UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

September 15, 2010

Mr. Jon Franke, Vice President
Crystal River Nuclear Plant (NA1B)
ATTN: Supervisor, Licensing &
Regulatory Programs
15760 West Power Line Street
Crystal River, FL 34428-6708

SUBJECT: PUBLIC MEETING SUMMARY – SPECIAL INSPECTION RESULTS
CRYSTAL RIVER NUCLEAR PLANT – DOCKET NO. 50 – 302

Dear Mr. Franke:

On September 2, 2010, the Nuclear Regulatory Commission (NRC or the staff) conducted a public meeting at the Crystal River Nuclear Plant EOF/Training Center in Crystal River, FL. The purpose of the meeting was for the NRC to present the results of the Special Inspection that was conducted from October 13, 2009 to September 2, 2010, and that addressed the circumstances surrounding a delamination discovered in the concrete of the containment building at the Crystal River nuclear power plant last fall.

Mr. M. Franke of the NRC staff provided opening remarks. Mr. L. Lake of the NRC staff then presented the results of the inspection, which included a discussion of the delamination and an assessment of Progress Energy's actions to address the issue. Progress Energy then presented additional information and addressed the NRC inspection results. The public was invited to observe the meeting and had opportunities to communicate with the NRC after the business portion of the meeting.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and enclosure will be available electronically for public inspection in the NRC Public Document Room (PDR) or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this meeting, please contact me at 404-997-4436.

Sincerely,

/RA/

Mark Franke, Chief
Engineering Branch 3
Division of Reactor Safety

Enclosures:
1. List of Attendees
2. Handout – NRC Presentation Slides ML102440205
3. Handout – Progress Energy Presentation Slides ML102581096

cc w/encl.: (See page 3)

cc w/encl:
R. J. Duncan, II
Vice President
Nuclear Operations
Carolina Power & Light Company
Electronic Mail Distribution

Brian C. McCabe
Manager, Nuclear Regulatory Affairs
Progress Energy Carolinas, Inc.
Electronic Mail Distribution

James W. Holt
Plant General Manager
Crystal River Nuclear Plant (NA2C)
Electronic Mail Distribution

Stephen J. Cahill
Engineering Manager
Crystal River Nuclear Plant (NA2C)
Electronic Mail Distribution

R. Alexander Glenn
Associate General Counsel
(MAC - BT15A)
Florida Power Corporation
Electronic Mail Distribution

Christos Kamilaris
Director
Fleet Support Services
Carolina Power & Light Company
Electronic Mail Distribution

William A. Passetti
Chief
Florida Bureau of Radiation Control
Department of Health
Electronic Mail Distribution

Daniel R. Westcott
Supervisor
Licensing & Regulatory Programs
Crystal River Nuclear Plant (NA1B)
Electronic Mail Distribution

Joseph W. Donahue
Vice President
Nuclear Oversight
Carolina Power and Light Company
Electronic Mail Distribution

Jack E. Huegel
Manager, Nuclear Oversight
Crystal River Nuclear Plant
Electronic Mail Distribution

David T. Conley
Associate General Counsel
Legal Dept.
Progress Energy Service Company, LLC
Electronic Mail Distribution

Mark Rigsby
Manager, Support Services - Nuclear
Crystal River Nuclear Plant (NA2C)
Electronic Mail Distribution

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Crystal River Nuclear Generating Plant
U.S. NRC
6745 N Tallahassee Rd
Crystal River, FL 34428

Attorney General
Department of Legal Affairs
The Capitol PL-01
Tallahassee, FL 32399-1050

Ruben D. Almaguer
Director
Division of Emergency Preparedness
Department of Community Affairs
Electronic Mail Distribution

Chairman
Board of County Commissioners
Citrus County
110 N. Apopka Avenue
Inverness, FL 36250

PUBLIC MEETING – CRYSTAL RIVER 3 NUCLEAR PLANT
EXIT MEETING FOR SPECIAL INSPECTION CONTAINMENT DELAMINATION

SEPTEMBER 2, 2010

ATTENDEES SHEET

NAME	ORGANIZATION
Loretta Murray	Progress Energy Florida
Gail Simpson	Progress Energy Florida
GEORGE THOMAS	NRC/NRR
Kriss Kennedy	NRC/RII
DON NEAL	PRIVATE
Sally Price	THE Newscaster
MARK FRANKE	NRC
GARRY MILLER	PGN
Ophelia PAYNE	Public
BRENDAN COLLINS	NRC/RII
Charles A. Williams	PGN
Anthony Masters	NRC/RII
JASON Paige	NRC
Farideh Saba	NRC
BOB OLIVEIRA	ANI
Mike Fahey	Citizen
ROGER HANNAH	NRC/RII
TOM MORRISSEY	NRC SRI
Dan Rich	NRC RII
Victor McCree	NRC

PUBLIC MEETING – CRYSTAL RIVER 3 NUCLEAR PLANT
EXIT MEETING FOR SPECIAL INSPECTION CONTAINMENT DELAMINATION

SEPTEMBER 2, 2010

ATTENDEES SHEET

NAME	ORGANIZATION
Louis Lake	NRC
Rick Pellage	Central Power & Lime
PAUL FAGAN	Progress Energy
Janet Garvin	Public
John H. Ring	Public (Citrus Vets)
Roger Southerville	Public
Jim KEENUM	Public
DENNIS HERRIN	CR-3 LICENSING
Dan Westcott	CR-3 licensing
SEAN BUTLER	PROGRESS ENERGY.
Brian McCabe	Progress
SUZANNE GRANT	Progress Energy
Chris Van Ormer	Citrus County Chronicle
Cathy Uronis	Public
GAIL DAVIS	PUBLIC
JAMES HOLT	Progress
Bretlee JORDAN	CCSO - REP Coordinator
Pamela Rowe	CCSO - REP Assistant
Kathy Morse	Public
Tony DELAUNE	Public

Enclosure 1

PUBLIC MEETING – CRYSTAL RIVER 3 NUCLEAR PLANT
EXIT MEETING FOR SPECIAL INSPECTION CONTAINMENT DELAMINATION

SEPTEMBER 2, 2010

ATTENDEES SHEET

NAME	ORGANIZATION
Stephen Cahill	Progress Energy
Ronald M Bright	Florida Municipal Power Agency
LARRY Remmele	CITIZEN
BILL SHMIELEWSKI	"
Charlie Duppstadt	"
Jack Marshall	CITIZEN
ERNEST KAPOPOULOS	Progress Energy
Jessica Lambert	Progress Energy
Jim Scarola	Sr. VP PEF
MARK Embree	Citizen
John STRIO	CITIZEN
MARK RIGSBY	PROGRESS ENERGY MGR SSS
Elmer + Doris Kelley	CITIZEN
Wm F. Hartsfield	"
MARILYN SERIANNI	"
TOM OVERA	"
BEVERLY OVERA	"
Richard Pennebaker	St. Petersburg Times
John York	St. Petersburg Times
DAWN MARIE CLARY	TOWN OF YANKEETOWN

