (11,000 gallons) of waste tendon grease will be generated as a result of this modification. Correct handling and disposal is required.

Creation of containment opening:

Breaching the containment liner plate opens the inside of containment to the general ambient environment and could potentially provide an unrestricted path for airborne contamination. Additionally, the access opening provides a means by which rain water can enter the containment building and possibly affect equipment.

Basis: Offsite Dose Calculation Manual
Industrial Waste Water Permit (IWWP)
Chemical Control CHE-NGGC-0045
Mac and Mac (hydrodemolition contractor) Work Instructions (Z24).
Work Order Task 1165094-Task-03, Water supply and disposal for concrete removal

7. <u>Interface Requirements:</u>

This EC interfaces with the following ECs:

1. EC 63020, SG Replacement – Outside Erection Crane & Inside Auxiliary Crane
2. EC 63022, Steam Generator Rigging and Transport, covers the rigging and handling plans for the steam generators.
3. EC 70377, Temporary Power Requirements, Outside the RB for SGRP
4. EC/ED 70586, Containment Opening Liner Plate Owner Reconciliation
5. EC/ED 59400, Identify the Source and Limitations for Crystal River South (CRS) Water Supply and Discharge for OTSG Outage RFO-16
6. Work Order Task 1165094-Task-03, Water supply and disposal for concrete removal.
7. EC/ED 61170, Methodology Study-SGR Transport Through Containment
8. EC/ED 70443, SGR Project Reconciliation
9. EC 63021, Temporary Man-lift Outside RB to the Roof.

Basis: See references listed above.

8. <u>Material Requirements:</u>

All materials used in the restoration of the temporary access opening must be compatible with the existing materials and meet or exceed the <u>original material requirements</u> listed below (Note: Restoration of the opening requires development of concrete mixture proportioning that will produce a concrete that will meet the required physical properties (strength, density, elastic modulus, creep and shrinkage, durability, etc.) and provide appropriate characteristics for placeability in the subject application (workability, consistency, no segregation, and no bleeding). Additional considerations are required to achieve high early strength to permit tendon stressing as soon as practical after placement, and to maintain physical compatibility with the existing concrete by limiting the creep and shrinkage strains of the concrete):

<u>FOLLOWING ARE THE ORIGINAL MATERIAL REQUIREMENTS:</u>

<u>Original Concrete:</u>

- Minimum compressive strength of 5000 psi
- Unit weight of 150 psf
- Poisson's ratio 0.2

- Maximum slump 3”
- Cement ASTM C150 Type II
- Coarse and fine aggregate to conform to ASTM C33

Rebar:
- Originally installed rebar conformed to ASTM A615-68 Grade 40

Flexible (or rigid) tendon sheathing:
- The original 5 ¼” OD mechanical welded steel tube manufactured to ASTM A513-69

Tendons:
- Original 163-7mm diameter low relaxation wires conformed to the requirements of ASTM A421-65, Type BA with a minimum ultimate tensile stress of 240,000 psi.

Tendon Anchor Heads (163 wire stressing washer):
- Original anchor heads were SSS-100, ASTM A514 Grade E material

Tendon split shims:
- Original material was modified Armco VNT (Proposed ASTM A633-E)

Tendon grease:
- Per containment DBD the original tendon grease was Visconorust 2090P and/or 2090P-2

Tendon grease end cap gaskets, studs, nuts and washers:
- Furnished per the original Prescon drawing 5EX7-003 Sheet A-9D, Revision 1 for all hoop and upper vertical ends and drawing 5EX7-003 Sheet A-9C for the lower vertical ends.

Tendon grease caps (cans):
- H.R. – L.C. steel per original Prescon drawing 5EX7-003 Sheet A-9D, Revision 1

Rebar splices:
- All rebar splices were originally required to be Cadwelds for all bars larger than #11

Liner plate:
- ASTM A283 Grade C with a minimum copper content of 0.2%

Liner plate stiffener angles:
- ASTM A36

Basis: Original material requirements are contained in Ref. 2.1, Design Basis Document for the Containment (Tab 1/1) & the following original Gilbert Associates construction specifications:

SP-5569	SP-5566
SP-5618	SP-5646
SP-5583	RO-3040
SP-5844	

9. Mechanical Requirements:

The inside surface of the reactor building is lined with a carbon steel liner to ensure a high degree of leak tightness during operating and accident conditions. Per Reference 2.1 the nominal liner plate thickness is 3/8" for the cylinder and dome and 1/4" for the base. Cutting and removal of the liner plate from within the temporary access opening will result in a new pathway whereby airborne contamination could potentially migrate from the RB to the general environment. There are no Improved Technical Specification (ITS) Limiting Conditions for Operation (LCOs) for containment integrity during Modes 5, 6 and defueled (TS 3.6.1), however, ITS Required Actions require containment closure during Mode 6 to mitigate accident consequences (TS 3.9.3 LCO, TS 3.9.4 Action A.4 and TS 3.9.5 Action B.3). AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending. Therefore, the containment shell with the exposed liner plate in the opening must be evaluated for the 5.14 psi internal pressure generated by a LODHR accident while in Modes 5 and 6 descending (defueling).

During Modes 5 and 6 ascending (refueling) AI-504 still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig.

The exposed liner plate within the opening will also be used as formwork for the newly placed concrete (Refer to Section B.4.10 when considering the liner plate as formwork).

During hydrodemolition of the concrete containment wall there is the potential for water to drain down the exposed vertical tendon sheaths into the tendons gallery where it must be contained, collected and pumped out of the gallery.

Basis: Design Basis Document for the Containment (Tab 1/1),
AI-504 (Ref. 7.3)
Improved Technical Specifications and NRC letter 3F0189-02.

10. Structural Requirements:

During the SGR outage the creation and restoration of the containment temporary access opening results in several unique interim structural configurations of the containment shell. Each of these unique structural configurations, the applicable loads, load combinations and acceptance criteria must be evaluated to ensure compliance with all relevant design codes, licensing commitments and design basis calculations. A brief description of the containment shell interim structural configurations and the associated calculations is contained in Section B.6.10. Detailed information concerning the analytical methodologies employed in the evaluations is contained in Section B.6.5.

Tendon work platforms will be suspended from frames (upper support frames) that are lifted to the RB roof pre-outage. Refer to Section B.6.5-o for the work platform design criteria and Section B.6.10 for an evaluation of the acceptability of placing and moving the work platforms (upper support frames) on the RB roof and of the lift requirements, safe load path and other restrictions.

Concrete formwork will be installed on the exterior face of the RB wall at the access opening to provide temporary containment and support for the fresh concrete until it hardens sufficiently to support itself. Formwork must be designed to the requirements of calculation S06-0007 and specification CR3-C-0002 (Z15). Refer to Section B.6.10 for a summary of the formwork design criteria.

The 3/8" thick, ASME A283 Grade C steel liner plate must provide support for the newly placed concrete on the inside face of containment.

There shall be no reduction in design margins for the containment shell as a result of this modification.

Basis: Design Basis Document for the Containment (Tab 1/1)
FSAR Chapter 5, Sections 5.1 thru 5.2.
Calculation S06-0007 and S06-0005

11. **Hydraulic Requirements:**

The pumps and associated piping supplied for the hydrodemolition operation must be capable of providing and recovering the water needed for operation of the hydrodemolition equipment.
Basis: N/A

12. **Chemistry Requirements:**

Water requirements for hydrodemolition:
It is recommended that at least 2,000,000 gallons of clean water must be available for hydrodemolition activities and must be supplied at the rate of 360gpm. Water specimens must be obtained to verify baseline chemical and radiological testing of the water prior to the start of hydrodemolition. The details for water supply and disposal for concrete removal will be included and approved per Work Order Task 1165094-Task-03.

Waste water requirements:
Waste water from the hydrodemolition process (approximately 2,000,000 gallons over a three day period) will be tested before discharge to ensure it meets Plant and the State of Florida permit requirements including the Industrial Waste Water Permit (IWWP). Refer to Section B.6.6 for an evaluation of the water requirements.
Water requirements for replacement concrete mix for the temporary construction opening:
The testing requirements and acceptance limits of ASTM C1602 shall apply by reference to ASTM C94. The concrete mixing water will probably be obtained from a non-potable source and should meet the requirements of Section 5 of ASTM C1602.

Diesel fuel/oil requirements:
Diesel fuel will be required to fuel the diesel driven hydrodemolition pumps. Adequate precautions must be taken to ensure no spills.

Tendon grease:
It is estimated that approximately 200 drums (11,000 gallons) of waste tendon grease will be generated as a result of this modification. Correct handling and disposal of grease is required.

Basis: Industrial Waste Water Permit
Chemical Control per CHE-NGGC-0045
Mac and Mac (hydrodemolition contractor) Work Instructions (Z24).

13. **Electrical Requirements:**

None.

Basis: This EC does not affect the permanent station electrical distribution system. Temporary construction power requirements are addressed by EC 70377, Temporary Power Requirements.

14. **Layout and Arrangement Requirements:**

During R15 the left side and right side bottom corners of the liner plate cut were scribed on the liner plate inside containment. The size of the liner plate cut is as shown on Drawing #421-349. Also during R15 the outside face of containment was surveyed and the bottom corners of the liner plate cut laid-out (on the face of the concrete wall).

Basis: Mammoet Drawing #HTS02-1/1, Detail Hook Construction Hatch.

15. **Operational Requirements Under Various Conditions:**

The containment building (shell) is designed as a passive structural component with no operational requirements other than to house the primary nuclear system and to provide biological shielding from fission products that could become airborne under accident conditions. Containment integrity is required in Modes 1, 2, 3, and 4, Ref. 9.5 (TS 3.6). There are no Improved Technical Specification (ITS) Limiting Conditions for Operation (LCOs) for containment integrity during Modes 5, 6 and defueled (TS 3.6.1) however, there are Improved Tech Spec Required Actions for containment closure during Mode 6 to mitigate accident consequences (TS 3.9.3 LCO, TS 3.9.4 Action A.4 and TS 3.9.5 Action B.3). Additionally, AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending (defueling).

During Modes 5 and 6 ascending (refueling) AI-504 still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig.

Basis: Design Basis Document for the Containment, Revision 5 (Tab 1/1),
G/C Inc. Specifications SP-5569 and SP-5618,
Improved Technical Specifications Section 3.6 and 3.9
AI-504Scope of EC, see Section B.2.

16. **Instrument and Control Requirements:**

None

Basis: Creation and restoration of the temporary access opening during Modes 5 and 6 will not affect any instrument and Control requirements.

17. **Access and Administrative Control for Plant Security:**

Creation of the temporary access opening in the containment wall will create the potential for uncontrolled access into the containment building which will require that Plant Security implement compensatory measures that they deem appropriate while the containment liner is breached.

Basis: Plant Site Security Plan.

18. **Redundancy, Diversity, & Separation Requirements of Structures, Systems and Components:**

There are no requirements for redundancy, diversity or separation of structures that creation and restoration of the temporary access opening would impact.

Basis: Scope of EC

19. **Failure Effects on Requirements of Structures, Systems, and Components:**

The primary function of the reactor containment building and its steel liner is to house the primary nuclear system and to provide biological shielding from the fission products that could become airborne under accident conditions. Its failure could result in the uncontrollable release of radioactivity and its integrity is vital for the safe shutdown and isolation of the reactor. Creation of the access opening will occur during Modes 5 and 6 during which time containment Operability is not required (TS 3.6.1) but containment closure is required (B 3.9.3 LCO, B 3.9.4 Action A.4 and B 3.9.5 Action B.3 and AI-404). While defueled, the partially detensioned containment could possibly pose a threat to the adjacent Auxiliary Building (due to the presence of the spent fuel pools), during a seismic or tornado event (II/I relationship). Similarly, during refueling the partially detensioned containment poses a II/I threat to the Auxiliary Building and is also vulnerable to a LODHR accident.

Basis: Improved Technical Specifications 3.6 and 3.9
FSAR Section 5.0
AP-404 and AI-504

20. **Test /NDE Requirements:**

Containment performance acceptance testing and pre-service inspections shall be performed in accordance with the plants specific commitments to the applicable sections of ASME Section XI Subsections IWA, IWE and IWL. These tests and inspections shall apply to the inside and outside faces of the restored section of the liner plate, liner plate welds, rebar, tendons, tendon anchorage assemblies, new concrete surfaces and the Containment Pressure/ Integrated Leak Rate Test for the restored containment shell.

All other required testing to support this EC is identified and evaluated in Section B.6.20 and in the EC Testing Section E00R0

Basis: ASME Section XI Subsections IWA, IWE and IWL
FSAR Section 5.6

21. **Accessibility, Maintenance, Repair, and ISI Requirements:**

Creation and restoration of the temporary access opening essentially returns the plant to its pre-outage condition, consequently, plant accessibility, maintenance and repair are not impacted. There will be an impact on the methodology employed in identifying and determining tendon predicted tendon forces for future ISIs.

Basis: Calculation S07-0003
ASME Section XI Subsections IWA, IWE and IWL
NUREG-0612

22. **Personnel Requirements and Limitations:**

A number of infrequently performed and quite complex construction work activities are involved in steam generator replacement projects. Personnel performing these activities will be trained and qualified in performing them.

Basis: N/A

23. **Transportability Requirements:**

All rigging, lifting and material handling activities will comply with ProcedureMNT-NGGC-0021, (Rigging, Lifting and Material Handling Program) and MNT-NGGC-0005, (Control of Rigging and Temporary Loads). There are a number of lifts associated with this EC and they are listed in Section B.6.23. These lifts must be evaluated to ensure they can be done safely and cannot impact any safety related SSC in the area.

Basis: MNT-NGGC-0021
MNT-NGGC-0005
EC 63020

24. **Fire Protection or Resistance Requirements:**

The only flammable material being installed by this EC is the tendon grease, which will be replaced with new grease. However, creation and restoration of the temporary access opening involves flame cutting of the liner plate and existing steel reinforcement bars in the containment wall and welding activities associated with the restoration of the liner plate and reinforcement. Eight vertical tendons will be destructively detensioned by plasma cutting the button heads at the lower anchorage in the tendon gallery. Hoop tendons will be destructively detensioned by plasma cutting the button heads at the suspended 8' x 10' tendon work platforms at buttress numbers 2 and 5. The hydrodemolition equipment is driven by diesel pumps that will be located on trailer rigs, outside the protected area. These activities must be evaluated and reviewed per the requirements of the Station Fire Protection Program.

All welding, cutting, or burning shall be per FIR-NGGC-0003, "Hot Work Permit".

Determination of fire loading shall be per FIR-NGGC-0004, "Determination of Combustible Loading and Equivalent Fire Severity".

All transient combustibles shall be controlled per AI-2200, "Guidelines for Handling, Use and Control of Transient Combustibles".

For administrative and technical guidance for the development and operation of the Fire Watch Program at CR-3 refer to AI-2210, "Fire Watch Program".
Pre-Fire Plan – Containment Building, AI-2205E

Coatings must comply with FIR-NGGC-0004.
There is no adverse impact with Station compliance with "Appendix R" to 10CFR50.

Basis: FIR-NGGC-0003
FIR-NGGC-0004
AI-2200
AI-2210
AI-2205E
Station Fire Protection Plan (FPP, Rev.25)

25. **Handling, Storage, and Shipping Requirements:**

Materials procured by this EC shall be handled, stored and shipped per the requirements of MCP-NGGC-0402 "Material Management (Storage, Issue and Maintenance)" and ANSI N45.2.2 – 1972 "Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Stations". FSAR Table 1-3 "Crystal River Unit 3 Quality Program Commitments" Sheet 15 of 45 commits to the 1972 edition of N45.2.2.
The primary materials procured for this EC are:

- Replacement tendons and tendon sheaths
- Replacement shims, anchor heads, caps (cans) and grease and grease end cap gaskets.
- 55 gallon drums.
- Replacement liner plate material
- Sand, aggregate, cement and admixtures for the new replacement concrete
- New #11 rebar and replacement #8 rebar

Basis: MCP-NGGC-0402 (Ref. 6.13)
ANSI N45.2.2 – 1972 (Ref. 1.15)
FSAR Table 1-3

26. Other Requirements to Prevent Undue Risk to the Health and Safety of the Public:

None.

Basis: Refer to Section B.6.6

27. Materials, Processes, Parts, and Equipment Suitability for Application:

Protective coatings must be DBA qualified for use inside containment, in accordance with CPL-XXXX-W-005 (Ref. 3.2). Site applied coatings must be applied per MNT-NGGC-0009 for Service Level I or II inside containment, as appropriate. Coatings on support components supplied by vendors must be removed and replaced, unless the vendor components were procured with approved coatings and application/inspection methods. The CR3 Coatings Program Manager will provide input for the appropriate procurement requirements, if vendor applied coatings are to be used.

Welding shall be in accordance with Corporate Welding Manual NGGM-PM-0003.

Specifications:

The following specifications were generated and are included as Attachments to this EC:

CR3 C-0002, Formwork for the Restoration of the SGR Access Opening (Attachment Z15)
CR3-C-0003, Procurement Specification for Concrete Work for the Restoration of the SGR Opening (Attachment Z25).

No other material specifications were prepared since the EC Sections B6.8, B6.9 and B6.10 address material, code and test requirements for all components required for the construction opening. Also included as attachments to the EC are the PSC Field and Quality Control Manual (Attachment Z23) which addresses all aspects of tendon detensioning, removal reinstallation and retensioning, and the BPI-Grip Splicing Manual and Installation and Examination Manual (Attachments Z26 and Z28 respectfully).

Basis: MNT-NGGC-0009
CPL-XXXX-W-006
CPL-XXXX-W-005

28. Safety Requirements for Preventing Personnel Injury:

The hydrodemolition process will produce very high noise levels resulting from the high pressure water jets and diesel pump motors, requiring special consideration for personnel hearing protection. Plant Safety personnel shall be responsible for monitoring the noise levels &

for establishing what protective measures, including postings, must be provided inside & outside of containment during hydrodemolition activities.

Although concrete removal operations are not expected to result in concrete fragments flying around the work area, a safety net will be erected to provide a protective screen between the actual hydrodemolition work at the containment wall and the surrounding area on the chipping platform. This safety net will also act to prevent concrete fragments from falling off the chipping platform and potentially causing injury to personnel below the platform.

Detensioning and retensioning the tendons involves components (tendons, bolts, stressing washers, etc) that are stressed to very high levels through the use of high pressure hydraulic rams. Additionally, the majority of this work is done on either work platforms suspended from the top of the containment roof or from the roof itself. All work activities associated with the tendons will be controlled by CR3 work orders that incorporated Precision Surveillance Corporations (PSC) Field and Quality Control procedures. PSC has done similar work on several steam generator replacement projects, as well as being the primary provider of services related to Plant Tendon Surveillance Programs for the majority of post-tensioned containment buildings in the United States. Their previous experience and proven work procedures are the industry norm and should provide reasonable assurance that all tendon related work will be done in a safe and efficient manner. The Site Safety department must ensure that proper and sufficient consideration is made of the requirements for fall protection and of the dangers involved in working at heights.

The majority of the #8 rebar splices will be by mechanical means utilizing cold swaging technology. Swaging equipment for the installation of steel coupling sleeves consists of a hydraulic press, pump and associated hoses with suitable swaging dies. The manufacturer of the swaging system chosen for CR3 will be responsible for providing training on the use of their equipment.

Basis: OSHA requirements
SAF-NGGC-2172, "Industrial Safety"
AI-1801, "Heat Stress Management"
AI-1803, "Safety Standards for Ladders & Scaffolds"
AI-1816, "Industrial Safety Signs and Tags"
BPI-GRIP Systems Splicing Manual (SM01) contained in Attachment Z26R0.

29. (CR3) Circuits for systems with Improved Tech Spec testing requirements:

None.

Basis: Creating and restoring an opening in the side of the containment building during Modes 5 and 6 will not affect any circuits with Improved Tech Spec testing requirements.

30. (CR3) Emergency Diesel Generator Loading Impact Assessment:

None.

Basis: Creating and restoring an opening in the side of the containment building during Modes 5 and 6 has no impact on the Emergency Diesel Generator Loading.

B.5 Assumptions:

1. AR 284485 captures the Risk Assessment and Operability Reviews for EC 63016. Tracks risk assessment to completion. Refer to Caveat Outstanding #5 below.
2. AR Closed-out per Rev.5 of EC63016
3. AR Closed-out per Rev.5 of EC63016
4. AR Closed-out per Rev.5 of EC63016
5. AR 289302 created to track post-job critique for EC 63016.
6. AR Closed-out per Rev.5 of EC63016
7. AR 292126 tracks issue date of concrete specification CR3-C-0003.
8. AR Closed-out per Rev.5 of EC63016
9. AR Closed-out per Rev.5 of EC63016
10. AR Closed-out per Rev.5 of EC63016
11. AR Closed-out per Rev.5 of EC63016
12. AR Closed-out per Rev.5 of EC63016
13. AR 295907 has been initiated to track the post-job-brief

Caveats Outstanding:

1. Caveat #1 was closed-out per Rev. 5 of EC63016
2. Caveat #2 was closed-out per Rev. 5 of EC63016

3. Caveat #3 was closed-out per Rev. 5 of EC63016

4. Caveat #4 was closed-out per Rev. 5 of EC63016

5. AR 284485 captures the Risk Assessment and Operability Reviews for EC 63016. Tracks risk assessment to completion. These deliverables were being generated simultaneously with the preparation and issuance of SGR-012, "Regulatory Selection Process for SGR Activities". Note that prior to EC issue, all risk assessments and OCRs in the current format have been reviewed by Major Projects Engineer, Engineering Reviewer, Licensing, Operations, and Engineering Supervisor. The final sign-off requirements on these potential condition OCRs will likely require the review and signoff of a licensed SRO. The tracking mechanism for this caveat outstanding will be A/R 284485, Assignments 1-4.

Perform a failure Modes and effects evaluation or provide justification for why it isn't needed:

The structural integrity of the containment shell in response to all FSAR and DBD described events, including loads resulting from SGR activities have been evaluated under calculations S06-0005 and S06-0006. Additionally the predicted tendons forces to end of plant life have been evaluated under calculation S07-0003. These calculations demonstrate that the restored containment shell is acceptable and meets all design basis acceptance criteria contained in calculation S06-0002. The new concrete mix, additional reinforcing bars and the introduction of mechanical rebar splices have all been evaluated in the EC and found to be acceptable and/or equivalent to the existing. The restored containment shell therefore introduces no new failure modes.

B.6 Evaluation:

1. Basic Functions of Each Structure, System and Component:

Reactor Building Containment Structure:
The CR3 Reactor Building is similar in design to the containment buildings for the Three Mile Island Nuclear Station Unit 1, the Turkey Point Plant, the Palisades Plant, the Point Beach Plant, and the Oconee Nuclear Station.

The containment is a concrete structure with a cylindrical wall, a flat foundation mat, and a shallow dome roof. The foundation slab is reinforced with conventional mild-steel reinforcing. The cylinder wall is prestressed with a post-tensioning system in the vertical and horizontal directions. The dome roof is prestressed utilizing a three-way post-tensioning system. The inside surface of the reactor building is lined with a carbon steel liner to ensure a high degree of leak tightness during operating and accident conditions. Nominal liner plate thickness is 3/8 inch for the cylinder and dome and 1/4 inch for the base.

The foundation mat is bearing on competent bearing material and is 12-½ feet thick with a 2 feet thick concrete slab above the bottom liner plate. The cylinder portion has an inside diameter of 130 feet, wall thickness of 3 feet 6 inches, and a height of 157 feet from the top of the foundation mat to the spring line. The shallow dome roof has a large radius of 110 feet, a transition radius of 20 feet 6 inches, and a thickness of 3 feet. The containment has been designed to limit the leakage rate to 0.25% by weight of contained atmosphere in 24 hours at the design pressure and temperature.

Per Section 5.2 of the FSAR and Ref. 2.1 the design of the containment building is based on:

- The containment of radioactive material which might be released from the core following a Design Basis Loss-Of-Coolant-Accident (LOCA).
- Temperature and pressure generated from the LOCA, i.e. 281 degrees F and 55 psig. (The design pressure is 55 psig but the DBA pressure is 54.2 psig (Ref. FSAR Section 14.2.2.5.9 and TS B 3.6.1).
- Operational and Safe Shutdown Earthquakes
- Severe weather phenomena, i.e. hurricane winds, tornado and tornado missile

The post-tensioned, reinforced concrete containment building was designed by the ultimate strength methods in accordance with ACI 318-63, Part IV-B and Part V, Chapter 26 "Prestressed Concrete". The load capacity of members was reduced by a capacity reduction factor $\Phi=0.90$ for flexure in accordance with Section 1504 of ACI 318-63 (FSAR Section 5.2.3.3.1).

S&L has created several finite element models to accurately model the geometry and stiffness properties of the containment building shell and foundation, both with and without the access opening. Design basis loads and load combinations, including the construction loads expected during SGR have been applied to these models and the resultant stresses have been shown to be compliant with the design basis acceptance criteria of Reference 2.1 and Section 5.2.3 of the FSAR (Ref.9.1). Therefore, based on these evaluations it can be concluded that the activities involved in the creation and restoration of the temporary access opening will have no effect on the overall function and design of the containment building. These evaluations are documented in Calculations S06-0002 thru S06-0007, S07-0003 and S09-0025.

2. **Performance Requirements such as Capacity, Rating, and System Output:**

Since the reactor containment building acts as a passive barrier, it has been verified for all applicable Design Basis loads and load combinations, including all loads resulting from SGR activities, to ensure its structural integrity during the creation, restoration and through end of plant life. Its failure could result in the uncontrollable release of radioactivity and its integrity is vital for the safe shutdown and isolation of the reactor. Since the containment is essentially returned to its original configuration there will be no changes to any performance requirement for capacity, rating or system output.

The containment building will maintain the design capacity of the original design. This is documented with calculation S06-0005, S06-0006 and S07-0003, further discussed in Section B.6.5-p.

3. **Codes, Standards, and Regulatory Requirements:**

During all stages of the steam generator replacement outage the post tensioned, reinforced concrete containment building will comply with all applicable design basis loads, load combinations, codes and standards as evaluated and documented in structural calculations S06-0005 and S06-0006. Note that while the Unit is defueled there are no Technical Specification Limiting Conditions of Operation that require containment integrity or required Tech Spec Actions applicable to the containment building. However, containment still meets the applicable requirements of ACI 318-63, Parts IV-B and Part V while defueled as documented in calculation S06-0005. The design conditions for pressure and temperature are maintained. This is further discussed in Section B.6.5.

Design Margins:

There are no reductions in design margins as a result of this modification. All element stresses meet the acceptance criteria of References 2.1 and 9.1.

Per Section 4.5.1 of Calculation S06-0006, after full restoration of the SG access opening, critical concrete sections in the access opening bay between Buttresses #3 and #4 will have a resistance level (combination of dead load and prestress load) equal to or larger than the resistance of these sections before the creation of the access opening, except for the area around the access opening and the thickened area around the equipment hatch, where detailed evaluations were performed. For elements with equal or larger resistance, and design loads which remain same, design margins will be the same or better. Hence they meet the acceptance criteria of Section 7.0 of Ref. 5.7.

For the elements in the area around the access opening and the thickened area around the equipment hatch, based on Section 4.6 of Calculation S06-0006, element loads for all applicable load combinations are found to be less than the allowable loads. Hence they meet the acceptance criteria of Section 7.0 of Ref. 5.7.

Code/Standard Reconciliation:

- FSAR Section 5.7 references only ACI 349-85 and 97.
  Calculation S06-0006 references ACI 349-01 for calculating the modulus of rupture for concrete (Fr).

  Evaluation: The formula for calculating the Fr is the same for all referenced years of ACI 349, i.e. $Fr = 7.5\,(f'c)^{1/2}$, therefore using the '01 edition is acceptable.

- The original tendon wire specification was ASTM A421-65. The new tendon wire has been purchased to ASTM A421-98a.

Evaluation: ASME Section XI, IWA-4224, states, "Materials, including welding materials, may meet the requirements of later dates of issue of the material specification..., provided the materials are the same specification, grade, type, class, or alloy, and heat-treated condition, as applicable. Differences in the specified material tensile and yield strength shall be compared and evaluated. If the replacement material has a lower strength, a comparison shall be made of the allowable stresses. If the tensile or yield strength is reduced and allowable stresses are reduced, the effect of the reduction on the design shall be reconciled."

ASTM A421-65 was the original material specification for the tendon wire. Replacement wire has been purchased to ASTM A421-98a with the added requirement that the wires ultimate tensile strength is ≥240 ksi, therefore there is no reduction in minimum tensile or yield strengths. Therefore no reconciliation is required in accordance with Section XI, IWA-4224. The results of Precision Surveillance Corporations Tendon Tensile testing for the new 7mm wire/tendon is contained in Attachment Z20 which clearly indicates that the Guaranteed Ultimate Tensile Strength (GUTS) of the wire is based on 240 ksi (GUTS = 2334 kips).

- Original CR3 design code of record is ACI 318-63. However, tendon pre-stressing limits have been adjusted to reflect the requirements of ACI 318-05.

Evaluation: Paragraph 2606(a)2 in ACI 318-63 limits tendon stress at load transfer (seating) to 0.70 f_s' but addresses the type of wire available at the time that it was drafted. This limit was revised in 1983 to account for the improved properties inherent in low relaxation wire, which is the type used for both original and replacement tendons at CR3. The 2005 edition limits wire stress at load transfer to 0.82 f_{py} but no more than 0.74 f_{pu} (in current terminology f_{pu} rather than f_s' is used for wire ultimate tensile strength). IWA-4226 generally allows the use of later editions of the Construction Code and requires reconciliation if materials are substituted. As noted and evaluated in the previous "bullet" no material reconciliation is required. Use of the later ACI code edition is therefore acceptable. Also, refer to Attachment Z30 for an evaluation of the resulting shear stress in a tendon anchor head resulting from stressing a tendon to the maximum allowable load of 0.74 times specified tensile strength.

- The original #8 reinforcement in the outer face of the containment wall conformed to ASTM A615-68 Grade 40 material; the replacement material will be ASTM A615 (latest edition) Grade 60 (grade 40 is unavailable).

Evaluation: ASME Section XI, IWA-4224, states, "Materials, including welding materials, may meet the requirements of later dates of issue of the material specification..., provided the materials are the same specification, grade, type, class, or alloy, and heat-treated condition, as applicable. Differences in the specified material tensile and yield strength shall be compared and evaluated. If the replacement material has a lower strength, a comparison shall be made of the allowable stresses. If the tensile or yield strength is reduced and allowable stresses are reduced, the effect of the reduction on the design shall be reconciled."

- The yield and tensile strength, elongation and chemical properties of the new steel are equal to or better than the original ASTM A615 Grade 40 steel, therefore no reconciliation is required in accordance with Section XI, IWA-4224.

- Liner Plate - ASTM A283 Grade C
Tensile and yield strengths in latest material specifications are equivalent to the original installation. Therefore no reconciliation is required in accordance with Section XI, IWA-4224.

4. **Design Conditions such as Pressure, Temperature, Fluid Chemistry and Voltage:**

Creation and restoration of the temporary access opening in the containment building will not change any of the design conditions for containment.

- Calculation S06-0006 verifies the restored containment for the accident pressure of 55 psig, tornado differential pressure of 3 psig and RB spray actuation of -2.5 psig
- Calculation S06-0005 verifies the containment shell with the opening and liner plate exposed for a LODHR accident pressure of 5.14 psig during Modes 5 and 6 descending (defueling) with Stage 1 prestress (Ref. B.6.5-d).
- Calculation S09-0025 evaluates the containment shell with the access opening and exposed liner plate during Modes 5 and 6 ascending (during refuel), with Stage 2 prestress (Ref. B.6.5-d) for a LODHR accident pressure of 1.4 psig (Ref. 5.29).

NOTE: AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending (defueling

During Modes 5 and 6 ascending (refueling) AI-504 still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig. During refueling operations the containment will be in Stage 2 prestress (Ref. B.6.5-d).

The liner plate was conservatively evaluated for both 5.14 and 8 psig in Calculation S06-0007.

- The maximum suction force of -6 psig (Ref. Calc S00-0006) on the interior of the containment results in compression of the containment shell and acts on the liner plate.

5. **Loads such as Seismic, Wind, Thermal, and Dynamic:**

5-a: Dead Load:

The dead load of the containment shell, dome, liner plate and base mat has been accounted for through element self weight in the finite element models and associated GTSTRUDL runs generated by S&L (References 5.8 thru 5.12 and 5.25). In addition, the dead weight of the containment interior structures and equipment will be in accordance with Ref. 5.19 calculations and applied to the model as uniform pressure loads on the base mat elements. The unit weight of concrete is 150 lb/ft^3 per Ref. 2.1.

5-b: Seismic Loads:

The appropriate seismic loads have been applied to the containment finite element models generated by S&L (References 5.8 thru 5.12) as discussed below:
Per the Containment DBD (Ref. 2.1), and Section 5.2.1.2.9 of the FSAR (Ref. 9.1), the design basis seismic parameters are as follows:

- Operating Basis Earthquake (OBE)
  0.05 g, maximum horizontal ground motion acceleration
  0.033 g, maximum vertical ground motion acceleration
- Safe Shutdown Earthquake (SSE)
  0.1 g, maximum horizontal ground motion acceleration
  0.067 g, maximum vertical ground motion acceleration

The damping factor for the shell is 2% of critical damping. The horizontal and vertical excitations are considered occurring simultaneously and the responses are added using absolute sum, in accordance with the licensing design basis. Specification SP-5209 (Ref. 3.1) provides the OBE horizontal response spectra for various elevations on the containment shell. The containment shell model is shown in Ref. 3.1 and the response spectra curves along with their corresponding digitized values are provided. The ZPA (i.e. zero period acceleration) of these response spectra provides the maximum OBE acceleration of the shell at various elevations.

Seismic OBE and SSE loads have been accounted for in the analysis through self-weight excitations. In order to do so, the containment shell and dome was divided into several segments with the center of each segment located at an elevation for which the seismic response spectrum has been generated in Ref. 3.1. Using the applicable acceleration (ZPA) from the corresponding response spectrum, the equivalent static load for each segment can be simulated using the element self-weight. Note that the vertical accelerations will be equal to 2/3 of the horizontal accelerations and the SSE accelerations will be twice the OBE accelerations.

5-c: Wind Load:

Consistent with the design basis evaluations (Ref. 5.19 thru 5.23), the calculation of the wind load for load combinations applicable during the SGR outage are based on the parameters:

Per Ref. 2.1, 5.7 and FSAR Section 5.2.1.2.5 the initial design basis analysis of the containment shell and dome was based on the following parameters:

- The wind load calculations were based on ASCE paper No, 3269.
- A 110 mph basic wind velocity at 30 feet above grade with a 100 year period of recurrence. The wind velocity at the top of the dome corresponding to this basic wind velocity was determined to be 179 mph.
- Wind pressure corresponding to the 179 mph was calculated as 0.568 psi and conservatively was applied uniformly over the entire height of the structure (Ref. 2.1).

5-d: Prestress:

The containment shell has been evaluated for reduced prestress during the SGR outage and for the restored prestress after the outage to the end of current plant life based on the following parameters as discussed below. During and after the steam generator replacement, the vertical and hoop prestress within the containment shell will differ from the initial prestress, however, the steam generator replacement has no impact on the dome prestress.

The containment shell has been evaluated for two reduced prestress configurations that will occur at different time periods <u>during</u> the SGR outage:

- **Stage 1 Prestress** - Reduced prestress based on de-tensioning 17 hoop and 10 vertical tendons within the opening.
- **Stage 2 Prestress** – Reduced prestress based on de-tensioning 17 hoop and 10 vertical tendons within the opening and de-tensioning an additional 9 hoops above and below the opening (total of 35 hoops de-tensioned) and 10 additional vertical tendons on either side of the opening (total of 30 verticals de-tensioned).

(i) <u>Design Basis (Initial) and Minimum Required Vertical and Hoop Tendon Forces at the End of Plant Life:</u>

Per Ref. 2.1 and Calculation S80-0002 (Ref. 5.5) and S06-0002 (Ref. 5.7), the initial and minimum required vertical and hoop tendon forces at the end of plant life are as follows:

- The Guaranteed Ultimate Tensile Strength (GUTS) = 2335 Kips/tendon (A = 9.723 in^2, fu = 240 ksi).
- The initial prestress = 80% GUTS = 1867 kips/tendon
- The lock-off prestress = 70% GUTS = 1635 kips/tendon (168 ksi)
- Minimum required prestress in a vertical tendon at 40 years = 1149 kips (mean anchorage force)
- Minimum required prestress in a horizontal tendon at 40 years = 1252 kips (mean anchorage force)

(ii) <u>Reduced Prestress During SGR</u>:

During the time frame between cold shut down and full restoration of the SG access opening, due to the removal and de-tensioning of a number of vertical and hoop tendons within and around the access opening, the prestress in the containment shell cylinder will be reduced, i.e. Stage 1 and Stage 2 prestress and is evaluated in Calc S06-0005. The reduced prestress during this time was calculated based on the number of tendons removed and de-tensioned and considering the expected tendon forces for the remaining tendons at the time of steam generator replacement. The expected prestress at the time of replacement was determined based on the average effective prestress considering all losses due to concrete shrinkage, concrete creep, steel relaxation, and elastic shortening of the concrete.

- <u>Prestress Force in Existing Tendons (not removed/de-tensioned) – During SGR:</u>
  Per pages Section 4.2.1 of Ref. 5.9 (Calc S06-0004) and Ref. 5.23 (G/C Calc #1.01.19, the projected tendon forces at end of the SGR outage are:

Note: Reference to (kip/ft) in the equations below equate to one kip (1000 lbs) per linear foot of wall).

- End of SGR vertical tendon force = 1462 kips/tendon (498.13 kip/ft)
  (Based on lockoff stress of 168 ksi – tendon losses of 17.6 ksi over ~ 33 years)

- End of SGR hoop tendon force = 1340 kips/tendon (832.71 kip/ft)
  (Based on lockoff stress of 164.75 ksi – tendon losses of 26.92 ksi over ~33 years)
  Note: hoop lockoff stress at the anchorage is 168 ksi but due to friction losses the average stress along the length of the tendon is 164.75 ksi. Refer to discussion below concerning Friction Losses.

The vertical tendon force of 498.13 kips/ft was converted into equivalent vertical point loads and applied to the appropriate element nodes in the GTSTRUDL models at the top and bottom of the containment wall.
The hoop tendon force of 832.71 kips/ft was converted into an equivalent uniformly distributed pressure load, i.e. pressure load = tendon force (kip/ft)/radius, and applied to the wall elements in GTSTRUDL as a "Surface Force".

Evaluation of Friction Losses
When a tendon is tensioned, it is initially loaded to 0.80 of specified minimum ultimate tensile strength (GUTS) and then seated at 0.70 GUTS. When a hoop tendon is loaded to 0.80 GUTS at the ends, friction between the tendon and sheath reduces force at the center to about 0.671 GUTS. When the end load is subsequently reduced to 0.70 GUTS, the distribution of force along the tendon length can be represented by a series of linear segments with the following min / max points.

0.70 GUTS from the end to the duct point of tangency about 16 ft from the end
0.735 GUTS at a point about 0.3 radians of arc from the center of the buttress
0.671 GUTS at the center

The initial rise to 0.74 GUTS is conservatively neglected in the reactor building design which considers the mean force, F_m, in the tendon to be the average of the end and center forces.

$F_m = (0.70 + 0.671) / 2 = 0.686$ GUTS = 164.5 ksi

After a tendon is tensioned, only end anchorage force can be measured. Therefore, tendon forces during the operating lifetime of the structure are always identified as end anchorage forces. End anchorage forces are measured, trended and evaluated against end anchorage force acceptance criteria.

(iii) Prestress After SG Replacement to End of Plant Life (EOL):

The vertical and hoop prestress after restoration of the steam generator replacement access opening was determined based on the expected end of life tendon forces for vertical and hoop tendons and is evaluated in Calc S06-0006. The expected end of life tendon forces for those not removed and/or de-tensioned during the SG replacement will essentially remain unchanged, whereas, the tendon forces for the replaced and re-tensioned tendons are higher due to less prestress losses. When calculating losses for these tendons, the creep and shrinkage strains of the new concrete at the SG access opening were based on the values established through the parametric study of the material properties, documented in Calculation S06-0004 (Ref. 5.9). The cross sectional area of a tendon is 9.723 in^2 (Page 29 of Ref. 5.7).

➢ Prestress Force in Existing Tendons (not removed/de-tensioned) - EOL:
Per pages 4 and 6 of calculation S80-0002 (Ref. 5.5), Section 4.2.1 of Ref. 5.9 and Ref. 5.23, the projected tendon forces at end of plant life are:

- End of life vertical tendon force = 1453 kips/tendon (494.95 kip/ft)
(Based on lock–off stress of 168 ksi – tendon losses of 18.56 ksi over 40 years)

- End of life hoop tendon force = 1325 kips/tendon (823.82 kip/ft)
(Based on lock–off stress of 164.75 ksi – tendon losses of 28.39 ksi over 40 years)
Note: hoop lockoff stress at the anchorage is 168ksi but due to friction losses the average stress along the length of the tendon is 164.75 ksi.

The vertical tendon force of 494.95 kips/ft was converted into equivalent vertical point loads and applied to the appropriate element nodes in the GTSTRUDL model at the top and bottom of the containment wall.

The hoop tendon force of 823.82 kips/ft was converted into an equivalent uniformly distributed pressure load, i.e. pressure load = tendon force (kip/ft)/radius, and applied to the wall elements in GTSTRUDL as a "Surface Force" load.

➢ Prestress force in re-tensioned/replaced tendons - EOL:
Per Ref. 5.23 (G/C Calc #1.01.19) the initial lock-off stress is 168 ksi for the vertical tendons and 164.75 ksi for the hoops, then per Section 4.2.2 of Ref. 5.9:

- End of life vertical tendon force = 1566 kips/tendon (533.46 kip/ft)
(Based on lock-off stress of 168 ksi – tendon losses of 6.93 ksi thru EOL~7 years)

- End of life hoop tendon force = 1516 kips/tendon (942.06 kip/ft)
(Based on lock-off stress of 164.75 ksi – tendon losses of 8.82 ksi thru EOL~7yrs)

The vertical tendon force of 533.46 kip/ft was converted into equivalent vertical point loads and applied to the appropriate element nodes in the GTSTRUDL model at the top and bottom of the containment wall.

The hoop tendon force of 942.06 kip/ft was converted into an equivalent uniformly distributed pressure load, i.e. pressure load = tendon force (kip/ft)/radius, and applied to the wall elements in GTSTRUDL as a "Surface Force" load.

