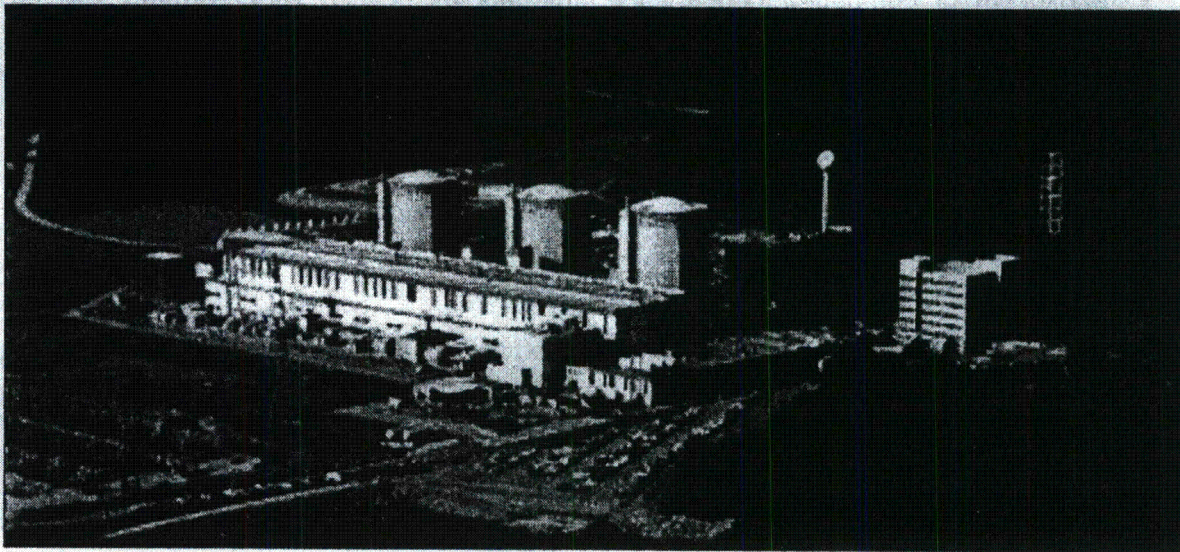


# **OCONEE NUCLEAR STATION**



**Duke Energy Carolinas, LLC**  
**Seneca, SC**



**HQ:** Eric Leeds, Bill Ruland, Allen Howe, Michael Cheok, Nancy Salgado, John Stang

**RII:** Victor McCree, Rick Croteau, Jonathan Bartley

**Site Visit:** January 18, 2012

## **KEY AREAS / ISSUES TO BE COVERED DURING THE SITE VISIT**

- Walkdown of completed construction activities associated with Tornado and High Energy Line Break issues (Natural Phenomena Barrier System)
- Ongoing construction activities associated with Protected Service Water
- Plans for the installation of MSIV's on all three Oconee units
- Activities associated with the replacement of the existing RPS / ES system on Unit 3 with a fully digital system (Unit 1 was installed in 2011 and was a 1<sup>st</sup> of a kind activity)
- Plant site tour including the following areas:
  - Turbine building
  - Main control rooms (Unit 1 / 2 and Unit 3)
  - Standby Shutdown Facility (SSF)
  - Protected Service Water building and associated cable raceways
- Meet with the station and Oconee Major Projects (OMP) management team
- Overview of the site's interim and long-term protective measures to address the vulnerability from a dam break at Lake Jocassee