Enclosiure 1

PUBLIC MEETING – CRYSTAL RIVER 3 NUCLEAR PLANT
EXIT MEETING FOR SPECIAL INSPECTION CONTAINMENT DELAMINATION

SEPTEMBER 2, 2010

ATTENDEES SHEET

NAME	ORGANIZATION
MARK P. KNUTHO	THORN
Pete Judd	Self - Sr. Citizens of
Rogerio Reyes	Clwtr & Dunedin, FL
Gail Lonneville	IRT-CR
	Admin Assist NRC CR

Enclosure 1

NRC Special Inspection Team

Exit Meeting for Crystal River

September 2, 2010

Enclosure 2

Purpose

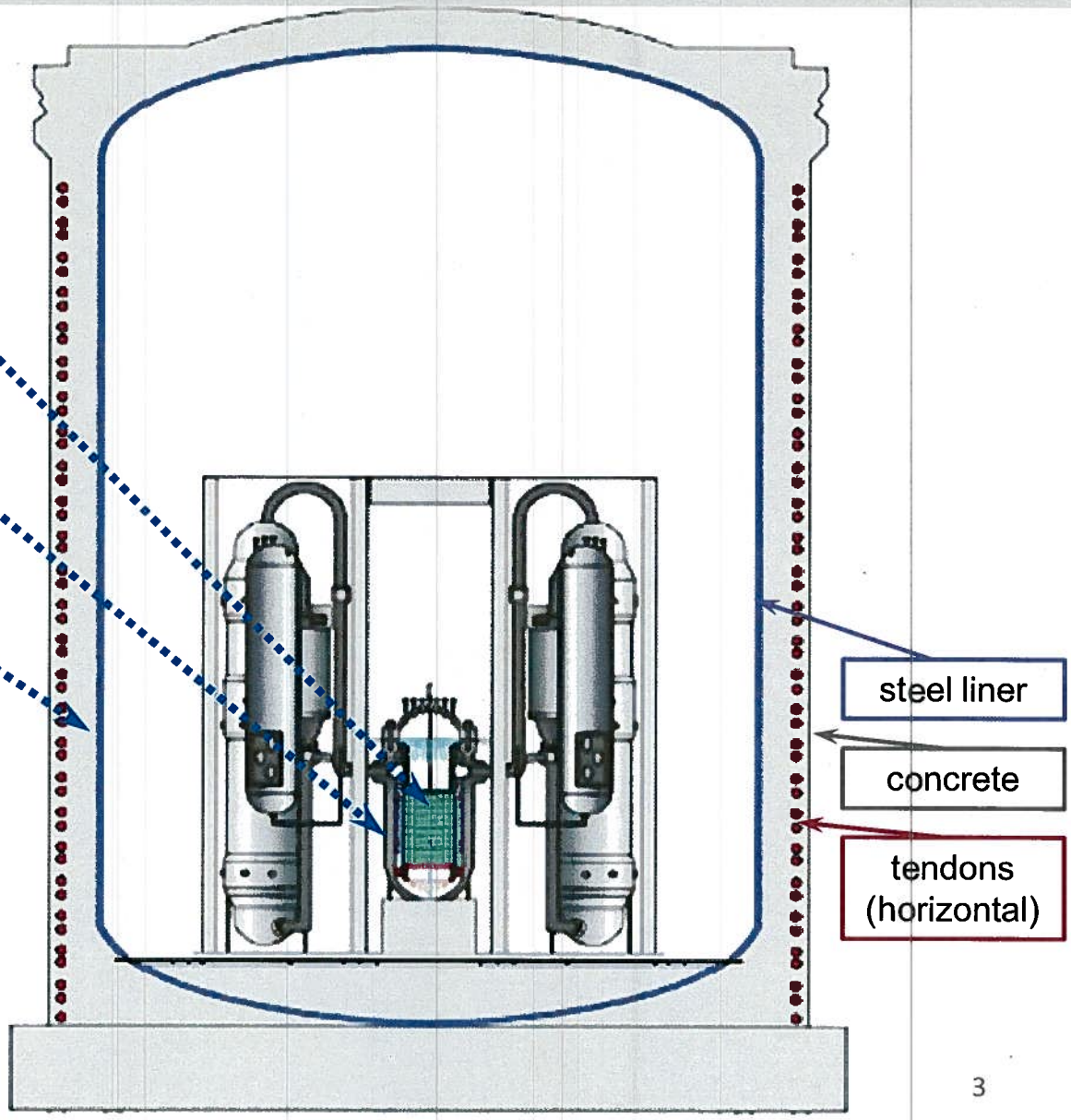
- Background
- Inspection
- Results

Fission Product Barriers

Barrier #1:
cladding enclosing the fuel

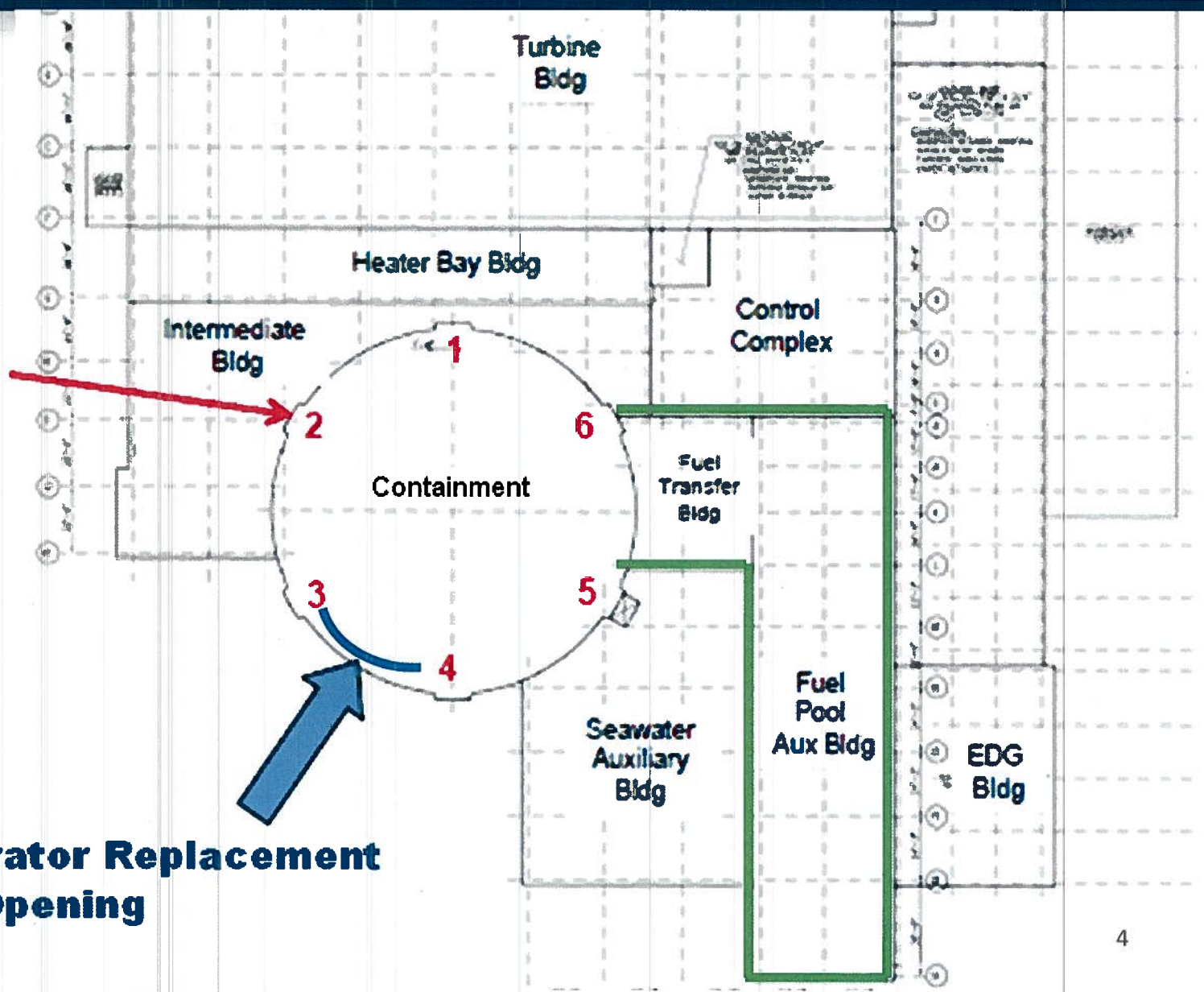
Barrier #2:
reactor vessel & piping

Barrier #3:
containment