5-e: Tornado Load:

Referring to Ref. 2.1, 5.7 & Section 5.2.1.2.6 of the FSAR (Ref. 9.1), the RB has been designed to withstand short term tornado loadings, including tornado generated missiles.
The tornado design basis requirements are:

- Tangential wind velocity of 300 mph.
- An external pressure drop of 3 psig.
- Missile equivalent to a utility pole 35 feet long, 14 inches in diameter, weighing 50 lb./cu.ft. traveling at 150 mph.
- Missile equivalent to a one ton automobile traveling at 150 mph.

In addition, the effect of the following tornado-borne missiles was also analyzed:

- A 4 inch by 12 inch by 12 feet long wooden plank traveling end-on at 300 mph.
- A missile equivalent to a 3 inch diameter schedule 40 pipe, 10 feet long, traveling end-on at 100 mph.

The above items are described in more details in the following sections.

5-f: Tornado Wind Loads:

The containment shell has been evaluated for tornado wind loads as described below and applied to the containment finite element models as pressure loads:

Per Ref. 2.1, 5.7 and Section 5.2.1.2.6 of the FSAR (Ref. 9.1), the initial design basis analysis was performed using a 300 mph wind which was applied in accordance with standard wind design practice and utilizing applicable pressures, shape factors, and drag coefficients from ASCE Paper No. 3269. Consistent with the design basis calculations, using a tornado wind speed of 300 mph, the wind pressure loads for evaluation of the containment shell and dome during and after the SG replacement outage were determined in accordance with ASCE Paper No. 3269 and included in the design basis load combinations as applicable, with the following exceptions:

- Tornado Wind During Modes 5 and 6 - Stage 1 Prestress:
  Per Ref. 2.1 tornado wind is not part of any accident loading combination. It is considered under normal operating loading combinations only. Therefore, during Modes 5 and 6 the accident loading combinations (specifically those containing LODHR accident pressure of 5.14 psi) will envelope the normal operating loading combinations that include tornado wind (Ref. Calc. S06-0005). Additionally, the probability of a tornado occurring during Modes 5 and 6 has been evaluated to represent an insignificant source of risk (probability of a tornado striking CR3 during a 90 day period is 2.12E-08) based on the maintenance risk assessment documented in AR # 00284485.

- Tornado Wind While Defueled – HTS/TLD Installed– Stage 1 thru Stage 2 Prestress:
  The primary activities during this time period that impact the containment analysis are (i) rigging the SGs into and out of containment on the HTS and (ii) the movement of the Auxiliary crane on the HTS. The probability of a tornado occurring while defueled has been evaluated to represent an insignificant source of risk (probability of a tornado striking CR3 during a 90 day period is 2.12E-08) based on the maintenance risk assessment documented in AR # 00284485, consequently, consideration of tornado wind is not required. Additionally, EC #63022 "Steam Generator Rigging and Transport" requires that all rigging activities on the OLS be discontinued when winds in excess of 30 mph are forecast. This requirement essentially eliminates hurricane and tornado loads from consideration in the evaluation of the containment shell integrity during movement of the SG's into and out of containment.

- Tornado Wind While Defueled thru Refuel – HTS/TLD Disassembled – Stage 2 Prestress:
  The primary activities during this time period that impact the containment analysis are the disassembly of the HTS/TLD, reinstallation of the liner plate, start of refueling operations and restoration of the temporary access opening, including re-tensioning of the tendons. Although the probability of a tornado occurring during this time period has been evaluated to represent an insignificant source of risk based on the maintenance risk assessment documented in AR # 00284485, the containment has conservatively been evaluated to the requirements of Ref. 9.2, 9.3 and 9.4 to preclude any II/I concerns while Stage 2 prestress exists (Ref. Calc. S06-0005):

  - Tangential wind velocity of 212 mph
  - An external pressure drop of 1.2 psig.
  - Total Tornado Load = Tornado Wind Load + 0.5 (Tornado Differential Pressure Load)

- Tornado Wind after Restoration of the Access Opening to the End of Plant Life:

  Tangential wind velocity of 300 mph.

5-g: Tornado Depressurization:

The containment shell has been evaluated for tornado depressurization loads as described below and applied to the containment finite element models as pressure loads:

Per Ref. 2.1, 5.7 and Section 5.2.1.2.6 (b) of the FSAR (Ref.9.1) a tornado depressurization of 3 psi was considered in the initial design basis analysis of the containment shell and dome. This 3 psi depressurization pressure is applicable to a structure which is not vented; for a vented structure (i.e. structure with openings) the depressurization pressure will be less than 3 psi. It is conservatively assumed that during all construction stages associated with the steam generator replacement, until plant end of life that the containment structure is not vented and may be subjected to a maximum of 3 psi tornado depressurization load. In addition, the load combinations shall consider the fact that the maximum tornado wind pressure and the maximum tornado depressurization pressure may not coincide. As can be seen from the design basis load combinations (Ref. 2.1 and FSAR, Table 6-3, load combinations 21 through 24), this was considered by considering a depressurization of 3 psi and 0.55 psi being concurrent with tornado wind pressure. The following depressurization loads shall specifically apply during SGR activities until end of plant life (Calc. S06-0005):

- Modes 5 to 6 - Stage 1 Prestress:
  Per Ref. 2.1 tornado load (tornado wind + tornado depressurization) is not part of any accident loading combination. It should be considered under normal operating loading combinations. Therefore, during Modes 5 and 6 the accident loading combinations (specifically those containing LODHR accident pressure of 5.14 psi) will envelope the normal operating loading combinations that include tornado depressurization. Additionally, the probability of a tornado occurring during Modes 5 and 6 has been evaluated to represent an insignificant source of risk (probability of a tornado striking CR3 during a 90 day period is 2.12E-08) based on the maintenance risk assessment documented in AR # 00284485, therefore load not considered.

- Tornado Depressurization while Defueled–HTS Installed-Stage 1 & Stage 2 Prestress:
  SGs are rigged out and into containment on the HTS/TLD. Later, the auxiliary crane (527 kips) will be moved over the HTS. The probability of a tornado occurring during this time period has been evaluated to represent an insignificant source of risk based on the maintenance risk assessment documented in AR # 00284485, therefore load not considered.

- Tornado Depressurization While Defueled thru Refuel – HTS Disassembled -Stage 2 Prestress:
  The primary activities during this time period that impact the containment analysis are the disassembly of the HTS/TLD, reinstallation of the liner plate, start of refueling operations and restoration of the temporary access opening, including re-tensioning of the tendons. Although the probability of a tornado occurring during this time period has been evaluated to represent an insignificant source of risk based on the maintenance risk assessment documented in AR # 00284485 the containment has conservatively been evaluated to the requirements of Ref. 9.2, 9.3 and 9.4 to preclude any II/I concerns while Stage 2 prestress exists (Ref. Calc. S06-0005):

  - ♦ Tangential wind velocity of 212 mph
  - ♦ An external pressure drop of 1.2 psig.
  - ♦ Total Tornado Load = Tornado Wind Load + 0.5 (Tornado Differential Pressure Load)

- Tornado Depressurization for the Fully Restored Access Opening to End of Life:
  The containment has been evaluated for an external pressure drop of 3 psi.

5-h: Tornado Generated Missiles:

Tornado generated missiles have not been evaluated for either during or after the steam generator outage based on the following:

During steam generator construction activities (from entry to Mode 5 through completion of refuel) the risk of damage to any safety related component from a tornado missile strike has been shown to represent an insignificant source of risk, without taking credit for the low probability (2.128E-08) of a tornado striking the CR3 containment during a 90 day period (Refer to the risk assessment for Tornados and Tornado Missiles documented in AR 00284485.

For the time period after the completion of the steam generator outage to end of plant life, tornado generated missiles are not considered based on the following excerpt from Ref. 2.1:

"Consideration of the tornado missile load (on containment) did not include the postulation of such loads in design load combinations. Rather, capability to withstand the local effects of such impact was considered to have been demonstrated by comparison with the analysis carried out for Three Mile Island for aircraft impact. The containments for the two plants were almost identical, and the aircraft impingement load was found by inspection to be significantly more severe than that associated with the postulated tornado missiles. Based on the preceding statement, tornado generated missiles need not be included in the load combinations considered for analysis of the containment shell and dome".

5-i: Thermal Loads:

The effects of thermal loads on the containment shell have been evaluated for the following three items for all phases of the steam generator outage and for the restored containment thru end of plant life:

- Thermal loads due to restrained expansion of containment liner
- Axial (average cross-sectional) temperature within the concrete
- Temperature gradient through the thickness of the concrete sections

The calculated temperature profiles were input as individual load cases into GTSTRUDL and included in the applicable load combinations per Ref. 5.7.

The design basis temperatures for the containment shell for various conditions are provided in Ref. 2.1 under the parameter "Thermal". The corresponding non-linear temperature profiles are not available from the existing quality records. Therefore, the temperature profiles were considered to vary linearly through the concrete thickness.

Note that thermally induced loads are self-relieving loads and will reduce through cracking of the concrete sections. The reduction in thermally induced loads can be accounted for using computer programs or can be estimated by hand calculations that equate the cracked concrete section to the reduced concrete stiffness, as was done in References 5.10 and 5.11. During the accident conditions, the pressure and temperature within the containment rises within minutes and within hours the pressure drops significantly. While the containment liner temperature can rise very quickly once subjected to higher temperatures, the temperature rise within the concrete sections will be quite slow and by the time they start to see any substantial increase, the pressure within the containment will be significantly less. Due to this slow rise in concrete temperature and reduction in accident pressure prior to any significant increase in concrete temperature, during the accident conditions, the axial temperature and temperature gradient through the thickness of the concrete sections was based on the steady state temperature profile of the concrete sections under the normal containment temperature right before the accident.

Temperatures during the Steam Generator Replacement Outage (SGRO)
During the SGRO, the applicable load combinations are combinations 26a through 34a and 35 through 41 of Ref. 5.7 (Calc. S06-0002), Table 6-4 and are as follows:

➤ During Modes 5 and 6 Descending (Defueling):
For load combinations 26a through 34a, the liner temperature shall be equal to the peak temperature due to LODHR as specified in Attachment 3 of Ref. 5.7, and the steady state temperature profiles within the concrete sections shall be determined considering the temperatures provided in Attachment 3 of Ref. 5.7 for the time frame between cold shut down and de-fueled Modes, as follows:

- Accident temperature (Ta) = 173 °F
- Operating temperature (To) = 110 °F (inside containment)
- Outside containment ambient temp = 69 °F
- Soil temperature = 74 °F
- Original concrete placement temp (T_{place}) = 70 °F (Ref. 2.1)

Based on the above temperatures and the heat transfer characteristics of the containment wall, dome and base mat, the temperature distributions are evaluated in Ref. 5.10 (Calc S06-0005). These evaluations yield the average inside (T_{in}) and average outside (T_{out}) concrete face temperatures of each element, including the liner average temperature (T_{liner}), from which:

Change in axial (average cross-sectional) concrete temperature = $\{(T_{in} + T_{out}) /2\} - T_{place}$ (deg F)

Temp gradient thru thickness of concrete element = $\{(T_{in} - T_{out})/\text{element thickness}\}$ (deg F/ft)

Change in liner plate temperature = $\{T_{liner} - T_{place}\}$ (deg F)

The calculated temperature profiles were input as individual load cases in GTSTRUDL and included in the applicable load combinations per Ref. 5.7. The effects of liner plate expansion, i.e., the expansion of the liner plate creates large forces in the concrete due to concrete's smaller coefficient of expansion (Coefficient of thermal expansion of concrete $=55\times10^{-10}$ per degree F and 65×10^{-7} per degree F), were evaluated using a modified GTSTRUDL model that included the base model with additional liner plate elements at the dome, walls and base mat.

➤ While defueled thru Full Restoration of Access Opening:
For load combinations 35 through 41 (Calc. S06-0002,Table 6-4), the steady state temperature profiles within the concrete sections were determined considering the temperatures provided in Attachment 3 of Ref. 5.7 (Calc. S06-0002), for the time frame

between de-fueled Mode and full restoration of the access opening. The liner temperature shall be that for the inside containment.

- Accident temperature (Ta) = N/A
- Operating temperature (To) = 90 °F (inside containment)
- Outside containment ambient temp = 69 °F
- Soil temperature = 74 °F
- Original concrete placement temp (T_{place}) = 70 °F (Ref. 2.1)

Based on the above temperatures, the heat transfer characteristics of the containment wall, dome and base mat are evaluated in Calc S06-0005 (Ref. 5.10). These evaluations yield the average inside (T_{in}) and average outside (T_{out}) concrete face temperatures of each element, including the liner average temperature (T_{liner}), from which:

Change in axial concrete temperature = $\{(T_{in} + T_{out}) /2\} - T_{place}$ (deg F)
Temp gradient thru thickness of concrete element = $\{(T_{in} - T_{out})$/element thickness$\}$ (deg F/ft)

Change in liner plate temperature = $\{T_{liner} - T_{place}\}$ (deg F)

The calculated temperature profiles were input as individual load cases into the GTSTRUDL model and included in the applicable load combinations per Ref. 5.7 and documented in Ref. 5.10. The effects of liner plate expansion, i.e., the expansion of the liner plate creates large forces in the concrete due to concrete's smaller coefficient of expansion, were evaluated using a modified GTSTRUDL model that included the base model with additional liner plate elements at the dome, walls and base mat (Ref. 5.10).

➢ During Modes 5 and 6 Ascending (Refueling):
For load combinations 26a through 34a, the liner temperature shall be equal to the peak temperature due to LODHR during refueling as specified in Attachment 3 of Ref. 5.7, and the steady state temperature profiles within the concrete sections shall be determined considering the temperatures provided in Calculation M09-0031 (Ref. 5.29 and Design Letter SGR07-026 located in Attachment Z16) for the time frame between Modes 5 & 6:

- Accident temperature (Ta) = 114.7 °F
- Operating temperature (To) = 83 °F (inside containment)
- Outside containment ambient temp = 69 °F
- Soil temperature = 74 °F
- Original concrete placement temp (T_{place}) = 70 °F (Ref. 2.1)

Based on the above temperatures, the heat transfer characteristics of the containment wall, dome and base mat are evaluated in Calc S09-0025 (Ref. 5.30). These evaluations yield the average inside (T_{in}) and average outside (T_{out}) concrete face temperatures of each element, including the liner average temperature (T_{liner}), from which:

Change in axial concrete temperature = $\{(T_{in} + T_{out}) /2\} - T_{place}$ (deg F)

Temp gradient thru thickness of concrete element = {(T_{in} - T_{out})/element thickness} (deg F/ft)

Change in liner plate temperature = {T_{liner} - T_{place}} (deg F)

The calculated temperature profiles were input as individual load cases into the GTSTRUDL model and included in the applicable load combinations per Ref. 5.7 and documented in Ref. 5.10. The effects of liner plate expansion, i.e., the expansion of the liner plate creates large forces in the concrete due to concrete's smaller coefficient of expansion, were evaluated using a modified GTSTRUDL model that included the base model with additional liner plate elements at the dome, walls and base mat (Ref. 5.30).

Temperatures from full restoration of access opening until end of plant life.
The applicable load combinations for this time frame are load combinations 6b through 34b of Table 6-4, Ref. 5.7. The containment design basis accident temperature for this time frame is 281°F (Ref. 5.7, Section 6.2.1.6). Therefore, the liner plate temperature has been considered as 281°F. Ref. 2.1 provides the design basis temperature profiles through the containment shell for various conditions. The steady state temperature profiles within the concrete sections are in accordance with those noted in this table with the exception of those for winter accident. The noted temperatures for the winter accident condition will not be concurrent with the maximum peak pressure within the containment building. The temperature profiles have been evaluated similarly as above in Ref. 5-11.

5-j: Pressure Loads:

The containment shell has been evaluated in calculations S06-0005 and S06-0006 and S09-0025 for the pressures shown below and found to be structurally acceptable.
Replacement of the steam generators has no impact on the design basis normal operating and accident pressures within the containment building (Reference Progress Energy Letter SGR 06-0054 contained in Attachment Z16). Referring to the containment DBD (Ref. 2.1) and Section 5.2.1.2.1 and Table 5-3 of the FSAR (Ref. 9.1) the following pressures were considered in the design basis analysis of the containment and are included in the load combinations applicable during (and after) the SG replacement outage where appropriate:

- Internal accident pressure of 55 psig
- Internal pressure of 3 psig above external pressure during a tornado
- Internal pressure of 2.5 psig below the external pressure due to the accidental actuation of the reactor building's spray system.
- Internal accident pressure due to a LODHR accident of 5.14 psig during Modes 5 thru 6 descending (defueling) .
- Internal accident pressure due to a LODHR accident of 1.4 psig during Modes 5 and 6 ascending (during refuel).

The maximum suction force of -6 psig (Ref. Calc S-00-0006) on the interior of the containment results in compression of the containment shell and is therefore enveloped by the 55 psig accident pressure. Also note that this negative pressure of 6 psig was used to evaluate the maximum suction force on the liner plate. Since the liner plate and its embedded stiffener angles are being restored to their original design there is no impact on its ability to resist the 6 psig pressure load.

During Modes 5 and 6 descending (defueling) containment structural integrity is not required per the Technical Specification's, however, per AI-504 and AP-404 containment closure is required to mitigate the dose consequences of a fuel handling accident involving recently irradiated fuel or the consequences of a loss of decay heat accident. During this time period containment closure requirements are dominated by concerns over loss of decay heat accidents (LODHR) which result in a maximum RB internal pressure of 5.14 psi and maximum accident temperature of 173 degrees F (Ref. 7.3).

NOTE: AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending (defueling).

During Modes 5 and 6 ascending (refueling) AI-504 still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig.

The liner plate was conservatively evaluated for both 5.14 and 8 psig in Calculation S06-0007.

5-k: Polar Crane Loads:

The containment shell has been evaluated in calculations S06-0005 and S06-0006 for all loads and load combinations due to the polar crane as described below, and found to be structurally acceptable.

The original design basis polar crane loads are provided within Gilbert Associates, Inc. calculation 1.01.9 (Ref. 5.22):

- Bridge Weight = 284.45 kips
- Trolley Weight = 147 kips

There are two controlling loading configurations associated with the polar crane during the SG replacement outage:

1. Per Ref. 10.1, during the steam generator replacement outage, with both the TLD and the polar crane operating at the same time, the maximum load that the polar crane can lift is 60 kips with a minimum spacing of 8'-0" between the TLD bogie wheels and Polar crane wheels. Per Calc S06-0009 the induced horizontal load at the wheels of the polar crane are considered to be 2% of the vertical moving load, however, the analysis of the containment shell during SG replacement activities (Calc S06-0005, Section 4.2.11.3) conservatively considered 4%. The worst case loading on the polar crane rail resulting from the wheels of the TLD located over the access opening was combined with the reactions from the polar crane wheels (dead weight of polar crane + 60 kips lifted load) and distributed to the W36 crane support brackets, based on the minimum spacing of 8'-0' between the wheels of the TLD & Polar crane. These loads were then input to the finite element model as point loads.

2. During the movement of the auxiliary crane (conservatively assumed as 527 kips per Attachment Z33) over the HTS, the containment shell model was evaluated with the polar crane located over the access opening with a 60 kip lifted load. While the auxiliary crane is on the HTS the maximum load that the polar crane can lift is 60 kips. Note: The auxiliary crane is a pedestal crane mounted on a skid that transverses the HTS and supports the erection and dismantling of the TLD.

5-I: Loads Due to SG Replacement Activities (Stage 1 Prestress):

The containment shell finite element model has been evaluated for all loads resulting from moving the steam generators into and out of containment, while utilizing the horizontal transfer system and the temporary lifting device, and found to meet all design basis acceptance requirements (Ref. 5.7). These loads and their application are described below:

During the replacement (rigging) of the steam generators (occurs during Stage 1 prestress only), the containment shell will be subjected to local loads from the Temporary Lifting Device (TLD) moving along the Polar Crane rail and loads from the Inside and Outside Horizontal Transfer System (HTS). The magnitude and the location of these loads are in accordance with the applicable design calculations prepared by Mammoet (Ref. 5.13 and 5.14). Maximum weight of the steam generators is (Ref. page 5 of 10 of Calc S06-0009):

- Weight of old OTSG (Controls design) = 1,270 kips (includes 10% impact factor)
- Weight of new OTSG = 1,028 kips (includes 10% impact factor)

1. During the SG replacement the worst case loading on the polar crane rail results from the TLD gantry lifting an old steam generator out of its cubicle. This load is transferred by the TLD girders to the center tower and to the bogie sets on the polar crane rail. The resulting bogie wheel loads are then transferred to the crane support brackets via the crane rail girders. The reactions at these brackets were distributed to the relevant element nodes in the containment finite element model (Ref. Calc S06-0005 and S06-0009). The maximum bogie wheel loads are as follows (Ref. page 6 of 10 of Calc S06-0009):

- Max vertical TLD bogie wheel load = 138 kips
- Max perpendicular (radial to rail) load = 4.6 kips
- Max horizontal (parallel to rail) load = 3.8 kips

2. The inside and outside horizontal transfer system (IHTS and (OHTS) consists of two parallel beams, each supported on the containment wall, centered about the bottom of the access opening. The worst case loading to either the IHTS or OHTS is from skidding the steam generators out of containment. The maximum reactions from the IHTS at the bottom of the access opening (at each beam) are (Ref. S06-0026):

- Vertical force = 619 kips (includes 10% impact factor)
- Horizontal force perpendicular to wall = 62 kips
- Horizontal force parallel to wall = 12 kips

3. The controlling reactions from the OHTS at the bottom of the access opening (at each beam) are (Ref. S06-0013):

    - Vertical force = 323.21 kips (includes 10% impact factor)
    - Horizontal force perpendicular to wall = 61.82 kips
    - Horizontal force parallel to wall = 8.41 kips

The above loads/reactions were conservatively combined as follows and a load factor of 1.7 was conservatively applied (typical load factor for live load per ACI 318):

- (Load 1 + Load 2) x 1.7
- (Load 1 + Load 3) x 1.7

The resulting loads were combined with loads from containment dead weight, stage 1 prestress, operating temperature, liner plate expansion and the weight of the polar crane (with 60 kip lifted load) and applied to the containment FEM model (Ref. Calc. S06-0005). The resulting element membrane forces and moments were compared to column strength interaction diagrams for axial compression and bending moment that were developed based on the containment wall thickness and area of compression and/or tension reinforcement (Refer to Section 4.3 of Calc S06-0005). The section of containment wall directly under, and supporting the HTS at the access opening, was verified by a combination of hand and computer generated calculations (Refer to Section 4.7, Calc S6-0005) which accounted for the lack of development of the existing rebar due to the creation of the Opening.

5-m: Loads Due to SG Replacement Activities (Stage 2 Prestress):

Loads resulting from the auxiliary crane were evaluated in combination with Stage 2 prestress and found to be acceptable (Ref. Calculation S06-0005).

As soon as the last steam generator is lifted into its cubicle, an additional 20 vertical and 18 hoop tendons will be de-tensioned (Stage 2 prestress). The major load on the HTS while in Stage 2 prestress is from the auxiliary crane as it is skidded over the IHTS and OHTS while disassembling the TLD. Per calc S06-0005 (Section 4.2.11.2 and Attachment Z33) the maximum load to the HTS from the auxiliary crane is 527.3 kips or 263.65 kips per beam. (NOTE: Per Mammoet Calculation 001004168-C40 Appendix C Page 1 contained in EC 63020 Attachment Z06, the total weight of the crane including counter weights and the cart is 322.347 therefore the load of 527 kips used in Calculation S06-0005 is conservative)

5-n: Load Combinations for the Evaluation of the Containment Shell:

Load combinations are per Table 6.4 of Calc S06-0002 which is based on Table 5-3 of the FSAR. Drawing 421-346 depicts the applicable load combinations at different phases of the steam generator replacement project thru end job life.

5-o: Loads and Load Combinations for the Tendon Work Platforms:

The nominal 8' x 10' and nominal 10' x 20' tendon work platforms that are suspended from the Upper Support Frames on the containment roof rail system are designed for all relevant loads and load combinations to ensure that they cannot fall and damage safety related components below. Since the primary concern is ensuring structural stability, the allowable stresses may be taken to the elastic limit during accident load conditions. Refer to Attachment Z34 for PSC design calculations and sketches for the tendon work platforms and upper support frames.

The tendon work platforms that will be placed on the containment roof during Modes 1 thru 4 will be designed for the following two load combinations:

Combination 1: Dead + live
Combination 2: Dead + Live + OBE*
Combination 3: Dead + Live + Wind*

- Allowable stress may be increased by 1/3 for wind and seismic loads acting alone or in combination with the design dead and live loads.

Combination 4: Dead + Live + SSE **

** Allowable steel stress may be increased to the elastic limit
SSE = 2 x OBE and Vertical acceleration = 2/3 horizontal acceleration

Hurricane Wind (This criteria is based on the CR3 DBD for Containment - Ref 2.1):

- Basic wind velocity is 110 mph at 30' above grade
- Wind velocity at top of containment = 179 mph
- Corresponding wind pressure is 0.568 psi

5-p: Calculations

Calculations have been prepared by S&L to verify the structural integrity of the post-tensioned concrete containment shell for all design basis loading conditions during the creation and restoration of the temporary construction opening, and to the end of plant life. These calculations demonstrate that the restored configuration (post restoration of the opening) is found to be acceptable and meeting the design basis acceptance criteria noted in Calc S06-0002 for all applicable loads and load combinations for the time frame between full restoration of the SG access opening and the end of plant life. These calculations are listed below in numerical order with a brief description of their purpose:

- **Calculation #S06-0002:** Containment Shell Analysis for Steam Generator Replacement Design Criteria

  The purpose of this calculation is to establish the design inputs, requirements, methodologies and acceptance criteria for the required analyses of the containment shell that are documented in calculations S06-0003 through S06-0007 and S07-0003 (References 5.8 thru 5.12 and 5.25). This detailed design criteria will be based on current CR-3 design basis and will be established through examination of the design basis documents (DBD's, EDBD's, existing drawings and calculations), and licensing commitments.

- **Calculation #S06-0003:** Containment Shell Analysis for Steam Generator Replacement - Benchmarking

The objective of the benchmarking analysis is to ensure that the new Finite Element Models created by S&L for the evaluations of the containment shell during the implementation of the SG replacement are valid and appropriate.
The FSAR (Section 5.2.4.1.1) states that the original (design basis) deflections and stresses in the containment shell were calculated by an exact numerical solution of the general bending theory of shells. The solution method was performed using Kalnin's computer program (Ref. 2.1) by analyzing a thin shell of revolution (uniform thickness) for axisymmetric global loads such as dead load, prestress, pressure, etc.

Kalnin's program was the state of the art when the plant was designed and it could likely be utilized to analyze the fully restored Shell if it was available. However, Kalnin's program is not capable of analyzing the structure with the opening in place or any other Shell discontinuity. Kalnin's program modeled the Shell as a continuous surface. Alternative methods available at the time were used to analyze the equipment hatch and personnel access lock openings in the Shell. The static method of solution in Kalnin's program is the multi-segment method of direct integration, which uses the equations of linear elasticity and takes into account bending and membrane action in the shell. The dynamic method of solution is the superposition of normal modes of free vibration to determine the Shell structural response to an earthquake.

The new Finite Element Analysis (FEA) models are created using the GTSTRUDL program through the generation of a 3-D model of the containment, which includes the containment shell, dome, basemat, representative soil springs and the equipment hatch. The FEA models for the Shell are three dimensional models representing the containment shell, dome, basemat, and foundation soil springs. Similar to the design basis analysis, the models utilize thin shell elements that take into account bending and membrane action in the shell. Linear soil springs were also modeled similar to the design basis analysis to simulate the support provided by the rock foundation. Load application to the FEA models was performed in a similar manner to the original design basis model, except for seismic OBE and SSE loads, where a more conservative approach was used. The conservative approach utilizes element self-weight excitations in the horizontal and vertical directions to calculate the equivalent seismic forces using Zero Period Accelerations. The resulting structural response due to horizontal and vertical excitations was then combined using the absolute sum in accordance with the licensing design basis.
Due to the use of different modeling techniques, different software, and possible minor differences in applied loads, some difference in results is expected.

- **Calculation S06-0003 Conclusions:**

The calculation concluded that the benchmarking models are valid.

Kalnin's program is no longer available and even if it were, it would not be capable of analyzing the containment shell with steam generator access opening and equipment hatch opening. Thus, regardless of Kalnin's program availability, use of an alternate analysis tool was required.

The loads, load combinations, and acceptance criteria used within the calculations are consistent with those for the design basis; the only difference is use of a new analysis tool. GTSTRUDL is a fully validated and verified general purpose finite element program quite suitable for linear finite element analysis used within the calculations. In addition, this program has been used in a number of applications by various organizations for containment evaluations related to steam generator and reactor vessel head replacements.

In order to ensure that the GTSTRUDL model used for these evaluations was capable of adequately predicting the induced forces, a benchmarking evaluation (Calculation S06-0003) was performed. In this benchmarking evaluation, for the same loadings, the induced forces within the shell from GTSTRUDL analysis were compared against the available analysis results from the existing design basis analysis. This comparison showed that the existing design basis analysis results, though different, were conservative in comparison to the GTSTRUDL results. As a result, to further assess accuracy of the GTSTRUDL model, the benchmarking evaluations were expanded to compare the GTSTRUDL results with the results from manual calculations. For sections at about mid-height of the containment wall located away from the base mat junction and dome, for loads such as dead load, pre-stress, and accident pressure, the induced membrane forces can be determined quite accurately using manual calculations. Comparison of the membrane forces obtained from manual calculations with those obtained from the GTSTRUDL analysis showed that the GTSTRUDL results matched the manual calculation results more closely that did the design basis calculations.

Based on the above benchmarking results, it was concluded that the initial analysis results were conservative and should remain as design basis. Furthermore, it was concluded that the GTSTRUDL model was yielding accurate results and its use was appropriate for the intended purpose.

- **Calculation #S06-0004:** Containment Shell Analysis for Steam Generator Replacement-Properties of New Concrete for Access Opening and Number of Hoop and Vertical Tendons to be De-tensioned.

This calculation was prepared before the decision was made to use a common Young's Modulus of Elasticity = 2500 ksi for both the original and new (patch) concrete for all SGR containment shell analysis. Refer to discussion below and the "Conclusions" at the end of this section for the basis for using E = 2500 ksi.

Sections 4.1.1 and 4.1.2 of this calculation determined various Young's Modulus's for both existing and new (patch) concrete based on short and long term loads. These moduli were then used in Section 4.2 to determine the number of vertical and hoop tendons to be detensioned, and to evaluate if prestress levels in and around the opening could be returned to their original, pre-outage levels.

NOTE that Sections 4.1.1 thru 4.1.2 and 4.2 of this calculation are essentially superseded by Calculations S06-0005 and S06-0006 and are discussed herein only to the extent that Calculation S06-0004 documents the historical analytical processes followed in arriving at the methodologies used in Calculations S06-0005 and -0006. As discussed in more detail below, based on the evaluations and results contained in Calculation S06-0004, the creep adjusted (equivalent) Young's Modulus of the new and old concrete were equalized by adding vertical and hoop reinforcement to the access opening so that the axial stiffness of the concrete section within the opening was made nearly equal to or higher than the axial stiffness of the existing surrounding concrete. When determining the cross sectional stiffness, the effective Young's modulus for the existing and replacement concrete were determined considering the effect of concrete creep. However, based on the reasoning contained in Calculation S06-0002, Young's Modulus for both the old (existing) and new (patch) concrete was later set (after the completion of Calculation S06-0004) at 2500 ksi for all evaluations of the containment shell during replacement activities (Calculation S06-0005), and for the restored containment to end of plant life (Calculation S06-0006).

- Section 4.1.1, 4.1.2 and 4.1.4 - Properties of New and Old Concrete

  The purpose of these sections is to determine the mechanical properties of the new concrete that will be used for the restoration of the SG access opening and for the old concrete surrounding the access opening. The effective Young's Modulus (E) for the existing and replacement concrete are determined considering the type of load (i.e. short term or long term loading) and the effects of creep (long term loading only). Determination of the effective Young's modulus is in accordance with the guidelines of ACI 209R-92 and summarized as follows:

  For short term loads where creep effects are negligible, Young's modulus of the new and existing concrete are based on applying the age factors from ACI 209R-92, Table 2.2.1 to the specified concrete strength and then calculating the individual Young's modulus from:

  $Ec = 57(F'c)^{1/2}$

  For example, for the old (existing) concrete the specified concrete strength is f'c =5000 psi (Ref. 2.1) and the concrete is greater than 10 years old (initial pour date was approximately 7/1972). Therefore, from Table 2.2.1 the time ratio is 1.18, hence the time adjusted Young's modulus is:

  $Ec = 57(5000x1.18)^{1/2} = 4378.253$ ksi

  For long term loads (i.e. prestress) the effects of creep must be included in determining an age adjusted effective value of Young's modulus (E) per the requirements of ACI 209R-92 and the White Paper contained in Calculation S06-0004 (Attachment 1).

As previously noted, Sections 4.1.1, 4.1.2 and 4.1.4 determine the different values of Young's modulus for both the new (patch) and old (existing) concrete based on both short term and long term loads and the effects of creep. Following is a summary of the E values determined per the requirements of ACI 209R-92:

For short term loads (i.e. effects of creep are negligible):
E original/existing concrete outage = 4378.253 ksi
E original/existing concrete EOL = 4378.253
E patch concrete outage = 4768.962
E patch concrete EOL = 4978.943

For long term loads (re-tensioning) applied at the outage (i.e. creep are included):
E exist concrete outage = 3767.17 ksi (under re-tension load at end of SGR outage)
E exist concrete EOL = 3066.97 (under re-tension load at end of plant life)
E patch concrete outage= 3601.04 (under re-tension load at end of SGR outage)
E patch concrete EOL = 2921.90 (under re-tension load at end of plant life)

For Long term loads (initial prestress) applied to original concrete (creep included):
E exist concrete outage = 2681.62 ksi (under initial prestress at end of SGR outage)
E exist concrete EOL = 2681.62 (under initial prestress at end of plant life)

- Section 4.1.3 Reinforcing Steel within Replacement Concrete

One of the primary goals of the SGR project team was to try and restore the prestress within and around the access opening to the design basis level prior to the SG outage. However, preliminary evaluations utilizing the above E values in the FEM model showed that restoring the prestress would not be possible unless the axial stiffness of the concrete sections within the opening are nearly the same or higher than the axial stiffness of the existing concrete sections around the opening. These preliminary evaluations clearly indicated that since the E of the existing concrete (surrounding the opening) was higher than the E of the patch concrete (see values above), i.e., the patch concrete is "softer" than the surrounding original concrete, then it was not possible to return the prestress level in the patch concrete to its pre-outage level. Consequently, a decision was made to add reinforcement to the access opening, thereby increasing the stiffness of the concrete within the opening. Section 4.1.3 of this calculation equated the strain compatibility between the existing concrete and the new (patch) concrete in the access opening and determined the additional area of reinforcement required to make the E of the new patch concrete approximately equal to the E of the surrounding old concrete, taking into account the effects of creep (long term loads). This was done as follows:

E existing concrete (Eec) at outage = 3767.168 ksi
E patch concrete (Epc) at outage = 3601.038
For strain compatibility and remembering that there is one layer of #8s vertical and horizontal, then:

$(Ac-A_8).Eec + A_8.Es = (Ac-As-A_8).Epc + (As+A_8).Es$

Where As = required area of additional steel for strain compatibility
The required area of steel equates to #11s at 11" c/c both each way, each face.
A similar calculation was made for amount of reinforcement at EOL which also resulted in #11s at 11" c/c both ways, each face.

- Section 4.2 – Number of Hoop Tendons to be De-tensioned & GTSTRUDL Results

Based on the results of equalizing the E values of the old concrete and new patch concrete, Calculation S06-0004 continued in Section 4.2 to evaluate the containment shell to determine if the prestress levels in and around the access opening could be restored to their pre-outage levels based on de-tensioning and then re-tensioning 30 vertical and 35 hoop tendons. The analysis was performed using the following FEM models:

FEM Model A:
- Original design basis prestress. Tendon forces are based on original lock-off stress (0.7xFu) and losses at end of outage and EOL.
- Access opening has not been created yet and is not in model.
- Creep adjusted E is based on age of concrete when initially loaded and load duration to end of outage and EOL, i.e. E = 2681.62 ksi (for both end of outage and EOL)
- Element forces and stresses analyzed at end of SGR outage and EOL

FEM Model B:
- Same as Model #A except access opening is included in model.
- Tendon forces are based on original lock-off stress (0.7xFu) and losses at end of outage and EOL.
- Creep adjusted E is based on age of concrete when initially loaded and load duration to end of outage and EOL, i.e. E = 2681.62 ksi (for both end of outage and EOL)
- Reduced prestress in containment shell from de-tensioning 30 vertical and 35 hoop tendons is derived from two main load cases:
  B1. All vertical and hoop tendons included in load case (as in Model A).
  B2. Only the 30 vertical and 35 hoop tendons included in second load case
  B3. Final reduced prestress = B1-B2

FEM Model C:
- This model reflects re-tensioning of the tendons at the end of the SGR outage. Young's modulus is the same for the new patch concrete and existing concrete, E= 3767.168 ksi (reflects the stiffening of the concrete section within the opening by adding rebar (#11s at 11" c/c vertical and horizontal, both faces).
- Include 30 vertical tendons and 35 hoop tendons. Tendon forces are based on re-tensioning to 0.7 Fu – tendon losses to EOL

By adding the results from Models B and C (at end of SGR outage and EOL) and comparing to the design basis results for vertical and hoop prestress from Model A , it can be easily determined if the prestress in and around the access and hatch area can be restored to pre-outage levels.

- **Calculation S06-0004 Conclusions:**

Based on Section 4.1 the required properties of the new (patch) concrete are:
— Cement Type III (Note that this was later changed to Type I based on further evaluation by Sargent and Lundy – Refer to Specification CR3-C-0003)
— Concrete compressive strength of 7000 psi at 28 days
— 5-day concrete compressive strength of 6000 psi
— Ultimate creep coefficient of 1.5

The above properties were later verified and used in calculations S06-0005 and S06-0006 and will control the concrete mix design.

The calculation determined that a total of 35 hoop tendons (17 within the opening and 9 above and 9 below the SG access opening should be removed and/or de-tensioned. An additional 30 vertical tendons (i.e. 10 within the opening and 10 on either side of the opening) should be removed and/or de-tensioned. The number of vertical and hoop tendons to be removed and/or de-tensioned, as determined in this calculation, was later verified as acceptable in calculations S06-0005 and S06-0006.

The calculation determined that the prestress levels in and around the access opening after re-tensioning would be at levels similar to those before the SGR outage.
After Calculation S06-0004 was completed and issued it was decided by S&L and Progress Energy that since the creep adjusted Young's Modulus (E) of the new and old concrete have been equalized (by adding #11 rebar's to the access opening), that for all future analysis a reduced E value = 2500 ksi would be used for both short and long term loads. This value was chosen because it is the value that Gilbert Commonwealth used in their original design basis calculations. For a more in-depth discussion concerning the applicability of using E = 2500 ksi for both short and long term loads refer to Calculation S06-0002 Page 15.

— **Calculation S06-0005** – Containment Shell Analysis for Steam Generator Replacement-Shell Evaluation during Replacement Activities

The purpose of this calculation is to evaluate the containment shell with steam generator access opening and reduced prestress for all applicable loads and load combinations for the following two time frames during the steam generator replacement outage:

➢ Time frame after cold shut down (Mode 5) and prior to de-fueled with the access opening created and the exposed liner plate in-place.
➢ Time frame after de-fueled Mode and prior to full restoration of the SG access opening (without the liner plate).

A finite element model was created using the GTSTRUDL program through the generation of a 3-D model of the containment, which includes the containment shell, dome, basemat, representative soil springs, equipment hatch and the temporary access opening. The exposed liner plate within the opening was modeled separately using non-linear FEM techniques (Ref. to Calculation S06-0007) and evaluated for a LODHR accident pressure load of 5.14 psi (during defuel). The resulting reactions from the support points around the perimeter of the plate were then applied to the containment FEM model as point loads around the perimeter of the opening.
The reduced prestress is based on the conclusions of Calculation S06-0004 as follows:

- A total of 35 hoop tendons (i.e. 17 within the SG access opening, 9 above and 9 below the access opening) will be removed and/or de-tensioned. The tendons within the SG access opening will be removed and the ones above and below the SG access opening will be de-tensioned only.

- A total of 30 vertical tendons (i.e. 10 within the opening and 10 on either side of the opening) will be removed and/or de-tensioned. The tendons within the opening will be removed and the tendons on either side will be de-tensioned.

As was previously noted in Task 3 of Calculation S06-0002, preliminary evaluations have shown that with full reduced prestress based on de-tensioning all 35 hoop and 30 vertical tendons at the start of the outage (Mode 5) and applying accident load cases and construction loads (resulting from lifting the steam generators), sections around the access opening will be overstressed. Therefore, calculation S06-0005 has evaluated the containment shell for two reduced prestress configurations that will occur at different time periods during the outage:

- Stage 1 Prestress - Reduced prestress based on de-tensioning 17 hoop and 10 vertical tendons within the opening.

- Stage 2 Prestress – Reduced prestress based on de-tensioning 17 hoop and 10 vertical tendons within the opening and de-tensioning an additional 9 hoops above and below the opening (total of 35 hoops de-tensioned) and 10 additional vertical tendons on either side of the opening (total of 30 verticals de-tensioned).

The following primary load conditions were then evaluated:

Stage 1 Prestress Modes 5 and 6 (cold shutdown), prior to exposed liner plate being cut:

— All accident load cases/combinations, including a LODHR accident. The effects of liner plate expansion due to accident temperature were included in this analysis through a second FEM model that revised the base model to include additional elements at the dome, wall and mat to represent the liner plate. Refer to Section B.6.5-i for an evaluation of the applicable thermal loads and Section B.6.5-d for the applicable tendon prestress loads.

Stage 1 Prestress while Defueled:

— Construction loads resulting from rigging the steam generators into and out of containment. Seismic and tornado loads are not included in this construction load case based on the maintenance risk assessment contained in AR # 00284485.

Stage 2 Prestress while Defueled w/ HTS:

— Construction loads resulting from miscellaneous loads on the horizontal transfer system. Controlling load is the auxiliary crane. Seismic and tornado loads are not included in this construction load case based on the maintenance risk assessment contained in AR # 00284485.

Stage 2 Prestress while Defueled w/o HTS:

— Horizontal Transfer System disassembled. Containment shell is essentially verified to ensure no II/I collapse. Therefore, the containment shell has been evaluated for dead, seismic and tornado loads.