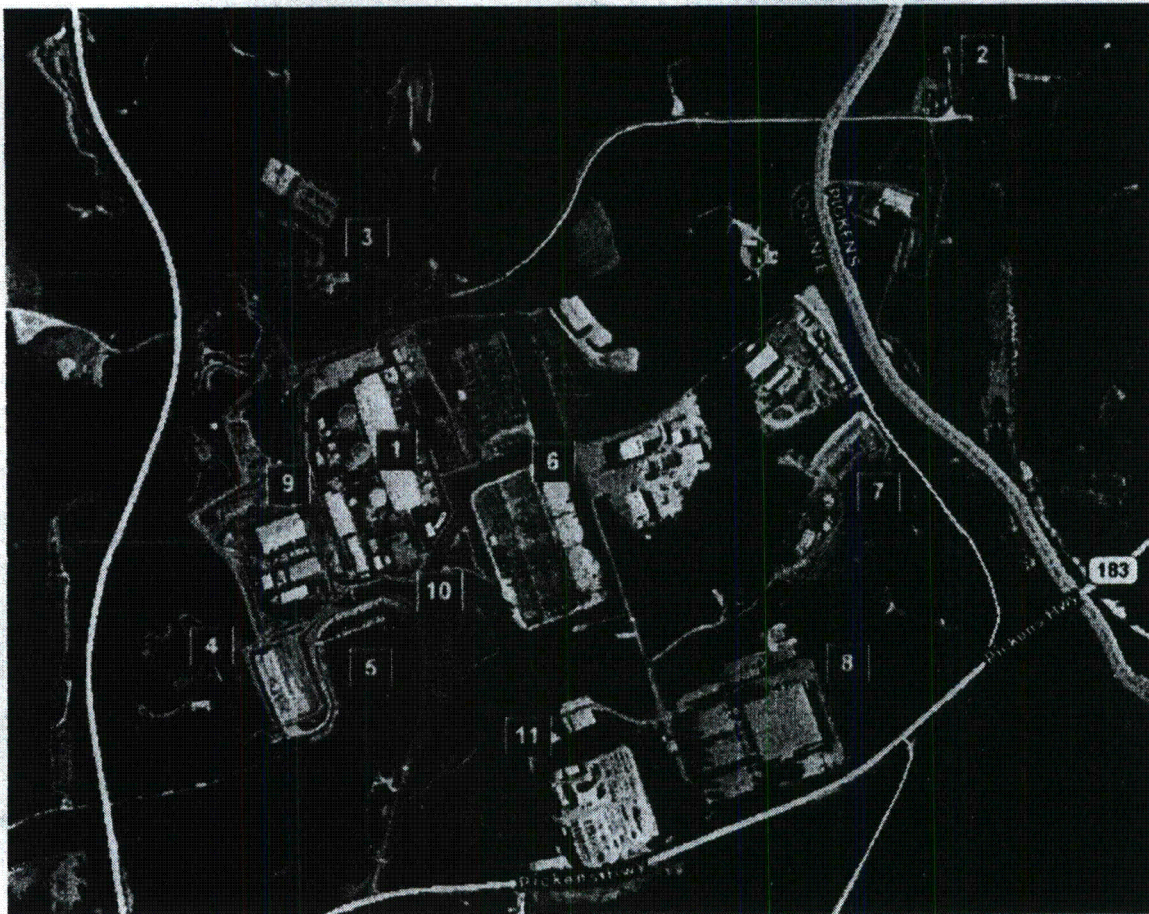
## ITINERARY FOR OCONEE SITE VISIT

### January 18, 2012

- 8:30 a.m. Arrive at the Oconee World of Energy for discussion of site issues and overall progress in addressing past / current regulatory challenges.
- 9:30 a.m. Introductions and opening remarks for the public meeting
- 9:45 a.m. Discussion of Major Projects Status
- 11:45 a.m. Public comments
- 12:15 p.m. Closed Discussion (includes working lunch)
- 1:00 p.m. Closing Remarks
- 1:15 p.m. Depart the World of Energy and tour the current / planned external flood protection modifications located outside of the Protected Area
- 1:45 p.m. Process into the Protected Area (Senior Resident to provide escort duty)
- 2:00 p.m. Tour the following areas within the Protected Area:
- BWST / Auxiliary Bldg tornado missile protection modification areas
  - Standby Shutdown Facility (Diesel generator / switchgear / control room)
  - Protected Service Water building and associated underground electrical trenches
  - Flood protection wall constructed at the intake canal
  - Turbine Building 1<sup>st</sup> and 3<sup>rd</sup> floors (train vulnerability from fire & flood overview)
  - Unit 3 main control room (including preparations to install the new RPS / ES equipment), Unit 1 / 2 main control room (including new RPS / ES equipment on Unit 1) and the Unit 2 cable room
- 3:30 p.m. Meeting between Duke (Dhiaa Jamil and Bill Pitesa) and NRC (Eric Leeds, Victor McCree and Rick Croteau). Other Duke and NRC personnel to meet separately.
- 4:15 p.m. Depart Oconee site for the Greenville / Spartanburg Airport
- 7:00 p.m. Depart Greenville / Spartanburg Airport for BWI Airport