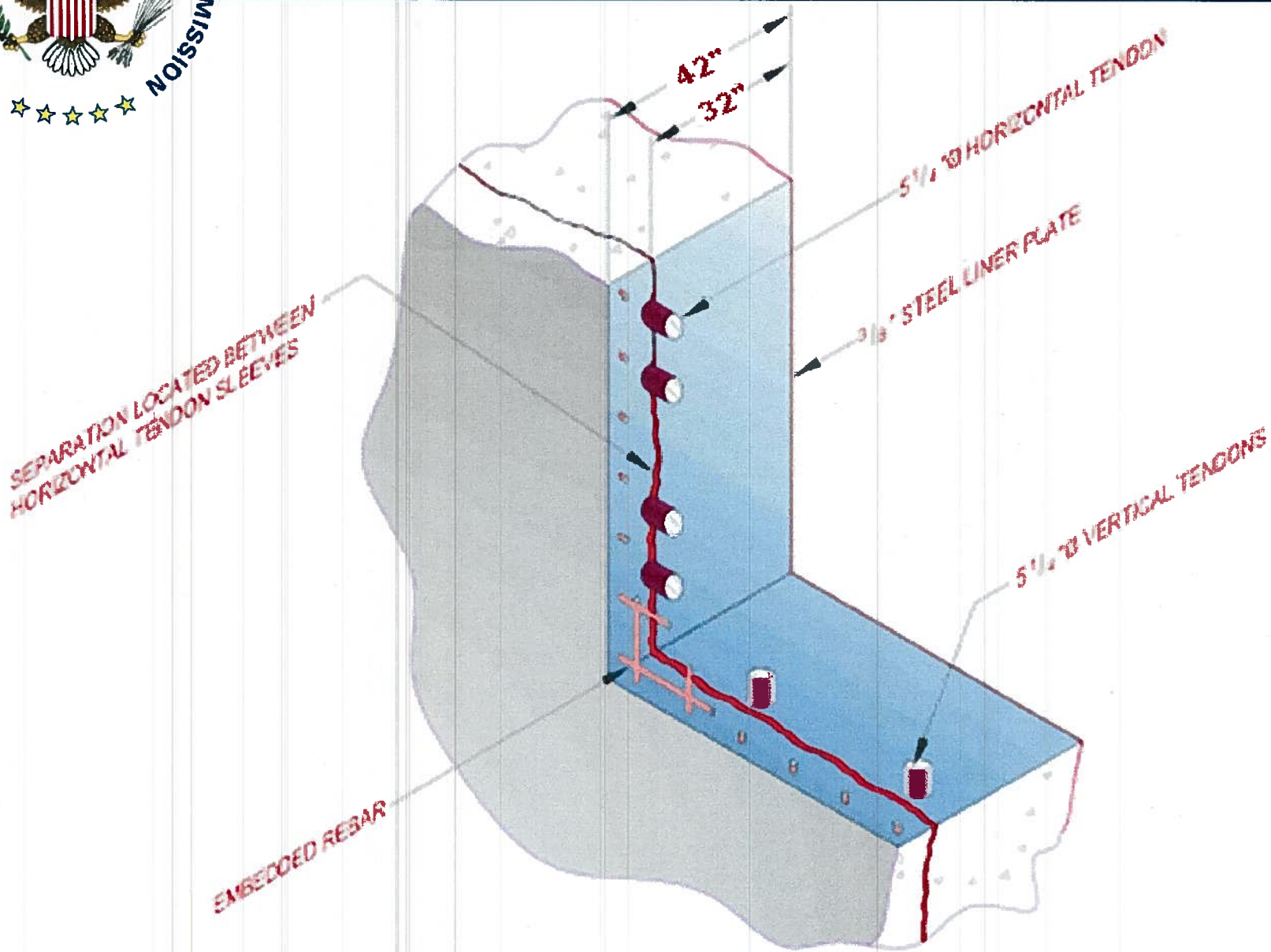


NOT TO SCALE

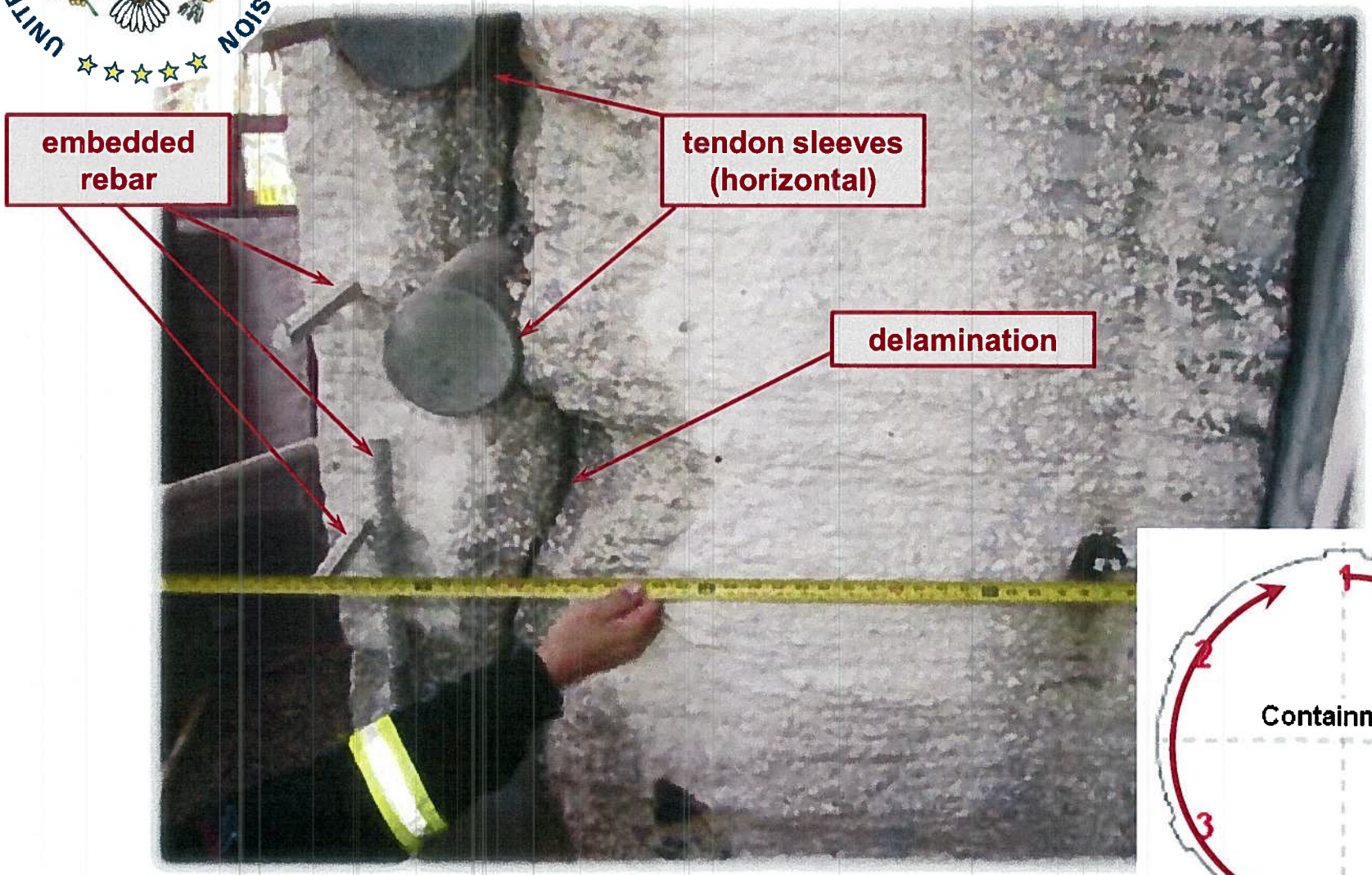
Plan View

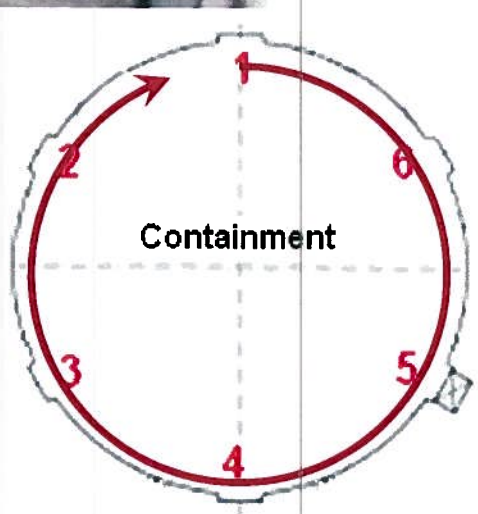

Turbine Bldg
Heater Bay Bldg
Intermediate Bldg
Control Complex
Buttress #
(typical)
1
2
3
4
5
6
Containment
Fuel Transfer Bldg
Seawater Auxiliary Bldg
Fuel Pool Aux Bldg
EDG Bldg
Steam Generator Replacement Opening