Stage 2 Prestress while Refueling (Modes 6 and 5 ascending):

— Refer to Calculation S09-0025 which evaluated the containment shell with the steam generator access opening, exposed liner plate and reduced pre-stress (Stage 2 Prestress). Refueling operations have started, thus a LODHR accident is possible.

Containment shell has been evaluated for dead, seismic and tornado loads.

- **Calculation S06-0005 Conclusions:**

Sections 4.6 and 4.7 of this calculation evaluated the following critical sections in the bay of the access opening and found that they met the acceptance criteria in Section 7.0 of Ref. 5.7:

a) Bottom of containment wall
b) Sections at Elevation 98'
c) Sections at elevation 103'
d) Thinner edge of transition elements around equipment hatch (thickness=3.5')
e) Thicker edge of transition elements around equipment hatch (thickness = 5.5')
f) Thickened shell around equipment hatch
g) Wall around access opening

This calculation also evaluated the compressive stresses around the opening while in Stage 1 prestress (ignoring accident temperature and pressure in the load cases). The maximum stress interaction was less than 0.5 indicating that the compressive forces are relatively low

Based on the above evaluations, the containment shell with the SG access opening and reduced prestress is adequate for all applicable loads and load combinations during the SG replacement outage.

- **Calculation S06-0006:** Containment Shell Analysis for Steam Generator Replacement -

Evaluation of the Restored Shell.

The objective of this calculation is to examine the fully restored containment shell for all applicable loads and load combinations for the time frame between full restoration of the SG access opening and the end of plant life and demonstrate its compliance with the design basis acceptance criteria contained in Calculation S06-0002.

Once the SG containment access opening is fully restored, creation and restoration of the SG access opening results primarily in different prestress load and distribution of the dead and prestress loads. For areas inside and adjacent to the SG access opening, some additional moments occur due to de-tensioning and re-tensioning of the tendons. For the remaining areas, the change in the resulting element forces and moments due to loads other than dead and prestress are insignificant.

The state of prestress at the end of plant life includes the prestress from re-tensioning the following replaced/detensioned hoop and vertical tendons to 70% of GUTS, i.e., the lock-off pre-stress (Refer to Section B.6.5-d) within and around the opening at the conclusion of the SG outage:

Hoop tendons:
A total of 35 hoop tendons (17 within the opening, 9 above and 9 below the opening)

Vertical tendons:
A total of 30 vertical tendons (10 within the opening & 10 on either side of the opening)

For elements of the fully restored containment shell located away from the SG access opening, this calculation compared the resulting membrane forces (i.e. sum of the membrane force due to dead load and prestress) in both the meridian and hoop directions to those of the design basis analysis. The element is considered as meeting the design basis acceptance criteria if both the meridian and hoop direction membrane forces are equal to or greater than those prior to the SGR outage without any further analysis.

For the elements within and adjacent to the opening this calculation determined the resulting element forces for all applicable load combinations and the resulting stresses for the critical elements. Element resultants were calculated by combining the results from Model 2 and Model 3, including the results for all other load cases evaluated in model 3 (seismic, operating temperature, liner plate expansion and accident pressure). The resulting element forces and moments were plotted against allowable Axial Force / Moment Interaction Diagrams for all load combinations. For elements that fell outside the interaction diagrams the individual elemental stresses were calculated and compared to the acceptance criteria contained in the Analysis section of the Containment DBD & Section 7.0 of Calc S06-0002. Calculation S06-0006 utilized 4 Finite Element Models for the evaluations as described below. The results from Model #1 (original EOL prestress + dead load) are compared to the results of Model 2 + Model 3 (EOL prestress + dead load after effects of SGR included). If the prestress levels in Model 2 + 3 equal or exceed the prestress level in Model 1 then the section is acceptable.

Model #1

Represents the original containment configuration before the creation of the SG opening, with original prestress of 70% GUTS, i.e., the lock-off pre-stress, minus tendon losses due to creep, shrinkage, elastic shortening and steel relaxation at 40 years. End of plant life vertical and hoop prestress forces are calculated for 0.0P (where P = internal pressure), 1.0P, 1.25P and 1.5P based on the accident load case combinations. Note that as the internal pressure increases from 0 to 1.5P the containment expands resulting in increasing tensile stress in the tendons which in turn increases the prestress load in the concrete. The FEM model is evaluated for dead load, and hoop and vertical prestress forces based on a unit load of 100 kip/ft and dome prestress. Post processing results for element nodal membrane forces and moments, for each load case, are processed into Excel workbook spreadsheets. Appropriate factors (Section 4.2.3 and 4.2.4 of S06-0006) based on the end of life tendon forces are applied to the unit load results for tendon prestress loads at 1.0 P (where P = internal pressure), 1.25P and 1.5P and combined with dead load.

Model #2

Represent's the end of outage configuration with wet concrete in the opening. The purpose of this model is to obtain the RB prestress for vertical and hoop prestress loads before adding the re-tensioning forces from re-tensioning the 35 hoops and 30 vertical tendons. This FEM model basically uses a model similar to Model #1 but with the opening included in the model, and subtracts the 30 vertical and 35 hoop tendons that are to be detensioned from the model. The dead weight of the wet concrete is applied as joint loads at the bottom of the opening. Load evaluation for dead load + prestress, and post processing are similar to Model #1.

Model #3

Represent's the restored configuration with all tendons retensioned (no opening). The tendon forces are adjusted to include tendon losses from end of SGR outage to end of plant life (approximately 7 years). Vertical and hoop prestress forces are calculated for 0.0P (where P = internal pressure), 1.0P, 1.25P and 1.5P based on the accident load case combinations. This FEM model which has only the prestress forces included from the retensioned tendons is evaluated for the following loads:

- Seismic (Refer to Section B.6.5-b for seismic design basis parameters)
- Vertical and hoop re-tensioning forces (Refer to Section B.6.5-d)
- Operating temperature (Refer to B.6.5-i for description of thermal loads) (For accident temperature loads refer to "Liner Plate Model" below).
- Accident pressure of 55 psi

Load evaluation for dead load + prestress, and post processing are similar to Model #1.

Liner Plate Model

The effects of liner plate expansion due to accident temperature were included in this analysis. The base FEM model was revised to include additional elements at the dome, wall and mat to represent the liner plate. The force exerted on the concrete due to liner plate expansion was evaluated based on a change in temperature of 211 degrees F; 70 degrees ambient and 281 degrees accident temperature (Ref. 5.7, Section 6.2.1.6).

- **Calculation S06-0006 Conclusions:**

For elements of the fully restored containment shell located away from the SG access opening, this calculation proved that the prestress level in the restored containment was equal to or greater than the original prestress pre-SGR outage. The calculation also determined the resulting element forces for all applicable load combinations and the resulting stresses for ALL elements and found that the containment shell with restored SG access opening was acceptable and met all design basis acceptance criteria for all the applicable loads and load combinations for the time frame between full restoration and end of plant life.

- **Calculation S07-0003:** Containment Shell Analysis for Steam Generator Replacement Predicted Tendon Forces for Future ISI

The purpose of this calculation is to establish the methodology for determination of the predicted vertical and hoop tendon end anchor forces for future tendon ISIs, thru end of plant life (per current licensing basis), considering the impact of de-tensioning and re-tensioning a number of vertical and hoop tendons required for steam generator replacement. This task is performed in accordance with the requirements of ASME Section XI, Subsection IWL (Ref. 1.7). Steam Generator Replacement will not impact the dome tendons; hence the prediction of end anchor forces for these tendons shall be per the existing methodology.

Tendon end anchorage forces are a function of the original pre-stress force minus the time dependent losses due to shrinkage, creep and tendon steel relaxation and the pre-stress loss to elastic shortening which is not time dependent but does depend on the pre-stressing sequence.

The following tendons must be retensioned:

Hoop tendons:
A total of 35 hoop tendons (17 within the opening, and 9 above & 9 below the opening)

Vertical Tendons:
A total of 30 vertical tendons (10 within the opening and 10 on each side of the opening)

After sufficient cure time for the new concrete in the opening, the replaced tendons and the detensioned only tendons will be retensioned to the initial lock-off pre-stress level of 70% GUTS, instead of the existing pre-stress level in these tendons at the time of the start of the steam generator replacement outage. Consequently, two different methodologies must be developed to determine the methodology for predicting tendon end anchor forces for (i) the retensioned tendons and (ii) all the remaining tendons that were not detensioned. The calculation must also investigate the impact of the change in pre-stress sequencing and the impact due to the differences in creep and shrinkage properties of the new concrete used for closing the opening and the remaining existing concrete in the containment shell.

The original 144 vertical tendons were split into 31 sequences and the 282 hoops into 60 sequences. Calculation S07-003 creates 6 new vertical sequences (I thru VI) containing a total of 30 verticals, and 8 new hoop sequences (I thru VIII) containing a total of 35 hoops.

- **Calculation S07-0003 Conclusions:**

The calculation showed that the impact of higher pre-stress in the de-tensioned and replaced tendons during the steam generator replacement outage on the remaining tendons is negligibly small and can be ignored. In addition, the different creep and shrinkage properties of the new concrete have a negligible impact on the existing tendons, but do impact those passing through the access opening.

Therefore, the methodology for calculating the anchor end forces for the existing tendons that were not detensioned remains unchanged. The calculation creates new formula that determine tendon forces for the 9th and 10th surveillances (35 and 40 year respectfully), accounting for the effects of the new tendon sequencing on elastic shortening and the effects of losses due to creep, shrinkage and steel relaxation.

- **Calculation S06-0007:** Liner Evaluation for Steam Generator Replacement

Note that the LODHR accident postulated to occur during the SGR activities is not a current design basis load condition.

The purpose of this calculation is to:

a. Evaluate the functionality of the liner plate to withstand the effects of a postulated Loss of Decay Heat Removal (LODHR) accident loading during the steam generator replacement construction activities with all concrete in the access opening area removed.

b. Provide reactions imparted to the supporting containment wall at the access opening resulting from the above evaluation for input into Calculation S06-0005 (Shell Analysis during Replacement Activities).

c. Evaluate the structural adequacy of the containment liner for use as formwork for continuous placing of wet concrete to restore the containment wall in the SGR opening area and to recommend the maximum allowable pour rate for the replacement concrete.

d. To determine the allowable load on each form tie and determine the maximum spacing of form-ties. Form ties are to be sized by the formwork designer.

Simplified Elastic and Rigorous Plastic Analysis of liner for postulated LODHR accident

The occurrence of a LODHR accident during the concrete removal construction activities is an extremely low probability event and, therefore defined as a faulted plant condition. ASME Code Section III, Division 1 Subsection NE/Appendix F allowable for faulted load reflects conditions of plastic hinge mechanism, large deflection, and membrane yielding of the liner plate system. Per Table NE-3221-1 thermal load evaluation is not required for Service Level D; therefore, the liner plate in the access opening is evaluated for LODHR internal pressure only. ASME Section III Div.2 Paragraph CC-3110 (e) provides that the design of the metal containment portion not backed by concrete for load carrying purposes, such as access opening liner plate carrying the LODHR accident pressure load, shall meet the requirements of ASME Section III Division 1, Subsection NE.

Revision 0 of Calculation S06-0002 (Design Criteria) stated that S&L was to use a maximum of 235 degrees F and 8 psi for the LODHR accident temperature and pressure respectively, per AI-504 "Guidelines for Cold Shutdown and Refueling". However, per Progress Energy Letter SGR06-0102 (Attachment 3 of Calculation S06-0002) the peak internal temperature and pressure due to a LODHR accident was reduced to 173 degrees F and 5.14 psi and Calculation S06-0002 was revised accordingly. Note that the peak pressure due to a LODHR accident while defueling was consequently revised in AI-504 from 8 psi to 5.14 psi. Calculation S06-0007 therefore conservatively evaluated the liner plate for both 8 psig and 5.14 psig with material properties at 235 degrees F conservatively used for both cases. The design evaluation of the liner plate system for the faulted condition LODHR loading is based on large deflection nonlinear behavior, based on the following two approaches:

1. Evaluation of the maximum uniform pressure and maximum deflection using simplified formulas and analyses applicable for plastic and large deflection behavior of flat membrane plates. This method is conservative and adequate for determining the maximum pressure and deflection, and the bounding liner reaction forces for evaluation of the concrete containment shell supporting the liner. This also provides an expeditious means to sanity-check the results of the complex ANSYS computer program analysis.

2. A detailed nonlinear finite element analysis of the liner plate system using the ANSYS v 8.1 computer program is performed to determine the membrane and flexural strain levels in the liner plate to confirm leak-tightness of the liner. The model includes the curvature of the plate and is performed both with and without the presence of the vertical stiffener angles.

Evaluation of Liner as Concrete Formwork

The liner plate within the opening was evaluated for use as formwork during continuous placement of wet concrete to restore the containment wall. Determination of the lateral pressure on the liner plate was based on ACI 347-04 (Ref 1.4), Section 4.3.1, Eq. (2.4) which is applicable when placing concrete with a slump of 7" or less, a placement rate of less than 7 ft/hr, and a placement height exceeding 14 ft.

The calculation determined the following based on a pour rate of 4 ft/hr, maximum slump at placement of 7" and a minimum placing temperature of 70 deg F:

- Maximum lateral pressure = 1300 psf
- Maximum bending stress in the liner based on 18" c/c span between vertical stiffener angles.
- Maximum vertical spacing of form ties based on composite action between the plate and vertical stiffener angle, an allowable bending stress of 0.5 Fy and 0.3 Fy for shear.
- Maximum bending stress and deflection in the vertical stiffener angle.
- Maximum shear flow in the weld between the vertical stiffener and the plate.

NOTE: If the lateral pressure on the concrete formwork is electronically monitored with load cells during placement and maintained at equal to or less than 1300 psf (design pressure for formwork) then the maximum slump may be increased to 9" (Reference test results for Phase III and Phase III Additional Tests contained in Attachments Z48R3 and Z55R3), and the maximum pour rate may be adjusted accordingly. The requirements of ACI 347-04 (Ref 1.4), Section 4.3.1 and Calculation S06-0007 would no longer apply.

- **Calculation S06-0007 Conclusions:**

The calculation concluded that the 3/8" thick liner plate is adequate to withstand the effects of a LODHR accident pressure, both with and without vertical stiffeners. The liner will maintain its leak-tight integrity to contain a LODHR accident peak accident pressure of 8 psi (conservative).

The calculation also determined that the minimum acceptable liner thicknesses to assure structural and leak-tight integrity of the liner plate, without any vertical stiffeners, under two postulated LODHR accident scenarios were:

5.14 psi............3/16" minimum thickness

8.00 psi.............1/4" minimum thickness

The calculation also determined that the liner plate within the opening was acceptable to use as formwork during the continuous placement of concrete meeting the following conditions:

Normal Concrete Mix (with vibration)

➢ Slump:	7" maximum*
➢ Maximum pour rate:	4 ft/hour*
➢ Maximum vertical tie spacing:	36" (+/- 3") vertical, 18" (+/- 1") horizontal
➢ Design Pressure:	1300 psf
➢ Form tie axial load:	6.5 kips/anchor

* As previously noted if the lateral pressure on the concrete formwork is electronically monitored with load cells during placement and maintained at equal to or less than 1300 psf

(design pressure for formwork) then the maximum slump may be increased to 9" (Reference test results for Phase III and Phase III Additional Tests contained in Attachments Z48R3 and Z55R3), and the maximum pour rate may be adjusted accordingly. The requirements of ACI 347-04 (Ref 1.4), Section 4.3.1 and Calculation S06-0007 would no longer apply.

- **Calculation S09-0025:** Containment Shell Analysis for SGR – Evaluation for Re-fueling Prior to Restoration of Access Opening

  The purpose of this calculation is to evaluate the containment shell with the steam generator access opening, exposed liner plate and reduced pre-stress (Stage 2 Prestress), i.e. 17 hoop and 10 vertical tendons removed from within the opening and an additional 9 hoops above and below the opening (total of 35 hoops de-tensioned) and 10 additional vertical tendons on either side of the opening detensioned (total of 30 verticals de-tensioned). Refueling operations have started, thus a LODHR accident is possible. Per Ref. 5.29 the maximum operating temperature inside containment is 83 degrees, maximum accident temperature inside containment is 114.7 degrees and maximum accident pressure is 1.4 psig. Calculation S09-0025 conservatively evaluated the shell in this configuration for 119 degrees maximum accident temperature and 2.1 psig maximum accident pressure (Note that the 2.1 psig pressure used in calculation S09-0025, Section 4.2 was effectively reduced to 1.54 psig by reducing the load factor from 1.5 to 1.1 for the pressure load, i.e. 1.1 x 2.1 > 1.5 x 1.4.

- **Calculation S09-0025 Conclusions:**

  The calculation determined that the resulting element stresses in the containment shell with Stage 2 pre-stress and exposed liner plate were acceptable and met the critical load combination of Dead Load + 1.5 LODHR Accident Pressure + Stage 2 Operating Temperature + Liner Expansion due to Accident Temperature + Polar Crane.

6. **Environmental Conditions:**

Radiation decontamination of the liner plate, concrete rubble, waste water, scrapped tendons and any associated anchorage components, grease and other items may be required before disposal. Discharge of the water and rubble may continue uninterrupted while samples are being tested and analyzed. After the concrete rubble has been released by RP it will be hauled offsite to a landfill.

The containment opening task manager is responsible for water delivery, storage and the means of piping it to and from the containment and is outside the scope of this EC. He is also responsible for determining if the settling ponds have adequate storage for the expected 2 million gallons of waste water from hydrodemolition. Additionally it must be taken into account that during plant cool down, CR-3 will begin a condensate release to the settling ponds. As soon as the plant enters mode 5, condensate will be released as fast as permitted (360 gpm max) in order to drain the secondary system to allow work to commence. This could add approximately 500,000 gallons of condensate to the settling ponds (Reference H05R0). This needs to be taken into consideration when assessing the available volume in the ponds.

The details for water supply and disposal for concrete removal are outside the scope of this EC (except for identifying critical parameters, i.e. volume of water and testing requirements) and will be included and approved per Work Order Task 1165094-Task-03. Additionally, AR 00292151 has been assigned to the containment task manager to ensure he develops all these activities and adds them to the Work Order.

Water requirements:

Concrete will be removed by the hydrodemolition process utilizing 2 - 2000 HP diesel pumping unit power packs. Each power pack contains three (3) high pressure pumping units delivering approximately 60gpm @ 20,000 psi per pump to the hydrodemolition concrete removal track system. Each power pack therefore delivers approximately 180gpm, so with two power packs operating the total water requirements are 21,600 gallons per hour. According to Mac & Mac it will take their equipment approximately 37 hours to create the opening (excluding time for others to cut and remove exposed rebar and tendon sleeves), for total water requirements of approximately 800,000 gallons. However, it is recommended that at least 2,000,000 gallons of water are available for hydrodemolition activities and can be supplied at the rate of 360gpm (Refer to Attachment Z24).

ECED 59400 identified the possible source of this water as the well fields located to the east of CR3, operated and maintained by the fossil group at Crystal River South (CRS). Well water could be diverted through existing CRS plant piping or temporary piping to one of the existing abandoned oil storage tanks (Cap. 8,000,000 gallons) which have been successfully used in the past by CRS to satisfy requirements for bulk water storage for other high water demand projects. Water from this storage tank could then be pumped either via temporary piping or existing available plant piping to the hydrodemolition equipment located at the containment access opening.

Water supplied to the hydrodemolition contractor should have total suspended solids of less than 45ppm and must undergo laboratory analysis to baseline radio nuclides and other chemical parameters as determined by RP and the chemistry department.

Waste water disposal:

Samples for radiological testing and analysis will be taken at the collection bins and tested at the on-site RP/Chemistry laboratory in accordance with existing site procedures. Discharge of the water and rubble may continue uninterrupted while samples are being tested and analyzed. Specific details on radiological sampling and analysis of the waste generated during hydrodemolition will be addressed by SGR RP in the Containment Opening RP Task Plan (issue date tracked by NTM AR 292005) and the associated work package.

Waste water from the collection tanks is pumped via hoses or temporary piping to a skid mounted wastewater treatment facility provided by Mac & Mac located in the staging area approximately 400' from the containment opening. The portable waste water treatment facility consists of three 20,000 gallon tanks that can treat up to 360 gallons of water per minute. Treatment basically consists of a four step process of settling, flocculation, pH measurement and adjustment, and the capture of grease (if present) in grease traps before discharge. Grease and oil will be captured in Tank #3 thru absorbent booms. Refer to Section B.6.12 for an evaluation of the non-radiological waste water tests that are required as a pre-requisite for discharge.

The current plan is to route the waste water via existing plant piping or temporary piping and discharge it to the south percolation ponds which have been determined (by CR3 and corporate environmental) to be within the current definition of wastewaters under the Plant Industrial Waste Water Permit. Therefore, sending the pre-tested (Refer to B.6.12 for testing requirements) waste water to the ponds is currently allowed. Refer to ECED 59400 for an evaluation of the risks associated with using the percolating ponds for effluent disposal. The source and storage of supply water, the use of the existing plant piping/facilities, use of the percolating ponds, and the erection/support of temporary piping for the disposal of the waste water is outside the scope of this EC and will be addressed by the relevant work orders. The details for water supply and disposal for concrete removal will be included and approved per Work Order Task 1165094-Task-03.

Diesel fuel/oil

Diesel fuel that will be stored in mobile tanks to fuel the hydrodemolition equipment will be managed in accordance with site procedures. All mobile diesel equipment shall have integral secondary containment or be placed within a secondary containment.

Tendon grease disposal:

Waste grease is managed in accordance with EVC-SUBS-00107, Waste Vendor Program. The grease may have to be waste profiled (chemical profiling) before disposal. It will be tested by RP before release.

Temporary access opening curtain:

A temporary curtain will be installed on the outside face of containment to protect the inside of containment from rain. The curtain cannot be credited with restricting the flow of airborne radioactive contamination. The curtain will be hung from a commercially available rail and bracket system attached to the concrete containment wall, just above the opening. Details for the curtain, rail, support system and anchorage can be found in the Containment Opening Task plan.

7. **Interface Requirements:**

EC 63020 contains details of the large erection mobile crane located outside containment. One of the functions of this crane is to support all tendon rigging related activities, liner plate removal and reinstallation, lifting concrete formwork into position and removal and possibly support the installation of rebar.

EC 63022 contains details of the chipping platform which have been reviewed to ensure they are compatible with the hydrodemolition equipment. This EC also contains installation details for the horizontal transfer system and the resulting construction loads to the containment wall.

EC 70377 provides for the temporary power requirements outside the RB for the SGR project, including hydrodemolition and tendon related activities.

The following vendors/contractors are involved in this EC:

S&ME (This is not an acronym): Concrete testing laboratory. Responsible for all material tests associated with identifying a highly specialized concrete mix for the replacement concrete to be placed in the access opening.
S&L: Sargent and Lundy Engineers: Responsible for the structural analysis of the containment shell resulting from the creation and restoration of the temporary access opening in the containment shell. Also responsible for designing the replacement concrete mix parameters and developing the IWE/IWL replacement plans.

Mac and Mac Hydrodemolition Services: Responsible for creating the opening in the concrete containment wall using high pressure water technology. Also responsible for providing a water treatment plant that will treat the waste water from the hydrodemolition process prior to discharging.

PSC: Precision Surveillance Corporation: Responsible for supplying the new tendons, associated anchorage components, tendon grease, tendon work platforms and other hardware associated with detensioning, removal, reinstallation and pre-stressing of the tendon. PSC will provide supervisory personnel to oversee all activities related to detensioning, removing, reinstalling, retensioning and inspecting all affected tendons. They are also responsible for evaluating the suspended tendon work platforms for hurricane, tornado wind and seismic loads.

CBI: Chicago Bridge and Iron: CBI personnel will be responsible for cutting and removing (rigging) the steel liner plate from within the opening, weld repair of any damaged areas and reinstallation and welding of the liner plate to CR3 welding procedures.

8. <u>Material Requirements:</u>

As noted in B.4.8 all materials used in the restoration of the temporary access Opening must be compatible with the existing materials and meet or exceed the original material requirements.

Following is an evaluation of each material/item to be utilized by this EC:

<u>8-a: Concrete</u>

Restoration of the opening requires development of concrete mixture proportioning that will produce a concrete that will meet the required physical properties (strength, density, elastic modulus, creep and shrinkage, durability, etc.) and provide appropriate characteristics for placeability in the subject application (workability, consistency, no segregation, and no bleeding). Additional considerations are required to achieve high early strength to permit tendon stressing as soon as practical after placement, and to maintain physical compatibility with the existing concrete by limiting the creep and shrinkage strains of the concrete. Refer to Specification CR3-C-0003 (Z25) for concrete requirements for restoration of the SGR opening.

The design requirements for the hardened concrete are as follows (Reference Calc. S06-0004):

- Compressive strength shall be at least 6000 psi at 5 days & at least 7000 psi at 28 days.

- The ultimate creep coefficient, ϕu, shall not exceed 1.5.

Progress Energy will procure 2 different samples of each constituent material, i.e., sand, large aggregate, cement, silica fume, fly ash and admixtures (as identified by S&L) prior to any qualification testing, in sufficient quantities to ensure adequate supplies are available for all future tests, mock-ups and placement at the opening (including an allowance for waste), and store these materials at a secure location at the CR3 site. Care must be taken to ensure that these materials remain separated and are not contaminated from any other source. These materials are purchased Safety Related or procurement is to dedicate them as Safety Related. Each supplier will ship to S&ME (the concrete testing laboratory) sufficient quantities of each constituent material, ensuring that the samples shipped are a good representation of the bulk material, for use in all phases of their test plan.

Development of the concrete mix is the responsibility of Sargent and Lundy working in conjunction with S&ME and will follow a three- phased test plan as follows:

Phase 1:
Phase I involves the initial identification and material qualification testing of constituent materials for the replacement concrete. Up to two samples of each material may be tested. Based on the results of the material testing, S&ME will provide Progress Energy with recommendations relative to trial mixture proportioning. Phase 1 tests will be performed under S&MEs 10CFR50 Appendix B Program.

Phase 2:
Phase 2 consists of the performance testing of the trial mixes. During this phase several preliminary trial mixes will be batched and selected tests performed with the intent of narrowing the number of trial mixes to two. The freshly mixed concrete for these two trial mixes will then be tested for (at a minimum) mix temperature (ASTM C 1064), unit weight (ASTM C 138), air content (ASTM C 231), & slump (ASTM C 143). Test specimens of the hardened concrete are then tested at 5 and 28 days for compressive strength (ASTM C 39) and static modulus of elasticity (ASTM C 469). Based on the results of Phase 2 tests, S&ME will recommend the preferred mixture proportioning. S&MEs 10CFR50 Appendix B Program does not apply to Phase 2 testing.

Phase 3:
Phase 3 testing is performed under S&MEs 10CFR50 Appendix B Program. Testing consists of repeating Phase 2 tests plus creep and shrinkage testing per ASTM C 512 to confirm the acceptability of the concrete mix for intended application.

Constituent materials and minimum required properties are identified in the document "Laboratory Testing Requirements for Concrete Proportioning" contained in Attachment 1 of the concrete specification CR3-C-0003 (Z25).

The concrete specification CR3-C-0003 (Attachment Z25) provides the specification for the concrete to restore the containment access opening and includes storage of the constituent materials, batching, mixing, placing and curing of the concrete. Table 1 of this document

contains the mix proportions for the replacement concrete. Refer to Section B.6.10 for an evaluation of the replacement concrete/material requirements compared to the original concrete.
Final Concrete Mix Proportions:
Refer to Table 1 of Specification CR3-C-0003 for constituent material mix proportions.

Method of Dedicating the Concrete for the Access Opening as Safety Related:
The six concrete constituents (aggregate, cement, sand, fly ash, admixture and stabilizer) that makeup the safety related concrete design mix have been dedicated for use in safety related applications in accordance with Material Evaluations 07774R00, 07773R01, 07767R01, 07768R00, 07769R00 and 07770R00, respectively.

- Concrete is classified as "Safety Related" (Q).

Evaluation of why Testing for Poisson's ratio of concrete is not required:
(Refer to Attachment Z38)
Testing to determine the concrete Poisson's ratio in accordance to ASTM C469 "Standard Method for Static Modulus of Elasticity and Poisson's ratio of Concrete in Compression," does not require extra test specimens, just the use of an extensometer to measure the transverse strain of the test specimens in addition to the compressometer used for the determination of the elastic modulus.

The Poisson's ratio is used in the computer programs for structural analysis to account for the effect of transversal deformations. The Poisson's ratio in concrete varies within a narrow range such as 0.17 to 0.20. Therefore, the effect of this variation in the results of the structural analysis if any is negligible.

The value of the Poisson's ratio used during the structural analysis of the replacement concrete was the same used in the plant FSAA. That is $v = 0.20$ which is adequate for the analysis performed.
Poisson's ratio is not a parameter tested for quality control during production and placement of concrete, and it not required to be tested in any structural design code or specification whether it is a structure built of reinforced concrete, prestressed concrete, or steel.

Conclusion: For these reasons, Poisson's ratio was not included in the testing program for the concrete mixture design program, and will not be included in the testing required for the concrete quality control during construction.
8-b: Tendons

The new replacement tendons shall meet the requirements of the original tendons as detailed in the Containment DBD sections pertaining to tendon wire, tendons and tendon anchorage components, which are listed below.

The following 10 vertical and 17 hoop tendons will be replaced in the opening:

- 34V8 thru 34V17

- 42H27 thru 42H34 and 53H27 thru 53H35

Each tendon consists of 163 7mm diameter low relaxation wires that conform to the requirements of ASTM A421-98a, Type BA with a minimum ultimate tensile stress of 240,000 psi. The tendons will be shop fabricated by PSC (Precision Surveillance Corporation) with one end button-headed and the other end square cut and suitable for button heading in the field. The requirements for button-heads shall be the same as those originally furnished by the Prescon Corporation. Tendon lengths are as shown on in Attachment #Z18R0. Each tendon is twisted ¼ of a turn every 10 feet and one full turn every 40 feet. Tendons will be protected from corrosion after fabricated by coating them with Visconorust 1601 Amber by Viscosity Oil Company. This coating does not have to be removed, it is the same coating used in original construction and is 100% compatible with the tendon grease (Visconorust 2090-P2, 2090-P4).

Refer to Section B.6.10 for an evaluation of the limitations on pre-stressing the tendons affected by SGR, i.e., tendons in and around the access opening.

Evaluation of different code years for tendon wire:
Refer to Section B.6.3

The existing tendons that are being removed from within the opening are not to be re-used. They will be cut into suitable lengths and shipped off-site for disposal.

- Tendons are classified as "Safety Related" (Q) and are supplied by PSC

8-c: Tendon Anchor Heads (163 Wire Stressing Washer)

New tendon anchor head material is evaluated below:

The original stressing washers were fabricated from SSS-100, ASTM A514 Grade E material per drawing 5EX7-003 Sheet A8, Revision 3. CR3 and PSC procurement departments identified ASTM A514 Grade E material as extremely difficult to obtain, and may not be available in lots of less than 40,000 lbs (Refer to Attachment Z03). An evaluation by the CR3 materials engineer (Refer to Attachment Z01) concluded that substituting ASTM A514 Grade Q material for ASTM A514 Grade E was acceptable. The second problem with the original material specs was the reference to "SSS-100", a term that both procurement departments have problems identifying. In trying to establish whether Armco SSS-100 steel was the same or similar to ASTM A514, the CR3 materials lead engineer recommended that Dr. Moccari at the Harris Energy and Environmental center was contacted. Dr. Moccari located an old industry guide (dated December 1968) on materials "Alloy Digest" (Refer to Attachment Z05) that contained a fact sheet on SSS-100. According to this source, SSS-100 is equivalent to ASTM A514. Comparing the properties listed in the fact sheet to those for ASTM A514, both mechanical and chemical properties are very similar. Armco was bought by AK Steel in 1999. AK Steel does not produce SSS-100 steel. Based on this information all reference to SSS-100 steel was deleted from the newly created PSC drawing CR-N1009-502, "163 Wire Stressing Washer" (Attachment Z02) which replaces drawing 5EX7-003 Sheet A8, Revision 3 for the new anchor heads for the replacement tendons (34V8 thru 34V17 and 42H27 thru 42H34 and 53H27 thru 53H35).

Nil ductility transition temperatures (NDTT) requirements:
FSAR Table 5.2.2.3.3 specifies ASTM A514 Type E material for tendon stressing washers and specifies that these have an NDTT no greater than -15 deg F. The new tendons fabricated for the CR3 SGR project have ASTM A514 Type Q washers. The ASTM specifications for yield and ultimate do not depend on Type. However, the ASTM does not address NDTT. The following evaluation was prepared by Dr. Ahmad Moccari at the Harris Energy and Environmental Center (Attachment Z36R0):

Elemental chemical compositions of ASTM A514 Grade E and Grade Q are documented (Per ASTM Handbook, Volume01/04) as;

	Grade E %	Grade Q %
Carbon	0.12-0.20	0.14-0.21
Manganese	0.40-0.70	0.95-1.30
Phosphorous, max	0.035	0.035
Sulfur, max	0.035	0.035
Silicon	0.20-0.30	0.20-0.35
Nickel	-------	0.90-1.50
Chromium	1.40-2.00	0.35-0.65
Molybdenum	0.40-0.60	0.15-0.25
Vanadium	---------	0.03-0.08
Titanium	0.01-0.10	----------
Boron	0.001-0.005	----------

"Nil ductility transition temperatures (NDTT) is defined as the temperature at which steel loses its ability to flow plastically in the presence of a sharp, cracklike discontinuity. If no sharp notch or crack is present, temperatures as low as -75 °C (-100 °F) are necessary to produce brittle fracture (ASM Metal Handbook, Volume 1, p 412). The typical NDTT range for High-Strength low alloy steel with a minimum yield strength of 345 and 550 MPa is -70 to -30 °C."

"NDTT ranging from 38 °C (100 °F) to as low as -90 °C (-130°F) have been recorded in tests on normalized and tempered cast carbon and low-alloy steels in the yield strength range of 207 to 655 MPa (30 to 95 ksi) (Figure 6). Comparison of the data in Figure 6 with those of Figure 7 shows the superior toughness values at equal strength levels that low-alloy steels offer compared to carbon steels. Depending on alloy selection, NDTT values of as high as 10 °C (50 °F)to as low as -107 °C (-160 °F) can be obtained in the yield range of 345 to 1345 MPa (50 to 195 ksi) (Figure 7). An approximate relationship exists between the Charpy V-notch impact energy-temperature behavior and the NDTT value. The NDTT value frequently coincides with the ductile-brittle transition temperature determined in Charpy V-notch tests (ASM Metal Handbook, Volume 1, pp 367-378)."

The notch toughness transition temperatures are controlled principally by chemical composition (particularly carbon) and ferrite grain size. The transition temperature increases by about 5 °F for 0.01 percent increase in carbon content. Based on this and the carbon contents of Grade E and Grade Q the transition temperature could raise by about 5 °F. The main differences in the chemical compositions of these two grades are the manganese and nickel concentrations. The transition temperature increases by about 10 F for each increase of 0.1 percent in manganese content. Nickel has beneficial effect on notch toughness and lower transition temperature when it is about 2 percent. It is believed that small differences in chemical compositions of these two grades have slight effect on NDTT.

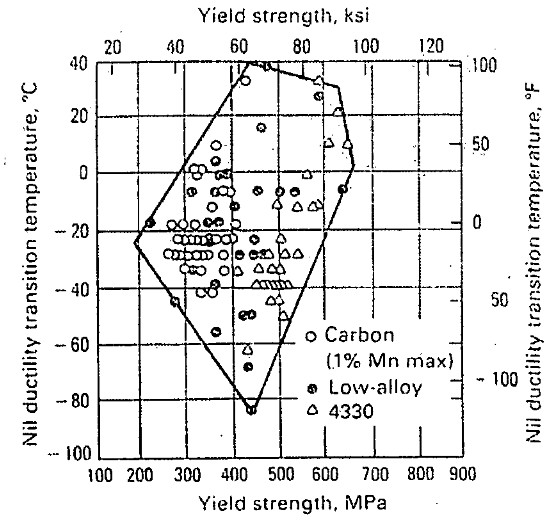

Fig. 6 Nil ductility transition temperatures and yield strengths of normalized and tempered commercial cast steels

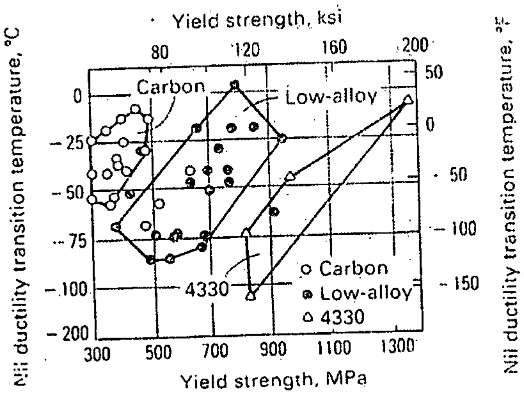

Fig. 7 Nil ductility transition temperatures and yield strengths of quenched and tempered commercial cast steels

Tendon anchor heads (stressing washers) are classified as "Safety Related" (Q)

8-d: Tendon Split Shims

New tendon split shim material is evaluated below:

Per FSAR Section 5.2.2.3.3 the original shim material was Modified Armco VNT (Proposed ASTM A633-E). This material is no longer available and in 1993 CR3 procurement evaluated alternative materials and identified Armor Plate HY-80, Type 1 (MIL-S-16216) as an alternative material that meets the mechanical properties outlined in Section 5.2.2.3.3. PEERE 987 Revision 0 documented the review and approval of this material for use.

Prior to the 8th in-service tendon surveillance (30 year), the CR3 procurement department ordered sufficient shims for both the 8th surveillance and SGR outage. The assigned Catalog ID numbers can be found in the BOM in Section D.

- Split shims are classified as "Safety Related" (Q)

8-e: Tendon Grease:

Per DBD 1/1, Containment (Section, Tendon Grease), Visconorust 2090P and 2090P-2 was used to field coat the inside of the tendon conduit and used as bulk filler after tendon insertion. The new grease is Visconorust 2090-P4 manufactured by the Viscosity Oil Company as specified in SP-182, RB Structural Integrity Tendon Surveillance Program.
P-4 is an improved version of the P-2 grease previously used at CR3. Note that P-2 grease is no longer available & was superseded by the P-4 grease approximately 10 years ago.

- Tendon grease is safety classified as "Safety Related"(Q)

8-f: Tendon Grease End-Cap Gaskets and Associated Hardware:

Tendon grease cap gaskets, nuts, washers and studs are furnished per the original Prescon drawing 5EX7-003 Sheet A-9D, Revision 1 for all hoop and upper vertical ends and drawing 5EX7-003 Sheet A-9C for the lower vertical ends.

- Grease cap gaskets and associated hardware are classified as "Non Safety Related"

8-g: Tendon Grease End-Caps (Cans):

Requirements for ordering new replacement grease caps are evaluated below:
The existing caps will be reused for all vertical and hoop tendons that were replaced, i.e. all tendons within the opening. Since the new tendons will have similar elongation as the existing tendons when initially tensioned, there is no need to order new, extended caps.

New extended caps will be ordered for all tendons that are detensioned and then retensioned only, i.e. outside the opening. These extended caps are longer than the original caps to accommodate additional tendon elongation resulting from retensioning. These extended caps will be furnished per the original Prescon drawing 5EX7-003 Sheet A-9D, Revision 1 for all hoop and upper vertical end caps. The existing end caps will be re-used for all new replacement tendons within the opening and for all retensioned only vertical lower end caps in the gallery. This is a non-structural item.

- Tendon grease caps are classified as "Non Safety Related"

8-h: Tendon Sheaths:

Requirement's for replacement tendon sheath material is evaluated below:

The existing tendon sheaths within the opening will have to be replaced. The original construction specification #RO-3040 required rigid conduit to be mechanical welded steel tube manufactured to ASTM A513-69 with an O.D. of 5 ¼" and an I.D of 5". Flex conduit was to have a similar O.D. and I.D. The tendon sheathing is classified as a non-safety related component since its only purpose is to form the void in the concrete to contain tendon grease. Therefore, every effort will be made to meet the original material requirements in ASTM A513

Deleted: will be destroyed during hydrodemolition of the concrete and however, material that is equal to, or better than that specified below is acceptable without further evaluation:

- Rigid tendon sheathing shall be fabricated from ASTM A513, Type 5 resistance welded tubing with a 5" internal diameter and 5 ¼" outside diameter.
- Rigid tendon splices (including the couplers) shall be fabricated from ASTM A513, Type 5 resistance welded steel tubing per the details shown on Drawing #421-350
- Tendon sheaths are classified as "Non-Safety Related"

8-i: Concrete Reinforcing Steel:

Material requirements for new #8 and #11 rebar are evaluated below:

New #8 Rebar:
The existing reinforcement removed from the opening (#8 rebar) is tagged and stored with the intent of reusing it during the restoration of the opening. However, it is quite possible that some of the reinforcement will have to be replaced due to damage or misplacement. The existing #8 reinforcement conformed to ASTM A615-68 Grade 40 material; the replacement material will be ASTM A615 (latest edition) Grade 60 (grade 40 is unavailable). Since the yield and tensile strength, elongation and chemical properties of the new steel are equal to or better than the original ASTM A615 Grade 40 steel, the use of Grade 60 steel is acceptable for replacing the existing #8 rebars.

Evaluation of using a later code year for the new #8 rebars: Refer to Section B.6.3

New #11 Rebar:
The new #11 rebar cage that is to be installed in the opening is also ASTM A615 Grade 60 material. Refer to Section B.6.10 for and evaluation of the acceptability of using Grade 60 steel instead of Grade 40 steel within the opening. Refer to Drawings 421-350 and 351 for rebar installation details.

- All new steel reinforcement is classified as "Safety Related" (Q)

8-j: Mechanical Reinforcing Steel Splices:

The use of Cadwelds at CR3 is discouraged by station security so mechanical splices will be used. All rebar splices (only the #8 rebars will be spliced) will be by mechanical means, except where physically impossible due to space limitations, i.e. at the four corners of the opening. Refer to Section B.6.10 for an evaluation of the type and code requirements for the mechanical splice recommended for use in the containment Opening (cold swaging). Refer to Section B.6.20 for test requirements. When mechanical splicing is impossible, fusion welding will be used (Refer to Section B.5.2.7-b).

All mechanical splices shall be BarGrip XL – Nuclear / Type 2 Series cold-swaged steel coupling sleeves for #8 size rebar, as manufactured by BarSplice Products, Inc, Dayton OH. Refer to Drawings 421-350 and 351 for splice details and BPI-GRIP Systems Splicing Manual (SM01) contained in Attachment Z26R0.