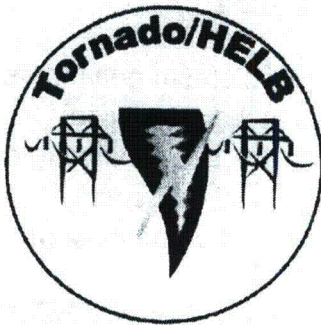


# OCONEE NUCLEAR STATION



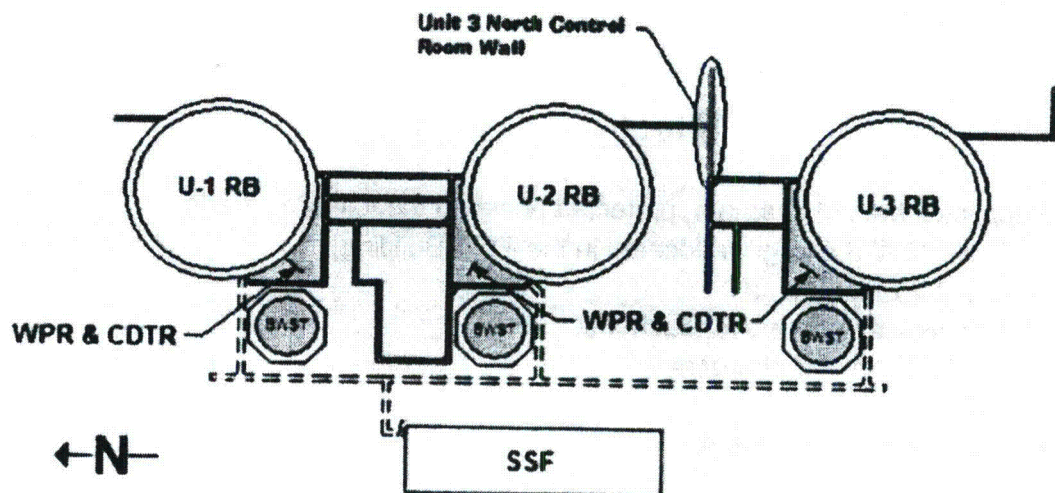
- 1..... Power Block (turbine building, auxiliary building, reactor buildings)
- 2..... Keowee Hydro Station (emergency AC power for the station)
- 3..... Training Center and World of Energy visitors center
- 4..... ISFSI
- 5..... Circulating Water intake structure
- 6..... Switchyards
- 7..... Security Training Facility & Firing Range
- 8..... Complex – contains warehousing, engineering and admin support
- 9..... Standby Shutdown Facility (SSF)
- 10.... New Protected Service Water building
- 11.... Mausoleum containing the original steam generators & reactor heads





## Natural Phenomena Barrier System (NPBS)

- Designed to protect plant safe shutdown equipment and structures from the effects of tornado wind, differential pressure, and missile loads.
- Cask Decon Tank Room (CDTR) and West Penetration Room (WPR) walls will be protected with steel plate, Fiber Reinforced Polymer and heavy gauge metal siding.
- Borated Water Storage Tanks (BWSTs) will be protected with steel plate.
- Protects BWST instruments and piping from possible tornado missiles
- BWST Superstructure consists of steel plating and beams using 4500 linear feet of QA-1 welds and 4800 QA-1 bolted connections
- Eliminates reliance on the Spent Fuel Pool- to-High Pressure Injection flow path.



## **PROTECTED SERVICE WATER (PSW)**

- Provides a protected means of supplying water to fully pressurized steam generators for decay heat removal (both steam generators on all three units at the same time)
- System electrical power provided by 100 KV Fant Line from the Lee Combustion Turbine facility (Normal) and underground path from Keowee Hydro (Emergency).
- The new equipment building is designed to resist a tornado event and will contain new *electrical distribution equipment for the PSW system*.
- Replicates many functions of the Standby Shutdown Facility (SSF) for Tornado/HELB events
- Greatly reduces the overall risk associated with events at the station