Delamination Location

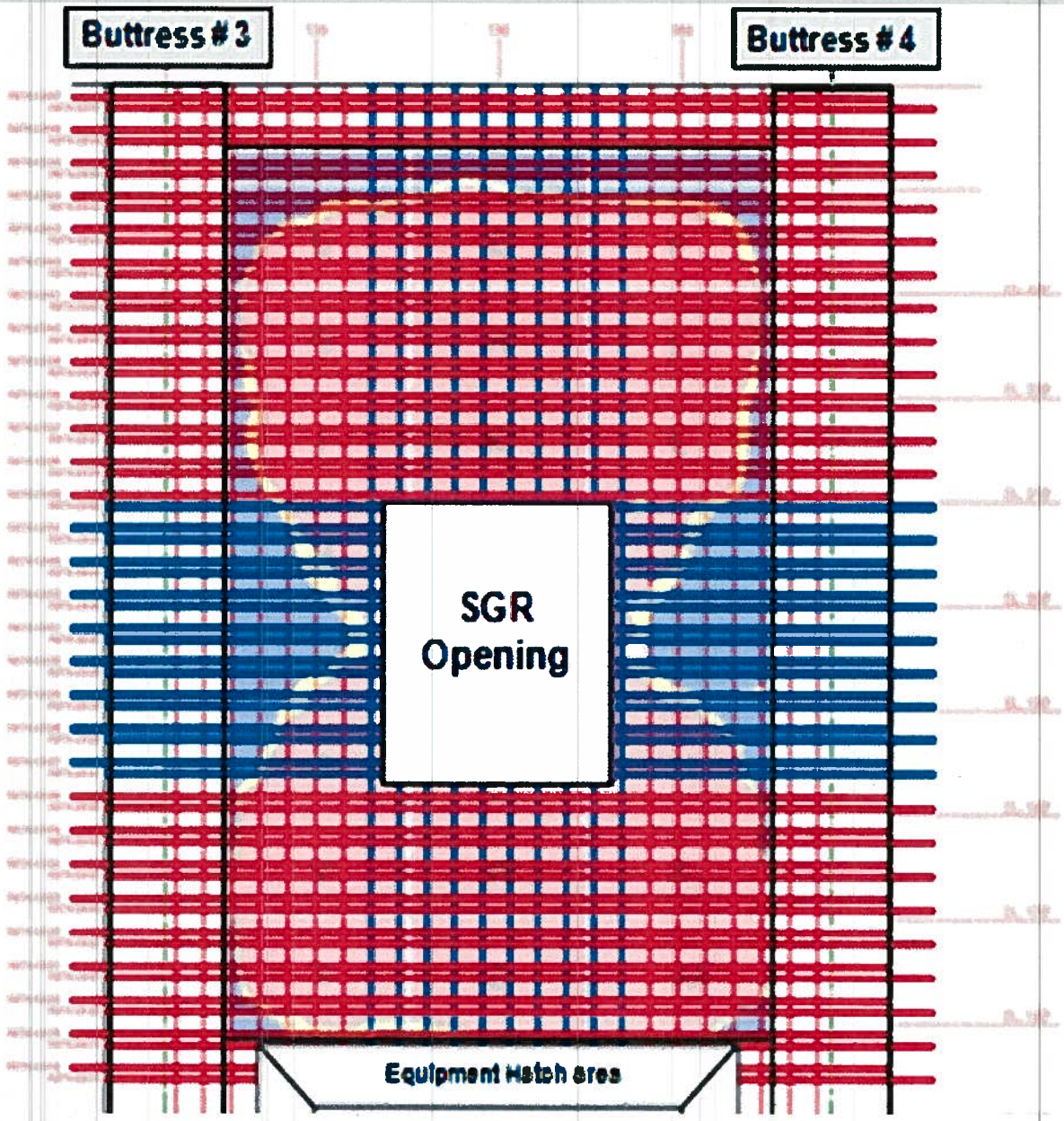


Delamination Location





Tendon Pattern



Tendon Pattern at time of cutting Steam Generator Replacement Opening

- **Tensioned**
- **De-tensioned and Removed**

INSPECTION SUMMARY

Special Inspection

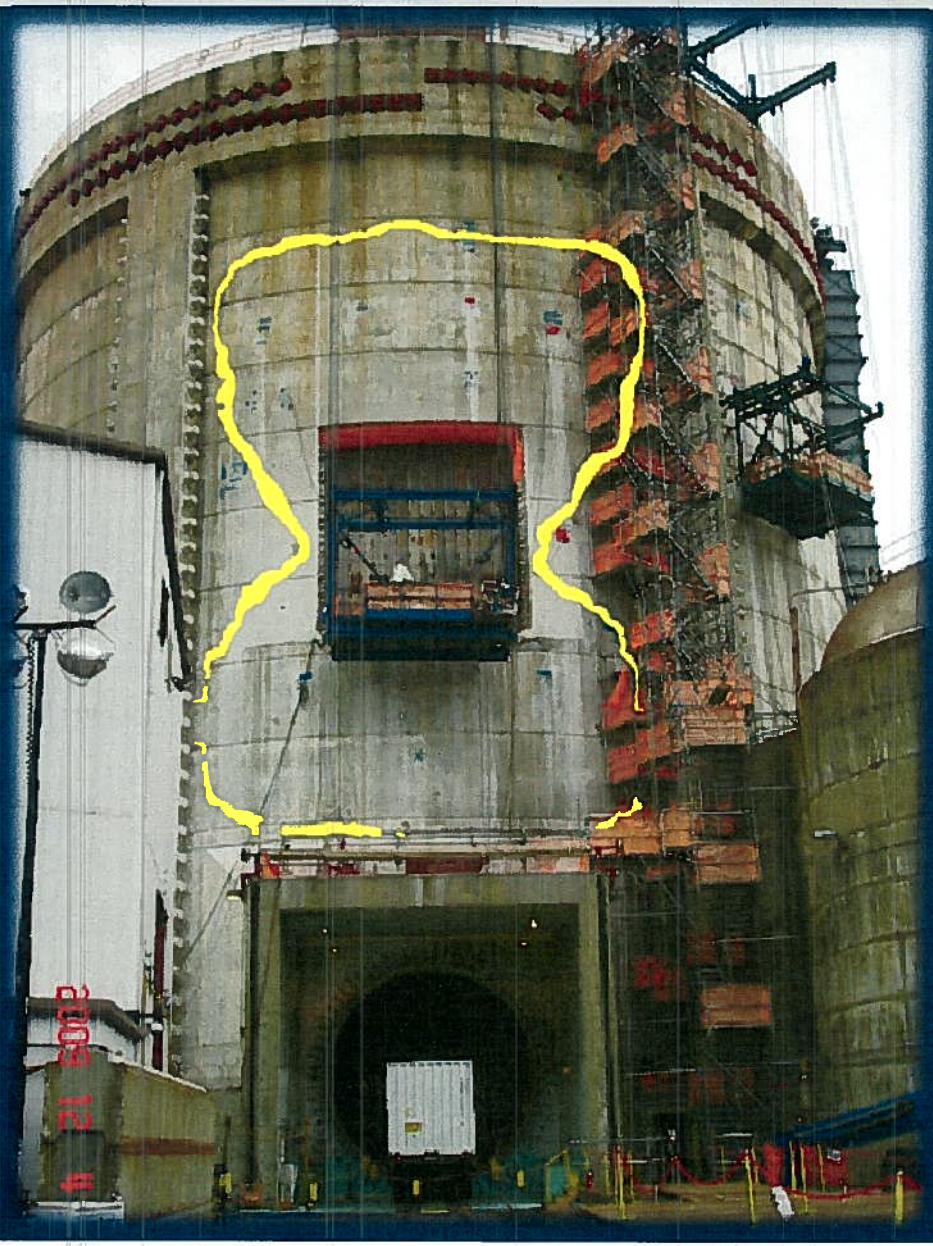
- 6 member team
  - NRC Staff and Independent Experts
- More than 100 years relevant experience