- Mechanical splices are classified as "Safety Related" (Q)
- Couplings shall be manufactured from seamless steel tubing that conforms to ASTM A519 Grade 1018

8-k: Liner Plate and Stiffener Angles:

The intent of the SGR Project Team is to reuse the original liner plate section cut from the opening. However, spare liner plate material is furnished as a contingency to cover the possibility that the existing liner plate is damaged beyond repair. The new 3/8" thick liner plate material shall conform to the requirements of ASTM A283 Grade C with a minimum copper content of 0.2% (Ref. DBD 011 and FSAR Section 5.2.2.4a). Tensile and yield strengths in latest material specifications are equivalent to the original installation. Therefore no reconciliation is required in accordance with Section XI, IWA-4224.

If replacement stiffener angles for the liner plate are required due to damage of the original angles, then they shall be fabricated from ASTM A36 material similar to original installation (FSAR Section 5.2.2.4e).

- Liner plate material is classified as "Safety Related" (Q)
- Stiffener angles are classified as "Safety Related" (Q)

9. **Mechanical Requirements:**

Liner plate evaluation:
An evaluation of the containment liner plate function shows that it is essentially a leak-tight membrane which limits the release of radioactive products from the containment following a LOCA, secondary system pipe break, loss of decay heat removal accident (LODHR) or fuel handling accident. A breach of the liner in Modes 5 or 6 would not create an immediate consequence to the public, but would create a potential release path for radioactivity in the event of fuel damage, a fuel handling accident or loss of decay heat leading to fuel failure. The following provisions shall therefore apply during the SGR outage:

- The liner shall not be cut at the front end of the outage until the unit is completely defueled and the plant has entered No Mode. Refueling operations shall not commence until the liner plate has been re-installed, welded back in-place and inspected.

- Per Calculation S06-0007 (Reference 5.12) the minimum acceptable liner plate thicknesses to ensure structural and leak-tight integrity under two different postulated LODHR accident scenarios has been established as follows:

    - 5.14 psi...............3/16" minimum thickness
    - 8.00 psi...............1/4" minimum thickness

During Modes 5 and 6 containment structural integrity is not required per the Improved Technical Specification's, however, there are ITS Required Actions and requirements in AP-

404 and AI-504 that require containment closure, pressure retaining to mitigate the dose consequences of a fuel handling accident involving recently irradiated fuel or the consequences of a loss of decay heat accident. During this time period containment closure requirements are dominated by concerns over loss of decay heat accidents (LODHR). During Modes 5 and 6 descending (defueling) a LODHR accident will result (Ref. Calc. S06-0002, M-92-0041, Revision 2, page 14 of 16, Section 8.3 and PE Letter #SGR06-0102 and AI-504) in a maximum RB internal pressure of 5.14 psi and maximum accident temperature of 173 degrees F. During defueling operations the containment will be in Stage 1 prestress (Ref. B.6.5-d).

During Modes 5 and 6 ascending (refueling) AI-504 still requires containment closure, however, per calculation M09-0031 (Ref. 5.29) a LODHR accident would result in a maximum accident temperature and pressure of 114.7 degrees F and 1.4 psig.
During refueling operations the containment will be in Stage 2 prestress (Ref. B.6.5-d).

NOTE: The presence of the vertical stiffener angles on the backside of the liner plate were conservatively ignored in the ANSYS model used for the evaluation of the liner plate, contained in Calculation S06-0007.

Any damage to the 3/8" thick liner plate that occurs during hydrodemolition, and/or just prior to cutting the plate is acceptable if the reduced thickness of the plate is ≥3/16". Damaged areas must be evaluated for potential repair and/or replacement actions.

The existing stiffeners on the backside (concrete side) of the liner plate are angles L3x2x1/4" (ASTM A36). If any of these angles are damaged they are to be either repaired or replaced with the same size angle and material (A36 or better). For original fabrication details of the liner plate refer to Ref. 4.25 (Chicago Bridge & Iron - Shell Stretchout and Plate Details). Repair details for the cut liner plate angles are on drawing 421-351.

- If the existing liner plate section removed from the opening has been damaged beyond repair, a replacement will be fabricated from contingency material (Refer to Section B.6.8-k for material evaluation and the BOM contained in Attachment D00).

- The 3/8" thick, ASME A283, Grade C steel liner plate will be re-installed to its original configuration using full penetration butt-welds that utilize low hydrogen electrodes and welding from two sides, in accordance with the original construction Specification SP-5566. Alternatively, per ECED 70586 (Containment Opening Liner Plate Owner Reconciliation) the full penetration weld can be made from one side with backing on the outside of the liner shell. Double-sided welding will require back-grinding to sound metal prior to completion of the joint. Vertical welding progression is always uphill. Welds with backing will be flat-topped and blended into the surrounding base metal as suitable for subsequent Non-Destructive Examinations. The backing need not be removed. Double-sided welds will be flat-topped on both sides and blended into the surrounding base metal for subsequent

Non-Destructive Examinations. Weld details are shown on drawing #421-351. Welders will be qualified to the current Edition of ASME Section IX and Progress Energy's Corporate Welding Manual, NGGM-PM-0003.

- The original liner plate welds were full penetration welds as identified in the FSAR Section 5.2.2.4.4, the original construction specification SP-5566 and Chicago Bridge and Iron Drawing No. 68-3871-11, Rev.5, (Reference 4.24). Therefore, using a full penetration weld is justified.

- Temporary fit-up devices may have been welded to the liner plate to aid in aligning and supporting the reinstallation of the liner plate (Refer to Section A.5.1.16). These welds must be either:

  - Removed (by grinding) and all removal areas inspected and tested per the requirements of ASME Section XI, Division I, Subsection IWA and IWE AND/OR
  - Cut-off each fit-up device on the exterior face (concrete side) approximately ½" above the liner plate. This alternative method will eliminate grinding of the liner plate. However, all welds must be examined as necessary to ensure that the underlying liner material is intact. Interior attachments must be removed and ground smooth.

- Non-destructive examinations and tests (Visual, vacuum box and MT as applicable) shall be in accordance with Section B.6.20 to ensure weld acceptability and leak-tightness.

- The restored liner plate shall receive a detailed visual examination per IWE-5240 as amended by 10CFR50.55a (b)(2)(ix)(G) prior to the start of pressurization (ILRT) and following completion of depressurization.

- The restored liner plate shall receive a VT-3 inspection of the accessible outer face (concrete side) liner plate surface prior to pouring concrete to ensure no damage during reinstallation of rebar and tendon sheaths.

- The liner plate coating must be reapplied. NOTE: Liner plate coating cannot be removed or applied to the steel liner plate unless reviewed and approved by the ASME Code Section XI, IWE/IWL (ISI) Program Coordinator. Approval shall be documented by review and approval of the Work Order Task (Reference MNT-NGGC-0009).

- Breaching the liner plate provides another pathway whereby radioactive contamination, both airborne and loose surface contamination, can migrate outside the containment building. This shall be mitigated by stationing an air sampler and hand frisker outside the access opening. Additionally, a plastic/vinyl (or equivalent) curtain shall be hung in the opening to protect the interior of the building from inclement weather. This curtain can also act to impede air flow from inside containment to outside containment. The curtain will be opened as needed to allow for material movement through the opening. Refer to Section B.6.10 for the installation requirements for the curtain.

- Refer to Section B.6.10 for an evaluation of using the liner plate as formwork for the new concrete within the opening.
- During hydrodemolition of the concrete in the access opening there is the potential of water running down between the liner plate and concrete wall at the bottom of the opening. The primary barrier to this occurring is the bond between the concrete and liner plate and the stiffener angles embedded in the concrete. Even if some water does accumulate between the liner plate and concrete wall it will evaporate or be absorbed by the surrounding dry concrete over the next 2 months of the outage (a protective curtain is hung on the outside of containment, as previously discussed above, to protect the inside of containment from inclement weather). After the opening has been restored, the availability of oxygen behind the liner plate (between the plate and concrete) will be very limited which would inhibit corrosion of the plate due the presence of any moisture.

Evaluation of Sump Pump requirements in the Tendon Gallery:

During hydrodemolition of the concrete containment wall, water will drain down the exposed vertical tendon sheaths into the tendons gallery where it is collected in 55 gallon drums. However, it is expected that considerable overflow will occur (based on previous SGR experience) which will be collected in the tendon gallery sump. Since this waste water contains dissolved concrete (cement, sand and larger aggregate) it must be kept out of the plants waste water system. SGR mechanical workers will establish sufficient boundaries or barriers that will prevent the concrete waste water from reaching tendon sump. The station gallery sumps, SDP-3A and SDP-3B will remain in normal operation.. Tsump pumps will be installed inside of the barrier, which will pump the waste water that collects in the sump to the portable water treatment plant located outside the protected area. Prior to the beginning of hydrodemolition activities, steps must be taken to confirm the proper operation and discharge volume of the temporary sump pump they supply. In the unlikely event that some water from the hydro-demolition process leaks past the barriers, it would be processed from the tendon gallery sump to the Turbine Building sump. This water would then be processed out with the normal station release process contained in OP-407N, Liquid Releases From the Secondary Plant. There is no need for additional testing the water that drains into the tendon gallery if the gallery is classified as being outside the RCA. If the gallery is classified as being inside the RCA then additional sampling is required by RP.

A concern was raised about the possibility of water/liquids from another source entering the tendon gallery sump and co-mingling with the hydrodemolition effluent prior to being pumped out to the portable water treatment plant. Operations (David Jones) was contacted and this issue discussed with the conclusion being that other sources of liquids entering the tendon gallery sump are low volume.

10. **Structural Requirements:**

Design Margins:
There are no reductions in design margins as a result of this modification. All element stresses are within allowable code requirements.

Per Section 4.5.1 of Calculation S06-0006, after full restoration of the SG access opening, critical sections in the access opening bay between Buttresses #3 and #4 will have a resistance level (combination of dead load and prestress load) equal to or larger than the resistance of these sections before the creation of the access opening, except for the area around the access opening and the thickened area around the equipment hatch, where detailed evaluations were performed. For elements with equal or larger resistance, and design loads which remain same, design margins will be the same or better. Hence they meet the acceptance criteria of Section 7.0 of Ref. 5.7.

For the elements in the area around the access opening and the thickened area around the equipment hatch, based on Section 4.6 of Calculation S06-0006, element loads for all applicable load combinations are found to be less than the allowable loads. Hence they meet the acceptance criteria of Section 7.0 of Ref. 1.

Maintenance Risk Assessment for the Creation and Restoration of the Access Opening:

An assessment of the risks posed to the plant from all major structural activities associated with the creation and restoration of the temporary access opening are documented and tracked by NTM AR#284485.

General overview/evaluation of the methodology used in the structural calculations:

Refer to Section B.6.5-a thru B.6.5-p for an in-depth evaluation of the loads, load combinations, acceptance criteria and analytical methodology that supports the structural evaluation of the containment building both during the SGR outage and after full restoration to the end of current plant life. Following is a brief description of the containment shell interim structural configurations and the associated calculation:

- Calculation S06-0004 determined the mechanical properties of the new concrete that will be used for the restoration of the SG access opening and for the old concrete surrounding the access opening. The effective Young's Modulus (E) for the existing and replacement concrete are determined considering the type of load (i.e. short term or long term loading) and the effects of creep (long term loading only). Determination of the effective Young's modulus is in accordance with the guidelines of ACI 209R-92. The calculation also determines the number of hoop and vertical tendons that should be removed and/or detensioned during the steam generator replacement outage.

- Calculation S06-0005 has evaluated the breached containment with the exposed liner plate in-place for Stage 1 prestress (10 vertical and 17 hoop tendons removed) and applicable dead, thermal, wind, seismic, polar crane loads and pressure/temperature loads resulting from the postulated LODHR accident during Modes 5 and 6 descending (defueling).

- Calculation S06-0007 has conservatively qualified the exposed liner plate for two different postulated LODHR accident scenarios and established the minimum acceptable liner thicknesses to assure structural and leak-tight integrity of the liner plate, as follows:

    - 5.14 psi...............3/16" minimum thickness
    - 8.00 psi...............1/4" minimum thickness

  The calculation also determined that the liner plate within the opening was acceptable to use as work during the placement of wet concrete with form-ties attached to the vertical angle stiffeners. Due to the relatively low slump concrete being placed against the liner plate and the existing bond between the liner plate and stiffener angles (below the opening), wet concrete is not expected to penetrate between the liner and concrete wall. Even if a small amount of wet concrete did run between the liner and containment wall, it would set hard with any excess water being absorbed by the surrounding dry concrete, thereby posing no threat to the liner plate, especially considering the lack of available oxygen between the liner and concrete wall to cause corrosion. There is no available OE to indicate this is a problem.

- Calculation S06-0005 evaluates the breached containment shell with the liner plate cut and removed for Stage 1 prestress, applicable dead, thermal, and steam generator rigging loads. The polar crane is conservatively assumed to be located adjacent the opening with a 60 kip load.

- Calc S06-0005 has evaluated the breached containment with Stage 2 Prestress (additional 20 vertical tendons and 18 hoop tendons de-tensioned). The controlling load on the HTS is the auxiliary crane (weight is approximately 527 kips-Refer to Attachment Z33), in combination with applicable dead load, thermal load & Stage 2 prestress. The polar crane is conservatively assumed to be located over the opening with a 60 kip load. This calculation also evaluated the compressive stresses around the opening while in Stage 1 prestress (ignoring accident temperature and pressure in the load cases). The maximum stress interaction was less than 0.5 indicating that the compressive forces are relatively low

- To preclude any II/I concerns during this time the breached containment shell with Stage 2 prestress has been evaluated in calculation S06-0005 for the applicable dead load, thermal load, earthquake, and tornado wind and depressurization. The tornado wind and depressurization forces were based on the requirements of Ref. 9.2, 9.3 and 9.4 for this time period.

- Calculation S06-0006 evaluates the fully restored containment shell for all applicable loads and load combinations for the time frame between full restoration of the SG access opening and the end of plant life and demonstrates its compliance with the design basis acceptance criteria contained in Calc S06-0002.

- Calculation S07-0003 establishes the methodology for determination of the predicted vertical and hoop tendon end anchor forces for future tendon ISIs, thru end of plant life (per current licensing basis), considering the impact of de-tensioning and re-tensioning a number of vertical and hoop tendons required for steam generator replacement.

- Calculation S09-0025 evaluated the containment shell with the steam generator access opening, exposed liner plate and reduced pre-stress (Stage 2 Prestress), i.e. 17 hoop and 10 vertical tendons removed from within the opening and an additional 9 hoops above and below the opening (total of 35 hoops de-tensioned) and 10 additional vertical tendons on either side of the opening detensioned (total of 30 verticals de-tensioned). Refueling operations have started, thus a LODHR accident is possible. Per Ref. 5.29 the maximum operating temperature is 83 degrees, maximum accident temperature is 114.7 degrees and maximum accident pressure is 1.4 psig. Calculation S09-0025 conservatively evaluated the shell in this configuration for 119 degrees maximum accident temperature and 2.1 psig maximum accident pressure.

The following evaluations apply to structural related activities/components that support this EC:

- Evaluation of the applicability of ACI 209R-92 (97) report to nuclear containment structures (Refer to Attachment Z38):

Article 1.1 in ACI 209R-92(97) states "Special structures, such as nuclear reactor vessels and containments, bridges or shells of record spans, or large ocean structures, may require further considerations which are not within the scope of this report."

ACI 209R-92(97) is a five chapter report on the prediction of creep, shrinkage and temperature effects in concrete structures.

At the time the original report was published (written in the 1970's and approved by ACI TAC for publication in 1982), two of the three principal authors of the report were involved in the design of nuclear containments, and other members of the Subcommittee II were involved in the design of long span bridges.

The scopes of Chapters 1, 2 and 5 of this report were general, but the scopes of Chapters 3 and 4 were mainly oriented to common reinforced concrete building structures, and to simple span prestressed members used in bridges up to medium spans. It was the opinion of the writers to caution report users of the limitations of this report.

In the case of the CR3 concrete replacement, Chapter 2 of ACI 209R-92(97) was the only portion of this report used as a guide to estimate the creep coefficient and concrete shrinkage strain for the calculations of the stresses and strains in the new replacement concrete after post-tensioning forces were reapplied. The main goal of the analytical studies was to find concrete creep and shrinkage strains that assure the restoration of an acceptable level of prestressing in the wall, and to provide the specific target values required for the concrete mixture design and testing program.

Since an extensive test program is being implemented on the concrete constituent materials as well on the creep and shrinkage of the concrete mixtures to be used in CR3, to applicability of ACI 209R-92(97) is not an issue at all, because this testing program will remove most of the limitations of the prediction models in Chapter 2 of ACI 209R-92(97).

ACI Committee 209, decided to restructure the new revisions to ACI 209R-92(97) as independent reports to avoid conflict of applicability and to facilitate future revisions.

In 2005 ACI Committee 209 published the Report ACI 209.1R-05 "Guide to factors Affecting Shrinkage and Creep of Hardened Concrete in Engineering," 12pp., which is a new and more complete version of Chapter One in the ACI 209R-92(97) report. This new report is in the process of revision for a new edition.
In 2008 ACI Committee 209 published the Report ACI 209.2R-08 "Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete," 44 pp. This report is a new and more complete version of Chapter Two in the ACI 209R-92(97). In Section 1.1 of this report it is stated "For structures where shrinkage and creep are deemed critical, material testing should be undertaken and long-term behavior extrapolated from resulting data. This is precisely was it is being done with the CR3 concrete in the ongoing testing program.

Since, ACI 209.2R-08 is now available and tests are performed to determine the creep and shrinkage strain of the concrete that will be used as well as other properties, it is better to refer to it, instead of the reference to ACI 209R-92(97) that was the only document available from ACI at the time the CR3 analysis was performed in year 2007.

Conclusion: The implementation of the ongoing tests program to determine the concrete creep and shrinkage strains in the concrete to be used in CR3 conforms to the new ACI 209.2R-08 and removes any potential questioning about the applicability of ACI 209R-92(97) to CR3 project. It is recommended to reference ACI 209.2R-08 report instead of the previous reference to ACI 209R-92(97).

- Evaluation of saw-cut around perimeter of the opening

When there are less than 90 days prior to the start of the R16 outage while the Unit is in any Mode, after the outline of the opening has been scribed on the face of containment, a concrete saw cut with a maximum depth of ½" may be made around the perimeter (along the scribe lines) of the opening. The reinforcement in the outer face consists of #8s at 12" center to center, with 2 ¼" clear concrete cover. Reducing this concrete cover to 1 ¾" provides adequate protection of the rebar for the maximum 90 day period during which the saw cut may be made. The ½" deep saw-cut has no impact on the ultimate strength of the containment shell which is based on the tensile strength of the steel liner plate, rebar and tendons with no strength contributed from the fully cracked containment shell concrete. The ½" saw-cut is therefore acceptable.

- Evaluation of the replacement concrete/concrete mix:

The original concrete properties are listed in Section B.4.8 and the properties for the replacement are listed in Section B.6.8-a. For ease of comparison the two sets are shown below:

Existing Concrete	Replacement Concrete
Minimum compressive strength of 5000 psi	Minimum compressive strength of 7000 psi
Unit weight of 150 psf	Unit weight of at least 145 psf
Poisson's ratio 0.2	Poisson's ratio 0.2
Maximum slump 3"	Maximum slump 7" (*)
Cement ASTM C150 Type II	Cement ASTM C150 Type I
Coarse & fine aggregate conforms to ASTM C33	Coarse & fine aggregate conforms to ASTM C33
Unavailable-essentially 'creeped' out at this time	Creep coefficient not to exceed 1.5

A special high early strength, safety related concrete has been developed to permit tendon stressing as soon as practical after concrete placement that is compatible with the existing concrete by limiting creep and shrinkage strains. The requirements for concrete testing are documented in "Laboratory Testing Requirements for Concrete Proportioning" (Refer to Attachment 1 in Attachment Z25). Concrete properties for the replacement concrete were derived in Calculation S06-0004. The final mix proportions will be determined and will be identified in Table 1 of Specification CR3-C-0003 (Z25).

A minimum 28 day concrete compressive strength of 7000 psi was primarily chosen to match the higher strength of the existing concrete due to aging. Based on Reference 10.1 the strength of the existing concrete is approximately 6720 psi. Per Calculation S06-0004, Section 4.1.1 the required minimum compressive strength of the replacement concrete prior to retensioning the tendons within the opening is 6000 psi. Additionally, this calculation evaluated the creep adjusted Young's modulus of the replacement concrete also based on a strength of 6000 psi. Based on these requirements the 28 day strength of 7000 psi is not critical for the analysis.

To reduce prestress losses in the replaced concrete, low creep concrete has been specified. Note that the existing concrete is essentially "creeped-out" due to its age.

To restore the temporary access opening, concrete will be poured in one continuous placement at a maximum rate of 4ft/hour (*) to limit concrete pressure on the formwork and liner plate (Reference Calculation S06-0007). Test cylinders will be made for testing the concrete at 3, 5, 28 and 90 days (but not limited to) to verify attained compressive strength. Retensioning of the tendons outside the opening cannot start until the concrete has attained a compressive strength of at least 5000 psi which is to be verified by cylinder breaks.

*Concrete slump and pour rates may be increased if a form pressure monitoring system is installed. Refer to following evaluation.

- Allowable Increase in Concrete Slump and Pour Rates Due to Form Pressure Monitoring System:

If the lateral pressure on the concrete formwork is electronically monitored during placement and maintained at equal to or less than 1300 psf then the maximum slump may be increased to 9" (Reference test results for Phase III and Phase III Additional Tests contained in Attachments Z48R3 and Z55R3) and the maximum pour rate may be adjusted accordingly.

- Evaluation of Use of ASTM C150 Type I Cement vs. Type II (Ref. Attachment Z37)

Answer to the question: Why ASTM C150 Type I cement was specified and used instead of Type II cement, if high early compressive strength is required in the CR3 concrete replacement?

ASTM C150 "Standard Specification for Portland Cement" defines the eight types of cements, (I, IA, II, IIA, III, IIIA, IV and V) based on minimum and maximum physical and chemical requirements.

Type IV production was discontinued decades ago, and Types IA, IIA and IIIA are not produced since it is easier, more economic and more reliable to introduce air in a concrete mixture using air entraining admixtures rather than using these types of cement.

Type V cement and Type II cement conforming to the Optional Chemical and Optional Physical requirements are produced in a limited number of plants in the USA and Canada, where local conditions require their use.
At present, most of the cement plants produce only one cement that meet simultaneously the ASTM C150 requirements for Types I, Type II (No optional Requirements) and Type III.

The two cements for the CR3 concrete were selected based on their test results, with emphasis on a compressive strength of 3900 psi at 3 days. This strength compares well with the required minimum strength at 3 days of 1450 psi in ASTM C150 for Type II cement, and with the minimum required strength of 1740 psi at 3 days for Type I cement. The cement for CR3 is a Type I cement performing as good as or better than Type II cement.

During the cement procurement phase of this project, the required minimum 3 days strength was reduced from 4000 psi to 3900 psi because of the cement availability and the assurance to meet the compressive strength required. Tests performed on the two cements selected exceed procurement requirements.

Conclusion: Results from tests performed on the two cements selected for the CR3 project exceed procurement requirements and Type II cement requirements in ASTM C150.

- Comparison of concrete test results for compressive strength using autogenous curing and standard curing methods:

The use of autogenous curing containers is not planned during the containment opening concrete placement. Although autogenous containers would better represent the curing environment before formwork removal, their use involves additional resources and storage space. Therefore, standard curing methods will be used during actual concrete placement at the opening. To better understand what the difference in compressive strengths would be between the two methods, S&ME was tasked with testing a batch of concrete (concrete proportions based on results of Phase II testing i.e. Option 1A) and determining the difference in compressive strength between te two curing methods at 1, 2, 3, 5 and 28 days.

Attachment Z55R3 contains the S&ME test methodology and test results. Test results for compressive strength are reproduced below:

Age, days	Autogenous Containers	Alternative Proposed Curing	Autogenous/Alt
1	5,620 psi	4,760 psi	18% increase
2	6,450	5,930	9% increase
3	6,590	6,320	4% increase
5	6,860	6,830	0%
28	8,050	8,480	5% decrease

The results clearly indicate that the autogenous cured cylinders have higher early age strength which is as expected. The heat of hydration is (to some extent, over and above the standard cylinders) trapped inside the containers resulting in a harder concrete. These results would indicate that formwork could be removed as early as one day after completion of concrete placement.

- Installation and Removal of concrete formwork on the outside face of the containment wall for concrete placement:

Formwork shall be of all-steel construction designed to meet the requirements stipulated below. Formwork will be tied to the existing liner plate angles with steel ties as shown on drawing #421-351.

Ensure that the face of the formwork (Flex-Form panel skin) against which the concrete will be poured is modified to match the existing grooves in the face of the containment concrete wall. Gluing shaped to suit wooden strips to the formwork skin may be one option that construction/field engineering may consider.

Calculation S06-0007 has determined the resulting lateral pressure on the formwork based on slump and maximum pour rates. Calculation S08-0021 contains the design for the formwork and AR 293932 has been generated to track the completion of this calculation. Formwork will be evaluated for continuous placement of concrete to restore the access opening to the requirements specified in Calculation S06-0007 and Specification CR3-C-0002 (Attachment Z15R0).

Formwork may be removed three days after the completion of concrete placement or when it attains a compressive strength of 3000 psi, whichever occurs first. Formwork must be removed prior to the ILRT to allow access for IWL examinations of the new concrete surface.

Note that tendon retensioning cannot start until the replacement concrete in the opening reaches a compressive strength of 5000 psi verified by compressive tests. The three outer most vertical tendons at buttress numbers 3 and 4 will be retensioned first (Refer to drawing 421-352 contained in Attachment Z12).

Lateral pressure on the formwork resulting from concrete placement will be monitored by an electronic pressure sensing system. If such a system is used, the concrete pour rate may be adjusted higher or lower to maintain a maximum lateral pressure of 1300 psf or less.

- Evaluation of formwork for severe weather (hurricane) protection (Refer to Sheet #2 of 8, Attachment Z55R3 for severe weather formwork drawing):

NOTE: The severe weather formwork must be installed when either a Hurricane or Tropical Storm Watch or Warning (in accordance with the EM-220 Violent Weather Committee instructions) has been declared.

NOTE: Due to the large surface area of the formwork panels, all lifting activities associated with installing or removing the severe weather or production formwork are restricted to when wind speeds are less than 20 mph.

Separate formwork will be provided to protect the containment opening in the event of severe weather (hurricane). This set of forms has been designed to resist hurricane force winds of 110 mph at 30' above grade, resulting in a pressure of 30 psf per Ref. 2.1 and 5.27. Total maximum wind load generated will be 30 psf x 25' x 27'= 20,250 lbs. The forms will be mechanically attached to the 5000 psi concrete containment wall with ½" diameter Hilti Kwik Bolt 3 carbon steel anchor bolts with a minimum embedment of 3 ½" and maximum hole depth of 5". These anchor bolts may be installed pre-outage or during the outage. Per Reference 6.25, Ft = 2661 lbs and Fv = 2068 lbs, with a factor of safety (FOS) of 4.0. Therefore, assuming a prying factor of 2 the number of bolts required = (2 x 20,250)/2661 = 16 bolts. Since the overall form height will be approximately 30', a total of 8 anchor bolts at approximately 4'-0" c/c (+/- 12") will be provided on each side of the containment opening form for a total of 16 anchor bolts.

Blocking under the forms may be installed by construction, as required. If blocking is installed it must be placed, at a minimum directly, over the W27x84 structural beams that support the work platform. Refer to Attachment Z54 for an engineering evaluation of the loads to the work platform.

- Evaluation of closure curtain in the access opening for inclement weather protection:

A plastic/vinyl (or equivalent) curtain will be hung in the containment wall access opening to protect the interior of the building from inclement weather. This curtain can also act to impede air flow from inside containment to outside containment and may be opened as needed to allow material movement through the access opening. The support rail from which the curtain will be hung will be installed on the outside face of the containment wall, above the opening, with 5/8" diameter Hilti Kwik Bolt 3s, with a minimum embedment of 3 ½" and a maximum hole depth of 5". Refer to Reference 6.25 for anchor bolt allowable loads and corresponding embedments. Anchor bolts may be spaced as required to meet the curtain rail manufacturer's installation requirements or as directed by field engineering. This installation is non-safety related.

- Evaluation of limitations on pre-stressing tendon force (determine retensioning tolerance)

The 2001 Edition (with Addenda through 2003) of ASME Section XI, Article IWL-4000, *Repair / Replacement Activities*, specifies requirements applicable to concrete containment (reactor building) repair and replacement work. It includes a number of specific instructions and references Sub-Section IWA for coverage of general programmatic issues. In particular, it references IWA-4224, IWA-4225 and IWA-4226 for requirements applicable to post-tensioning systems. In addition, IWL-4000 includes a reference to IWL-2310(b) for certain visual examinations. Otherwise, it does not reference IWL-2000, *Examination and Inspection*, for Repair and Replacement work. And, it does not specify limits on tendon seating forces.

IWA-4221 covers replacement items (as opposed to repair work on an existing item) but effectively states that repair work can always be done to the requirements of the original Construction Code unless a re-design is involved. The restoration of the reactor building opening does not qualify as a re-design since it is intended to restore the structure to a condition as close as is reasonably possible to that existing prior to creation of the opening. Therefore, the original Construction Code, ACI 318-63, is a valid code to use for the restoration work.

IWA-4226 generally allows the use of later editions of the Construction Code and requires reconciliation if materials are substituted.

The CR3 design code of record is ACI 318-63. Paragraph 2606(a)2 in this edition limits tendon stress at load transfer (seating) to 0.70 f_s' (where f_s'= ultimate strength of pre-stressing steel) but addresses the type of wire available at the time that it was drafted. This limit was revised in 1983 to account for the improved properties inherent in low relaxation wire, which is the type used for both original and replacement tendons at CR3. Paragraph 18.5.1(b) in the 2005 edition limits wire stress at load transfer to 0.82 f_{py} but no more than 0.74 f_{pu} (in current terminology f_{pu} rather than f_s' is used for wire ultimate tensile strength). Since the yield of low relaxation wire is at least 90% of the ultimate, 0.82 f_{py} is at least 0.9 x 0.82 f_{pu} = 0.74 f_{pu}. Therefore, using the revised limit given in ACI 318-05, it would have been permissible to seat tendons at 0.74 f_{pu} or, in equivalent load terms, 0.74 GUTS (Guaranteed Ultimate Tensile Strength), at the time of construction. The change in the seating force limit is discussed in ACI 318-05, Commentary Paragraph R18.5.1.

IWA-4226 allows a later edition of the Construction Code to be used for the reactor building opening restoration work since wire material is the same and the reconciliations covering the changes to anchor head and shim material show that the load carrying capacity of these items is not reduced. Therefore, ACI 318-05 can be considered applicable to the restoration work and, consequently, both original and new tendons may be re-tensioned to 0.74 GUTS. Use of the later edition of ACI 318 has been addressed in Section B.6.3.

Refer to Attachment Z30 for an evaluation of the resulting shear stress in a tendon anchor head resulting from stressing a tendon to the maximum allowable load of 0.74 times specified tensile strength.

Refer to Attachment Z31 for additional comments from S&L concerning the tendon retensioning tolerance of +4%, -0% and affects on tendon anchor head.

For reference, the 2001 Edition (with Addenda through 2003) of ASME Section III, Division 2, Paragraph CC-4464.1 states that the limit on tendon seating force is to be given in the Construction Specification. The CR3 Construction Specification references Prescon (the post-tensioning system supplier) procedures for tendon seating force limits. No Prescon procedures have been located.

Refer to Attachment Z31 for additional comments from S&L concerning the tendon retensioning tolerance of +4%/-0%.

Conclusion: Tendons will be tensioned/retensioned to 70% GUTS +4%, -0%

- Evaluation of the design and use of the tendon work platforms and upper support frames

The design criteria for the work platforms can be found in Section B.6.5-o.

Refer to the Maintenance Risk Assessment contained in NTM AR #284485 which assesses the risk posed to the plant by this activity.

No more than 60 days prior to the start of R16 refueling outage while the Unit is in any Mode, four Upper Support Frames (a.k.a. USF) supplied by Precision Surveillance Corporation (PSC) will be lifted and staged on the containment roof rail system. Each USF supports a tendon work platform (2 - nominal 8'x10' platforms and 2 – nominal 10'x20' platforms) with four independent drive cables and four independent safety cables each. PSC has qualified all four USFs (with platforms attached) for dead, live, hurricane, and seismic loads (Refer to Attachment Z34 for calculations and associated sketches) while staging them on the RB roof rail This calculation has also verified that the USFs have sufficient strength to resist tornado wind loads and cannot break apart during a tornado and become a source of missiles. The tie-downs that this calculation specifies ensure that the USFs cannot slide off the RB roof as a result of any of these loads.

Section B.6.23 contains a list of all the major lifts that will be made using the mobile crane, both pre-outage and during the outage, associated with the containment opening including the

USFs, and tendon work platforms, including estimated weights and load drop analysis. Sketch 63016-SK-S001 (Attachment G01) depicts the safe load path, crane configuration, lift radii and total lift weights (including weight of rigging) for the USFs, work platforms and the tendons coilers. Refer to EC 63020 "SG Replacement – Outside Erection Crane & Inside Auxiliary Crane" for additional crane details.

Each USF is lifted to the containment roof, in the vicinity above the equipment hatch at AZ. 150 degrees, placed on the existing rail system and then hooked up to a work platform. Each combined USF and suspended work platform is then rolled around to a temporary staging location as discussed below before final staging at buttress #2 (8'x10' platform), #3 (nominal 10'x20'), #4 (nominal 10'x20') and #5 (8'x10').

In the event of violent weather (as described below) all work platforms will be lowered to the ground and secured:

- Tornado Watch: Alerts an area of the possibility of a tornado and usually lasts for 2 to 4 hours.
- Tornado Warning: Issued when a tornado has been sighted in the area.
- Whenever winds exceed 30 mph
- Hurricane and Tropical Storm Watch and Warning (in accordance with the EM-220 Violent Weather Committee instructions)

The USF and platform combination for buttress numbers 2, 3 and 5 will be rolled clockwise around the roof (from their initial position at approximate AZ 150 degrees). The 8'x10'platform at buttress #5 must be rolled clockwise (due to the presence of the stack on the south side of buttress #5) past the Spent Fuel Pool (SFP), while the plant is in Modes 1 thru 4. Alternatively, construction has the option to temporarily store the platform on the IB roof during Modes 1 thru 4, as discussed below. Prior to the issuance of EC 64487 the SFP was covered by metal missile shields which were analyzed and accepted as providing adequate missile protection of the fuel, including dropping the approximately 8500# hydraulic tendon testing jack/ram. EC 64487 however justified the removal of these missile shields. Consequently, EC–ED 68398R0 was issued to provide the NUREG-0612 justification for tendon surveillance testing over the SFPs without the missile shields installed. This EC-ED evaluated staging a 8'x10' work platform at either buttress number 5 or 6 and the potential for dropping the hydraulic ram onto the fuel pools. The EC-ED concluded that the USF is designed for hurricane winds, seismic forces and the full dead & live loads of the platform and that a sufficiently large distance separated the work platforms from the edge of the fuel pools. Additionally, the USFs for SGR have been qualified (Refer to Attachment Z34) for hurricane and tornado winds and seismic loads while they are moving along the rail system. Based on these conclusions, moving the 8'x10' work platform past the spent fuel pool & staging it at buttress #5 is acceptable during any Mode.

During plant operation work cannot be performed in the area between buttress numbers 1 and 3 to avoid potential exposure of personnel to high pressure steam from the main steam vents, located on top of the Intermediate Building (IB). However, Precision Surveillance Corp (PSC) has stated that all work associated with moving and staging the platforms at buttress numbers 2 and 3 (and 5) can be achieved by personnel working and staying within the boundaries of the

RB roof. No worker will be required to perform work activities on the outside face of the RB. Additionally, the work platforms at buttress numbers 2 and 3 (and #5 if required) will be lowered and stored on (or lowered to within several feet of) the roof of the Intermediate Building, below the top of the steam vents, thus eliminating the possibility of damage to the work platforms from a steam vent discharge, damage that could result in falling debris. The Intermediate Building (IB) is a Class 1 Structure (Ref FSAR Section 5.1.1.1), designed for tornado missile load. The maximum uniformly distributed load from a stored platform to the 2'-0" thick reinforced concrete IB roof is approximately 85psf (weight of a nominal 10'x20' platform is 17,000 lbs per B.6.20 resulting in 85psf) which is acceptable. Based on the preceding precautions the work platforms at buttress numbers 2, 3 (and 5 if required) can be moved and temporarily staged on the IB roof during plant operation. A walk down of the IB roof was conducted with both safety and operations to verify that the area was suitable for temporarily storing the platforms and that there was no additional safety concerns. Safety has also verified that it is acceptable for personnel to move around the roof of the RB between buttress numbers 1 and 3 with the plant at power, as described above.

The remaining nominal 10'x20' work platform will be rolled counterclockwise from its initial position at approximate AZ 150 degrees to the east side of buttress #4. The USF and suspended platform pose no seismic or hurricane wind II/I risk to the BWST based on the platform location relative to the BWST. There are no safety related components directly beneath the platform at buttress #4 that could be impacted due to a dropped load based on a walkdown with operations (Dave Jones) on 6/18/2008. Additionally, PSC design calculations (Attachment Z34) have qualified the USF/platform configuration for both seismic and hurricane/tornado wind forces.

NOTE: It is acceptable to store tools, gang boxes and other miscellaneous equipment required to support tendon related activities on the platforms during Modes 1 thru 4, while the platforms are being moved around the RB roof to either their temporary storage location on the IB roof or while they are being staged at buttress numbers 4 and 5, based on the following:

1. All items must be secured so that they cannot fall off the platforms. This restriction also applies during adverse weather conditions.

The maximum weight of an individual item is limited to 200 lbs to ensure no damage to the IB roof or the seawater room roof. Based on a maximum fall height of 130', final velocity would be approximately 62 mph, with the missiles resulting kinetic energy (KE) equal to 26,285 ft-lbs. By comparison, per Reference 9.1, Section 5.2.1.2.6 the KE generated by a 10' long 3 inch diameter schedule 40 pipe is 25,300 ft-lbs and maximum penetration is 0.3 inches. The maximum additional load to the platforms during Modes 1 thru 4 resulting from storing small tools, etc is 500 lbs. (limited by the allowable live load to the IB roof).

The Upper Support Frames and platforms are proof load tested to 125% of their rated load capacity by PSC prior to their shipment to the site. After assembly at the site, each platform is to be functionally tested at 125% of their rated capacity through the full range of movements expected (Refer to testing section E00 for test procedure).

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Note that the USFs and associated equipment must be stored, while on the containment roof, in a secure manner for adverse weather conditions, both before and during the SGR outage. Refer to site procedure EM-220, Violent Weather (Reference 7.18) for additional guidance.

- Evaluation and specific requirements for removing and salvaging vertical tendons 34V12 and 34V13 from within the access opening during Modes 5 and/or 6:

Refer to PSC Manual "Post Tensioning System Field and Quality Control Procedure Manual" (Attachment Z23) F&Q6.0 procedure for detensioning/removal of tendons for possible reuse.

After entering Mode 5, two vertical adjacent tendons (34V12 and 34V13) may be detensioned with a hydraulic ram, the buttonheads removed with a hand grinder, each tendon coiled and then saved as a contingency against the remote possibility that a new replacement vertical tendon is identified as being too short to use for tendon reinstallation. If it is determined that one or more of these two original tendons must be reused, then the tendon(s) will be sent to PSC for restoration. Note that tendon 34V12 has 162 existing wires and 34V13 has 159 existing wires. If these tendons are to be reused, then PSC is to add wires to ensure that each tendon has 163 wires.

Note that construction has the option to plasma cut these two tendons if required. Plasma cutting may be performed on either the buttonheads or directly above the anchor head, and will be dependent on field conditions. Plasma cutting directly above the anchor head may result in the overall tendon length being too short to reuse at its current location, although it may still be of sufficient length to reuse at a different location.

One wire will be removed from each of the two tendons prior to tendon removal, its length measured as accurately as possible, recorded, and this information sent to engineering for evaluation. The measured length will be compared to the length shown on the original fabrication and stressing cards to determine if the information on these cards is accurate.

Detailed visual examinations per IWL-2310(b) of the tendon anchorage prior to removal, and of the tendon during removal, must be made to ensure the tendon is acceptable for reuse. During tendon removal the full length of the tendon should be monitored for gross damage from corrosion. If gross damage is identified, removal shall stop and Engineering contacted to determine any potential corrective actions and continuation approval.

- Evaluation of replacement tendon sheathing and grease:

Tendon sheathing for original plant construction was fabricated from flexible conduit that could be bent by hand or rigid conduit (Ref. 3.8, Sections 3.07.1, 3.06). According to Reference 3.8 flexible conduit was constructed so that a hydrostatic pressure of 10 psig could be maintained without leaking water. Section 3.07.2 of Reference 3.8 states that gasketing materials were to be incorporated into the conduit if necessary to meet leak-tightness criteria. The replacement tendon conduit will be fabricated from rigid conduit that conforms to ASTM A513, Type 5 resistance welded tubing, as discussed in Section B.6.8-h. The leak-tightness of the joint between the new replacement tendon sheathing and the existing tendon sheathing has been

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ensured through the fabrication of a splice section as shown in drawing 421-350. After each splice section has been installed, all exposed joint lines are coated with Belzona for added safety to ensure the leak-tightness of the joint. This design provides reasonable assurance that the re-insertion of a tendon into a tendon sheath should not compromise the leak-tightness of the new tendon sheaths within the opening, thus ensuring no leakage of grease.

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It should be noted that the replacement grease for all affected tendons is Visconorust 2090-P4 which is wax based and is designed not to break down into separate components. The original P2 grease would break down into its individual components at high temperatures allowing the oil component to flow out. The P4 grease has a higher viscosity and higher melting point (120 to 140 degrees F) compared to the P2 and is also designed to adhere to the tendon wires. Since using P4 grease, PSC has seen a decrease in grease leakage while performing tendon in-service inspections at post-tensioned containments.

Combining the improved properties of the P4 grease with the new rigid conduit and engineered splice detail within the opening should ensure that no grease leakage occurs within the opening after insertion of the new tendons.