### **Mechanical Features:**

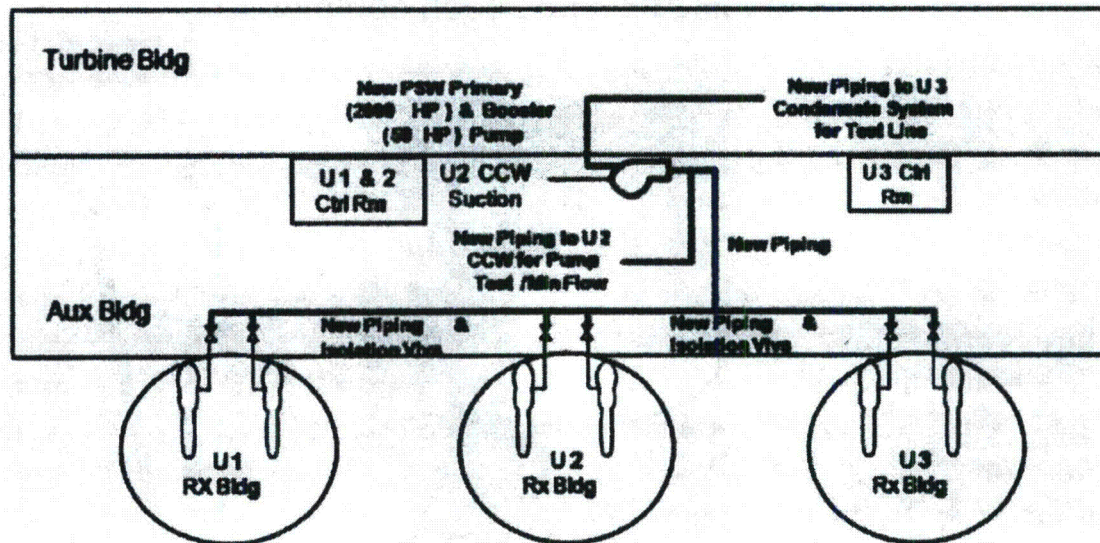
- HELB and Tornado protected system capable of being promptly aligned and operated from each Unit's control room.
- System will be capable of simultaneously feeding the six pressurized steam generators (2 S/Gs per unit).
- The PSW system replaces the current low-head pump with a booster pump and a high-head pump. All of the system piping and valves necessary for a high head system will be replaced and tie-ins are scheduled to be functionally tested during the upcoming Unit 3 Refueling outage starting in April 2012

### **Electrical Features:**

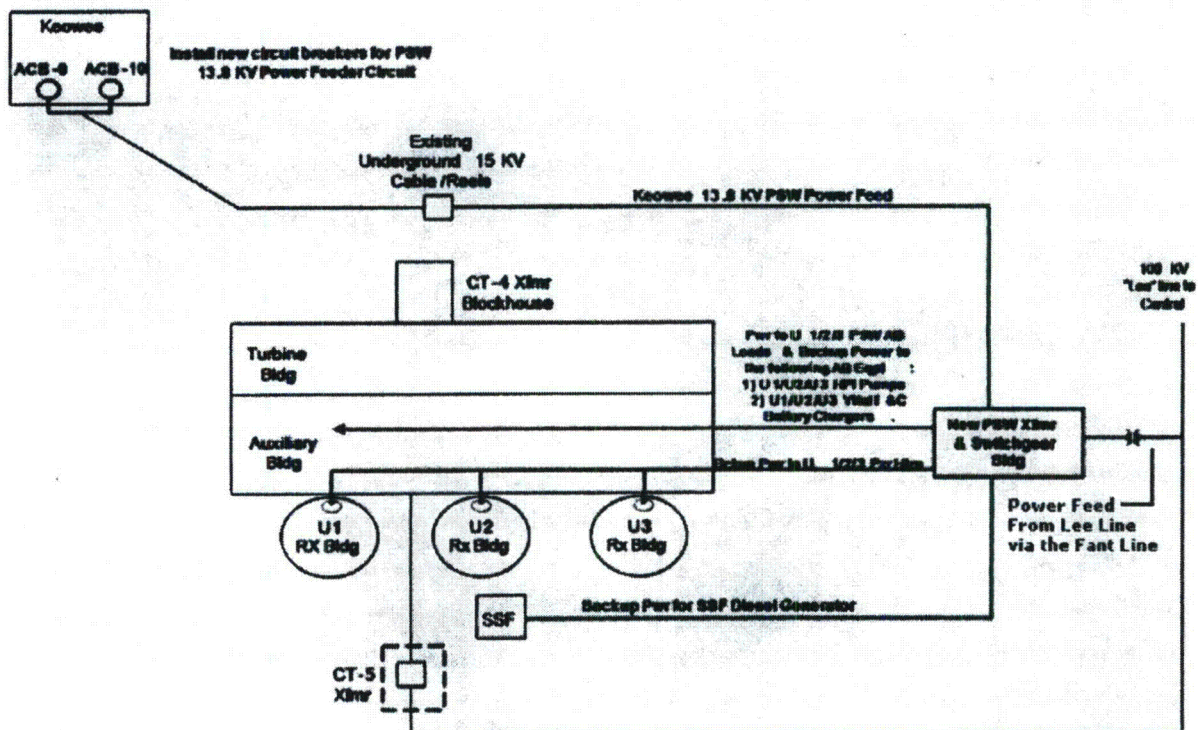
- Supplies a train of alternate, protected power to the following loads:
  - New PSW Switchgear (located in the PSW Building)
  - One HPI train per unit
  - Pressurizer Heaters for each unit
  - Vital I&C battery chargers
  - SSF
  - RCS vents for each unit