UNITED STATES NUCLEAR REGULATORY COMMISSION

Inspection Results

- Progress Energy Investigation
- Safety Significance

Extent of Delamination



Inspection Results

- Generic Implications
- Progress Energy Corrective Actions

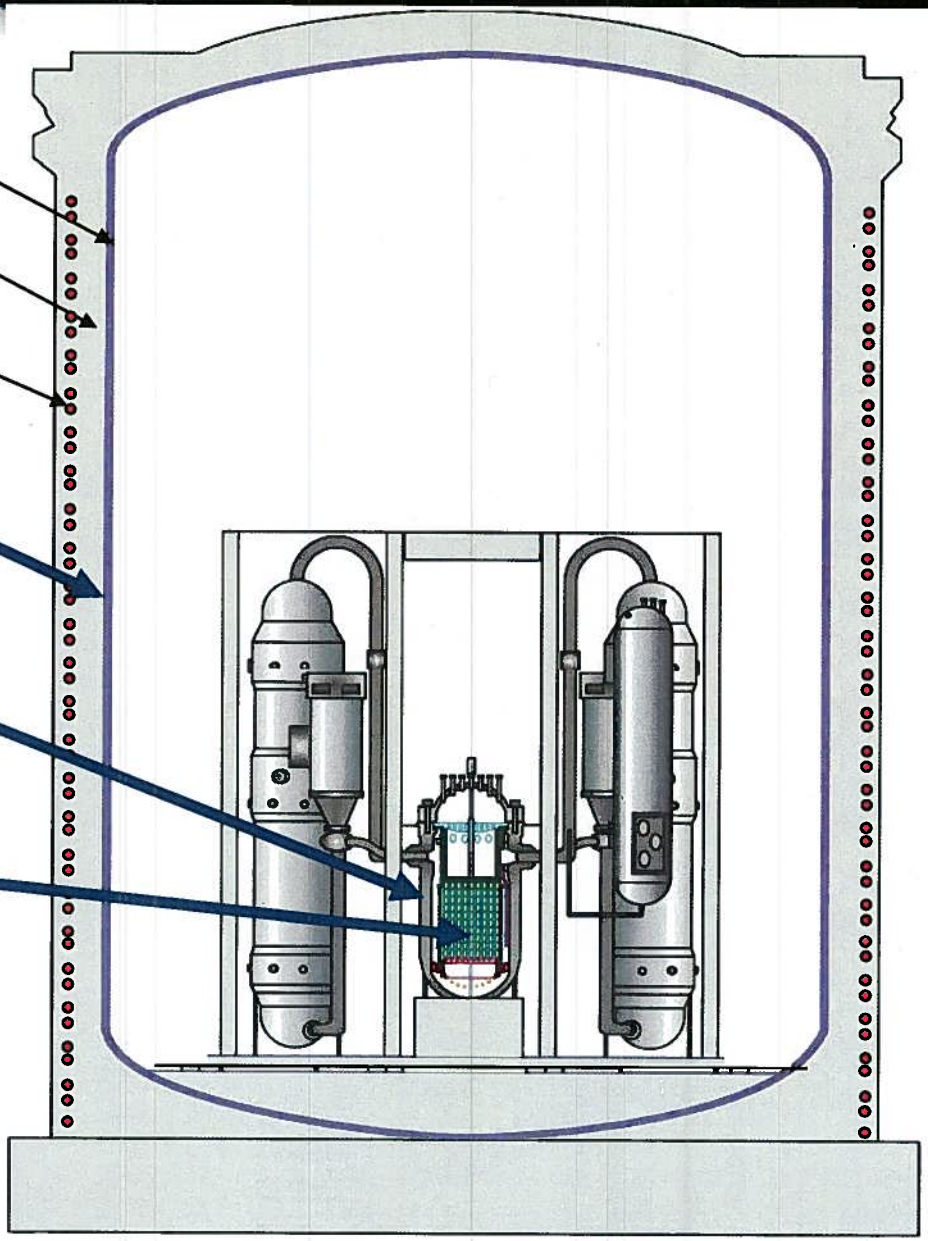
Crystal River Unit #3 Containment Investigation and Repair

September 2, 2010

Progress Energy

Enclosure 3

Fission Product Barriers
Simplified Schematic



Tendon depiction is for illustrative purposes and is not an exact scale

Steam Generator Replacement Opening

Identification of Issue

SGR Opening Dimensions

@ Liner
23' 6" x 24' 9"

@ Concrete Opening
25' 0" x 27' 0"

Progress Energy

Root Cause Analysis
Investigation & Design Basis Team

- **Comprehensive Team Commissioned**
  - Progress Energy personnel - expertise across fleet
  - Industry peers:
    - *Exelon*
    - *Southern Company*
    - *SCE&G*
  - External expertise:
    - *Performance Improvement International (PII)*
    - *MPR Associates*
    - *AREVA*
    - *Worley Parsons*
    - *Wiss, Janney, Elstner Associates (WJE)*
    - *Construction Technology Laboratories (CTL)*

Progress Energy

Root Cause Analysis

Investigation & Design Basis Team (continued)

- **Material Laboratories Support**
  - *MacTec*
  - *Soil & Materials Engineers (S&ME)*
- **Field Data Support**
  - *Sensing Systems, Inc*
  - *Core Visual Inspection Services (Core VIS)*
  - *Nuclear Inspection & Consulting, Inc*
  - *Precision Surveillance*
  - *Gulf West Surveying, Inc*
  - *AREVA*

Root Cause Analysis

Investigation & Design Basis Team (continued)

- **Numerous PhDs (11) with expertise in:**
  - *Root Cause Investigation Techniques*
  - *Nuclear Engineering*
  - *Nuclear Operations & Maintenance*
  - *Material Science & Testing*
  - *Concrete Standards & Construction*
  - *Concrete Testing*
  - *Concrete Creep*
  - *Concrete Fracture*
  - *Human Performance*
  - *Process Analysis*
  - *Containment Analysis*
  - *Computer Modeling*

Concrete Operational Experience (OE)

- **Worley Parsons**
  - 1976 dome delamination investigation and repair (as Gilbert Commonwealth)
- **Structural Preservation Systems (SPS)**
  - Largest Concrete Repair Contractor in the US, 2nd largest Concrete Contractor (of any type) in the US
  - Performs > 4,000 repair projects per year
- **Wiss, Janney, Elstner Associates, Inc (WJE)**
  - Structural engineering and materials science firm specializing in failure investigations and problem solving
  - Specialist in structural condition assessments and design of repairs and retro-fits for reinforced and post tension concrete structures
  - Conducted original CR3 Structural Integrity Test (SIT)