- Requirements for measuring amount of tendon grease removed per IWL-2526:

The volume of grease drained from both vertical and hoop tendons outside the access opening must be measured and recorded as required by IWL-2526. It is not necessary to measure and record the volume of grease that drains from the vertical and hoop tendons that are being removed from the access opening since nearly all the grease in the tendon conduit voids will be removed by pulling a cleaning waffle through the conduit. Consequently, 100% of the net volume of grease must be replaced in these removed tendons. Note that it is not necessary to replace the grease cans in the gallery from the time they are removed until the time they are reinstalled prior to regreasing. In lieu of replacing caps, construction will insure that the anchorage is protected with a light coat of grease and covered with a plastic bag when the tendon end is not being worked.

- Control of grease during re-filling of tendon sheaths:

To ensure that the tendon sheaths are filled and the tendons adequately covered with grease the following controls have been put in place. Grease removal and replacement is addressed in PSCs Field and Quality Control Manual, F&Q 5.0 and F&Q 17.0, respectfully. The Work Orders will refer directly to this manual (Attachment Z23). There are three QC Hold Points in F&Q 17.0 (i) verification that exit grease is clean and free of air bubbles, (ii) record grease temperature at exit end (iii) record amount of grease pumped into tendons void and (iv) verify grease caps are installed and are leak tight.

There are two primary methods for determining if the tendon voids have been adequately filled with grease.

(i) The grease caps are reinstalled at both ends of a tendon and the grease cap plug removed from both caps. Grease is pumped into the tendon void from one end of the tendon until it exits at the other end indicating that the void is full. The amount of grease pumped into the void will be recorded.

(ii) The net volume of each tendon void has been calculated (Attachment Z62) and the volume of grease removed is recorded in F&Q 5.0. Per IWL-3221.4 the absolute difference between the amount removed and the amount replaced shall not exceed 10% of the tendon net duct volume.

- Re-greasing Sequence:

Hoop tendons must be re-grease prior to entering Mode 4 since work is prohibited in the area between buttress numbers 1 and 3 with the plant at power due to the potential exposure of personnel to high pressure steam from the steam vents.

Vertical tendons may be re-greased in any Mode but must be completed within 30 days after entering Mode 2.

- Tendon Access Hatch Cover Removal and Reinstallation:

In support of pre-outage degreasing of the 30 vertical tendons affected by the SGR project, the tendon access hatch cover (Ref. drawing SC-421-011 and S-502-036) was removed to allow unobstructed access to the vertical access shaft that leads down to the tendon gallery. During removal of the hatch cover, several of the existing 3/8" diameter Phillips wedge anchors were identified as either missing, or broke during removal due to excessive corrosion.

During reinstallation of the hatch cover, broken and missing wedge anchors will be replaced with 1/2"diameter Hilti Kwik Bolt 3 (KB3) anchor bolts produced from AISI 316 Stainless Steel with a minimum embedment of 3 1/2". Construction has the option to install the new 1/2" diameter KB3s either at the same location as the existing anchor bolts (Option 1) or relocate within the tolerances specified below (Option 2):

Option 1: Install new Hilti KB3s at the same location:
Remove the existing defective 3/8" diameter Phillips wedge anchor and drill a ½" diameter hole to replace the damaged anchor with a 1/2"diameter x 5 1/2" long Hilti KB3 per the requirements of MP-804. The existing 1/2" diameter holes in the hatch cover (drilled thru the L6x4 – Ref. 4.3) must be enlarged to a 5/8" diameter hole to accommodate the 1/2" Hilti KB3s.

Option 2: Relocate Anchor Bolt location:
Either remove the existing 3/8" diameter anchor bolt and grout the abandoned hole per MP-804 or cut it off flush with the top of concrete, hammer it into the hole and grout. The revised location for the new anchor must be within 3" of the existing installed location and the minimum center to center spacing between two adjacent ½" Hilti KB3s is 7", as shown in Section C03R4. Grout abandoned holes per MP-804. The minimum bolt spacing has been reduced from 7 7/8" to 7" to ensure constructability and is acceptable based on the much higher allowable load for a ½" Hilti KB3 with a minimum embedment of 3 ½" (Ft = 1853#, Fv = 2351#) compared to the allowable loads for a 3/8" Phillips wedge anchor with a 3" minimum embedment (Ft = 1497#, Fv = 1659#). The structural integrity of the hatch cover was originally

evaluated in calculation S-90-0009, Rev. 0 that determined a maximum anchor tension load of 675 lbs and maximum shear load of 44 lbs (Note that this calculation must be revised to reflect the substitution of ½" Hilti KB3s for any existing damaged 3/8" diameter Phillips wedge anchors).

- Evaluation of #8 Rebar material requirements:

The existing steel reinforcement in the outside face of the containment shell is ASTM A615-68 Grade 40 material. The replacement material will be ASTM A615-(latest revision) Grade 60 steel. Since the yield and tensile strength, elongation and chemical properties of the new steel are equal to or better than the original ASTM A615 Grade 40 steel, the use of Grade 60 steel is acceptable for replacing the existing #8 rebars. Note that substituting Grade 60 for Grade 40 is also standard industry practice.
The primary function of the new #11 rebar cage that is to be installed in the opening is to provide additional sectional stiffness to the fresh concrete, thereby ensuring strain compatibility between the creep adjusted Young's Modulus of elasticity for the existing concrete surrounding the opening and the fresh concrete within the opening. Use of ASTM A615 Grade 60 material is therefore acceptable. Refer to drawings #421-349 and 350 (Attachments Z09 and Z10) for rebar installation details.

- Evaluation of hoop end adjustment for #11 rebar mats:

To facilitate pre-assembling the #11 rebar mats (2) on the ground and lifting them into position in the opening, the hoop bars will need approximately 6" clearance at each end, at the two sides of the opening (Refer to Drawing 421-350 and 421-351). This slight reduction in steel provided has been evaluated by S&L (Attachment Z37) and found to be acceptable.

- Evaluation of minimum rebar tension splice length for #8 rebars:

The minimum length of lap for tension lap splices has been calculated based on the requirements of Section 12.15 of ACI 318-05 which yields longer splice lengths than those required by ACI 318-63 (code of record). Per Section 12.15 of ACI 318-05 the splice was classified as a Class B splice with a minimum length of lap = 1.3 Ld. These lap splices have been staggered (Refer to drawing 421-351 for details).

- Evaluation of butt-welded rebar splices:

As an alternative to mechanical splicing of rebar (as described below) rebar may be butt-welded together using approved procedures contained in the Corporate Welding Manual NGGM-PM-0003 and as shown on drawing #421-351. Note that a new welding procedure is being developed for welding rebar applicable to the SGR containment opening (NTM AR #289322).

- Evaluation of the requirements for staggering the #8 rebar mechanical (swaged) splices within the opening:

The mechanical swaged splices required for splicing the new, replacement #8s within the access opening to the #8 stubs protruding from the inside perimeter concrete walls of the opening will not be staggered based on the following discussion:

Neither ACI 318-63, Section 805, "Splices in Reinforcement" or ASME Section III, Division 2 (Ref. 1.8), Section CC-4330, "Splicing of reinforcing bars" require rebar splices to be staggered. The swaged splices are designed and tested to develop 125% of the specified yield strength and 100% of the minimum ultimate tensile strength of the rebar to ensure a ductile failure of the rebar (Refer to discussion below under the bullet "Evaluation of the use of mechanical rebar splices"). The CR3 containment only contains one layer of #8s at 12" center to center (horizontal and vertical). The containment strength is based on the post-tensioned system of tendons and not the #8s whose primary purpose is to control cracking from shrinkage and temperature changes. Per calculation S06-0006 Section 4.6, the #8s were conservatively neglected during the evaluation of highly tension stressed areas in and around the construction opening that primarily resulted from bending moments due to thermal loads. The calculation showed that resulting fiber stresses were less than the concrete tension capacity, ignoring the #8s.

Conclusion: It is acceptable not to stagger the swaged #8 rebar splices .

- Evaluation of the use of mechanical rebar splices:

Refer to Section B.6.20 and E00R0 for testing requirements.
The use of mechanical swaged and arc-welded splices is acceptable based on the following: ASME Section XI, Subsection IWL-4000 "Repair and Replacement Activities", Subsection IWL-4230 states that "Damaged reinforcing steel shall be corrected by any method permitted in the original Construction Code or in ASME Section III, Division 2, with or without removal of the damaged reinforcing steel. ASME Section III, Division 2, Subsection CC-4331.2 (b3) (2001 Edition with 2002 and 2003 Addenda) allows the use of Swaged splices and Subsection CC-4331.2 (c) allows arc-welded joints.

➢ Comparison of code requirements per ACI and ASME for mechanical splices:

Requirements per ACI 318-63:
805(d) – Approved positive connections for bars designed to carry critical tension or compression shall develop in tension at least 125% of the specified yield strength of the bar.

Requirements per ACI 318-05
12.14.3.2 - A full mechanical splice shall develop in tension or compression, as required, at least 125% of the specified yield strength of the bar.
21.2.6.1 - Mechanical splices shall be classified as either Type 1 or Type 2 mechanical splices, as follows:
(a) Type 1 mechanical splices shall conform to 12.14.3.2;
(b) Type 2 mechanical splices shall conform to 12.14.3.2 and shall develop the specified tensile strength of the spliced bar.

NOTE: All mechanical rebar splices used to restore the access opening shall be Type 2

Requirements per ACI 349-01 (Provided for information only)

12.14.3.4 - A full mechanical connection shall develop in tension or compression, as required, at least 125% of the specified yield strength of the bar.
12.14.3.4.1- Mechanical connections shall be qualified for use in the construction on the basis of the following performance tests:

(a) *Static Tensile Strength Tests*—A minimum of six static tensile strength tests shall be conducted considering the range of variability's in splicing material, in material of reinforcing bars and in the anticipated environmental conditions. All test samples shall meet the requirement of 12.14.3.4.
(b) *Cyclic Tests*—Three specimens of the bar-to-bar connection for each reinforcing bar size and grade shall be subjected to 100 cycles of tensile stress variations from 5 to 90% of the specified minimum yield strength of the reinforcing bar. The specimens shall withstand the cyclic test without loss of static tensile strength capacity when compared with like specimen in (a) and tested statically to failure following cyclic tests.

12.14.3.6 - All welded splices and mechanical connections shall be visually examined by a qualified and experienced inspector to assure that they are properly installed at the place of construction. Where it is deemed necessary, the engineer shall be permitted to require the destructive tests of production splices to assure the compliance with 12.14.3.4.
12.14.3.7 - Mechanical connections shall be staggered if the strain measured over the full length of connection (at 0.9 yield) exceeds that of a bar that is not mechanically connected by more than 50% and if the maximum computed factored load stress in the bar equals or exceeds 0.5***fy***.

Requirements per ASME Section III, Division 2, Subsection CC:
CC-4333.2 Splice System Qualification Requirements

CC-4333.2.1 General Requirements. Each splice system Manufacturer shall conduct a series of performance tests in order to qualify his splice system for use.

CC-4333.2.2 Materials to Be Used for Performance Tests. The types of materials to be used for the performance test splices shall be the same as those intended for use in production splices. The actual materials used and the necessary dimensions of all test specimens shall be documented.

CC-4333.2.3 Type and Number of Performance Tests

(a) Static Tensile Tests. Six splice specimens for each bar size and splice type to be used in construction shall be tensile tested to failure using the loading rate set forth in SA-370. A tensile test on an unspliced specimen from the same bar used for the spliced specimens shall be performed to establish actual tensile strength. The average tensile strength of the splices shall not be less than 90% of the actual tensile strength of the reinforcing bar being tested, nor less than 100% of the specified minimum tensile strength. The tensile strength of an individual splice system shall not be less than 125% of the specified minimum yield

strength of the spliced bar. Each individual test report on both the spliced & unspliced specimen shall include at least the following information:

(1) tensile strength;
(2) total elongation;
(3) load–extension curve to the smaller of 2% strain or the strain of 125% of the specified minimum yield strength of the reinforcing bar.

(b) *Cyclic Tensile Tests.* Three specimens of the bar-to-bar splice for each reinforcing bar size (and grade for taper threaded splices and threaded splices in thread deformed reinforcing bar) and splice type to be used in construction shall be subjected to a low cycle tensile test. Each specimen shall withstand 100 cycles of stress variation from 5% to 90% of the specified minimum yield strength of the reinforcing bar. One cycle is defined as an increase from the lower load to the higher load and return.

CC-4333.2.4 Essential Variables. The performance tests must be completely reconducted when any of the applicable changes listed below are made. Changes other than those listed may be made without the necessity for repeating the performance tests.

(a) For all splice systems:
(1) A change in splice sleeve material or grade
(2) A reduction in the cross-sectional area of the splice sleeve
(3) A reduction in the bar engagement length
(4) An increase in reinforcing bar grade

(d) For swaged splices:
(1) A change in swaging pressure
(2) A change in die geometry
(3) A change in stud material
(4) A change in outside or inside diameter

Summary of Code Requirements for Mechanical Splices:

ACI 318-63	ACI 318-05	ACI 349-01	ASME Sect III, Div 2 CC
125% of the specified yield strength (fy) of the bar.	125% of the specified yield strength (fy) of the bar.	125% of the specified yield strength (fy) of the bar.	125% of the specified yield strength (fy) of the bar. Average tensile strength of the splice > 90% of the actual tensile strength of the reinforcing bar being tested, nor less than 100% of the specified min tensile strength.
	Type 2 mechanical		

----	splice shall develop the specified tensile strength of the spliced bar.	----	----
----	----	Minimum of six static tensile strength tests	Minimum of six static tensile strength tests
----	----	Three cyclic tests	Three cyclic tests
----	----	Measured strain in connector at 0.9fy < 150% unspliced bar at a strain of 0.9fy	----
----	----	Factored load stress in bar < 0.5fy	----

Pre-Construction Qualification Testing of the Mechanical Splice System per ASTM Section III Div CC-4333 (Ref. 1.8):

Prior to shipping splices to the field, the manufacturer (or Progress Energy) is to perform a series of static and cyclic tests that conform to the Code Requirements above, i.e. 6 static and 3 cyclic tests for #8 splices and #8 rebar. The acceptance criteria are as stated in the Code Requirements for ASME Sect III, Div 2 CC-4333. Refer to Section B.6.20 and Section E00 for a more detailed explanation of the test requirements.

Initial Splicer Qualification Testing:

CC-4333.4: Each splicer shall prepare two qualification splices for #8 rebars in each of the splice positions to be used (e.g., horizontal and vertical) and the completed qualification splices shall be tensile tested per SA-370 and the tensile results shall meet those specified in Table CC-4333-1 (also refer to Section B.6.20 and Section E00).

Construction Testing of Production Mechanical Splices:

During installation sister splices will be used to verify the consistency of the cold swaging operator and that the splice meets the specified tensile requirements. Refer to Section B.6.20 and Attachment E00 for instructions on producing and testing the sister splices. All sister splices will be tested to destruction and must meet 125% of the specified yield strength and a sequential average of 15 splices shall meet at least 100% of the minimum specified ultimate tensile strength.

11. Hydraulic Requirements:

The water requirements for the hydrodemolition activities are approximately 2,000,000 gallons of clean water and must be supplied at the rate of 360gpm.

12. **Chemistry Requirements:**

Water requirements for hydrodemolition:
ECED 59400 identified the possible source of this water (approximately 2,000,000 gallons) as the well fields located to the east of CR3, operated and maintained by the fossil group at Crystal River South (CRS). The hydrodemolition contractor (Mac and Mac) requires no specific chemical criteria that the water has to meet except that it is clean, i.e., Total Suspended Solids (TSS) of less than 45ppm and can be delivered at a rate of 300 gpm (Reference Attachments Z24 and Z35). RP/Chemistry laboratory baseline testing of the water before it is delivered to the hydrodemolition contractor for radio nuclides and other chemical parameters is required including verifying that TSS is less than 45ppm.

Chemical requirements for discharging the waste water are within the scope of this EC and are discussed below under "Waste Water'. The containment opening task manager is responsible for water delivery, storage and the means of piping it to and from the containment and is outside the scope of this EC. He is also responsible for determining if the settling ponds have adequate storage for the expected 2 million gallons of waste water generated from hydrodemolition. Additionally it must be taken into consideration that during plant cool down, CR-3 will begin a condensate release to the settling ponds. As soon as the plant enters mode 5, condensate will be released as fast as permitted (300 gpm max) in order to drain the secondary system to allow work to commence. This could add approximately 500,000 gallons of condensate to the settling ponds. This needs to be taken into consideration when assessing the available volume in the ponds.

The details for supply and disposal of the water for concrete hydrodemolition will be included and approved per Work Order Task 1165094-Task-03. Additionally, AR 00292151 has been assigned to the containment task manager to ensure he develops all these activities and adds them to the Work Order.

Waste water:
Samples for radiological testing and analysis will be taken at the collection bins and tested at the on-site RP/Chemistry laboratory in accordance with existing site procedures. Discharge of the water and rubble (from the collection bins to Mac and Macs skid mounted wastewater treatment facility) may continue uninterrupted while samples are being tested and analyzed. Specific details on radiological sampling and analysis of the waste generated during hydrodemolition will be addressed by SGR RP in the Containment Opening RP Task Plan (issue date tracked by AR 292005) and the associated work package
The environmental/chemistry groups have evaluated the current requirements of the Plant Industrial Waste Water Permit (IWWP) and concluded that waste water (non-radiological) treatment is required as a pre-requisite before discharging the water. The following waste water (non-radiological) tests will be performed as a pre-requisite for discharge:

- Only pH sampling will need to be performed as a pre-requisite for discharge. Contractor should strive to keep the pH between 6.0 and 9.0. Periodic sampling of pH will be needed. A "stop job" limit will be established at pH less than or equal to 2, or pH greater than or equal to 12.5.

- Recommended that laboratory samples for pH, TSS, and oil & grease be collected at about 3 times during project (start, middle, end), and results placed in project file and plant file. These samples are for documentation only, and would not require batch processing of the wastewater, or delay transfer.

Per Mac and Mac, the discharged waste water will meet the following criteria (given here for information only) which satisfy the requirements of the IWWP (NOTE: Only the requirement for pH limits is necessary for discharge per the IWWP):

- 6.0 thru 9.0 pH
- Total suspended solids < 30ppm
- Oil in the water, daily maximum of 18.4ppm with a monthly average below 13.8ppm.

Water requirements for replacement concrete mix for the temporary construction opening:
The testing requirements and acceptance limits of ASTM C1602 (Ref. 1.19) shall apply by reference to ASTM C94. The concrete mixing water will be collected from a non-potable source (well water) and should meet the requirements of Section 5 of ASTM C1602. Ice (if used) shall be obtained from a potable source and per ASTM C1602, Section 4.2 does not require testing.

Diesel fuel/oil requirements:
Diesel fuel that will be stored in mobile tanks to fuel the hydrodemolition equipment will be managed in accordance with site procedures. All mobile diesel equipment shall have integral secondary containment or be placed within a secondary containment.

Tendon grease disposal:
Waste grease is managed in accordance with EVC-SUBS-00107, Waste Vendor Program. Waste profiling (chemical profile) may be required before disposal. It will be tested by RP before release.

13. Electrical Requirements:

As previously noted this EC does not affect the permanent station electrical distribution system. However, temporary construction power may be required to support the construction activities associated with the creation and restoration of the access opening. Temporary power is addressed in EC 70377, Temporary Power Requirements.

14. Layout and Arrangement Requirements:

The only layout activities associated with this EC are the requirement to establish the boundaries of concrete removal on the outside face of containment, thus forming the temporary access opening in the concrete containment wall, and to establish the boundaries of the liner plate cut on the inside face of containment.

During R15, the outside face of containment was surveyed and the bottom corners of the liner plate cut (on the face of the concrete wall) laid out. The boundaries of concrete removal can be established based on the survey marks and Drawings:

- 421-348, Reactor Bldg Temporary Access Opening for SGR – Vertical & Horizontal Tendon Positions.
- 421-349, Reactor Bldg Temporary Access Opening for SGR – Plan Views.

15. **Operational Requirements Under Various Conditions:**

There are no design changes to the containment that will affect any operational requirements. No evaluation is required; however the following table has been added to clarify the operational status of the plant during which the major activities related to the creation and restoration of the access opening will occur. This table will also aid in the preparation of the Installation Instructions.

PLANT MODE	ACTIVITY
Any Mode	Partial degreasing of vertical tendons in and around the opening. Activity cannot start more than 60 days before Mode 5
Any Mode	Tendon anchorage inspections per ASME Section XI, Subsection IWL. Activity cannot start more than 60 days before Mode 5
Any Mode	Survey and layout the basic geometry of the opening.
Any Mode	Hoisting and installation of tendon work platforms and equipment onto the reactor building roof. Activity cannot start more than 60 days before Mode 5.
5 and 6	Ram detensioning, removal and salvage of two adjacent vertical tendons from within the access opening.
5 and 6	Plasma detensioning and removal of the remaining 8 vertical and 17 hoop tendons from within the access opening
5 and 6	Hydrodemolition of the 42" thick concrete containment wall
5 and 6	Cutting and removal of the rebar and tendon sheaths within the opening.
Defueled	Cutting and removal of the steel liner plate at the opening.
Defueled	Detensioning of additional vertical and hoop tendons outside the opening (after all SG rigging activities are completed)
Defueled	Reinstallation and welding of the liner plate and its stiffener angles.
Defueled	Inspection and testing of the liner plate welds
Defueled or Modes 5 or 6	Install new (or existing) tendon sheaths, new rebar (#11) and existing rebar
Defueled or Modes 5 or 6	Install new replacement tendons in the opening
Defueled or Modes 5 or 6	Place new concrete
Defueled or Modes 5 or 6	Tension/retension all affected tendons
Prior to Mode 4	Perform ILRT
	Add new tendon grease to hoop tendons only.

Prior to Mode 4	
Any Mode	Add new tendon grease to vertical tendons only. Activity must be completed less than 30 days at power (after outage).

16. **Instrument and Control Requirements:**

There are no requirements for instrument and control as a result of creating and restoring the access opening.

17. **Access and Administrative Control for Plant Security:**

Station security shall be notified at least 24 hours prior to breaching the liner plate so that they may evaluate and implement compensatory measure. These requirements will be specified in the installation instructions; limits and precautions (Refer to Section D.2.1-4 in Attachment D00).

18. **Redundancy, Diversity, and Separation Requirements of Structures, Systems, and Components:**

The containment will be returned to essentially the same configuration and with no effects on Redundancy, Diversity, and Separation Requirements.

19. **Failure Effects on Requirements of Structures, Systems, and Components:**

NOTE: There has been no reduction in design margins as a result of this modification. All element and member stresses are within allowable code limits.

At certain times during the steam generator replacement outage the containment will be in a degraded condition, i.e. partially detensioned with a temporary access opening formed in the containment wall. After cold shutdown, in Modes 5 and 6, and during refueling operations, the containment must maintain its capacity to withstand the effects of a Loss of Decay Heat Removal Accident (LODHR) in combination with other design basis loads. While defueled, containment structural integrity is required while moving the steam generators and for II/I concerns with regard to interaction with the adjacent Auxiliary Building. Following is a discussion of the failure modes and effects for three distinct time periods that occur in the creation and restoration of the opening:

(i) Failure Effects on the structural requirements for the RB during the creation of the Access Opening in Modes 5 and 6 (Stage 1 prestress):

The temporary access opening will be created during Modes 5 and 6 when containment Operability is not required. However, there is an Improved Technical Specification Required Action Item (TS 3.9.5 Action B.3) that requires containment closure in Mode 6 in less than 4 hours to mitigate the dose consequences of a loss of decay heat removal accident. Additionally, AI-504 requires containment closure capable of withstanding 5.14 psi internal pressure should Decay Heat Removal be lost in Modes 5 or 6 descending (defueling). Creation of the opening during Modes 5 and 6 requires detensioning and removal of the hoop and vertical tendons within the opening (Stage 1 prestress) and hydrodemolition of the concrete, down to the liner plate. If a seismic event were to occur during this time period, failure of the containment could potentially result in the uncontrolled release of radioactive contamination. Calculation S06-0005 verifies the structural integrity of the containment shell and the exposed liner plate during Modes 5 and 6 for the following accident loads and combinations there-of:

- Reduced prestress
- Dead load
- Seismic
- Hurricane
- Pressure and temperature due to LODHR accident

(ii) Failure Effects on the structural requirements for the RB while Defueled and moving the steam generators on the horizontal transfer system (Stage 1 prestress):

The containment, while defueled, has a seismic II/I relationship with the adjacent Auxiliary Building due to the presence of the spent fuel pools. Damage to the partially detensioned containment resulting from a seismic event while moving the steam generators on the HTS would most likely be in the immediate vicinity of the HTS and access opening, which are approximately 135 degrees of arc from the spent fuel pool. Therefore, direct damage to the fuel from the effects of a seismic event while moving the steam generators on the HTS is highly unlikely. However, the containment shell has been analyzed and a probabilistic risk assessment developed to address containment integrity during this time period. Calculation S06-0005 has verified the structural integrity of the containment building for loads imposed by the horizontal transfer system (HTS) and temporary lifting device (TLD) that result from moving the steam generators in and out of containment. Tornado and seismic load cases were not evaluated based on the short time interval during which the HTS will be in use. The probability of an earthquake occurring that leads to fuel damage while the containment is partially detensioned and the HTS is in-place (assumed as a 30 day period) was calculated as 6.09E-07 for OBE and 3.45E-07 for SSE (Refer to Containment Opening Risk Assessment documented in AR 00284485). CR-3 does not have a seismic probabilistic risk assessment (SPRA) with which to compare this estimate of conditional fuel damage probability (CFDP). However, information from other plants that have conducted a SPRA is useful in comparing the CFDP calculated above for installation and use of the HTS to acceptable seismic core damage frequency (CDF) for power operation. Reference 9.7 contains the results of SPRAs conducted for 22 sites. The majority of plants reported core damage frequency between 1E-06 and 1E-04 per reactor-year. Only a small fraction reported CDFs higher than 1E-04 or lower than 1E-06. This is provided as a relative measure of risk posed by HTS use to acceptable seismic CDFs for operating plants. The CFDP due to a seismic event while the HTS is in use is below the lower range of the spectrum of CDF estimates from SPRAs. Therefore it can be inferred that no significant risk increase exists in this condition and normal work controls can be applied.

The probability of a tornado occurring while the containment is partially detensioned was determined to represent such a low probability as to be considered an acceptable risk (the probability of a tornado striking the CR3 containment during a 90 day period was calculated as 2.12E-08). These probabilities Refer to the Containment Opening Risk Assessment documented in AR 00284485 for an evaluation of the risk posed by a tornado strike and from tornado generated missiles, and the additional qualitative, defense in depth evaluation addressing tornado missile threat.

(iii) Failure Effects on the structural requirements for the RB while Defueled – After completion of all SG rigging activities, to just prior to start of refueling activities (Stage 2 prestress).

Similar to (ii) above, the containment during this time period has a seismic II/I relationship with the adjacent Auxiliary Building due to the presence of the spent fuel pools. After the old steam generators have been moved out of containment and the new steam generators rigged into their respective cubicles inside containment, 18 additional hoop and 20 additional vertical tendons around the opening are detensioned (Stage 2 prestress). To preclude any II/I interaction concerns, Calculation S06-0005 evaluated earthquake, tornado wind and tornado depressurization loads in combination with dead, reduced prestress (stage 2 prestress) and operating temperature. This evaluation is only concerned with demonstrating that the containment shell will not structurally fail and impact adjacent safety related systems, tornado wind and depressurization loads were determined based on the requirements of RG 1.76, Revision 1, NUREG/CR-4461, Revision 2 and SRP 3.3.2. Hurricane wind loads are enveloped by tornado winds. The following loads were considered in the design basis load combinations (per Table 5-3 of the FSAR):

- Dead load of the containment (including polar crane over opening)
- Reduced prestress load in the containment shell (Stage 2 Prestress)
- Reduced operating temperature
- OBE and SSE Earthquake
- Tornado wind and depressurization

(iv) Failure Effects on the structural requirements for the RB during restoration of the opening and during refueling operations (Stage 2 prestress).

During restoration of the Opening the containment still has a seismic II/I relationship with the adjacent Auxiliary Building due to the presence of the spent fuel pools. The analysis described in (iii) above (Calculation S06-0005) are valid for this time period and ensure that no failure of the containment will occur that could impact the spent fuel pools. After the liner plate has been welded in-place and NDE examinations completed, refueling operations will begin and an additional load case based on a LODHR accident during Modes 5 and 6 ascending have been evaluated in Calculation S09-0025.

The concrete containment shell with the temporary access opening, exposed liner plate and Stage 2 prestress have been qualified in calculation S09-0025 for the following loads in addition to those listed in item (iii) above:

- Dead load of the containment (including polar crane over opening)

- Reduced prestress load in the containment shell (Stage 2 Prestress)
- Reduced operating temperature of 83 degrees F inside containment
- Maximum LODHR accident temperature of 114.7 degrees F (Ref 5.29)
- Maximum LODHR accident pressure of 1.4 psig (Ref. 5.29)

20. **Test Requirements (Including Non-Destructive Examinations):**

The following tests and NDE will, at a minimum be required to support this EC (Refer to Section E00 for a complete list of tests associated with this EC):

- Containment pressure test:

The restored containment structure will be subjected to a pressure test as required by IWL-5000 and an integrated leak rate test (ILRT) that satisfies the Type A requirements of 10CFR50, Appendix J. The ILRT will be performed in accordance with the requirements of SP-178 "Containment Leakage Test-Type A Including Liner Plate" and ASME Section XI, Article IWL 5000.

a. Consistent with the requirements of IWL-5250 the new concrete in the access opening and a 2'-0" wide strip of the existing concrete extending beyond the perimeter of the opening shall receive a detailed visual examination in accordance with IWL-2310(b) prior to start of pressurization, at test pressure, and following completion of depressurization. The specified surface examination area shall be divided into a grid pattern consisting of approximately 2'-0" squares to help facilitate accurately recording the results of the surface examination. A suggested template for laying out the grid pattern and recording the examination results is included in Attachment Z60 for QCs information.

b. The liner plate requires a VT-1 examination per IWE-5240 as amended by 10CFR50.55a (b)(2)(ix)(G) prior to the start of pressurization and following completion of depressurization.

Refer to Section E00 for Acceptance Criteria.

- Mechanical splices:

Qualification of the Mechanical Splicing System (Pre-construction testing):
Per ASME Section III, Division 2, Subsection CC-4333.2, a minimum of six static tensile strength tests are performed on #8 spliced specimen. A tensile test on an un-spliced Grade 40 #8 is required to establish the actual tensile and yield strength. The six static tests shall be performed on Grade 40 to Grade 60 splices. The Grade 40 bar should control splice failure but it is possible that the harder Grade 60 may pull out.

Three low cycle tensile tests are performed on #8 spliced specimens. Each specimen shall withstand 100 cycles of stress variation from 5% to 90% of the specified minimum yield strength of the reinforcing bar. The three cyclic tests shall be performed on Grade 40 to Grade 60 splices. One cycle is defined as an increase from the lower load to the higher load and return.

Refer to Section E00 for Acceptance Criteria

Initial Splicer Qualification Testing:
Per ASME Section III, Division 2, Subsection CC-4333.4 each splicer shall prepare two qualification splices for #8 rebars in each of the splice positions to be used (e.g., horizontal and vertical) and the completed qualification splices shall be tensile tested per SA-370 and the tensile results shall meet those specified in Table CC-4333-1. Refer to Section E00 for Acceptance Criteria

Qualification testing during installation (i.e., Production splice testing):
During installation of the mechanical splices continuous testing of the mechanical splices will be required to ensure the consistency of the cold swaging operator and that the splice meets the specified tensile requirements. 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. Sister splices are splices that are made next to the production splices, under the same conditions and used for tensile testing. Sister splices shall be taken from each splicer at the following frequency, for each direction of splice:

- 1 sister splice for the first 8 production splices
- 2 sister splices for the next 30 or part thereof, repeated each 30 successive production splices.

Refer to Section E00 for Acceptance Criteria.

REBAR SPLICE QUALITY CONTROL REQUIREMENTS
The No. 8 reinforcing removed from the opening area will be spliced to stub bars by swaged sleeves where possible and otherwise by welding. To eliminate buckling that can result if a bar is connected by swaged sleeves at both ends (swaging causes a small increase in bar length), separate bars will be spliced to each stub and spliced together by lapping as shown on Drawing 421-351 (Reference 4.32).

Swaged sleeve splices will be installed and tested in accordance with manufacturer's instructions and the requirements of ASME Section III, Division 2 (Reference 1.8) Par. CC-4333 and shown on Drawings 421-350 and 421-351 (References 4.31 and 4.32). The manufacturer of the swaging system will provide training on the use of its equipment. The quality control (QC) requirements in Sections CC-2300, CC-4330 and CC-5320 of ASME Section III, Div. 2 (Ref. 1.8) will apply with the following exception as specified in the EC. Since the swaged couplings will be quite close to the face of the concrete in the opening, it will not be possible to cut out production splices and have a sufficient length of stub reinforcing remaining to remake these. Therefore, all testing will be on sister splices. The mix of sister splice reinforcing grade combinations (Grade 40 to Grade 40 and Grade 40 to Grade 60) will be consistent with that of the production splices.

These testing requirements are conservative when compared to the requirements of ASME Section III, Division 2 Subsection CC

- Liner Plate:

After the liner plate has been welded back to its original configuration, perform the following Non-Destructive Examinations (NDE) in accordance with the applicable sections of ASME Section VIII and ASME Section XI Subsections IWA and IWE on the liner plate butt welds around the perimeter of the opening:

- ➢ 100% visual examination
- ➢ 100% vacuum box leak testing
- ➢ 100% Magnetic Particle Testing (Double sided welds will receive Magnetic Particle Examinations on both sides of the liner shell. Welds with backing bar will receive Magnetic Particle Examinations after the first and final layers

NOTE: 100% magnetic particle examination may be used as an alternative to the original Owner examination requirements of 2% spot radiography and 20% liquid penetrant per the reconciliation evaluation contained in ECED70586.

Refer to Section E00 for Acceptance Criteria.

- Repairs to liner plate surfaces:

Damage areas of the liner plate shall be weld repaired and require the following tests:

- ➢ 100% visual examination
- ➢ 100% Magnetic Particle

Refer to Section E00 for Acceptance Criteria.

- Repairs of angle to liner plate welds:

Stiffener angle (L3x2x1/4) to liner plate weld repairs requires the following tests:

- ➢ 100% visual examination
- ➢ 100% Liquid Penetrant or Magnetic Particle Examinations

Refer to Section E00 for Acceptance Criteria.]

- Hydrodemolition water effluent testing prior to discharge:

Prior to discharging the waste water effluent, after it has been treated by Mac and Macs water treatment plant, pH sampling is required.

This activity is not included in Section E00 (Testing) since it is considered a normal construction support activity.

- Tendon work platform proof load test:

The two nominal 8'x10' and two nominal 10'x20' tendon work platforms must be load tested to 125% of their rated load:

1. Rated capacity of the large tendon work platform (nominal10'x20') is 22,000 lbs. Load test to 125% of rated capacity = 27,500 lbs.
2. Rated capacity of small tendon work platform (8'x10') is 4000 lbs. Load test to 125% of rated capacity = 5000 lbs.

Progress Energy is responsible for providing test weights. Each platform will be tested after it has been attached to its respective upper support frame (USF) directly above the equipment hatch shield structure, and prior to the USF (and attached platform) being staged at their respective buttress (Refer to Section B.6.10 for an evaluation of when and how the work platforms may be lifted and moved around the RB roof).

This activity is not included in Section E00 (Testing) since it is considered a normal construction support activity.

- Functional testing of the hydrodemolition equipment:

Approximately 2 weeks prior to cold shutdown functional testing of the hydrodemolition equipment is required. This will require testing of all the high pressure lines, electrical and hydraulic lines and controls. Two sheets of 8' x 10' (or similar) x 3/8" min. thick steel plates will be placed on the chipping platform against the reactor building wall for the purpose of testing the high pressure water nozzles and associate equipment.

This activity is not included in Section E00 (Testing) since it is considered a normal construction support activity.

- Pre-outage concrete testing:

Identification of concrete mix constituent material properties, proportions, mix design and mix properties will be done per Specification CR3-C-0003 Attachment 2 (Refer to Attachment Z25).

- Required concrete testing during access opening restoration:

Required tests and acceptance criteria for testing concrete during restoration and post modification tests are per specification CR3-C-0003

21. Accessibility, Maintenance, Repair, and ISI Requirements:

As noted in Section B.4.21 there are no changes to Plant accessibility, maintenance requirements or repair as a result of this EC.

ISI Requirements for the Tendons:

The current tendon ISI schedule for the original tendons is as follows:

- 9th Surveillance (35 years) is due R17 (2011).
- 10th Surveillance (40 years) is due R20 (2017)

Calculation S07-0003 has evaluated the impact on future predicted tendon forces resulting from detensioning and retensioning tendons outside the access opening and tensioning the new replacement tendons within the opening. This calculation predicts all tendon forces based on the current ISI schedule, i.e., 2011 and 2017.

However, CR3 is required to update their In-service Inspection Code Edition to the ASME Section XI 2001 Edition through the 2003 Addenda, effective 8/14/08. This new code edition now contains repair/replacement requirements for containment tendon replacements. The repair/replacement tendons are required to be tested initially at a 1 year + or – 3 month frequency (Refer to Table IWL-2521-2), then every 5 years thereafter. Therefore, calculation S07-0003 has also predicted the tendon forces at 2010 based on the following discussion. Due to the plant operating conditions at one year following the repair/replacement activity only the Vertical tendons could be tested within the given timeframe while the plant is at power in 2010. The Horizontal Tendons, due to their proximity to the Safety Relief Valves, cannot be tested while the plant is at power and would need to be deferred to the next scheduled refueling outage in accordance with IWL-2420 (b) (2011, Refuel 17) – Refer to UPDATE below . The plant is also scheduled to perform the 5 year tests on the original tendon scope in 2011 (Refuel 17).

The current schedule for ISI of the new and existing tendons is:

- 2009 - Pre-service examination of the repair/replacement scope.
- 2010 - 1year repair/replacement scope; 4% sample of both the vertical and hoop tendons affected by the repair. However, only the Vertical Tendons are accessible during plant operation, the Horizontal Tendons will be deferred to 2011, Refuel 17. Refer to UPDATE below which also defers the verticals to 2011.
- 2011 -1 year repair/replacement of the deferred scope (inaccessible Horizontal Tendons), plus 4% sample of both the vertical and hoop tendons affected by the repair, plus the normal 2% sample drawn from the population that excludes previously examined tendons and those affected by the SGR.
- 2017 - 4% sample of both the vertical and hoop tendons affected by the repair, plus the normal 2% sample drawn from the population that excludes previously examined tendons and those affected by the SGR

In lieu of multiple mobilizations to perform tendon testing over a three year period, the SGR Licensing engineer is developing a request for Code relief (Relief Request) proposing an alternative to Table IWL-2521-2's 1 year Initial Inspection schedule for the new replacement tendons following installation. A proposed alternative would be to perform the testing at 2 years, during Refueling Outage 17 (2011). This would also coincide with the 35 Year testing requirement for the original tendon scope.

UPDATE: In accordance with Relief Request #08-001-MX (Alternative Examination Schedule of IWL-2521-2 for Tendons Affected by the SGR Containment Opening Project) which has been approved by the NRC, the 4% sample of vertical tendons will be deferred until 2011, Refuel 17. The horizontal tendons will also be deferred to 2011 in accordance with ASME B and PV Code, Section XI, Table IWL-2521-2, Note 4.

ISI Requirements for the Liner Plate Welds:
Post modification VT-1 of the as-left weld will be required in accordance with ASME Section XI, Subsection IWE.

22. Personnel Requirements and Limitations:

Due to the relative infrequency and complexity of steam generator replacement projects, several mock-ups will be required to simulate complex work activities associated with the creation and restoration of the access opening. Personnel (craft) will receive valuable training from participating in these mock-ups that should result in these activities being executed in a safe and expeditious manner. There are no special requirements for these personnel beyond the normal and acceptable requirements that would apply for these job positions.

23. Transportability Requirements:

The majority of the components identified below must be lifted by a mobile crane (Refer to EC 63020) located outside the RB equipment hatch onto the RB roof or adjacent to the RB. Since there are safety related SSCs in the area, safe load paths must be established for these lifts. Note that during Modes 5 and 6 there are no safety related components in the vicinity of buttress numbers 2 and 3.
Safe load paths have been established for the following major lifts associated with the creation and restoration of the opening:

Hoop tendons (17 required) @ 4500 lbs each
Vertical tendons (10 required) @ 6500 lbs each
Tendon coiler (empty) @ 10,000 lbs each
Tendon work platform nominal 8'x10' (2 required) @ 4000 lbs each
Tendon work platform nominal 10'x20' (2 required) @ 17000 lbs each
Upper Support Frame for 8'x10' platform (2 required) @ 15000 lbs each
Upper Support Frame for nominal 10'x20' platform (2 required) @ 20000 lbs each
Tendon ram @ 8500 lbs each
Cut liner plate @ 8900 lbs
#11 rebar mat @ 7500 lbs each
Concrete formwork @ 32,000 lbs at 60' height

These safe load paths can be found in Attachments G01 thru G04. All of these lifts will utilize the outside mobile crane positioned adjacent to the equipment hatch shield structure. The maximum lift height in the vicinity of the MSB, EFT-2 and BWST is 70 feet based on a maximum dropped load of 30,000 lbs as evaluated in Calculation S08-0005. Since the evaluated dropped load of 30,000 lbs @ 70 feet envelopes all major lifts associated with the containment opening, this restriction is valid (60' x 32,000 < 70' x 30,000). Load drops associated with lifting the coilers and tendons to and from buttress numbers 3 and 4, and for lifting the hydraulic rams to buttress numbers 2 and 5 are addressed in the Risk Assessment documented in AR #00284485.

The lift weights and radii listed on the safe load path drawings are for guidance only. Final weights and radii will be determined by the rigging superintendent/crew in accordance with crane manufactures load capacity charts. All rigging is to be in accordance with the requirements of AI-650. Safe load paths cannot be changed without engineering approval. The actual weights and radii will not be significantly different from the weights and radii shown on the safe load path drawings.

24. Fire Protection or Resistance Requirements:

All of the activities involved in the creation and restoration of the construction opening have been evaluated to the requirements of the Station Fire Protection Program. The installation instructions will reference the procedures contained in Section B.4.24 thereby ensuring compliance with the Station Fire Protection Program.

There is no adverse impact with Station compliance with "Appendix R" to 10CFR50.

Diesel fuel precautions;
Diesel fuel that will be stored in mobile tanks to fuel the hydrodemolition equipment will be managed in accordance with site procedures. All mobile diesel equipment shall have integral secondary containment or be placed within a secondary containment. All activities must be coordinated with the Station Fire-Brigade and Pre-Fire Plans.