## Mechanical Portions of the Protected Service Water System



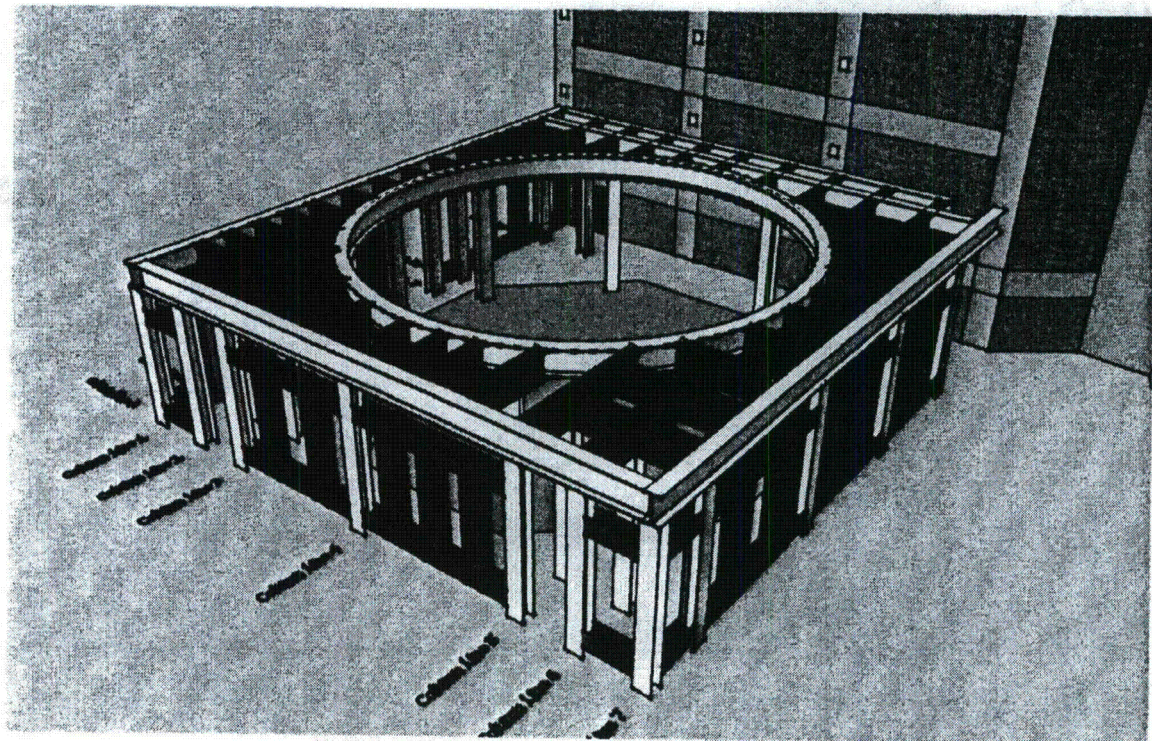
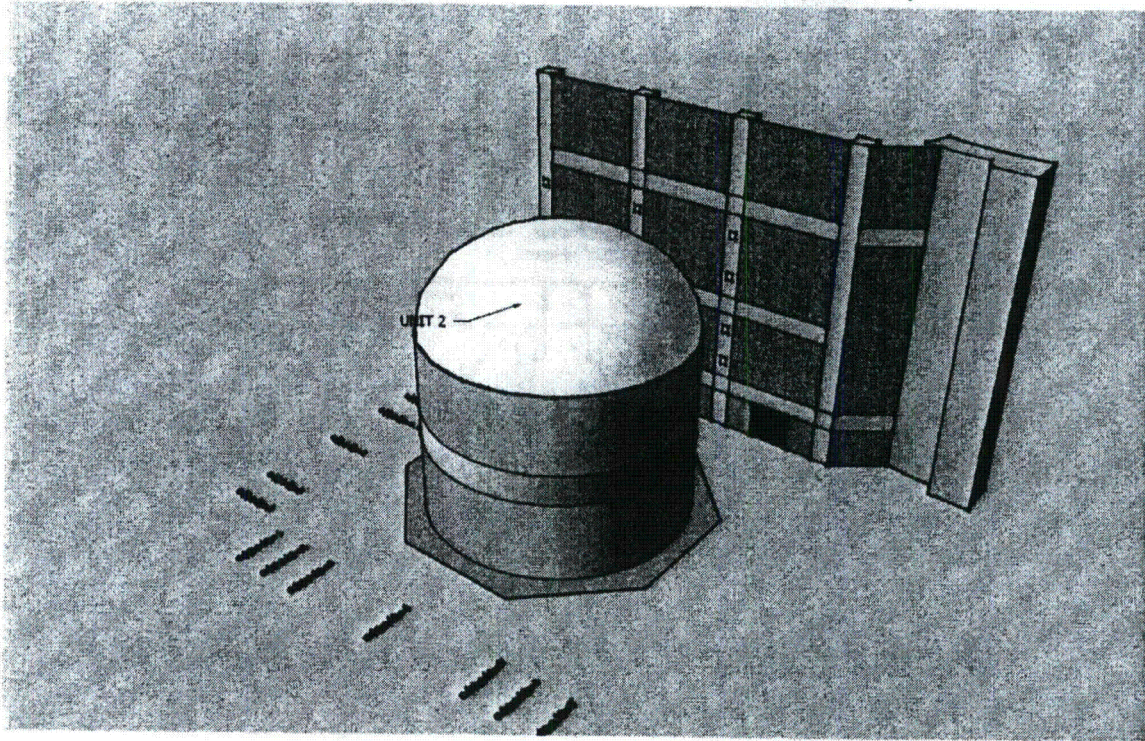
## Electrical Portions of the Protected Service Water System