Nuclear Safety Oversight Committee (NSOC)

Containment Sub-Committee Membership

Member	Title
John Elnitsky (PGN)	VP – New Generation Programs and Projects **(Chairman)**
Joe Donahue (PGN)	VP - Nuclear Oversight
Chris Burton (PGN)	VP - Harris
Greg Selby	Technical Director - EPRI
Dr. Shawn Hughes	VP - Shaw Stone & Webster
Dr. Paul Zia	Civil Engineering Professor, NCSU
Hub Miller	33 years industry oversight experience
Darrell Eisenhut	41 years industry operation and oversight experience

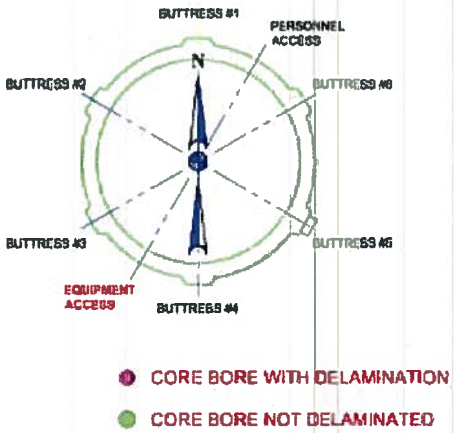
Progress Energy

Root Cause Analysis

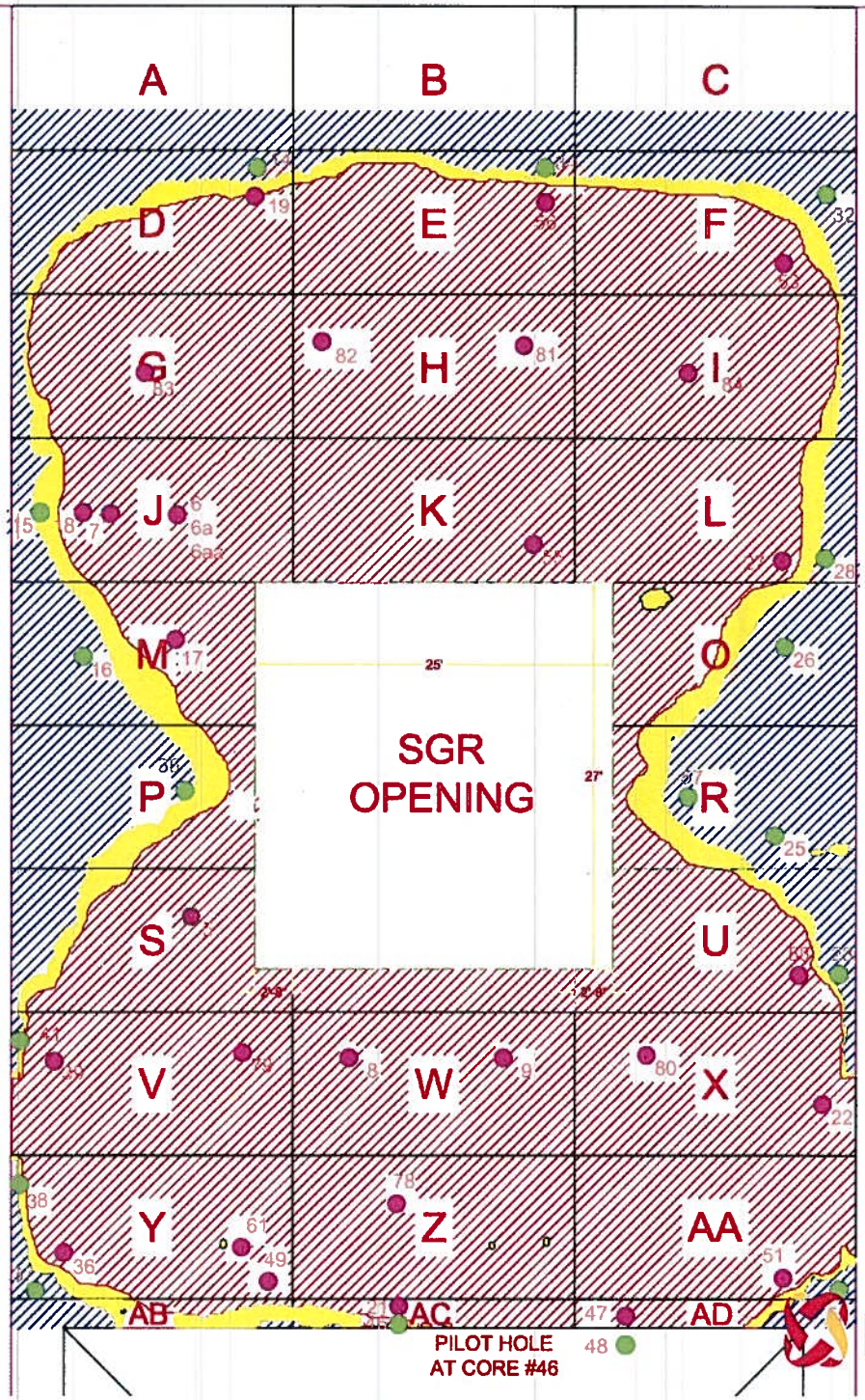
Investigation Approach

- **Complex Investigation with 75 Potential Failure Modes Considered**
- **Non-Destructive Testing (NDT) of Containment Wall Surfaces**
  - Use of Impulse Response (IR) Method and Ground Penetrating Radar (GPR)
    - Over 8,000 IR data points taken
  - Comprehensive on all accessible areas
- **Concrete Core Bores**
  - Over 150 core bores performed
  - Ranged from 1" to 8" diameter, 6" to 32" long
  - Validated Impulse Response (IR) data, along with boroscopic inspections
  - Laboratory testing

Core Borings



Conclusion – Physical observation of core boring has validated the delamination boundary, as accurately predicted by Impulse Response (IR).