There is no adverse impact with Station compliance with "Appendix R" to 10CFR50.

25. Handling, Storage, and Shipping Requirements:

The handling, storage and shipping of all materials related to this EC shall conform, at a minimum, to ANSI N45.2.2 Level C requirements (Also Level C in MCP-NGGC-0402). The replacement tendons and associated hardware must be inspected prior to receipt to ensure that no damage has occurred since fabrication.

Radiological handling and storage of the cut liner plate section will be managed in accordance with the Containment Opening RP Task Plan.

26. Other Requirements to Prevent Undue Risk to the Health and Safety of the Public:

None. Refer to Section B.6.6

27. Materials, Processes, Parts, and Equipment Suitability for Application:

All materials procured for this EC have been evaluated in Section B.6.8.

Protective coatings that are applied to the liner plate in accordance with MNT-NGGC-0009 will ensure that the material, application and inspection requirements for DBA qualified coatings are met in accordance with CPL-XXXX-W-005. Coatings are purchased per CPL-XXXX-W-006. Coatings must comply with FIR-NGGC-0004.

Refer to Section B.6.8 for material evaluations.

28. Safety Requirements for Preventing Personnel Injury:

Pre-job briefs must emphasize the dangers of working at heights. Personnel access to the tendon work platforms must be limited to those individuals that have a need to actually be on the platforms. The pre-job brief should also emphasize the potential danger from dropped objects, especially considering the heights involved when working on the containment building roof or suspended on the work platforms. Adherence to and familiarity with PSC work procedures (Attachment Z23) is critical. Sufficient pre-outage training of the craft that will be involved in tendon work activities is required. An ALARA Work Plan will be required to minimize the overall dose received.

All work performed relating to this EC shall be in accordance with SAF-NGGC-2172, "Industrial Safety". All appropriate safety equipment is to be employed during the performance of this modification (e.g. eye, face, hearing, hand, foot protection, fall prevention / protection, respirators).

Due to the possibility of elevated temperatures during portions of this modification, personnel are to be trained in the hazards of heat stress. Personnel working on scaffolding must be familiar with the requirements for working at heights. All work controlled areas will be marked and tagged per AI-1816, "Industrial Safety Signs and Tags".

29. Circuits for systems w/ Improved Technical Specifications Testing Requirements:

None.

30. (CR3) Emergency Diesel Generator Loading Impact Assessment:

None.

B.7 Interfaces:

Based on contact with the below listed groups and individuals concerning this modification, the following results are documented:

DESIGN ENGINEERING STRUCTURAL:
The Design Verification milestone will document the seismic/structural review for this EC.
DESIGN ENGINEERING MECHANICAL:
This milestone will document the Mechanical Engineering review for this EC.

DESIGN ENGINEERING Electrical/I&C:
This milestone will document the Electrical/I&C Engineering review for this EC.

CONFIGURATION MANAGEMENT:
Review of AEL and ADL.

WELD ENGINEER:
Review welding requirements for liner plate full penetration welding and the attachment welds for construction aids, rebar welding and liner plate stiffener angles.

COATINGS
Review materials and installation instructions for conformance with procedures and requirements for protective coatings inside containment.
MAINTENANCE RULE:
This EC does not affect components within the scope of the Maintenance Rule required for the containment.

SYSTEM ENGINEERS:
System Engineers for the affected systems shall review the EC.

PROCUREMENT ENGINEERING:
This EC requires the purchase of vendor support components

PLANNER:
This EC requires the preparation of work instructions.

MECHANICAL MAINTENANCE:
Mechanical Maintenance review will document review for any impact to Plant Maintenance.

OPERATIONS:
Operations have reviewed this EC for turnover and operational impact.

RC/ALARA:
Work inside the RCA is included in this EC. According to RC, the Planner would send the work plan to the appropriate reviewer and any ALARA requirements would be determined.

ISI ENGINEER:
ISI engineer is required to review this EC for IWE/IWL, pressure testing, Repair and Replacement.

ENVIRONMENTAL ENGINEER:
This milestone will document the Environmental Engineering review for this EC.

REGULATORY AFFAIRS:
This milestone will document the Regulatory Affairs review for this EC.

FIRE PROTECTION:
This milestone will document the FP review for this EC.

SECURITY:
This milestone will document Securities review for this EC.

IWE/IWL ENGINEER
Designated Responsible Person/Engineer per IWE/IWL (Tracking AR 292796)

OTHER ECs:
EC 63020, SG Replacement – Outside Erection Crane & Inside Auxiliary Crane

EC 63022, Steam Generator Rigging and Transport, covers the rigging and handling plans for the steam generators.

EC 70377, Temporary Power Requirements.

ECED 70586, Containment Opening Liner Plate Owner Reconciliation

B.8 Quality Class Determination:

The quality class of this EC is Safety Related
Quality class of individual components and materials required for this EC are as follows:

1. The containment building is a **Class I Structure (Safety Related)** as described in the FSAR Sections 5.1.1.1 and 5.2.1 and the Design Basis Document for the Containment, (Tab 1/1). The primary function of the reactor containment building and its steel liner is to house the primary nuclear system and to provide biological shielding from the fission products that could become airborne under accident conditions. Its failure could result in the uncontrollable release of radioactivity and its integrity is vital for the safe shutdown and isolation of the reactor.
2. Tendons, tendon anchorage including stressing washers, shims and tendon grease are all **Safety Related.** These items ensure the structural integrity of the containment building.
3. Tendon end caps and sheaths are **Non-Safety Related.** Neither item contributes to the overall structural strength or integrity of the containment. The purpose of the tendon sheaths is to create a void in the concrete into which grease is pumped.
4. All materials required for the concrete mix, i.e., small and large aggregate, cement, admixtures, silica fume and fly ash are classified as **Safety Related.** The mixing water is Non-safety Related.
5. The steel liner plate and liner stiffener angles are **Safety Related.** Required to act as a leak tight membrane which limits the release of radioactive products from the containment.
6. Steel reinforcing bars are **Safety Related**. Required to ensure the structural integrity of the containment building.
7. Mechanical splices for the rebar are **Safety Related**. Required to ensure the structural integrity of the containment building.
8. Tendon USFs, tendon work platforms, chipping platform chute and safety curtains are **Non-Safety Related items.**

Safety Classification of Activities related to this EC:

9. Detensioning and removing tendons is classified as **Non-Safety Related.** Calculation S06-0005 proves they are not required for containment structural integrity after cold shutdown.

10. Hydrodemolition of the concrete, including cutting the rebar is a **Non-Safety Related** activity. Calculation S06-0005 has analyzed the containment after cold shut down with the access opening.
11. Cutting and removing the liner plate in defueled Mode is a **Non-Safety Related** activity.
12. Re-installing the liner plate is a **Safety Related** activity. Required to act as a leak tight membrane which limits the release of radioactive products from the containment.
13. Installing all reinforcing bars is a **Safety Related** activity. Required for structural integrity of the containment.
14. Installation of the tendon sheaths is a **Non-Safety Related** activity. They do not contribute to the structural integrity of the containment. (Refer to Item #3 above).
15. Installation of concrete formwork is a **Non-Safety Related** activity. Required to provide temporary support of the newly placed concrete until it can support itself.
16. Mixing and placing the new concrete is a **Safety Related** activity. Sound concrete is required to ensure containment structural integrity.
17. All work associated with reinstalling the tendon's is **Safety Related**. They are required to ensure containment structural integrity.
18. Performing an ILRT is a **Safety Related** activity. Required to show containment leak tightness.

C.1 Document/Drawing and Equipment Database Mark-Ups

C.2 Updates of Controlled Documents/Drawings

Doc. Type	Document Number	Sht	Description Of Change or Reference to Mark-Up
draw	5ex7-003	8a	Add note to stressing washer drawing - Refer to C01
draw	CR-N10009-502	1	**New** drawing – Refer to Z02
draw	421-346	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Load Combinations. Refer to Z06
draw	421-347	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Vertical & Horizontal Tendon Positions. Refer to Z07
draw	421-348	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR –Demolition Sheet 1 and 2. Refer to Z08
draw	421-349	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Demolition Sheet 2 of 2. Refer to Z09
draw	421-350	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 1 of 3. Refer to Z010
draw	421-351	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 2 of 3. Refer to Z11
draw	421-352	1	**New** drawing - Reactor Bldg Temporary Access Opening for SGR – Restoration Sheet 3 of 3. Refer to Z12
draw	421-032	1	**Existing** drawing – Reactor Building Stretch-Out of Exterior Wall Buttress #2, #3, #4 and #5. Refer to drawing C02R0 markup.
LICN	FSAR		Update FSAR per Change document #FSAR 2008-0017
SPEC	CR3-C-0002		New specification "Formwork for the Restoration of the SGR Access Opening in the Containment Wall".
SPEC	CR3-C-0003		New specification "Concrete Work for Restoration of the SGR Opening in the Containment Wall". NOTE that this specification will not be issued until summer 2009……waiting for the concrete mix test data that will be available some time next summer. Tracked by AR 292126.
LICN	ODCM		Update ODCM to include the temporary containment access opening for SGR.
POM	AI-504		Revise containment pressure due to LODHR accident from 8 psi to 5.14 psi. To support core reload in prestress condition 2, additional equipment is required (Reference AR 00284485, Assignment #4).
POM	CP-341		Revise containment pressure due to LODHR accident from 8 psi to 5.14 psi
Draw	S-502-036	2	Miscellaneous Security Barriers (Tendon Access Gallery Hatch). Refer to C03R5

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C.3 Other Required Updates

Item	Description Of Change or Reference to Mark-Up	Rq'd for T/O?	AR Number?

C.4 Equipment Parameter Notes

U	System	Tag # or Equipment #	Parameter
Current Major Revision			
Pending Minor Revision			

C.5 Equipment Document References

Unit	System	Tag # or Equipment #			
Doc. Type	Sub-Type	Document Number	Sht	Add or Delete	Title

Unit	System	Tag # or Equipment #			
Doc. Type	Sub-Type	Document Number	Sht	Add or Delete	Title

Drawing 5EX7-003 Sheet 8a

Add following note:

The details on this drawing are typical for all vertical, hoop and dome tendons except for the following tendons which will be replaced during the Steam Generator Replacement Outage and new stressing washers provided per Drawing #CR-N1009-502:

34V8 thru 34V17 (10 verticals)

53H27 thru 53H35 and 42H27 thru 42H34 (17 hoops)

Deleted: 3

D.1 Installation Package

D1.1 This EC will create and repair an opening in the Reactor Building wall. This opening is necessary for the transport of the old and replacement OTSG during the Steam generator replacement outage. The following is an over view of the activities required to accomplish these activities:

Pre-Outage:

1. Mock-ups and associated training of craft for complex work activities required for the creation and restoration of the access Opening.
2. Staging tendon upper support frames onto the Reactor Building roof and attaching the tendon work platforms.
3. Partial degreasing of 30 vertical tendons in and around the Opening prior to Plant shutdown.
4. Installation of a temporary work platform (a.k.a. "chipping platform") as described in EC #63022.
5. Survey and layout the basic geometry of the Opening, and shallow saw cutting of the Opening.
6. Deleted
7. Tendon anchorage inspections per ASME Section XI, Subsection IWL.
8. Disable sump pumps SDP-3A and 3B and Install temporary sump pump(s) in the tendon gallery sump. Test the temporary pumps to ensure that they are operable and deliver at least 300gpm.
9. Saw cutting of the perimeter of the containment access opening.

Modes 5 and 6:

10. Tendon anchorage inspections per ASME Section XI, Subsection IWL.
11. Detensioning, removal and final degreasing of 10 vertical and 17 hoop tendon's from within the Opening (mode 5 or 6).
12. Hydrodemolition of the 42" thick concrete containment wall from within the Opening.
13. Radiological and environmental testing and disposal of the hydrodemolition effluent (wastewater and concrete rubble)
14. Cutting and removal of the steel reinforcement bars (rebar) within the Opening; drilling of pilot holes in liner plate for cut line layout.
15. Cutting and removal of tendon sheathing within the Opening.
16. Perform core boring in accordance with AI-480, ASTM C-42 and Attachment Z65.

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Defueled Prior To Removal and reinstallation of the OTSG:

17. Cutting and removal of the steel liner plate at the Opening, about liner plate cut line.

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Defueled After Removal and Reinstallation of the OTSG and removal of lifting and rigging equipment:

18. Tendon anchorage inspections per ASME Section XI, Subsection IWL (detensioned tendons-see #18)
19. Detensioning of Additional 20 Vertical and 18 Hoop Tendons Outside the Opening.
20. Reinstallation of the liner plate and associated weld examination.
21. Re-apply liner plate coating (can also be done in Mode 6).

During No Mode or Modes 5 and 6

22. Install three layers of reinforcing steel and tendon sheaths.
23. Install replacement tendons.
24. Install formwork.
25. Replace the removed concrete.
26. Tension/re-tension and re-grease tendons (Hoop tendons must be re-greased prior to entering Mode 4 since work is prohibited in the area between buttress numbers 1 and 3 with the plant at power due to the potential exposure of personnel to high pressure steam from the steam vents. Vertical tendons may be re-greased in any Mode but must be completed within 30 days after entering Mode 2) and perform IWE/IWL inspections of tendon anchorage.

During Refueling activities but Prior to Mode 4

27. Remove temporary pumps from the tendon gallery sump and re-energize sump pumps SDP-3A and 3B.
28. Perform ILRT, IWL and IWE inspection of the repaired containment opening and repaired liner plate.

D.1.2 Replacement activities of this EC are required to support SGRP and shall be coordinated with the following ECs and associated work orders.
EC 63022, Revision 0, Rigging and Handling
EC 70377, Revision 0, Temporary power interface

D.2 Installation Requirements

D.2.1 Prerequisites / Precautions

- To ensure compliance with the Station Fire Protection Program all work related to this EC will be done in conformance to the following procedures:

  1. All welding, cutting, or burning shall be per FIR-NGGC-0003, "Hot Work Permit".
  2. Determination of fire loading shall be per FIR-NGGC-0004, "Determination of Combustible Loading and Equivalent Fire Severity".
  3. All transient combustibles shall be controlled per AI-2200, "Guidelines for Handling, Use and Control of Transient Combustibles".
  4. For administrative and technical guidance for the development and operation of the Fire Watch Program at CR-3 refer to AI-2210, "Fire Watch Program".
  5. Pre-Fire Plan – Containment Building, AI-2205E
  6. CP-137, Revision 20, Fire and HELB Barrier Breaches

- Ensure that all applicable environmental permits are obtained and in place before implementation of activities associated with this EC.
- Ensure that activities associated with this EC are in compliance with the applicable portions of EVC-CRNF-00003, "Use Crystal River Nuclear Plant Site-Specific Environmental Compliance Manual".

- Any hazardous waste that is produced by activities implemented per this EC shall be handled and shipped in accordance with Procedures EVC-SUBS-00016, EVC-SUBS-00008 and AI-1820,
- Any non-hazardous waste that is produced by activities implemented per this EC shall be handled and shipped in accordance with Procedure AI-1820
- All chemicals and other consumables shall be approved and properly labeled per CHE-NGGC-0045
- All lifting and rigging shall be performed in accordance with AI-650, "Rigging, Lifting, and Material Handling Program"
- All welding shall be performed per NGGM-PM-0003, Corporate Welding Manual.
- Standard inspection criteria for structural steel, welding, and bolting apply, per NUA-NGGC-1530 unless noted otherwise.
- Special care shall be taken to minimize damage to existing applied protective coatings. Care shall be taken during rigging, handling, unloading, and erecting structural steel and components. Any damage done to protective coating should be repaired in accordance with site procedure.
- Coatings must comply with FIR-NGGC-0004 and the requirements of MNT-NGGC-0009.

1. Mock-ups and Associated Training for Complex Work Activities Required for the Creation and Restoration of the Access Opening.

   Several mock-ups that will simulate complex work activities associated with the creation and restoration of the access Opening will be required and are considered essential to the successful completion of the project. These simulations aid in training the craft in executing these activities in a safe and expeditious manner. Mock-ups should incorporate any radiation protection/ALARA considerations deemed appropriate by RP. Mock-ups will be constructed as determined necessary to support construction activities. The following mock-ups and training categories are considered essential:

   - Tendon detensioning and re-tensioning
   - Tendon plasma cutting
   - Tendon removal and re-installation
   - Liner plate cutting and removal
   - Repairing the liner plate
   - Reinstallation and welding of liner plate
   - Installation of the new tendon sheaths
   - Mechanical splicing of the rebar
   - Fusion welding of rebar splices
   - Full size mock-up of the Opening for placement of concrete.
   - Visual inspections per IWE/IWL for the liner plate, tendons and concrete (training must meet IWL-2300 and IWE-2300 requirements).

2. The following Prerequisites / limitations shall apply to the Tendon activities:

   - The methodology and requirements for Calibration of all tools and equipment shall be evaluated, reviewed and approved by Progress Energy (CR3) Nuclear Assessment Section (NAS).

- Tendon Service Platforms (USF) cannot be installed prior to 60 days before the start of R16
- Each USF will be lifted to the containment roof, directly above the equipment hatch at AZ. 150 degrees and installed on the rail system (Refer to safe load path drawing #63016-SK-S001 contained in Attachment G01).
- Each work platform, suspended from an USF will be load tested to 125% of its rated load (Refer to Section E00 for test requirements).
- In the event of violent weather (as described below) all work platforms shall be lowered to the ground or the Intermediate Building roof and secured (Refer to plant procedure EM-220, Violent Weather for additional information:

    1. Tornado Watch: Alerts an area of the possibility of a tornado and usually lasts for 2 to 4 hours.
    2. Tornado Warning: Issued when a tornado has been sighted in the area.
    3. Whenever winds exceed 30 mph
    4. Hurricane and Tropical Storm Watch and Warning (in accordance with the EM-220 Violent Weather Committee instructions)

- Storm drains in the tendon gallery shall be protected from grease spills. Plastic sheeting shall line the tendon gallery floor and walls as required to contain grease.
- Work cannot be performed in the area between buttress numbers 1 and 3 until in cold shutdown due to potential exposure of personnel to high pressure steam from the steam vents. Therefore work on the suspended service platforms at buttress numbers 2 and 3 cannot begin until the unit enters cold shutdown. These platforms must be lowered (remotely controlled during lowering) and stored on the intermediate building roof until Mode 5.
- Partial degreasing of 30 vertical tendons can begin no sooner than 60 days prior to the start of R16 refueling outage while the Unit is in any Mode.
- A hot work permit per FIR-NGGC-0003, “Hot Work Permit” must be obtained prior to plasma detensioning of the tendons to be removed.
- Tendon removal shall not begin prior to the plant entering Mode 5.
- Re-greasing of the tendons can be completed while the Unit is in any Mode, but is to be completed no more than 30 days after the Unit is in Mode 2. All waste grease shall be collected and disposed of in accordance with EVC-SUBS-00107.
- Disposal of the waste grease (after release by RP) must comply with the “Waste Vendor Program” corporate policy # EVC-SUBS-00107. All documentation generated as part of the disposal, e.g., manifests, disposal certificates, etc, must be provided to the CR3 waste coordinator.

3. The following Prerequisites / Precautions shall apply to the Hydrodemolition activities

- The hydrodemolition activities will require 2,000,000 gallons of clean water supplied to the hydrodemolition contractor with total suspended solids of less than 45ppm and must undergo laboratory analysis to baseline radio nuclides and other chemical parameters as determined by RP and the chemistry department.

- The details for water supply and disposal for concrete removal are outside the scope of this EC and will be included and approved per Work Order Task 1165094-Task-03. It is anticipated the water may be supplied over an extended period of time from the well fields located to the east of CR3, operated and maintained by the fossil group at Crystal River South (CRS). This water may be stored in one of the existing abandoned oil storage tanks (Cap. 8,000,000 gals). Shoring utilized to support the disposal chute may be stabilized by temporarily attaching bracing to the MSB purlins as required. A 1/2"diameter hole is permitted through the exterior wall, insulation, and purlin. Upon removal of the temporary bracing the hole in the exterior wall will be sealed with a suitable sealant. The debris chute and shoring will be removed as necessary upon notification to implement the EM-220 Violent Weather Plan.
- Station security shall be notified at least 24 hours prior to breaching the liner plate so that they may evaluate and implement compensatory measures.
- Ensure that a fire barrier breach permit is in place as required by CP-137, Revision 20, Fire and HELB Barrier Breaches.
- The containment coordinator is to be informed prior to starting the hydrodemolition machine. The coordinator must then inform all personnel in the immediate area of the opening that hydrodemolition activities are about to start and noise levels will increase dramatically (Pertains to OE from other plants during hydrodemolition).
- The hydrodemolition contractor's diesel trucks and power packs must be reviewed by the Nuclear Plant Construction (NPC) Environmental Specialist to ensure compliance with air permits. If necessary per the permit, this data will be provided to the CR3 Environmental Specialist.
- Functional testing of the hydrodemolition equipment is required prior to cold shutdown. This will require testing of all the high pressure lines, electrical and hydraulic lines and controls. Two sheets of 8' x 10' x 3/8" min. thick (or similar) steel plates will be placed on the chipping platform against the reactor building wall for the purpose of testing the high pressure water nozzles and associated equipment (Refer to Section E00).
- Operations must be made aware that any venting of radioactive material from the RB with the containment breached must be handled in accordance with the CR3 Offsite Dose Calculation Manual (ODCM).
- Communication with the Control Room is vital to ensure that radiological releases are not performed while personnel are working in elevated areas around the containment building.
- Verify the settling (percolation) ponds are available and in a physical condition/configuration to receive the approved discharge from the hydrodemolition activities. Note that approximately 500,000 gallons of condensate may be added to the settling ponds during plant cool down (in addition to the 2,000,000 gallons from hydrodemolition).
- The discharge water from the hydrodemolition activities to the settling ponds must meet the following requirements:
    - Sampled and released by RP/Chemistry
    - pH between 6.0 and 9.0 pH
- A "stop job" limit will be established at pH less than or equal to 2, or pH greater than or equal to 12.5.
- Laboratory samples for pH, Total Suspended Solids (TSS), and oil & grease may be collected at about 3 times during project (start, middle, end), and results

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placed in project file and plant file. There are no specific limits for TSS or oil and grease.

- Sump pumps SDP-3A and SDP-3B located in the tendon gallery must be turned off/disabled immediately prior to the start of hydrodemolition operations.
- Steps must be taken to verify that the temporary sump pump installed in the tendon gallery is correct for the operation and has a discharge volume of 300gpm. Temporary sump pumps are to be installed in the tendon gallery sump prior to the start of hydrodemolition.
- A safety net must be erected around the hydrodemolition equipment and the chipping platform to contain any debris resulting from hydrodemolition activities.
- The hydrodemolition contractor is to reduce the water pressure to a workable minimum pressure when removing the final 6"-9" thickness of concrete before exposing the liner plate.
- After the opening has been created in the containment wall and hydrodemolition is complete, remove the temporary sump pumps and re-energize sump pumps SDP-3A and SDP-3B.
- As a precaution, in case the liner plate is punctured prior to the plant being defueled, Belzona and thin sheets of steel plate (1/16" to 1/8" thick) shall be available (close to hand) with which to seal the puncture.

3.a The following and precautions shall apply to the core boring of the Reactor Building:

- o Drill core bores in accordance with Plant Operating Manual AI-480 and ASTM C-42
- o The locations chosen for core bores shall be in good concrete with no visual cracking present.
- The core shall be located at the approximate distance half way between the liner plate and the vertical tendons.
- o If rebar or misc. steel is encountered, drill additional core at new location. Use drill stops for core boring.

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4. The following limitations and precautions shall apply to the Liner Plate removal and reinstallation activities:

- The liner plate cannot be cut until the plant is defueled
- Liner plate coating cannot be removed or applied to the steel liner plate unless reviewed and approved by the ASME Code Section XI, IWE/IWL (ISI) Program Coordinator. Approval shall be documented by review and approval of the Work Order Task.
- All welding shall be performed per NGGM-PM-0003, Corporate Welding Manual.
- Station security shall be notified at least 24 hours prior to breaching the liner plate so that they may evaluate and implement compensatory measure.
- Notify Operations and RP and insure the following has been accomplished prior to commencing the liner plate cut:
    - o Appropriate radiological postings installed outside the access Opening
    - o Personnel monitoring and air monitoring equipment (radiological) installed and operational outside access Opening.
    - o Satellite de-contamination facility established (Ref. RP Task Plan)
    - o A 12" wide strip of paint on either side of the liner plate cut line has been removed.
    - o Inside face of the liner plate must be decontaminated as practical.
    - o Satellite de-contamination facility established

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- Obtain a fire barrier breach permit per site procedure CP-137, Fire and HELB Barrier Breaches,
- Additional attachment welds on the metallic liner may be required to attach construction aids to the liner. These construction aids may include pads that will be permanently welded to the liner to support lifting rings and lugs.

D.2.2 Detail required sequencing of steps

This section will be broken up by major activity. The handoffs from one activity to another will be identified.

D.2.2.1 Tendon Degreasing, Detensioning, Removal, Reinstallation and Retensioning

Refer to PSC Manual "Post Tensioning System Field and Quality Control Procedure Manual" (Attachment Z23) for additional guidance in removal, inspection and reinstallation of tendons.
Note: The intent of all of the instructions contained in this document must be transferred to the work order instructions, clearly, accurately and in their entirety. However, CR3 procedures will always take precedence over the PSC F&Q Quality Control Procedures.

The methodology and requirements for Calibration of all tools and equipment shall be evaluated, reviewed and approved by Progress Energy (CR3) Nuclear Assessment Section (NAS).

1. Tendon Service Platform installation
   a. Install four Upper Support Frames (USF) supplied by Precision Surveillance Corporation (PSC) as directed by PSCs supervisory representative and in accordance with the information contained in the PSC design calculation contained in Attachment Z34. Note that all platform tie-down material/equipment will be supplied by PSC.
   b. Each USF shall be initially placed on the reactor building roof rails above the equipment hatch (approximate AZ 150), following the safe load path drawing (see attachment G01).
   c. Each of the four USFs will support a suspended work platform (2-8'x10' and 2-nominal10'x20' platforms). Each work platform is lifted over the equipment hatch shield structure at AZ 150 degrees, and attached to its respective USF with cables.
   d. After a work platform has been attached to its respective USF it will be proof load tested per the requirements of Section E00.
   e. The suspended work platforms come in two sizes. The 8' x 10' platforms (and USFs) will be moved and staged at buttresses 2 and 5 and the nominal 10' x 20' platform will be placed at buttresses 3 and 4 with the restrictions listed below in f.

f. The USF and platform combination for buttress numbers 2, 3 and 5 will be rolled clockwise around the roof (from their initial position at approximate AZ 150 degrees) and must be lowered to their temporary storage location on top of the intermediate building roof. They cannot be staged at buttress numbers 2 or 3 until Mode 5. Note that the platform at buttress number 5 may be temporarily stored on the IB roof if required until Mode 5. The platform sequence is buttresses 5 first followed by buttress 2 and finally buttress 3.

g. The USF and platform combination for Buttress number 4 shall be rolled counterclockwise from its initial position at AZ 150 degrees to the east side of buttress # 4. It may be staged at buttress #4 during any Mode.

2. Tendon Degreasing and Tendon Removal

   a. Partially degrease the following vertical tendons prior to shutdown (Refer to drawing 421-347 for tendon location) :
      i. 34V8 thru 34V17 (within the opening),
      ii. 45V22 thru 45V24 and, 34V1 thru 34V7 (about buttress #4 and adjacent to the opening)
      iii. 23V1 thru 23V3 and 34V18 thru 34V24 (about buttress #3 and adjacent to the opening)

   b. After partially degreasing the vertical tendons, perform the required ASME Section XI, subsection IWL inspections of the tendon anchorage components either before the outage or during the outage dependent on labor needs, and the following requirements:

      1. The following two vertical tendon anchorages (inside the opening) including the surrounding concrete require a detailed visual inspection per IWL prior to ram detensioning (Refer to Drawing 421-347 and Ref. 4.19 for location):

         - 34V12 and 34V13

      2. The anchorage components of the following 8 remaining vertical tendons that are being removed from the opening do not require IWL inspections, except for the concrete surrounding the tendon bearing plates that must be inspected to IWL requirements prior to detensioning:

         - 34V8 thru 34V11 and 34V14 thru 34V17

   The anchorage components of hoop tendons that are being removed do not require IWL inspections, except for the concrete surrounding the tendon bearing plates that must be inspected to IWL requirements. 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.

   c. Two vertical adjacent tendons (, 34V12 and 34V13) (Refer to drawing 421-347 for location) may be removed from within the opening after the reactor has shutdown (after entering Mode 5) and prior to the start of concrete hydrodemolition of the 42" thick containment wall and saved for possible re-use.

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These two tendons will be detensioned with a hydraulic ram, the buttonheads removed with a hand grinder, coiled and then saved as a contingency to ensure that replacement vertical tendons of sufficient length are available in the event that a new replacement tendon is identified as being too short. If it is determined that one or more of these three original tendons must be reused, then the tendon(s) will be sent to PSC for restoration.

Note that Tendon 34V13 may be plasma cut directly above the bottom anchor head.

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One wire will be removed from each of the two tendons, its length measured as accurately as possible, recorded, and this information sent to engineering for evaluation.

d.

e. With the plant in Mode 5 or 6 the following tendons can be removed:
   i. 8 vertical tendons 34V8 thru 34V11 and 34V14 thru 34V17 (Ref. to drawing 421-347 for location).
   ii. 17 hoop tendons 42H27 thru 42H34 and 53H27 thru 53H35 - (Ref. drawing 421-347 for locations)
   iii. After the hoop and vertical tendons have been removed from within the opening, the open tendon sheaths shall be degreased to the extent practical.

f. The remaining 8 vertical tendons to be removed from within the opening (34V8 thru 34V11 and 34V14 thru 34V17) will be destructively detensioned by plasma cutting the buttonheads at the lower anchorage in the tendon gallery. The tendon is then coiled–up at the upper anchorage (RB roof) and banded, removed from the coiler, wrapped in plastic and lifted to the ground by the mobile crane.

g. Hoop tendons to be removed from within the opening will be destructively detensioned by plasma cutting the buttonheads at the smaller work platforms located at buttress numbers 2 and 5. The tendon is then coiled–up at either buttress number 3 or 4 and banded, removed from the coiler, wrapped in plastic and lifted to the ground by the mobile crane.

h. After a tendon is removed, attach a temporary protective bearing plate cover to the bearing plate, over the open tendon sheath void (hoops only) to prevent further debris from entering the tendon sheaths. Alternatively the grease cap can be replaced using the old gaskets.

i. Tendon removal activities are completed

3. Tendon Detensioning around the access opening

   a. After the old steam generators have been transported out and the new steam generators into containment, and the Horizontal Transfer Structure is no longer required to support lifting the steam generators, the following tendons shall be detensioned:
      i. 45V22 thru 45V24 and, 34V1 thru 34V7 (about buttress #4 and adjacent to the opening)
      ii. 23V1 thru 23V3 and 34V18 thru 34V24 (about buttress #3 and adjacent to the opening)
      iii. 42H22 thru 42H26 and, 53 H23 thru 53H26 (below the opening)
      iv. 42H35 thru 42H39 and 53H36 thru 53H39 (above to the opening)

   b. Detensioning shall be accomplished in accordance with PSC procedures

c. Complete the required ASME Section XI, Subsection IWL inspections of all the detensioned tendon anchorage components and surrounding concrete prior to detensioning.

4. Tendon reinstallation (No Mode or Mode 5 or 6)

   a. Tendon reinstallation can commence once the liner plate has been installed and the 2 layers of reinforcing steel has been installed in the containment opening.
   b. Install vertical tendon sheaths (See Drawing 421-350 and 351)
   c. Install Horizontal tendon sheaths (See Drawing 421-350 and 351)
   d. Install tendon sheath support brackets (See Drawing 421-350)
   e. As hoop and vertical tendons sheaths are installed the tendon sheaths shall be cleaned, to the extent practical, to remove any debris.
   f. With the sheaths and support brackets installed, INSERT vertical and hoop Tendons into tendon sheaths. The following tendons will be re-inserted:
      - Vertical tendons 34V8 thru 34V17 (Refer to drawing 421-347 for location)
      - Hoop tendons 42H27 thru 42H34 and 53H27 thru 53H35 - (Ref. drawing 421-347 for locations)
   g. Vertical tendons are uncoiled into the open tendon sheaths at the RB roof while pulling from the tendon gallery. Buttonhead the tendons in the tendon gallery.
   h. Hoop tendons are uncoiled into the open tendon sheaths at buttress numbers 3 and 4 while pulling from either buttress numbers 2 or 5 with a tugger. Buttonhead the tendons at buttress 2 and 5.
   i. STOP installing tendons at the start of concrete placement and HOLD until concrete has reached a compressive strength of 3000 psi.
   j. Complete tendon installation into tendon sheath

5. Tendon retensioning (No Mode or Mode 5 or 6)

   a. See Drawing 421-352 for tendon retensioning sequencing
   b. With the tendon reinstallation completed and once the replacement concrete has reached a compressive strength of 5000 psi the following tendons can be retensioned :
      i. 45V22 thru 45V24 and, 34V1 thru 34V7 (about buttress #4 and adjacent to the opening)
      ii. 23V1 thru 23V3 and 34V18 thru 34V24 (about buttress #3 and adjacent to the opening)
      iii. 42H22 thru 42H26 and, 53 H23 thru 53H26 (below the opening)
      iv. 42H35 thru 42H39 and 53H36 thru 53H39 (above to the opening)
   c. Once the replacement concrete has reached a compressive strength of 6000 psi the following tendons in the opening can be tensioned:
      i. Vertical tendons 34V8 thru 34V17
      ii. 17 hoop tendons 42H27 thru 42H34 and 53H27 thru 53H35

   Tendons will be tensioned/retensioned to 70% GUTS (Guaranteed Ultimate Tensile Strength), *+4%, -0%*

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D.2.2.2 Hydrodemolition

Refer to Mac & Mac Hydrodemolition Work Instructions (Attachment Z24) for additional guidance in hydrodemolition activities.

1. Pre-outage activities

   a. Install field routed water supply and discharge piping
   b. Water supplied to the hydrodemolition contractor should have total suspended solids of less than 45ppm and must undergo laboratory analysis to baseline radio nuclides and other chemical parameters as determined by RP and the chemistry department.
   c. EC 63022 will install a chipping platform over the equipment hatch
   d. With the installation of the chipping platform the following hydrodemolition activities can commence including pre-operational testing of the equipment as described in Section D.2.1-3.
   e. Layout the containment opening (Ref Drawing 421-348 and 349)
   f. Make a concrete saw cut, with a maximum depth of ½" around the perimeter (along the scribe lines) of the Opening to preclude spalling and to provide a neat, straight edge to pour the replacement concrete up against.
   g. Install the hydrodemolition equipment including
      i. Water supply and pumping system
      ii. Water collection and discharge system
      iii. Hydrodemolition Support Frame bolted to the chipping platform (Ref. sketch G05R0
      iv. Provide two support plates bolted with hilti bolts on the outside surface of the containment wall. This plate is provided to secure the vertical members of the hydro-demolition support frame during disassembly of the support frame. The support plate is shown in Page 3 of Attachment G 05.
      v. A protective screen around the perimeter of the chipping platform and
      vi. Portable water treatment plant

   h. Place 55 gallon drums in the tendon gallery to collect water discharging from the tendon sheaths.
   i. Install a temporary sump pump(s) in the tendon gallery sump adequate to pump the discharge from the tendon sheaths to the portable water treatment equipment. Steps must be taken to verify that the temporary sump pump installed in the tendon gallery is correct for the operation and has a discharge volume of 300gpm. Temporary sump pumps are to be installed in the tendon gallery sump prior to the start of hydrodemolition.
   j. Bechtel to confirm the operation and discharge volume of the pump(s) prior to the start of hydrodemolition.

2. Mode 5 & 6 activities

   a. When the horizontal and vertical tendons in an area of at least 6' square within the containment opening have been removed, the hydrodemolition activities can commence (Field Engineering to verify tendon removal and mark location for design engineering concurrence).

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b. Install covers over the bearing plates or reinstall the grease caps, at the horizontal tendons as the tendons are removed to mitigate water excursion

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c. Install a water collection system in the tendon gallery to collect water from the vertical tendons and pump it to the portable water treatment equipment. It is recommended by PSC that the vertical tendon sheaths are NOT plugged, however, note that this is only a recommendation.

d. Operation of the hydrodemolition equipment will be in accordance with the hydrodemolition contractor's operational manual and work instructions (Attachment Z24) which will address the following:

   i. Operate the hydrodemolition equipment, in the area free of tendons, as needed to adjust the equipment to consistently remove 4 ½" +/- ½".

      1. During this first layer of hydrodemolition, no vertical tendons are to be encroached upon; therefore, the temporary sump pumps in the tendon gallery are not required to be installed and functional. However, someone in communication with the hydrodemolition control must be staged in the tendon gallery at all times while this initial layer is removed, and the evolution stopped immediately if hydrodemolition water enters the area without sump pumps functional.

   ii. With engineering approval (design engineer signature required), if sufficient depth control of concrete removal is demonstrated, 4 ½" +/- ½" may be removed from the entire containment opening.

      1. The temporary sump pumps in the tendon gallery are not required to be installed and functional during the removal of this initial layer; however, someone in communication with the hydrodemolition control must be staged in the tendon gallery at all times while this initial layer is removed, and the evolution stopped immediately if hydrodemolition water enters the area without sump pumps functional.

   iii. With engineering approval (design engineer signature required), in the area where tendons have been removed, remove the concrete in the opening past the tendon sheathing as needed to cut the rebar and tendon sheaths. Refer to Attachment Z10 to ensure sufficient rebar and tendon sheathing remains for splicing after these items are cut.

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   iv. After the rebar and tendon sheathing is cut and removed and the remaining tendons in the opening have been removed continue with hydrodemolition. Provide Design Engineering with samples (e.g. 1 foot long section) of both vertical and horizontal tendon sheaths.

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   v. Continue the demolition activities until the final opening is in accordance with Drawing 421-348 and 349.

e. The hydrodemolition contractor (Mac & Mac) is to reduce the water pressure to a workable minimum pressure when removing the final 6"-9" thickness of concrete before exposing the liner plate.

f. Samples of the waste water and concrete rubble from hydrodemolition are collected for radiological testing and analysis at the collection bins (located below the hydrodemolition equipment) and tested at the on-site RP/Chemistry laboratory in accordance with existing site procedures. Discharge of the water and rubble may continue uninterrupted while samples are being tested and analyzed. Specific details on radiological sampling and analysis of the waste generated during hydrodemolition will be addressed by SGR RP in the Containment Opening RP

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Task Plan (issue date tracked by NTM AR 292005) and the associated work package.

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D2.2.2.a Containment Opening Core Boring

a. Core boring can commence in Modes 5, 6 and Defueled.

b. Field to drill nine (9) 4 inch dia. core bores in accordance with Attachment Z65.

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D.2.2.3 Liner Plate Removal and Reinstallation

1. Liner Plate removal

   a. Using the project survey team lay out the cut outline. When laying out the cut lines, utilize the tolerance for liner plate opening width, as shown on drawings 421-348 and 421-349, to avoid locating the vertical cut lines over a stiffener angle and also to ensure sufficient clearance from a stiffener angle for welding a backing bar in-place (used for the full penetration weld repair).
      (i) To facilitate layout of cut line on exterior of liner plate, ¼" max pilot holes may be drilled along cut lines during Modes 5, 6 and Defuel.
      (ii) Bolts, all-thread or equivalent fastener with washers shall be installed in pilot holes, fasteners must be secured to liner plate after drilling, fastener must be installed unless plant is Defueled
      (iii) During drilling and if fastener is removed from drill hole prior to Defuel, the requirements of CP-341 must be adhered to.
   b. Liner plate removal can commence after the concrete demolition has been completed and the reactor has been defueled (in No Mode)
   c. Remove a 12" wide strip of paint from either side of the liner plate cut line. NOTE: Liner plate coating cannot be removed or applied to the steel liner plate unless reviewed and approved by the ASME Code Section XI, IWE/IWL (ISI) Program Coordinator. Approval shall be documented by review and approval of the Work Order Task.
   d. Install temporary fit-up devices per Attachment Z21, and as required to aid in lifting and removing the liner plate (also will aid in reinstallation).
   e. Cut the liner plate as shown on drawing 421-349. Prior to cutting of the liner plate attach the two chain falls, four slings, and the strong backs as shown in Attachment Z22 Pages 2 to 6. The chain falls and the bottom two slings shall be secure before final severance of the cut section. A minimum of two 12" long uncut tabs on each side of the liner plate approximately about 3' from the top and bottom of the horizontal cut line are required for attaching slings to the mobile crane for rig out.
   f. With the lifting frame supported by the mobile crane commence the liner plate cut.
   g. Prior to leaving the protective area, the liner plate will be surveyed for fixed and surface contamination and a radioactive materials tag will be attached to it.
   h. Move the Liner Plate to the decontamination facility
   i. Inspect the liner plate for damage
   j. Prep and Repair liner plate damage as practical. If liner plate is damaged beyond repair fabricate a replacement liner plate to the dimensions shown on drawing 421-349 and weld details shown on drawing 421-351.

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2. Liner Plate Reinstallation

   a. Reattach the lifting / rigging devices (Refer to Attachment Z22)

b. The liner plate can be reinstalled after the HTS Structure has been removed (ref EC 63022).
c. Weld the liner plate in place per drawing 421-351
d. Temporary fit-up devices may have been welded to the liner plate to aid in aligning and supporting the reinstallation of the liner plate These welds must be either:
   - Removed (by grinding) and all removal areas inspected and tested per the requirements of ASME Section XI, Division I, Subsection IWA & IWE.
     AND/OR
   - Cut-off each fit-up device from the surface of the exterior face (concrete side) of the liner plate approximately ½" above the liner plate. This alternative method will eliminate grinding of the liner plate; however, all welds must be examined as necessary to ensure that the underlying liner material is intact. Interior attachments must be removed and ground smooth.
e. Weld and repair the stiffener angles per drawing 421-351.
f. Inspect and test as required. Refer to the test and inspection criteria in Section E00.
g. Re-apply the liner plate coating. NOTE: Liner plate coating cannot be removed or applied to the steel liner plate unless reviewed and approved by the ASME Code Section XI, IWE/IWL (ISI) Program Coordinator. Approval shall be documented by review and approval of the Work Order Task.
h. Install the form ties provided by the concrete formwork supplier (Refer to drawing 421-351)

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D.2.2.4 Reinforcing Steel Removal and Reinstallation

1. Reinforcing Steel (#8s) Removal

   a. As the hydrodemolition activities expose the #8 reinforcement steel removal activities can commence
   b. Consistent with ASME Section XI requirements, the reinforcing steel exposed when the concrete is removed will receive a detailed visual examination by qualified personnel to determine if the original reinforcing steel is acceptable for re-use.
   c. Cut the reinforcement as shown in Drawing 421-348 and 349 and tag for future identification. Survey the removed rebar and then place in a secure storage location for possible future reuse in the restoration of the opening.
   d. Damaged rebar (specifically the stubs protruding from the face of concrete within the opening) may be repaired per the requirements contained in Section E00.

2. Reinforcing Steel Installation (No Mode or Modes 5 and 6

   a. After the hydrodemolition is completed measure the opening as needed for fabrication of two mats of #11 rebar. The intent is to fabricate the two mats on the ground and then lift them into place within the opening
   b. Cut to length the #11 rebar as needed for installation (Ref drawing 421-350 and 351).
   c. Prior to installing the #11s, concrete surfaces against which new concrete will be placed must be roughened in a manner that exposes the aggregate uniformly. Refer to the Concrete Specification CR3-C-0003 for additional guidance.
   d. With the installation of the liner plate and completion of required inspections, install the #11 rebar to construct two mats
   e. Using skill of the craft, cross-tie the two mats together to provide support for both mats during erection (suggest using short pieces of rebar, angle, etc, and tying them

to the #11s with rebar ties. The mats may be attached to fixed angle stubs as shown on drawing 421-350 to provide lateral bracing and stability.

f. After the tendon sheaths are installed, install the #8 mat.
g. The #8 mat will be installed using the following:
   i. New and reused rebar may be used
   ii. The majority of the rebar will be butt spliced to the existing reinforcement using cold swaged steel coupling sleeves as shown on drawings 421-350 and 351 and BPI-GRIP Systems Splicing Manual (SM01) contained in Attachment Z26. Supplemental installation and inspection requirements are contained in Attachment Z28. Formatted: Font color: Auto
   iii. Corner bars may be spliced by welding if insufficient space is available for cold swaging (Refer to drawing 421-351).
   iv. The reinstalled #8 bars shall be lap spliced as shown on drawing 421-351
   v. THE #8 reinforcing bar stubs must be examined following liner plate installation per IWL-4220(c) and repaired, if necessary, per IWL-4230.

D.2.2.5 Formwork and Concrete Placement

1 Concrete Form Work Installation

a. After the reinforcing steel has been installed and inspected formwork installation can commence
b. Insure the containment opening is clean and acceptable for concrete placement
c. Install the formwork in accordance with vendor requirements and drawings (Attachment Z56) that will be based on Specification CR3-C-0002, SGR Formwork for the Temporary Access Opening and Specification CR3-C-0003, Concrete Work for Restoration of the SGR Opening. The design of the formwork will be contained in Calculation S08-0021. AR 293932 has been generated to track the completion of this calculation and associated drawings..

2. Concrete Placement (No Mode or Mode 5 or 6)

   a Refer to Attachment Z25, Concrete Specification CR3-C-0003 which contains all of the requirements for concrete production, placement, curing and protection.

3. Concrete Form Work Removal and Finishing
   Refer to the requirements in Specification CR3-C-0003, Concrete Work for Restoration of the SGR Opening.

4. Formwork Installation for Adverse Weather Conditions:

   a. The severe weather formwork must be installed when either a Hurricane or Tropical Storm Watch or Warning (in accordance with the EM-220 Violent Weather Committee instructions) has been declared. Severe weather formwork need only be installed when the liner plate is not welded in-place (No Mode).

   b. Install the formwork in accordance with the vendor requirements and drawings (Attachment Z56).

   c. Attach the formwork to the concrete containment wall with ½" diameter Hilti Kwik Bolt 3 carbon steel anchor bolts with a minimum embedment of 3 ½" and maximum hole depth of 5". These anchor bolts may be installed pre-outage or during the outage. A minimum of 8 anchors at approximately 4'-0" center to center (+/-12") will be provided on each vertical side of the containment opening form for a minimum total of 16 anchors. Blocking under the forms may be installed by construction, as required. If blocking is installed it must be placed, at a minimum directly, over the W27x84 structural beams that support the work platform.

D.2.2.6 Re-install Tendon Gallery Access Cover

During removal of the hatch cover, several of the existing 3/8" diameter Phillips wedge anchors were identified as either missing, or broke during removal due to excessive corrosion.

1. Install replacement 1/2"diameter Hilti Kwik Bolt 3 (KB3) anchor bolts produced from AISI 316 Stainless Steel with a minimum embedment of 3 1/2"

   a. Identify which of the existing 3/8" diameter Phillips wedge anchors have to be replaced and follow either Option 1, Option 2 or a combination of Option 1 and 2 as described below:

   b. Construction has the option to install the new 1/2" diameter KB3s either at the same location as the existing anchor bolts (Option 1) or relocate within the tolerances specified below (Option 2)

Option 1: Install new Hilti KB3s at the same location:
Remove the existing defective 3/8" diameter Phillips wedge anchor and drill a 5/8" diameter hole to replace the damaged anchor with a 1/2"diameter x 5 1/2" long Hilti KB3 per the requirements of MP-804. The existing 1/2" diameter holes in the hatch cover (drilled thru the L6x4 – Ref. 4.3) must be enlarged to a 5/8" diameter hole to accommodate the 1/2" Hilti KB3s.

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Option 2: Relocate Anchor Bolt location:
Either remove the existing 3/8" diameter anchor bolt and grout the abandoned hole per MP-804 or cut it off flush with the top of concrete, hammer it into the hole and grout. The revised location for the new anchor must be within 3" of the existing installed location and the minimum center to center spacing between two adjacent ½" Hilti KB3s is 7", as shown in Section C03R4. Grout abandoned holes per MP-804. The minimum bolt spacing has been reduced from 7 7/8" to 7" to ensure constructability and is acceptable based on the much higher allowable load for a ½" Hilti KB3 with a minimum embedment of 3 ½" (Ft = 1853#, Fv = 2351#) compared to the allowable loads for a 3/8" Phillips wedge anchor with a 3" minimum embedment (Ft = 1497#, Fv = 1659#). The structural integrity of the hatch cover was originally evaluated in calculation S-90-0009, Rev. 0 that determined a maximum anchor tension load of 675 lbs and maximum shear load of 44 lbs (Note that this calculation

D.2.3 Installation documents, Inspections, Holds, and Clearances

1 Tendon Anchorage Inspection

   a Anchorage components can be cleaned and required visual inspections performed (per ASME Section XI, subsection IWL) either before the outage or during the outage dependent on labor needs. The anchorage components of vertical and hoop tendons that are being removed do not require IWL inspections, except for the concrete surrounding the tendon bearing plate that must be inspected to IWL requirements prior to Detensioning. 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

b The anchorage components of the new replacement tendons and retensioned only tendons per ASME Section XI, subsection IWL are to be performed after they have been pre-stressed.

2 Liner Plate

a The removed liner plate shall be inspected. Local / spot damage shall be weld repaired. If the liner plate has been damaged beyond repair it shall be replaced from the contingency material ordered in this EC (63016).

b Existing 3" x 2" x ¼" stiffener angles and the associated welds to the liner plate shall be inspected and any unacceptable damage repaired or replaced.

3 Liner Plate Welds

a After the liner plate has been welded back to its original configuration, perform Non-Destructive Examinations (NDE) – Refer to Section E00R0 for examination and testing requirements.

4 Concrete

a Refer to Attachment Z25, Concrete Specification CR3-C-0003 which contains all of the requirements for concrete production, placement, curing and protection, and form removal and finishing and inspection.

5 Reinforcing steel

a. Continuous testing of <u>Mechanical</u> splices is required. Testing of the splices (installation splice) will be required to ensure the consistency of the cold swaging operator and that the splice meets the specified tensile requirements. 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. Sister splices are splices that are made next to the production splices, under the same conditions as the production splices and used for tensile testing. Sister splices shall be taken from each splicer at the following frequency, for each direction of splice:

II 1 sister splice for the first 8 production splices

III 2 sister splices for the next 30 or part thereof, repeated for each 30 production splices.

The sister splices shall be <u>tensile tested (only) to destruction and must meet 125% of the specified yield strength</u> and a sequential average of no more than 12 splices shall meet at least 100% of the minimum specified ultimate tensile strength. Testing

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shall be based on the ultimate tensile strength of a Grade 40 bar, i.e., the lesser of the two grades (grade 40 or grade 60).

b. Refer to BPI-Grip Systems Field Splicing Manual (SM01) contained in Attachment Z26 for additional installation and inspection criteria.

c. As an alternative to mechanical splicing of rebar (as described in b.) rebar may be butt-welded together using approved procedures contained in the Corporate Welding Manual NGGM-PM-0003 and as shown on drawing #421-351. Note that a new welding procedure is being developed for welding rebar applicable to the SGR containment opening (NTM AR #289322).

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6 Containment pressure test

a. After all the tendons have been retensioned/tensioned perform a containment pressure test per IWL-5000 and ILRT per IWE 5000 and the requirements of SP-178 "Containment Leakage Test-Type A Including Liner Plate" to verify leak tightness of the liner plate weld.

b. New concrete shall receive a detailed visual examination per IWL-2310(b) prior to the start of pressurization, at test pressure and following completion of depressurization. The final examination will satisfy the requirements of ASME Section XI, Par. IWL-2230 for pre-service examination of repair/replacement activities.

c. The liner plate requires a VT-1 examination per IWE-5240 as amended by 10CFR50.55a (b)(2)(IX)(G) prior to the start of pressurization and following completion of depressurization. Note that the liner plate examination following depressurization may be done remotely per IWA.

D.3 Label Requests

Labels requiring change as a result of this EC include:
NONE

D.4 EC Parts List

Parts or other materials required by this EC are tabulated below. Any unique or long lead procurement actions are indicated in the description.

Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
1	33/ Each				ASTM A615 Grade 60 - #11 rebar 33 @ 27'-0" long; bent to a 65'-7½" radius (to centerline of bar) (891 lin. ft.)			1
2	33/ Each				ASTM A615 Grade 60 - #11 rebar 33 @ 27'-0" long; bent to a 66'-10" radius (to centerline of bar) (891 lin. ft.)			1
3	64/ Each				ASTM A615 Grade 60 - #11 rebar 64 @ 27'-0" long (1728 lin. ft.)			1
4	30/ Each				ASTM A615 Grade 60 - #8 rebar 30 @ 11'-6" long (345 lin. ft.)			1
5	30/ Each				ASTM A615 Grade 60 - #8 rebar 30 @ 19'-6" long (585 lin. ft.)			1
6	30/ Each				ASTM A615 Grade 60 - #8 rebar 30 @ 19'-0" long; bent to a 68'-3⅝" radius (to centerline of bar) Note: This bar may be flexible enough that it does not have to be bent. Verify with supplier. (570 lin. ft.)			1
7	30/ Each				ASTM A615 Grade 60 - #8 rebar 30 @ 10'-6" long; bent to a 68'-3⅝" radius (to centerline of bar) (315 lin. ft.)			1
8	160/ Each				BarGrip XL – Nuclear /Type 2 Series cold –swaged steel mechanical splices for # 8 Rebar.			1
9	12/ Each				Tendon Sheathing; ASTM-A513 Type 5 (or equal); 5" I.D., 5 1/4" O.D; 12 @ 27'-0" long (324 lin. ft.)			4
10	19/ Each				Tendon Sheathing; ASTM-A513 Type 5 (or equal); 5" I.D., 5 1/4" OD 19 @ 26'-0" long; bent to a 67'-8⅝" radius (to centerline of hoop) (494 lin. ft.)			4
11	60/				Tendon Sheath Coupler; ASTM-A513, Type 5 (or equal); 5 ½" I.D.,			4

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
	Each				6" O.D. x 6" long w/ 2 holes tapped for ½" – 13 set screws. Holes to be located 1" from ends (Refer to drawing 421-350).			
12	120/ Each				Cup Point – square head set screws (plane steel) ½" x 13 x 1" long. McMaster-Carr part #91410A712			4
13	60/ Each				Tendon sheath coupler adaptor- ASTM A513 Type 5; 5" I.D, 5 ¼" O.D. (1/8" wall thickness) x 18" long, swaged to 4 7/8" O.D. per drawing 421-350.			4
14	150/ Each				Grinnell Fig. 120 U-bolt or equal for 5" pipe (see detail #3 on drawing 421-350) with 2 hex nuts per u-bolt			4
15	85/ each				Steel angle L3x3x1/4 x 1'-3" long each (ASTM A36 minimum) (see detail #3 on drawing 421-350)			4
16	20/ Each				ASTM A283 Grade C; 3/8" thick plate x 4' x 8' (contingency material)			1
17	18/ Each				ASTM A36 Liner Plate Stiffener Angles; L3x2x1/4 x 28'-0" long; 18 required (contingency material) (504 lin. ft.)			1
18	1/ Each	270269		Tendon Tag #5011 (Typical for all tendons)	Vertical Tendon I.D x Length (ft. and inches)-Supplied by PSC 34V8 x 189'-0 ¼"			1
19	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V9 x 189'-4 ½"			1
20	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V10 x 189'-11 ¼"			1
21	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V11 x 190'-10"			1
22	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V12 x 191'-10 ¾"			1
23	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V13 x 191'-9"			1

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
24	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V14 x 190'-9 ½"			1
25	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V15 x 188'-11 ½"			1
26	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V16 x 189'-2 ¾"			1
27	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC 34V17 x 188'-10 ¾"			1
28	1/ Each	270269			Vertical Tendon ID No. x Length (ft. and inches)-Supplied by PSC SPARE x 191'-10 ¾"			1
29	1/ Each	270269		Tendon Tag #5011 (Typical for all tendons)	Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H27 x 155'-7"			1
30	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H28 x 155'-6"			1
31	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H29 x 155'-7"			1
32	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H30 x 155'-6 ¼"			1
33	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H31 x 155'-7 ¼"			1
34	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H32 x 155'-6"			1
35	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H33 x 155-8"			1
36	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 42H34 x 155'-6"			1
37	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H27 x 155'-6 ¾"			1
38	1/	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC			1

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
	Each				53H28 x 155'-7 ½"			
39	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H29 x 155'-7 ½"			1
40	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H30 x 155'-7 ½"			1
41	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H31 x 155'-7 ½"			1
42	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H32 x 155'-7 ½"			1
43	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H33 x 155'-6 ¾"			1
44	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H34 x 155'-6"			1
45	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC 53H35 x 155'-8"			1
46	1/ Each	270269			Horizontal Tendon ID No. x Length (ft. and inches)-Supplied by PSC SPARE x 155'-8"			1
47	9000/ Gallons	270269		0001430382	Visconorust 2090-P4 Grease - Supplied by PSC			1
48A	30/ Each	270269		9220159631	Grease Cap Gaskets - Supplied by PSC Gasket, Cap, End, 15-3/8" x I.D. x 16-5/8" O.D. x 5/8" thick, lower vertical tendon.Refer to Prescon drawing 5EX7-003A-A-9C, Rev. A for lower vertical gasket. (Also refer to sketch in Attachment Z52)			4
48B	100	270269		9220159636	Grease Cap Gaskets - Supplied by PSC Gasket, Cap, End, 14-1/2" x I.D. x 15-1/2" O.D. x 1/2" thick, hoop, and upper tendon caps. Refer to Prescon drawing 5EX7-003A-A-9D, Rev. A. (Also refer to sketch in Attachment Z52)			4
49	29/ Each	270269			ASTM A514 Grade Q; Tendon Anchor head (Refer to Attachment Z19R0 for details, PSC drawing CR-N1009-502 (163 Wire Stressing Washer) - Supplied by PSC			1
50	2/ pairs			9220158944	3" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
51	20/ pairs			9220158952	2" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
52	20/			9220158953	1" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR,			1

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Use
	pairs				REF. PE dwgs. 5EX7-003A-09C / 09D			
53	10/ pairs			9220158954	½" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
54	10/ pairs			9220158955	3/8" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
55	10/ pairs			9220158956	¼" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
56	10/ pairs			9220158957	3/16" Shims - Armor Plate HY-80, type 1, MIL-S-16216K with CMTR, REF. PE dwgs. 5EX7-003A-09C / 09D			1
57	32/ each				Liner Plate Construction aides U-Bar per CBI Drawing # 2A20-4 Refer to Attachment Z21R0			1
58	32/ each				Liner Plate Construction aides 1 ¼"DIA Blank Nut per CBI Drawing # 2A18-9. Refer to Attachment Z21R0			1
59	180,000 /lbs			9220174295	ASTM C150 Type 1 cement – Holcim (US) Inc. Artesia Plant PO Box 185 8677 Highway 45 South 45 Alternate Artesia, MS 39736 Phone: 800-292-4355 662-272-5121 Fax: 662-272-6012 Contacts: T. Cash 601-955-1622 Mr. Rutherford 662-272-5121			1
60	180,000 /lbs			9220174316	ASTM C150 Type 1 cement - **Holcim (US) Inc.** Holly Hill Plant PO Box 698 200 Safety Street/Highway 453 Holly Hill, SC 29059 Phone: 803-496-5027 Fax: 803-496-2733 NOTE: This material has been approved for use in the safety related concrete mix.			1
61	550,000 /lbs			9220174309	ASTM C33 Coarse aggregate, No. 67, ¾" gradation. **Vulcan Materials Company** Maryville Quarry 2201 Duncan Road			1

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
					Maryville, TN 37803 Phone: 865-983-0163 Fax: 865-983-1508 Contact: Jim Mays (sales) 865-577-2511 NOTE: This material has been approved for use in the safety related concrete mix.			
62	550,000 /lbs			9220174329	ASTM C33 Coarse aggregate, No. 67, ¾" gradation. **Vulcan Materials Company** Norcross Quarry 1707 Beaver Ruin Road Norcross, GA 30093 Phone: 770-923-2532 Kennesaw Quarry 1272 Duncan Road Kennesaw, GA 30144 Phone: 770-427-2401 Contacts: Mr. Stewart Malley – QC 404-386-3911 Bill Ottaway –Norcross Sales 770-454-3655 Shannon Wehunt – Kennesaw Sales 770-454-3646			1
63	350000/ lbs			9220174311	ASTM C33 fine aggregate with a FM of 2.7 thru 3.1 **Vulcan Materials Company** Maryville Quarry 2201 Duncan Road Maryville, TN 37803 Phone: 865-983-0163 Fax: 865-983-1508 Contact: Jim Mays (sales) 865-577-2511 NOTE: This material has been approved for use in the safety related concrete mix			1
64	350000/ lbs			9220174343	ASTM C33 fine aggregate with a FM of 2.7 thru 3.1 **B. V. Hedrick Gravel & Sand** Lilesville Quarry Lilesville, NC Contact: Peggy Jones 7843-672-3477 x1			1

Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
65	100000/ lbs			9220174532	Flyash Class C is preferred but Class F is acceptable as well. **ProAsh, Separation Technologies** Contact: Tiffany Duffy Separation Technologies LLC – ProAsh Florida Sales Representative Cell: (813)-846-2732 Fax: (813)-741-1876 Email: tduffy@proash.com NOTE: This material has been approved for use in the safety related concrete mix			1
66	40000/ lbs			9220174536	Silica Fume **Master Builders** Tel: 800-628-9990			1
67	117 Gallons			9220183089	RECOVER Hydration Stabilizer conforming to ASTM C494 Type D water-reducing and retarding admixture. Manufactured by Grace Construction Products, W. R. Grace & Co. Conn. NOTE: This material has been approved for use in the safety related concrete mix		QL2	QL2
68	557 Gallons			9220183080	ADVA Cast 575 HRWR (High Range Water Reducer) Certified to comply with ASTM C494, Type F and ASTM C1017 (Refer to Attachment Z52). Manufactured by Grace Construction Products, W. R. Grace & Co. Conn. NOTE: This material has been approved for use in the safety related concrete mix		QL2	QL2
69	4/ kits				Belzona (E-metal) 1211			4

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Installation					Design		Q Status	
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Buy	Use
	(enough to make approximately 20 gallons)							
					Following material is for the 20' x 20' concrete wall mockup:			
70	95/ each				ASTM A615 Grade 60 - #11 rebar x 19'-6" long, 95 each required. (1794 Lin. ft.)			1
71	42/ each				ASTM A615 Grade 60 - #8 rebar x 19'-6" long, 42 each required (820 Lin. ft.)			1
72	25/ each				5" schedule 40 PVC Pipe (require 25 @ 20'-0" long each) (substitutes for sheaths) (500 Lin. ft.)			4
73	25/ each				5" PVC Couplings			4
					Note: The tendon Contractor (PSC) will provide tendon components for the mock-ups.			4
74	N/A			N/A	Formwork material will be provided by formwork vendor. Contract for formwork will not be issued until late 2008, after this EC has been issued.			4
75	170/ Each				55 gallon steel drums			4
76	8 cubic yards				Test weight for load testing the tendon work platforms. Concrete block 8'x8'x3' (28,000 lbs)			4
77	2 cubic yards				Test weight for load testing the tendon work platforms. Concrete block 5'x5'x1.5' (5,250 lbs)			4
78	2				ASTM A36 ; 3/8" min. thick plate x 8' x 10' (functional testing of the hydrodemolition equipment)			4
79	25			9220185112	Tendon Grease cap/can (Height = 27")			4
80	24				½" diameter Hilti Kwik Bolt 3 (carbon steel) anchor bolts x 5 ½" long with minimum 1 5/16" threads. (KB3½ x 4 ½", Item #00282511) (required to anchor severe weather formwork to containment wall)			4

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Installation					Design			
Item No.	Qty/ Units	PO Number	PE Request	Catalog ID	Description (If available, include Manufacturer, Model, and Version)	Spec or CGI	Q Status Buy	Q Status Use
81	12				5/8" diameter Hilti Kwik Bolt -TZ anchor bolts x 10" long. (Required to anchor curtain to containment wall)			4
82	20				2"diameter Hilti Kwik Bolt 3 anchor bolts produced from AISI 316 Stainless Steel with a minimum embedment of 3 1/2" (KB3 316SS ½ x 5 ½"). Required for tendon access gallery hatch cover.			1

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E.1 Testing Requirements

Unique Prerequisites, Precautions, Limitations, Initial Conditions, and Outage Requirements:

Test and Acceptance Criteria:

Design Input/ Parameter/ Function	Test Procedure Or Method	Acceptance Criteria	Required for T/O Y/N?
E.1.1 Re-bar welding inspection requirements and repair. #8 rebars in outer face of containment wall may need to be butt welded as shown on drawing 421-351.	AWS D1.4 2005 Ed.	Production welds of reinforcement bars (splice) shall meet the fabrication and visual inspection requirements of AWS D1.4 2005 Edition and the Corporate Welding Manual. No further non-destructive testing is required by this EC.	Y
E.1.2 Mechanical Splice System Qualification (i.e. Pre-Construction Qualification testing). A minimum of six static tensile strength tests are performed for #8 mechanical splice specimen. A tensile test on an unspliced #8 is required to establish actual tensile and yield strength. The six static tests shall be performed on Grade 40 to Grade 60 splices. The Grade 40 bar should control splice failure but it is possible that the harder Grade 60 may pull out. Three low cycle tensile tests are performed on #8 spliced specimens. Each specimen shall withstand 100 cycles of	ASME Section III, Division2,Subsection CC-4333.2	STATIC TEST 1. Average tensile strength of the splice > 90% of the actual tensile strength of the reinforcing bar being tested, nor less than 100% of the specified min tensile strength. 2. The tensile strength of an individual splice must be greater than125% of the specified yield strength (fy) of the bar. Document the tensile strength, total elongation, load extension curve up to 2% strain (minimum). CYCLIC TEST 1. The mechanical splice must withstand the cyclic tensile test only. **Note:** 1. The static tensile and cyclic tests are performed on	

stress variation from 5% to 90% of the specified minimum yield strength of the reinforcing bar. The three cyclic tests shall be performed on Grade 40 to Grade 60 splices. One cycle is defined as an increase from the lower load to the higher load and return.		different specimens.	
E.1.3 Perform tensile testing to destruction of "Sister" splices to verify that production splices meet the specified tensile strength requirements for the mechanical (cold swaged) splice for the #8 rebars. This activity occurs while the plant is defueled.	Samples will be sent to an off-site lab for testing. Sister splices shall be taken from each splicer at the following frequency, for each direction of splice: -1 sister splice for the first 8 production splices -2 sister splices for the next 30 or part thereof, repeated each 30 successive production splices. (Reference ASME Section III, Division 2,Subsection CC-4333.5)	Each sister splice shall be tensile tested (only) to destruction and must meet 125% of the specified yield strength and a sequential average of 9 splices shall meet at least 100% of the minimum specified ultimate tensile strength. Each sister splice must be made from either: (1) One Grade 40 and one Grade 60 #8 rebar OR (2) Two Grade 40 #8 rebars. The specified yield strength and ultimate tensile strength will be based on a Grade 40 bar ONLY, i.e., the lesser of the two grades shall govern. Since the swaged couplings will be quite close to the face of the concrete in the opening, it will not be possible to cut out production splices and have a sufficient length of stub reinforcing remaining to remake these. Therefore, all testing will be on sister splices. The mix of sister splice reinforcing grade combinations (Grade 40 to Grade 40 and Grade 40 to Grade 60) will be consistent with that of the production splices.	Y
E.1.4 Inspect installed swaged rebar couplers	Refer to: Attachment Z28.	Refer to: INSTALLATION AND EXAMINATION OF SWAGED MECHANICAL SPLICES SUPPLEMENTAL REQUIREMENTS FOR THE	

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		CRYSTAL RIVER NUCLEAR POWER PLANT Contained in Attachment Z28.	
E.1.5 Repairs of angle-to-liner welds - 100% Visual Examination - 100% Liquid Penetrant or Magnetic Particle Examinations Note: These examinations may occur while the plant is either defueled or in Modes 6 or 5 ascending.	NDEP-0601and NDEP-0201 or NDEP-0301	NDEP-0601, ASME Section VIII, Appendix VIII and VI	Y
E.1.6 Temporary attachment welds (for removal and or alignment) to the liner plate: - 100% Visual Examination - 100% Liquid Penetrant or Magnetic Particle Examinations	NDEP-0601and NDEP-0201 or NDEP-0301	NDEP-0601, ASME Section VIII, Appendix VIII and VI	Y
E.1.7 After the liner plate has been welded back to its original configuration (while the plant is defueled), perform the following Non-Destructive Examinations (NDE) on the liner plate butt welds around the perimeter of the Opening: Note: These examinations must occur while the plant is defueled. 1) 100% visual examination 2) 100% vacuum box leak testing 3) 100% Magnetic Testing (Double sided welds will receive Magnetic Particle Examinations on both sides of the liner shell. One sided welds with backing bar will receive Magnetic Particle	1) NDEP-0601 2) NDEP-0704 3) NDEP-0301	1) NDEP-0601, Attachment "A" 2) NDEP 0704 3) ASME Section VIII, Appendix VI NOTE: 100% magnetic particle examination may be used as an alternative to the original Owner examination requirements of 2% spot radiography and 20% liquid penetrant per the reconciliation evaluation contained in ECED70586.	Y

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Examinations after the first and final layers). After completion of the above listed tests and examinations a pre-service detailed visual examination of the liner plate is required per the requirements of ASME Section XI, Subsection IWE-2200 and IWE-5240. This examination must be completed while the plant is defueled. Cut-off each fit-up device on the exterior face (concrete side) approximately ½" above the liner plate. However, all attachment welds must be examined, as necessary, to ensure that the underlying liner material is intact. Interior attachments must be removed and ground smooth. This examination/work activity must be completed while the plant is defueled.			
E.1.7-a VT-3 inspection of accessible outer face (concrete side) liner plate surface prior to pouring concrete to ensure no damage during reinstallation of rebar and tendon sheaths. This examination may be done while defueled or in Modes 5 or 6.			
E.1.8 Containment pressure test is required by IWL-5000. IWE 5000 requires a weld leak test. Both of these requirements can be satisfied by a containment leak rate test (ILRT) per SP-178.	SP-178	SP-178	Y

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Note: Mode restrictions are per the requirements of SP-178.			
E.1.9 New concrete shall receive a detailed visual examination per IWL-2310(b) prior to the start of pressurization, at test pressure and following completion of depressurization as required by IWL-5250. A pre-service examination of the new concrete is to be done per IWL-2230 following the pressure test. Note that one visual inspection can satisfy both IWL-2230 and IWL-5250 for pre-service examinations. The liner plate shall receive a detailed visual examination per IWE-5240 as amended by 10CFR50.55a (b)(2)(ix)(G) prior to the start of pressurization and following completion of depressurization. Note that the liner plate examination following depressurization may be done remotely per IWA.	IWL-5000 IWL-5250 IWL-2310 (b) IWL-2230 IWE-5240 IWE-2310	IWL-3000 IWE-3000	Y
E.1.10 Repairs to Liner Plate surfaces - 100% Visual Examination - 100% Magnetic Particle Examination Note: These examinations must occur while the plant is defueled.	NDEP-0601 and NDEP-0301	NDEP-0601 and ASME Section VIII	Y

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			N
E.1.16 Pre-outage concrete testing to determine constituent material properties, mix design and mix properties.	Refer to Attachments Z41 thru Z52	Attachments Z41 thru Z52 contain the concrete constituent material and concrete mix test plans and test reports prepared by S&ME.	N
E.1.17 Required concrete tests during restoration of the access opening and post modification tests.	Specification CR3-C-0003	Refer to Specification CR3-C-0003 (Attachment Z25)	N
E.1.18 QC is to inspect the reinstalled tendon sheaths	Visual inspection	Tendon sheaths must be inspected for cleanness to the extent possible to minimize any foreign materials from entering the sheaths prior to new replacement tendons being inserted. Ensure that all vertical tendon sheaths are reasonably parallel to each other; same requirement for the hoops. Ensure all joints are reasonable tight and have an adequate coat of Belzona. Check that sheathing couplers are installed per drawing 421-350 and that set screws are snug tight.	
E.1.19 Consistent with ASME Section XI requirements, the reinforcing steel exposed when the concrete is removed will receive a detailed visual examination by qualified personnel to determine if the original reinforcing steel is acceptable for re-use.	IWL-2310 IWL-4220 (c)	IWL-4220 (c)	
E.1.20 Liner plate coatings must be examined in accordance with the requirements of IWE 2000 and EGR-NGGC-0015.	IWE-2000 EGR-NGGC-0015.	IWE-3000 EGR-NGGC-0015.	
E.1.21 Quality check of field button heading	PSC Manual procedure	Checks include go-no go diameter measurements, eccentricity measurements and visual and measurement of splits.	

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¶
This activity occurs while the plant is defueled.
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Only pH sampling will need to be performed as a pre-requisite for discharge. Contractor should strive to keep the pH between 6.0 and 9.0. Periodic sampling of pH will be needed. A "stop job" limit will be established at pH less than or equal to 2, or pH greater than or equal to 12.5.¶
¶
Recommended that laboratory samples for pH, TSS, and oil & grease be collected at about 3 times during p ... [1]
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	(Attachment Z23)		

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Plant Industrial Waste Water Permit (IWWP)

Only pH sampling will need to be performed as a pre-requisite for discharge. Contractor should strive to keep the pH between 6.0 and 9.0. Periodic sampling of pH will be needed. A "stop job" limit will be established at pH less than or equal to 2, or pH greater than or equal to 12.5.

Recommended that laboratory samples for pH, TSS, and oil & grease be collected at about 3 times during project (start, middle, end), and results placed in project file and plant file. These samples are for documentation only, and would not require batch processing of the wastewater, or delay transfer.

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Test concrete rubble, tendon grease and scrapped tendons for radioactive contamination prior to disposal.

This activity occurs while the plant is defueled.

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Refer to the Containment Opening RP Task Plan for specific details on handling and testing of the waste generated during hydrodemolition.

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Liner plate must be surveyed for fixed and surface radioactive contamination prior to leaving the protected area.

This activity occurs while the plant is defueled.

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Refer to the Containment Opening RP Task Plan for specific details

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Perform tendon work platform proof load test (any mode).

This activity occurs while the plant is in any mode.

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Rated capacity of large tendon work platform (nominal 10'x20') is 22,000 lbs. Load test to 125% of rated capacity = 27,500 lbs.

Rated capacity of small tendon work platform (8'x10') is 4000 lbs. Load test to 125% of rated capacity = 5000 lbs.

Progress Energy is responsible for providing test weights. Each platform will be tested after it has been attached to its respective upper support frame (USF) directly above the equipment hatch shield structure, and prior to the USF (and attached platform) being staged at their respective buttress.

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E.1.15 Functional testing of the hydrodemolition equipment

This activity occurs while the plant is in any mode.

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Approximately 2 weeks prior to cold shutdown functional testing of the hydrodemolition equipment is required. This will require testing of all the high pressure lines, electrical and hydraulic lines and controls. Two sheets of 8' x 10' (or similar) steel plates will be placed on the chipping platform against the reactor building wall for the purpose of testing the high pressure water nozzles and associate equipment.

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Z13 (Laboratory Testing Requirements)

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Refer to Attachment Z13 (Laboratory Testing Requirements)

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F.1 Turnover/Closeout Summary

EC 63016 Return to Operations Transition Plan Summary

Systems can be 'Returned to Operations' (RTO) for Operations use and control prior to EC turnover if construction/maintenance and testing activities have been completed to the point that Engineering certifies that Operations can place the system in service as defined by plant procedures.

EC 63016 Return to Operations for Commencement of Core Reload (Mode 6)

The Project Manager, Responsible Engineer, or other designated representative will notify the Return to Service team that the modification is complete to the point that the Containment, relative to this EC may be considered Capable of "Containment Closure" with "Pressure Retaining Capability" to support core reload. This Return to Operations will be based on verification that required work orders for the containment are completed to the point to support this plant condition. The refueling activities can commence with the containment not fully "Operable" for Modes 1-4 operation provided sufficient construction/testing work has been completed to ensure the containment acting as a fission product barrier can perform functionally in the event of a loss of Decay Heat Removal capability. However, the containment must be restored to design conditions prior to commencement of Intergraded Leak Rate Testing (ILRT). The results of the ILRT must meet the required acceptance criteria prior to EC turnover and ascension to Mode 4.

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Below is a list of applicable Work Order tasks, tests, procedures, configuration updates, and required training that as applicable must be in the appropriate status to consider the containment Capable of "Containment Closure" with "Pressure Retaining Capability" to support commencement of core reload.

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Commencement of Core reload activities (Mode 6) prior to EC 63016 Turnover to Operations requires the following EC 63016 related activities to be complete: (WOT 1587116-12)

A. The following Work Order task associated with Work Order 1165090 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

1165090-04	Y,MW, RE INSTALL CONST. OPENING STEEL LINER PLATE

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B. The following Testing related Work Order tasks associated with the RB Liner must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

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1165090-03	Y, MW, CONTAINMENT OPENING LINER PLATE REMOVAL	EC Test Requirements **E.1.5** and **E.1.6**
1165090-04	Y,MW, RE INSTALL CONST. OPENING STEEL LINER PLATE	EC Test Requirements **E.1.7** and **E.1.10**

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C. The following two (2) EC 63016 specific 'Procedure Revisions' must be issued prior to Commencement of Core Reload:

POM ADM AI0504 (ref. PRR# 247252)
POM REG CP0341 (ref. PRR# 345424)

D. There is no training associated with this EC required for this RTO.

EC 63016 Return to Operations for Commencement of ILRT

The Project Manager, Responsible Engineer, or other designated representative will notify the Return to Service team that the modification is complete to the point that the Containment, relative to this EC may be considered capable of supporting the performance of an Integrated Leak Rate Test (ILRT). This Return to Operations will be based on verification that required work orders for the containment are completed to the point to support this plant condition. The ILRT can commence with the containment not fully "Operable" for Modes 1-4 operation provided sufficient construction/testing work has been completed to ensure the containment is in a proper configuration for ILRT testing. The results of the ILRT must meet required acceptance criteria prior to EC turnover and ascension into Mode 4.

Below is a list of applicable Work Order tasks, tests, procedures, configuration updates, and required training that as applicable must be in the appropriate status to consider the containment capable of supporting the performance of the Integrated Leak Rate Test (ILRT).

Commencement of Integrated Leak Rate Test (ILRT) activities prior to EC 63016 Turnover to Operations requires the following EC 63016 related activities to be complete: (WOT 1587116-20)

A. The following Work Order tasks associated with Work Order 1165094 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

1165094-07	Y, MW, REINSTALLATION AND TESTING OF THE EXISTING&NEW REBARS
1165094-08	Y, MW, INSTALLATION OF FORM WORK AT OPENING
1165094-09	Y, MW, REMOVAL OF FORM WORK AT OPENING
1165094-10	Y, MW, PLACEMENT OF NEW CONCRETE

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B. The following Work Order tasks associated with Work Order 1165095 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

1165095-07	Y, MW, REINSTALL 10 VERTICAL AND 17 HOOP TENDONS
1165095-09	Y, MW, RE-TENSION 20 VERTICAL AND 18 HOOP TENDONS
1165095-11	Y, MW, RE-TENSION, 10 VERT. AND 17 HOOP. TEND.

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C. The following Testing related Work Order tasks associated with the Containment Opening must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

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1165094-07	Y, MW, REINSTALLATION AND TESTING OF THE EXISTING &NEW REBARS	EC Test Requirements **E.1.1** and **E.1.2** and **E.1.3** and **E.1.4** and **E.1.18**
1165094-12	Y, MW, TESTING OF CONTAINMENT (ILRT)	EC Test Requirement **E.1.9**
1165094-10	Y, MW, PLACEMENT OF NEW CONCRETE	EC Test Requirements **E.1.16** and **E1.17**
1165094-06	Y, MW, REMOVAL OF THE EXISTING REBARS	EC Test Requirement **E.1.19**
1165095-07	Y, MW, REINSTALL 10 VERTICAL AND 17 HOOP TENDONS	EC Test Requirement **E.1.21**
1165090-04	Y,MW, RE INSTALL CONST. OPENING STEEL LINER PLATE	EC Test Requirement **E.1.7-a**

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D. There are no additional Priority 0 documents affected by the proposed activity.

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E. There is no training associated with this EC required for this RTO.

Turnover Summary

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Turnover requires the following EC 63016 related activities to be complete prior to Mode 4: (WOT 1587116-29)

A. The following additional Work Order task associated with Work Order 1165090 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

1165090-01	PURCHASE MATERIALS ASSOCIATED WITH WO 1165090 (EC63016)
1165090-02	Y, MW, PRE-OUTAGE FAB. CONTAIMENT OPENING LINER PLATE

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B. The following additional Work Order tasks associated with Work Order 1165094 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

1165094-01	PURCHASE MATERIALS ASSOCIATED WITH WO 1165094 (EC63016)
1165094-02	Y, MW, PRE-OUTAGE FABRICATION
1165094-03	Y, MW, WATER SUPPLY AND DISPOSAL CONCRETE REMOVAL
1165094-04	Y, MW, LAYOUT ACCESS OPENING, SCRIBE & SAW CUT 1/2" DEPTH
1165094-05	Y, MW, HYDRO-DEMOLITION OF CONCRETE
1165094-06	Y, MW, REMOVAL OF THE EXISTING REBARS
1165094-12	Y, MW, TESTING OF CONTAINMENT (ILRT)
1165094-13	SGR R16 PRE/POST OUTAGE DISABLE/RESTORE SDP-3A AND 3B PUMP
1165094-17	Y, MW, TESTING OF CONTAINMENT (ILRT)2

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C. The following Work Order tasks associated with Work Order 1165095 must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport:

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1165095-01	PURCHASE MATERIALS ASSOCIATED WITH WO 1165095 (EC63016)
1165095-02	Y, MW, PRE-OUTAGE CONT. OPENING TENDONS, GREASE REMOVAL
1165095-03	Y, MW, PRE-OUTAGE, INSTALL TENDON UPPER SUPPORT FRAMES
1165095-04	Y, MW, PRE-OUTAGE, ASME SECTION XI TENDON INSPECTIONS
1165095-05	Y, MW, PRE-OUTAGE, REMOVAL OF THREE VERTICAL TENDONS
1165095-06	Y, MW, DETENSION 7 VERTICAL AND 17 HOOP TENDONS
1165095-08	Y, MW, DETENSION 20 VERTICAL AND 18 HOOP TENDONS
1165095-19	Y, MW, POST OUTAGE, TENDONS GREASE REINSTALLATION HORZ

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D. The following Testing related Work Order tasks associated with the Containment Opening must be in a FINISHED, COMPLETE, H/OPS or CLOSED Passport (note tests E.1.11 through E.1.15 have been deleted from the EC):

1165094-17	Y, MW, TESTING OF CONTAINMENT (ILRT)2	EC Test Requirement **E.1.8 and E.1.9**

1165090-04	Y,MW; RE INSTALL CONST. OPENING STEEL LINER PLATE	EC Test Requirement **E.1.20**

E. There are no additional Priority 0 documents affected by the proposed activity.

F. There is no training associated with this EC required.

Closeout Summary

All Work Order Tasks (WO 1165090, WO 1165094, WO 1165095) are status FINISHED or COMPLETED

Assure AR's are COMPLETED or CLOSED

The following Priority "1" documents are to be issued prior to EC Closure and within update requirements of EGR-NGGC-0007.

421-346, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Load Combinations.

421-347, Revision 0, Reactor Bldg Temporary Access Opening for SGR – Vertical & Horizontal Tendon Positions.

421-348, Revision 0, Reactor Bldg Temporary Access Opening for SGR–Demolition Sht 1 of 2

421-349, Revision 0, Reactor Bldg Temporary Access Opening for SGR –Demolition Sht 2 of 2

421-350, Revision 0, Reactor Bldg Temporary Access Opening for SGR –Restoration Sht 1 of 3

421-351, Revision 0, Reactor Bldg Temporary Access Opening for SGR –Restoration Sht 2 of 3

421-352, Revision 0, Reactor Bldg Temporary Access Opening for SGR –Restoration Sht 3 of 3

CR-N1009-502, Revision 0, 163 Wire Washer and Split Shim Details

CR3- C-0002, Revision 0, Formwork for the Restoration of the SGR Access Opening

CR3-C-0003, Revision 0, Concrete Work for the Restoration of the SGR Opening

Prior to EC Closure SP-182 must be revised and issued to reflect changes resulting from EC 63016.

Prior to EC Closure, a "Post-Job Critique" will be held after EC 63016 has been installed to discuss and evaluate the various aspects of the EC.
This briefing will be chaired by the Responsible Engineer or his designee and will be attended by representatives of the organizations with insights into how well the job was accomplished.