Progress Energy

Root Cause Analysis
Laboratory Analysis

- **Concrete Core Laboratory Analyses**
  - Petrographic Examination
  - Modulus of Elasticity and Poisson's Ratio
  - Density, Absorption, and Voids
  - Compressive Strength, Splitting Tensile Strength, and Direct Tensile Strength
  - Fracture Energy
  - Accelerated Creep Test
  - Accelerated Alkali Silica Reaction (ASR) Test
  - Chemistry and Contamination Test
  - Scanning Electron Microscope (SEM) Examination of Micro-Cracking

Root Cause Analysis

Finite Element Analysis (FEA) Modeling Tools

- **Existing Industry Analysis Techniques Predicted Acceptable Margin to Delamination at CR3**

- **Investigation Required Development of New FEA Tools of Progressively Increasing Complexity based on Data Obtained from the Delamination**
  - 360° global containment model
  - Visco-elastic / non-linear model
  - Model includes individual tendons, rebar, liner, etc.
  - Sub-models (1" mesh) provide higher resolution of localized behavior

Root Cause Analysis
Summary

- **Conclusions**
  - Design is Acceptable for Normal and Emergency Operations
  - Construction was in Accordance with Design
  - Delamination Occurred During the Outage
  - Investigation was Thorough and Comprehensive
  - New State-of-the-Art Analytical Methods had to be Created to Analyze Containment Response

- **Root cause:** De-tensioning scope and sequence resulted in redistribution of stresses that exceeded tensile capacity
  - *Could not have been predicted based on existing information and models at that time*

Progress Energy

Design Basis & Repair

FSAR Structural Design Parameters

- **Containment Design Features Remain Unchanged**
  - Prestressed concrete cylindrical wall (shell), shallow dome roof
  - Carbon steel liner serves as fission product barrier
  - Liner anchored to concrete

- **Containment Design Basis Maintained**
  - Leak-tight structure to contain Design Basis LOCA
  - Elastic response to design basis loading to protect liner
  - Design loads and combinations based on operating, accident and applicable code requirements
  - Load factors applied to provide safety margin

Design Basis Repair
FSAR Design Loads

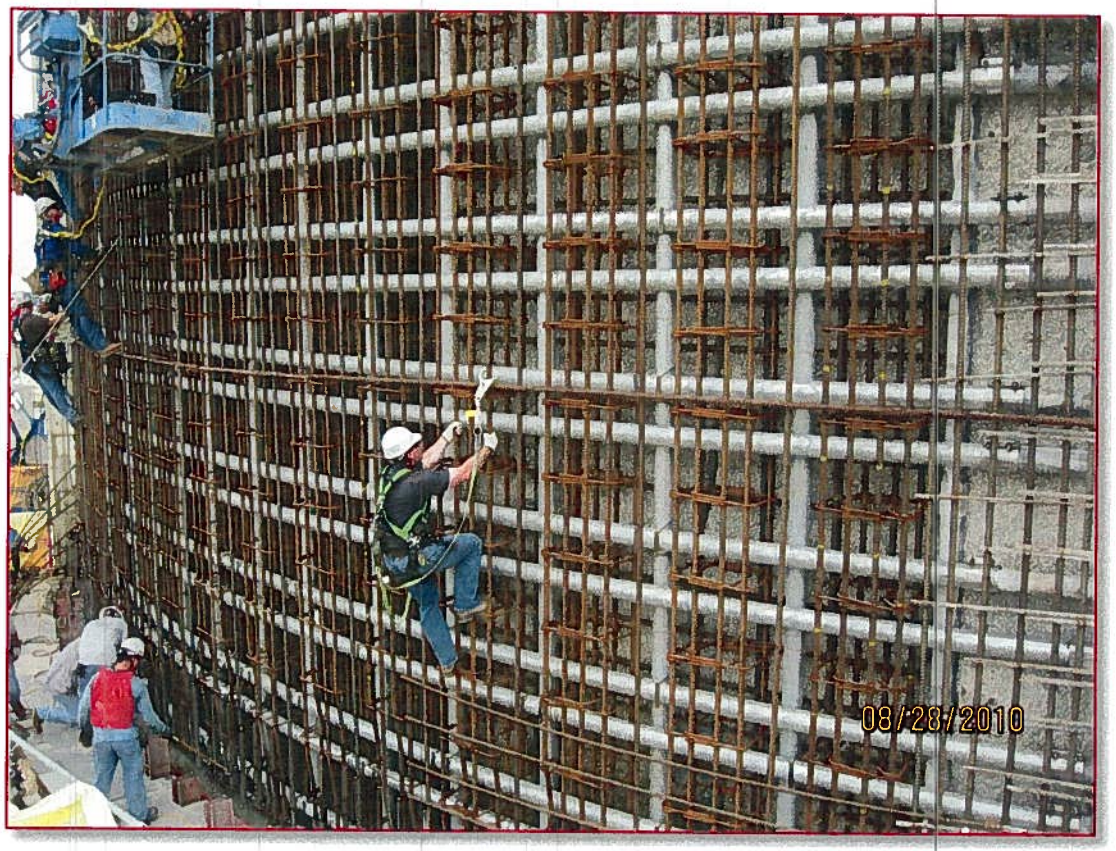
- **All Containment Design Loads Analyzed**
  - Live, Prestress, Dead Loads
  - Wind
  - Tornado Wind
  - Tornado Pressure
  - Tornado Missiles
  - Seismic
  - Temperature Loads
  - Accident Pressure (LOCA)
  - Accidental Containment Spray Actuation Pressure

Design Basis & Repair
Summary

- **Final repair condition expected to be acceptable under 10 CFR 50.59**
  - Design basis loading conditions will be satisfied
  - Design code requirements will be met
  - Changes to analysis inputs accepted by 50.59 evaluation
  - Analysis consistent with the existing FSAR described Method of Evaluation

Design Basis & Repair
Repair Sequence

- **Stress Relief Cut** - *Complete*
- **De-tensioning** - *Complete*
- **Concrete Removal** - *Complete*
- **Concrete Placement** - *In Progress*
- **Re-tensioning**
- **Post-Repair Testing**
- **Unit Restart**



Post Repair Testing
Pressure Tests

- **Integrated Leak Rate Test (ILRT) required per ASME XI code**
  - For removing / replacing liner in SGR opening
- **Plan to perform a Structural Integrity Test (SIT)**
  - Normally a one-time initial construction structural test
  - Test intent: measures structural integrity and deformation at 1.15 Peak Design Pressure (63.3 psig)
  - SIT will be followed by ILRT

Summary

- Containment original design and construction are acceptable for normal and emergency operations
- Planned repair approach meets design basis requirements and code requirements
- The final repair condition is expected to be acceptable under 10 CFR 50.59
- Containment will be fully capable of meeting its design safety function upon completion of repairs and testing

Progress Energy