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Deleted: The following Priority 0, POM document must be revised prior to EC Closure, it is not required for turnover:¶
¶
SP-182, RB Structural Integrity Tendon Surveillance Program.¶
¶
Creating and restoring the temporary access opening in the containment wall for SGR requires removing and replacing 10 vertical and 17 hoop tendons within the opening and detensioning an additional 20 vertical and 18 hoop tendons around the opening. After RFO 16, two separate groups of tendons will have to be tracked, the first group will consist of the tendons that were not affected by SGR and the second group will consist of the 65 tendons affected by SGR. SP-182 will require a revision to reflect the creation of this second group. This procedure is not required until the next tendon surveillance scheduled for 2011, it is however required for EC Closure. Refer to AR 291833 assigned to revise the Surveillance procedure.¶
¶
This EC does not change any scheduled tendon surveillance as required by SP-182. The next scheduled tendon surveillance is RFO 17 (2011).¶
¶
CP-341, Containment Penetration Control:¶
¶
Containment pressure resulting from a LODHR accident must be re ... [37]

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The attendees will be determined by the RE based on input needed and availability of appropriate individuals. Ref. AR 289302.

Catalog and Bill of Materials Impact

BOM Manufacturer:	Model:	Version:		
Manufacturer's Part Number	Catalog ID	Add or Delete	Q Status	Proposed Stocking Quantity
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1165090-03	Y, MW, CONTAINMENT OPENING LINER PLATE REMOVAL

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1165095-13	Y, MW, POST OUTAGE, REMOVE TENDON UPPER SUPPORT FRAMES
1165095-15	A,MW, PERFORM POST CALIBRATION OF PSC M&TE

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The following Priority 0, POM document must be revised prior to EC Closure, it is not required for turnover:

SP-182, RB Structural Integrity Tendon Surveillance Program.

Creating and restoring the temporary access opening in the containment wall for SGR requires removing and replacing 10 vertical and 17 hoop tendons within the opening and detensioning an additional 20 vertical and 18 hoop tendons around the opening. After RFO 16, two separate groups of tendons will have to be tracked, the first group will consist of the tendons that were not affected by SGR and the second group will consist of the 65 tendons affected by SGR. SP-182 will require a revision to reflect the creation of this second group. This procedure is not required until the next tendon surveillance scheduled for 2011, it is however required for EC Closure. Refer to AR 291833 assigned to revise the Surveillance procedure.

This EC does not change any scheduled tendon surveillance as required by SP-182. The next scheduled tendon surveillance is RFO 17 (2011).

<u>CP-341, Containment Penetration Control:</u>

Containment pressure resulting from a LODHR accident must be revised from 8 psi to 5.14 psi (Reference 5.2, 5.10 and 10.3). Procedure update is required prior to Shutdown.

<u>AI-504, Guidelines for Cold Shutdown and Refueling:</u>

Containment pressure resulting from a LODHR accident must be revised from 8 psi to 5.14 psi (Reference 5.2, 5.10 and 10.3). To support core reload in prestress condition 2, additional equipment is required (Reference AR 00284485, Assignment #4). Procedure update is required prior to Shutdown.

G.1 Installation Sketches

Sketch Number	Sht	Rev	Title
SK-63016-S001	1	0	Crane Configuration-Set Tendon Equipment on RB Roof
SK-63016-S002	1	0	Crane Configuration-Remove and Install Liner Plate
SK-63016-S003	1	0	Crane Configuration-Install Rebar Mat
SK-63016-S004	1	0	Crane Configuration-Install Concrete Forms for Concrete Placement
SK-63016-S005	1	2	Mac and Macs Hydrodemolition Frame

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H.1 **H.1 Validation Plan**

ATTACHMENT 1
VALIDATION PLAN
Sheet 1 of 2

Product/EC Stage	Process/Tool	Outsourced EC(1, 2, 3) ☐	Internal EC(1, 3) ☒	All other Engr Products(3) ☐	To Be Implemented ?(4)
At Initiation	Validation Plan	R	R	O	☒
	Risk Assessment Worksheet	X(5)	X(5)	O	☒
	Project kick-off meeting	X	O	O	☒
	Pre-job briefing	R	R	NA	☒
	Formation of an EC Team	O	O	NA	☒
	Scheduling/Work Management	X	X	O	☒
Development Phase	In-process review – 0% Design Challenge	X	X(5)/O	O	☒
	In-process review – 30% Design Challenge	X	X(5)/O	O	☒
	In-process review – 70% Design Challenge	X	X(5)/O	O	☒
	In-process review – Final Design Challenge	X	X(5)/O	O	☐
	Source review	O	NA	NA	☐
	Owner review	X	NA	NA	☐
	Error Prevention Tools (STAR, SAFE, OAQ-3, etc)	O	O	O	☒
	Design Review Board – Conceptual	X	X	O	☒
	Design Review Board - Final	X	X	O	☒
	Engineering change checklist	R	R	O	☒
	Outsource management checklist	R	O	O	☐
Post Implementation	Post-job briefing (AR 295907)	X	X	O	☒
	Post-job critique (AR 289302)	O	O	O	☒
	EPR	O	O	O	☐

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Risk Screen(4): ☐ H ☒ M ☐ L

Risk Screen Basis:

Work will commence (concrete removal) upon entry to Mode 5 (de-fueling the reactor vessel). The containment building must be capable of sustaining a positive pressure of 5.14 psi until the vessel has been de-fueled. Other critical or important components required for safety will be required to be in service during this time period. Therefore, consequences associated with starting to remove concrete at the start of Mode 5 are high. Probability is low based on prior performance of similar work during previous steam generator replacements. S&L analysis will show that the structural integrity of the containment shell is adequate for all loading conditions during and after SGR.

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Waiver Basis:

On 05/20/2008 the required 70% design challenge was held and it was determined that the design package did not meet all procedural expectations for 70% (See NCR #002802130). The design superintendent is waiving the need for another 70% design challenge due to three factors:

1. The final DRB is planned and scheduled.
2. The 70% package was lacking in 3 sections; 50.59, Installation Instructions, and Testing. These sections are being completed and will get extensive reviews by the appropriate personnel before the final DRB, thereby minimizing any risk of last minute significant comments, or rework of these sections. The 70% challenge was well attended by vendors, and plant personnel and several good comments were obtained and are being resolved.

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3. Third party reviews are also being utilized to ensure the technical adequacy of the EC.

Notes:

1. Required use of processes/tools per this procedure apply to PCHG-DESG, PCHG-ALTR and TCHG-DESG EC's (except child EC's) only. These tools are optional for all other EC types
2. Outsourced EC's are EC's which are developed by vendors. Internal EC's are EC's developed in-house.
3. O – Optional, X – Required (unless waived and waiver basis documented), R - Required.
4. Design Superintendent approval is required for EC's screened as high risk or for waiving DRB not previously waived for this application.
5. For EC's screened as high risk

H.2 Risk Management Worksheet

RISK MANAGEMENT
Sheet 3 of 4

Risk Management Worksheet

Scope of Work:

The scope of this EC is to create a 25'-0" wide x 27'-0" high opening in the containment concrete wall and a corresponding 23'-6" wide x 24'-9" high opening in the liner plate to facilitate the transfer of old and new Once Through Steam Generators (OTSG) into and out of containment. The creation of the opening will require the detensioning and removal of all vertical and horizontal tendons within the opening and detensioning of an additional number of tendons around the perimeter of the opening. All steel reinforcement (rebar) exposed within the opening must be cut and discarded and will be replaced with new rebar during restoration. After the new OTSG's have been installed in their cubicles, this EC will be responsible for restoring the containment wall to its original design basis, i.e. installation of new tendons, repair of the liner plate, re-installation of rebar, pouring concrete in opening void and re-tensioning of the tendons.

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Risk Critical Evolution:

SSCs exist inside and outside containment that are critical and important components during reactor de-fueling operations. Upon entry to Mode 5 the containment building must be capable of maintaining an internal positive pressure of 5.14 psi until the reactor vessel is de-fueled (potential loss of decay heat removal event). During refueling operations the containment shell must be capable of withstanding 1.4 psig internal pressure.

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Risk Assessment:	Risk Screen Level:
Probability: ☐1 ☐2 ☒3 **Consequence:** ☒1 ☐2 ☐3	☐ **H** ☒ **M** ☐ **L**

Basis for Probability and Consequence:

Work will start on detensioning the tendons and concrete removal during entry into Mode 5, commencement of reactor de-fueling activities. Consequently, critical or important components inside and possibly outside containment will be required to be in service, including the containment building which must be capable of maintaining 5.14 psi positive internal pressure until the reactor vessel has been de-fueled, at which time the containment can be breached. After the new OTSG's have been installed in their respective cubicles, the containment will be restored to its original design basis or better, thereby eliminating any unforeseen design basis problems. Therefore, consequences associated with the initial de-tensioning of the tendons and start of concrete removal are significant since fuel is still in the reactor and the containment must maintain 5.14 psi pressure. Probability is low based on prior performance of similar work during previous steam generator replacements.

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Design Parameter:	Risk Response Planning:	Risk Mitigating Process/Tool:
Initial de-tensioning of tendons and start of concrete removal	☐ **Avoidance** ☐ **Acceptance** ☒ **Mitigation**	Scheduling – Obtain thorough operations reviews to ensure that work can begin at entry to Mode 5. Perform thorough schedule reviews to ensure schedule logic implements any restrictions recommended by Operations. Site processes require this review and approval by Operations including associated risk assessments.

		Engineering Oversight – Concrete removal will be performed by skilled and experience craftsman under guidance of knowledgeable supervision. Engineering must ensure that the hydro-demolition contractor is keenly aware that he must reduce water pressure to a workable minimum pressure when removing the final 6" thickness of concrete prior to exposing the liner plate to preclude inadvertent pressurization of the liner. Workable minimum pressure is being established based on vendor work experience. This expectation can be achieved by adding a QC Hold Point in the work instructions and additionally by having engineering closely monitor the work. Section A.5.1.12 of the EC contains a highlighted description of this warning which will be transferred to the installation instructions. Design- Adequate design engineering analysis to ensure design basis compliance. Extensive calculations will be generated to ensure structural integrity of the containment building throughout all phases of the project. (Ref. EC59368R0 "RB-Containment Breach Requirements for ROTSG"). Additionally, third party reviews by industry experts are being utilized for analysis, Repair and Replacement activities, design concepts and approach.
Infrequently performed activity: Hydrodemolition of the RB concrete wall	☐ Avoidance ☐ Acceptance ☒ Mitigation	Design and Construction Engineering Oversight - Using hydrodemolition equipment to create an opening in the RB wall is an activity that has not been previously performed at CR3. However, using hydrodemolition equipment to create such an opening has been successfully employed at numerous other nuclear plants in support of their SGRs and reactor vessel closure head replacement projects. A majority of the CR3 SGR project team (refer to Section A.7 for a list of the EC Team members), both engineering and construction personnel have extensive prior experience working on SGRs and (RVHRs) and are cognizant of the potential problems associated with hydrodemolition. Pre-Operational Testing - Additionally, the hydrodemolition equipment will be set-up and a test run conducted prior to cold-shutdown. Previous Experience - The vendor performing the hydrodemolition (Mac and Mac), has been in the business of hydrodemolition for over 30 years and will be responsible for operating the equipment. Installation Instruction Precautions: The installation instructions contain a precaution for the hydrodemolition contractor to reduce water pressure for the final 6" thickness of concrete (before exposing the liner plate). This is to reduce the risk of prematurely penetrating the concrete wall through to the liner plate. A similar occurrence occurred at the Turkey Point Plant during their SGR in 2005 (Ref. to Section A.6 for O.E.) in which high pressure water from the hydrodemolition nozzles penetrated between the concrete wall and liner plate pressurizing a section of the liner plate causing extensive plate buckling.
Infrequently performed activity: Tendon, detensioning, removal and re-installation	☐ Avoidance ☐ Acceptance ☒ Mitigation	Previous Experience, including CR3: The vendor responsible for all tendon related activities including detensioning, removal, re-insertion, and retensioning the tendons is Precision Surveillance Corporation. This company has been responsible for all of the tendon related activities performed for the majority of all SGRs conducted in the USA over the past 10 -15 years. They have performed the last three 5 year in-service inspections for the CR3 tendons. They will be supplying highly experienced supervisory personnel to oversee all aspects of the job. Pre-Operational Training: Mock-ups will be constructed prior to cold shutdown and used to train craft in executing complex activities such as tendon detensioning and re-tensioning, tendon removal and re-installation and tendon plasma cutting, in a safe and expeditious manner (Refer to Section A.5.1.1 and the Installation Instructions Section D.2.1 for further

		information on what mock-ups are required or recommended . Engineering Oversight: Design engineering has identified the affected tendons and issued design drawings, that have been reviewed and approved, that clearly locate them. These tendons have been clearly identified in the installation instructions. These installation instructions have been reviewed by engineering reviewers as well as knowledgeable field engineering personnel and 3rd party engineering reviewers.
Complex analytical techniques	☐ Avoidance ☐ Acceptance ☒ Mitigation	Industry Recognized Expert - The evaluation of the containment shell for all phases of the SGR project thru end of plant life have been performed by Sargent and Lundy (S&L), an industry recognized leader in all aspects of Nuclear plant structural analysis. Owner Design Engineering Reviews: Although S&L engineers checked and reviewed all of the calculations they generated, the CR3 SGR responsible engineer thoroughly reviewed all of these analyses. Third Party Reviews: Additionally, third party experts were employed to review these analyses; specifically the Design Criteria, FEM model, concrete creep effects and overall analysis methods and accuracy.
Personnel Safety	☐ Avoidance ☐ Acceptance ☒ Mitigation	Pre-Job Briefs - must emphasize the dangers of working at heights. Personnel access to the tendon work platforms must be limited to those individuals that have a need to actually be on the platforms. The pre-job brief should also emphasize the potential danger from dropped objects, especially considering the heights involved when working on the containment building roof or suspended on the work platforms. Adherence to Vendor Procedures and Training - familiarity with PSC work procedures is critical. Sufficient pre-outage training of the craft that will be involved in tendon work activities is required. An ALARA Work Plan will be required to minimize the overall dose received. Due to the possibility of elevated temperatures during portions of this modification, personnel are to be trained in the hazards of heat stress. Adherence to CR3 Procedures - All work performed relating to this EC will be in accordance with SAF-NGGC-2172, "Industrial Safety". All appropriate safety equipment is to be employed during the performance of this modification (e.g. eye, face, hearing, hand, foot protection, fall prevention / protection, respirators). Personnel working on scaffolding must be familiar with the requirements for working at heights. All work controlled areas will be marked and tagged per AI-1816, "Industrial Safety Signs and Tags".

H.3 Pre-Job Checklist

ENGINEERING PRE- JOB BRIEFING CHECKLIST
Sheet 1 of 2

Product/EC No.: 63016 .	Product/EC Rev.: . 0 .
Title: Containment Opening	
Responsible Engineer: John P. Holliday	Date: 2/7/2006
Job Objectives: The main objective of this EC is to create an opening in the containment wall to facilitate moving the old OTSG's out and the new OTSG's into containment. Once the new OTSG's are in their respective cubicles this EC will then give direction on restoring the opening and returning the containment wall to its original design basis.	

Job Expectations: 1) To generate design documents and work instructions with a sufficient level of detail to ensure that the construction opening can be safely created and then restored to its original design basis after moving the new OTSG's into containment. 2) To provide design documents that address the correct sequencing of all major work activities connected with creating and restoring the construction opening. This will require considerable interface with Operations. 3) To generate 3D finite element models that accurately simulate the physical structure of the containment building, including the concrete walls, liner plate and tendons. These models will reflect the containment configuration at different stages of the project. A baseline model of the existing configuration (no construction opening) will initially be generated to confirm all modeling assumptions and techniques are acceptable. This confirmation process can be reasonably satisfied by comparing results from the baseline model to existing CR3 calculations, expected results and even hand calculations. This baseline model will then be used as the basis for further individual calculations that will address tendon detensioning and removal, creation of the construction opening, retensioning the tendons and restoration of the opening. 4) To accurately determine all design basis loads and their magnitude, including dead, live, seismic, hurricane, thermal and pressure. 5) To generate load combinations that will reflect all code, regulatory, original design basis and operational requirements for all stages of the project. These loads and load combinations will be applied to the finite element models generated in item #3 above. 6) To determine what the acceptance criteria is for all model components addressing the various stages and loading combinations throughout the implementations as well as the final as left condition. This will include the concrete walls, liner plate and tendons. Allowable stress and deflection limits will be based on design basis documents, codes of record and regulatory requirements. 7) To accurately and clearly define the results, i.e. stresses, strains and deflections obtained form the FE analysis and to compare these results to the acceptance criteria determined in #6 above 8) To work closely with the tendon and hydro-demolition contractors and Bechtel construction to ensure that all possible engineering challenges connected with creating and restoring the construction opening are addressed in the EC 9) Coordinate structural interference removal with mechanical and electrical discipline interference removal activities, as required.
Skill Sets Required (including impacted organization reviewers): 1) Knowledge of the ACI Building Code. 2) Knowledge of tendon removal and re-installation techniques 3) Knowledge of the hydro-demolition process 4) Knowledge of finite element plate and beam analysis, and seismic analysis techniques. 5) Coordination with team members to evaluate ongoing activities 6) Remain cognizant of plant personnel safety during concrete removal. 7) Knowledge of heavy load lifting activities
Error Precursors (TWIN analysis)

Task Demands	*Work Environment*	*Individual Capabilities*	*Human Nature*
☒ Time/Schedule Pressure ☐ High Workload ☒ Multiple simultaneous tasks ☐ Repetitive actions/monotony ☐ Unrecoverable / Irreversible actions ☐ Interpretation requirements ☐ Unclear goals, roles, responsibilities ☐ Lack of/or unclear standards ☐ Activity inputs adequate	☐ Distractions ☒ Changes from routine ☐ Confusing displays/Controls ☐ Work arounds/OOS equipment ☐ Hidden system responses ☒ Unexpected equip conditions ☐ Adverse physical conditions ☐ Vague or incorrect guidance	☒ Unfamiliarity with task ☐ Lack of knowledge ☐ New techniques not used before ☐ Lack of proficiency ☐ Unsystematic problem solving skills ☐ "Unsafe" attitude for critical tasks ☐ Illness/ Fatigue/ General Health	☐ Stress – Work/ Home ☐ Health patterns ☒ Assumptions ☒ Complacence ☐ Overconfidence ☐ Mind Set ☐ Inaccurate risk perceptions ☐ Mental shortcuts ☐ Limited short term memory ☐ Apparent emotional health ☐ First day back from days off ☐ First time evolution

ATTACHMENT 3
ENGINEERING PRE- JOB BRIEFING CHECKLIST
Sheet 2 of 2

Error Prevention Techniques	
☒ Self Check / STAR ☒ Peer Check ☐ Qualify, Validate & Verify (QV&V) ☐ Mentoring ☒ Procedure adherence ☒ Reviews ☐ Time out	☒ Checklists ☐ 5 Step Problem Solving Process ☒ Communication ☐ Task Planning Review ☒ Tests
Prioritization/Budget Required ☐ Yes ☒No	
☐ Sponsor identified ☐ Project prioritized & budgeted ☐ Capital/ O&M ☐ Maintenance to implement ☐ Contractor to implement	☐ Parts identified ☐ Elements for estimate identified

Additional Checklist Items

☒ Work assignment made / roles defined
☒ Validation plan completed
☒ Utilize the Product Quality Checklists for all modification related EC's
☒ Required reviews (preserve an independent verifier)
☒ Walkdown needs
☒ Schedule of milestones (design inputs, reviews, etc.)
☒ Formalized design inputs (for Outsourced products)
☐ Implementation of work management tool to schedule reviews
☒ Expectations and makeup of EC Teams and DRB (if needed)
☒ Review scheduling and plant interface considerations
☒ Review appropriate programs/ procedures to be utilized / used
☒ Review any applicable Technical Specifications
☒ Design basis considerations identified
☒ ALARA
☒ Personal safety (heat stress, electrical, safety equipment)
☒ Lessons learned / OE items – Include feedback on recent product quality concerns from CAP roll-up, EPR, EC, Team implementation roll-up and EC reviews [Significant NCR 105197]
- For EC (Permanent Design/Commercial Change, Alternate Replacements and Temporary Design/Commercial Change) reviews: Review the last 6 months of NCRs related to Engineering Change by running a text search report using "Engineering Change" or "EC."

☒ Methods of communicating and coordinating actions
☒ Individual accountability made clear
☒ Emphasis on doing the job right vs. schedule
☒ Apply "SAFE"
Summarize critical steps
Anticipate traps (error precursors and resulting error-likely situations)
Foresee consequences
Evaluate defenses (including error-prevention tools)

Comments:

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H.4 Engineering Checklist

ATTACHMENT 4
ENGINEERING CHANGE CHECKLIST
Sheet 1 of 5

Administrative		√
1	The correct revisions of EGR-NGGC-0003 and EGR-NGGC-0005 have been used.	√
2	Problem and solution statement are adequately documented in the Contents section of the EC.	√
3	The history/root cause of the issue that has necessitated the EC has been provided. Applicable NCRs and OE have been incorporated.	√
4	Options evaluated and the reasons for selection and elimination have been provided.	√
5	EC Team members are listed in the Contents section and the individuals who provided input are identified.	√
6	All pages and sketches are sized to be legible so that QA records can be made.	√
7	"Track changes", if used, has been set to display revision bars only.	√
8	The accuracy of the Table of Contents has been verified. Ensure page numbers in the Table of Contents match the page numbers in the sections.	√
9	EGR-NGGC-0005, Attachment 7 screening criteria has been used to determine required reviews.	√
10	An M&CS review has been included if an EC Parts List has been included in the EC or if a SSC MMV has been affected. Elimination of inventory has been considered, including budget impact.	√
11	A Configuration Management review has been included if the EC creates changes in EDB, drawings, tech manuals, or specifications.	√
12	The correct quality class has been included on the E101 Panel in accordance with EDB and the Quality Classification of Section B.	√
13	Turnover to Operations is either checked YES or NO on the E101 panel (and agrees with Turnover/Closeout Summary).	√
14	"Cavet Outst" is set on the E100 screen if caveats or exclusions (future details, missing documentation, vendor outputs, etc.) are identified in the scope of the EC.	√
15	Work Orders (required for turnover), Condition Reports, OE, etc. are included in the Cross Reference Panel X275. Delete Work Package and Work Request references.	√
16	The required discipline inputs and outputs have been design verified or engineering reviewed as required. Lead reviews and concurrent reviews have been completed.	√
17	All required reviews and approval signoffs have been included on the E111 Panel.	√
18	The applicable Discipline, Program, and 50.59 reviewers are qualified in PQD.	√
19	Validation plan is included in the review section of the EC package	√
20	DRB comments/resolutions are included in the review section of the EC package	√
21	An NIT SME has been included on the EC team for plant digital SSC-related products.	NA
22	"VALIDATION PLAN APPROVED" and "50.59 APPROVED AND ON XREF" attributes have been completed if applicable.	√

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ATTACHMENT 4
ENGINEERING CHANGE CHECKLIST
Sheet 2 of 5

	Design Specification	√
1	Design Specification scope is clearly defined and meets EGR-NGGC-0157 requirements for software.	√
2	All applicable design inputs identified in EGR-NGGC-0005, Attachment 2 and EGR-NGGC-0157 Attachment 1 have been assessed.	√
3	Design inputs indicate the basis and source of each input.	√
4	Design inputs are in accordance with the Design Basis Document (as applicable).	√
5	The applicable codes, specifications and standards are consistent with the plant commitments (e.g. UFSAR).	√
6	Interfaces with other SSCs are clearly identified in design inputs.	√
7	The evaluation is provided in the "evaluation" section, and not in the "design inputs" section.	√
8	Design inputs clearly address required operating conditions for equipme√nt (normal, transient, and accidents) and the expected performance requirements under these conditions.	√
9	All assumptions are clearly identified in a separate section and bases for assumptions (or method of validation) are provided.	√
10	Internal (plant specific) and external (nuclear and non-nuclear) operating experience is considered.	√
11	Modification includes a failure modes and effect discussion for new and modified equipment.	√
12	Evaluation identifies changes to margins and considers mitigation for reduced margins on interfacing SSCs.	√
13	Evaluation considers in-process Engineering Changes to interfacing SSCs and dispositions potential impacts based on possible cumulative effects and on required sequencing of implementation and document updates.	√
14	Evaluation considers and dispositions each identified design input.	√
15	Vendor-supplied technical data has been validated against design inputs.	√
16	Constructability walkdowns have been completed, if possible, to verify actual plant configuration and constructability of the design.	√
17	Where constructability walkdowns are not possible, the modification clearly identifies the possible risk that field changes based on actual as-builts will be required.	√
18	The Coating Engineer has reviewed or provided input if it adds components inside containment.	√
19	The impact to Preventive Maintenance program has been considered and reviewed. This includes: • establishing or revising the scope of PM activities, including material requirement changes (Note: Model Work Order may have staged Material Requests that require revision) (PM Planner) • establishing or revising the frequency of PM performance (System Engineer) • planning to reset schedule for PM performance based on modification activities (PM Program Manager)	√
20	Modifications that involve interface agreements have responsibilities (including engineer of record) and testing requirements defined by responsible groups.	√
21	New or changed electrical power requirements, including configuration changes to connected loads, have been reviewed by Electrical and calculation impact and acceptability has been documented.	√
22	Software and databases used meet the benchmarking and verification procedural requirements.	√
23	Impacts on PSA modes, assumptions and success criteria are identified.	√

ATTACHMENT 4
ENGINEERING CHANGE CHECKLIST
Sheet 3 of 5

	Document/DATABASE MARKUPS Impact Reviews	√
1	Electrical cable management impact has been identified and input provided by the cable management coordinator if wires, cables or conduits are added, removed or spared.	√
2	The applicable load lists in Operations procedures are considered for impact if adding, removing, or modifying electrical characteristics of a component fed from an electrical panel, bus or MCC.	√
3	Vendor Manual changes for addition or deletion of information have been identified and vendor manual is listed on ADL.	√
4	System Description and Design Basis Documents has been reviewed for impact.	√
5	Markups are provided for each impacted document or a precise description of the impact to each document is provided. Consider preparation of a sketch list to aid in document update, particularly for large projects and when multiple sketches impact the same drawing.	√
6	Review EDB requirements for affected or new equipment tags and ensure Maintenance Rule and ZTEF codes have been entered. Minimum required data fields for new equipment tags have been included per EGR-NGGC-0012. A Manufacturer Model Version has been identified for any procured component subject to maintenance. For calibrated devices, setpoint parameters have been identified.	√
7	If installing new equipment, consider if an EDB tag number(s) should be assigned. Ensure software components receive EDB tag numbers (per EGR-NGGC-0157).	√
8	For temporary changes, the appropriate incorporation code has been identified for documents on the ADL.	NA

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ATTACHMENT 4
ENGINEERING CHANGE CHECKLIST
Sheet 4 of 5

	Implementation Section	√
1	A succinct description of the EC implementation instructions has been included in the "Installation" section.	√
2	The Precautions and Limitations applicable to the instructions are included.	√
3	For concurrent modifications, the requirements of EGR-NGGC-0005, Attachment 3 have been met.	NA
4	For temporary modifications, requirements for temporary change tagging have been developed.	NA
5	The EC Parts List includes the necessary parts for the design, including software components. Each part has a PassPort catalog ID number.	√
6	The "Use" column of the EC Parts List is filled in correctly for the quality class of parts to be used in the design.	√
7	For temporary changes, an expiration date has been established and specific removal requirements have been considered.	NA
8	The installation instructions clearly identify ALL installation sketches to be used and, encompass the entire installation scope of the mod. For software components, installation instructions are provided.	√
9	QC Holdpoints currently not included in existing procedures needed for implementation of the EC are identified. Refer to NUA-NGGC-1530.	√
10	For ECs requiring turnover, a request for the planner to initiate an AD type Work Order Task has been included in the instructions [BNP only]	√
11	Implementation instructions have been written to ensure that design requirements are achieved and maintained throughout implementation.	√
12	A special procedure has been developed for PMT if an adequate procedure does not currently exist.	NA
13	Post modification testing includes design parameter/function to be tested and acceptance criteria.	√
14	If a Turnover is required to Operations, the "Ops Svc" field on the E103 Panel is checked for each impacted document in accordance with EGR-NGGC-0007 or if document is part of the POM.	√
15	A Turnover/Closeout Summary is included that identifies: • (for Master ECs) Scope of Child ECs including identification of affected SSCs and boundaries • Known activities to be verified in the turnover process, specifically, required Operations and Maintenance training • Identification of post-turnover testing requirements • Justification if no turnover is required • Identification of known exceptions and caveats for turnover • Identification of closure activities and schedule • Identification of any tracking mechanisms for turnover or closeout activities	√

Deleted: √ (item 3)
Deleted: √ (item 4)
Deleted: √ (item 7)
Deleted: √ (item 12)
Deleted: √ (item 12)

ATTACHMENT 4
ENGINEERING CHANGE CHECKLIST
Sheet 5 of 5

	Testing Considerations	√
1	It has been verified that the test will demonstrate satisfaction of all performance criteria, including software functions, of the modification in addition to verifying the operability of the affected components and systems.	√
2	It has been verified that the modification will be tested in all its operating configurations. It has been verified that the test determines the modification has not adversely affected the unmodified portions of the component or system.	√
3	It has been verified that the proposed test demonstrates proper functioning of the component or systems over its entire range of operation and can be performed under both current and anticipated plant conditions.	√
4	The test should verify that any substituted components or equivalency engineering was accurate and complete.	√
5	It has been verified that modifications to redundant equipment and components are tested identically and that subsequent testing receive the same level of review, verification, and validation as the initial test.	√
6	If the proposed test will cause plant parameters to change, it has been verified that all administrative and operating requirements are met for the anticipated changes.	√
7	Responsibility and authority to intervene or terminate the test if problems are encountered during testing have been established and communicated.	√
8	The test termination criteria are specified. It has been verified that the test termination criteria do not conflict with guidance contained in normal, off-normal, or emergency operating procedures. Methods for resolving discrepancies have been identified.	√
9	It has been verified and documented that any procedure or document referenced by the test procedure is the most current revision.	√
10	Consideration has been giving to whether or not this test is an infrequently performed test or evolution or requires heightened level of awareness procedures. The basis for this determination has been developed and documented. [BNP - 0PLP-017, CR3 – AI-550, HNP–PLP-100, RNP–PLP-037]	√
11	If senior managers are required to be present during the test, the appropriate managers and their responsibilities have been identified.	√
12	It has been verified that station personnel required to conduct the test are trained and qualified to perform the test.	√
13	Post modification testing includes plant mode required for testing and any special requirements.	√
14	Electrical and I&C post modification testing is specified per EGR-NGGC-0155.	√
15	If an SSC has been disturbed and then returned to original state, appropriate testing is specified.	√
16	If separate testing is performed on different portions of the affected SSCs (e.g., an electrical circuit), the overall test plan ensures that no portions of affected SSCs that are required to be tested are omitted.	√
17	Plant digital SSC-related testing has been implemented per criteria in EGR-NGGC-0157. Software functionality has been validated prior to installation using test systems, simulations, or mockups.	NA
18	Failure modes and effects analysis results are used as input to modification test planning and software validations.	√

Deleted: √

H.5 0% Design Challenge/Kickoff Meeting

No comments were recorded from this meeting

From: Henshaw, Keith
To: Widener, Matthew W; Gapp, Robert C;
CC:
Subject: RE: EC Kickoff Meetings
Date: Tuesday, March 07, 2006 4:09:19 PM
Attachments:

Matt / Bob,

Can one of you gentlement attend the kickoff meetings for the Steam Generator Replacement Project ECs? Scott Young will not be able to attend and recommended that one of you guys represent Security at this meeting. See attached for what I sent to Scott, and also Scott's reply is attached.

Thanks,
Keith Henshaw x4045

Kickoff Meetings for several Engineering Change (EC) packages required for the Steam Generator Replacement Project will take place on 3/16/06 from 1:00 PM - 3:30 in the SGR War Room. The following ECs will be discussed:

Rigging & Transport - Rigging of the Steam Generators in and out of containment
Haul Route - Steam Generator Haul Route outside of containment
Tower Crane / Aux Crane - Erection Crane for outside lifting systems and temporary cranes inside containment
Cavity Decking - Temporary Cavity covers and laydown areas during SGR outage
Containment Opening - Creation and restoration of a construction opening - includes Tendons & Concrete Repair
Elevator to Containment Roof - To support tendon work
Old Steam Generator Retirement Structure - Storage for old SGs
OTSG Anchorage - Upper Lateral Supports and Base Anchorage
Structural Interferences - includes existing platform removal to clear load path for steam generators

You are asked to please attend the meeting and represent your respective organizations. If you cannot make it, please send an alternate representative. If the scope of work has no impact in your respective area, please respond by e-mail stating this and you will not be sent future e-mails regarding 30% and 70% EC reviews for these modification packages:

Operations	Chuck Morris
Maintenance	Dalton Brass
Programs Engineer - Tendon Surveillance	John Mueller
System Engineering - Mx Systems	Pat Peterson
System Engineering - OTSG	Scot Stewart
System Engineering - Security	Brian Doran
SGR Project Engineering	Dan Jopling
ALARA	Mike Siapno
Task Mgr - Facilities and Containment Opening	Robin Kibler
Task Mgr - Rigging and Transport & RE	Keith Henshaw
Task Mgr - Interference Removal	Larry McDougal
Project Task Mgr	Ron Seagraves
Security	Scott Young
Responsible Engineer	Dexter Bradford
Responsible Engineer	John Holliday
Responsible Engineer	Rich Kopicki

Call me if you have any questions at x4045

Thank you,
Keith Henshaw
x4045

-----Original Appointment-----
From: Young, Scott
Sent: Tuesday, March 07, 2006 3:51 PM
To: Henshaw, Keith
Subject: Declined: EC Kickoff Meetings
When: Thursday, March 16, 2006 1:00 PM-3:30 PM (GMT-05:00) Eastern Time (US & Canada).
Where: SGR War Room

H.6 Review Comments (30% Design Challenge)

Conceptual Design Review Board & 30% Challenge EC 63016 Containment Opening 10/11/06		
Quorum Members		
Name	Organization	
Bryan Akins	RP	
Chuck Morris	Operations	
Bob Gapp	Security	
Dalton Brass	Maintenance	
Mike Siapno	SGP RP	
Andy Harmon	Nuc Eng & Services	
~~Pat Peterson~~ Rick Portmann	Engineering	
~~Jack Cur~~am	~~Fire Protecti~~on	
Bernard Martin	Bechtel Construction	
Magdy Bishara	SGR/ENG	

Conceptual Design Review Board & 30% Challenge
EC 63016
Containment Opening
10/11/06

Non Quorum Members

Name	Organization	
John Dyer	SGR	[signature]
John Byers	SGR	[signature]
Rudy Pinner	Environmental & Chemistry	
Doug [illegible]	SAFETY	
S.D. Powell	SGR - LICENSING	[signature]
SVEN SWENSON	SGR-DESIGN	[signature]
Dan Jopling	SGR DESIGN	[signature]
Curtiss Dew	Rx Systems	[signature]
DAVE ROTHROCK	LICENSING	[signature]

Subject: Action items from Containment Opening Conceptual Design Review Board (EC 63016)

A Design Review Board meeting was held October 11, 2006 for the SGR Containment Opening EC. All Quorum members were represented. Each quorum member indicated they had reviewed the package and were in a position to discuss and evaluate the proposed modification. The design concept was presented and a lively discussion followed. The discussion reflected team involvement and interest. The following action items resulted from the discussion:

1) A Chemistry representative needs to be included in future Containment Opening DRB
2) Evaluate the need for a remote RC restricted area for the water treatment/disposal facilities
3) The potential for contaminated repair work on the liner plate should be evaluated in the selection of the LP storage facility
4) The EC needs to evaluate the risk involved in the as-found condition of the liner plate and appropriate contingencies established
5) Required post mod testing/examination needs to be evaluated to minimize impacts on the project while meeting all design and licensing basis requirements
6) Insure the Sargent and Lundy's engineering efforts are compatible with PSC's ISI inspection activities

All these action items are assigned to John Holliday for inclusion in the final EC package.

At the end of the meeting the quorum members were asked if the design concept presented was acceptable and if the development of the EC based on this concept should continue. The quorum members all indicated the development of the EC should proceed.

Discipline/Program Review	Scope of Review		
Civil	30% DRB/Design Challenge Meeting Comments		
Reviewer	**Discipline**	**Date**	**Turnover Required?**
John Holliday	Civil	5/8/08	

Item	Comment	Resolution
1	A Chemistry representative needs to be included in future Containment Opening DRB	Rocky Thompson is included in all future DRBs/Design Challenges as a Critical Attendee
2	Evaluate the need for a remote RC restricted area for the water treatment/disposal facilities	Discussed with Mike Siapno, Kenny Young and Rocky Thompson.
3	The potential for contaminated repair work on the liner plate should be evaluated in the selection of the LP storage facility.	The dimensions of the cut liner plate have been forwarded to Mike Siapno. Mike will take into account the size of the liner plate when determining the overall size of the remote RP storage facility. This facility will probably be a large tent that tentatively may be located at either the CR3 or CR1 &2 parking lots.
4	The EC needs to evaluate the risk involved in the as-found condition of the liner plate and appropriate contingencies establish.	Spare liner plate material will be ordered as a contingency to cover the possibility that the existing plate is damaged beyond repair. Refer to Section A.5.1.16 of the EC for a detailed discussion and acceptance criteria for the as-found condition of the liner plate.
5	Required post mod testing/examination needs to be evaluated to minimize impacts on the project while meeting all design and licensing basis requirements	S&L has been tasked with preparing a Repair/Replacement Plan in accordance with ASME Section XI Subsection IWE and IWL. This plan will include the essential requirements for completion of all activities related to the liner plate, concrete and tendons (Material, cutting, detensioning, retensioning, rebar, sheaths, welding, repairing, inspections, testing, etc.). This plan will also address the test procedure and acceptance requirements for liner plate/containment leakage integrity, i.e., ILRT or some other acceptable test.
6	Insure the Sargent and Lundy's engineering efforts are compatible with PSC's ISI inspection activities	S&L has prepared calculations for predicting future tendon forces after the full restoration of the Opening based on current ISI inspection schedule thru 2016.

Progress Energy

memo

Date: 10/12/06 SGR06-0083

To: Distribution

From: D. Jopling

Subject: Action Items from Containment Opening Conceptual Design Review Board (EC 63016)

A Design Review Board meeting was held October 11, 2006 for the SGR Containment Opening EC. All Quorum members were represented. Each quorum member indicated they had reviewed the package and were in a position to discuss and evaluate the proposed modification. The design concept was presented and a lively discussion followed. The discussion reflected team involvement and interest. The following action items resulted from the discussion:

1) A Chemistry representative needs to be included in future Containment Opening DRB.

2) Evaluate the need for a remote RC restricted area for the water treatment/disposal facilities.

3) The potential for contaminated repair work on the liner plate should be evaluated in the selection of the LP storage facility.

4) The EC needs to evaluate the risk involved in the as-found condition of the liner plate and appropriate contingencies established.

5) Required post mod testing/examination needs to be evaluated to minimize impacts on the project while meeting all design and licensing basis requirements.

6) Insure the Sargent and Lundy's engineering efforts are compatible with PSC's ISI inspection activities.

All these action items are assigned to John Holliday for inclusion in the final EC package.

Progress Energy Florida, Inc.

At the end of the meeting the quorum members were asked if the design concept presented was acceptable and if the development of the EC based on this concept should continue. The quorum members all indicated the development of the EC should proceed.

D. L. Jopling
CR3 SGR, Supervisor

Distribution List:

M. Bishara
M. Siapno
B. Akins
C. Morris
P. Benjamin
D. Brass
R. Haddock
R. Portman
B. Martin

Cc:

J. Dyer
J. Byers
R. Pinner
D. Mills
S. Powell
S. Swenson
D. Jopling
C. Dew
D. Rothrock

Progress Energy

memo

Date: 8/23/06 SGR06-0065

To: Akins Jr, Leon B. (RP)
Morris, Chuck (Ops)
Gapp, Bob (Security)
Portmann, Rick (Eng)
Fletcher, Dick (Maj Pro)
Brass, Dalton (Maint)
Siapno, Mike (Maj Pro)
Harmon, Andy (Nuc Eng & Srv)
Peterson, Pat (Eng)

From: Magdy Bishara For MB

Subject: 30% Design ~~Review Board~~ Challenge – EC 63016 + Conceptual DAR

The Steam Generator Replacement Project will be holding a 30% Design Review Board on 09/20/06 at 10:00am in the SGR War Room (Northeast corner of the 2nd floor SAB). This DRB will evaluate EC 63016 "Containment Opening". This file can be found at:

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If you are an addressee, your sub-group's participation in the DRB is considered to be necessary. 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.

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.

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 Eng)
Reynolds, David (ANII)
McPherson, Sue (Mgr, IT)
Infanger, Paul (Supv, Licensing)
Young, Scott (Supt, Security)
Brewer, Bill (Mgr, Maint)
Donovan, Mike (Supt, Materials)
Foster, Berry, (Supv, EP)
Wilson, Ken (PE & Reg Affairs)
Jopling, Dan (Lead Eng)
Mills, Doug (Lead Occ Health & Safety)
Seagraves, Ron (Proj Task Mgr)
Rigsby, Mark (Supt, RP)
Powell, Sid (Maj Pro Licensing)
Widener, Matt (Lead Security)
Rass, Ken (Sr Ops Spec)
Hendricks, Chris (Supv, Materials)
Austin, John (Supt, NAS)

Progress Energy Florida, Inc.

To: Gapp, Robert C; Akins Jr, Leon B.; Morris, Charles J; Portmann, Rick; Brass, Dalton T.; Siapno, Michael M.; Harmon, Andy; Peterson, Patrick M.
Cc: Bishara, Magdy M.; Swenson, Matthew; Reynolds, David M.; McPherson, Susan M; Infanger, Paul E.; Young, Scott; Brewer, William J.; Donovan, Michael W.; Foster, Berry J; Wilson, Kenneth R; Jopling, Daniel L.; Mills, Douglas F; Seagraves, Ronald; Rigsby, Mark; Powell, Sid; Widener, Matthew W; Rass, Kenneth C.; Hendricks, Christopher M.; Austin, John G; Dyer, John
Subject: 30% DRB for EC 63016 SGR Containment Opening------Re-schedule

Gentlemen,

Senior management has requested that we re-schedule the 30% DRB for the SGR Containment Opening EC due to existing schedule conflicts. The new date is Wednesday September 27 at 10.00 am in the SGR War Room located in the NE corner of the second floor SAB.

Regards,

John Holliday (X4832)
RE for EC 63016