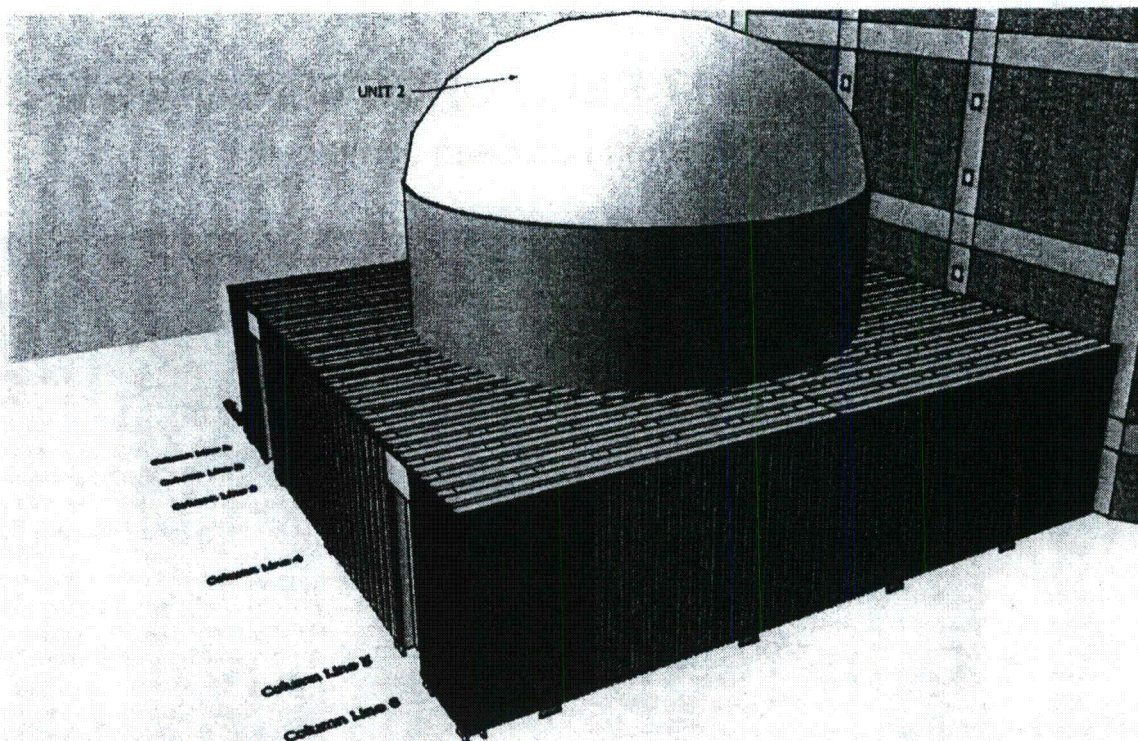


# BWST SUPER STRUCTURE PROTECTION

(This modification has been completed)



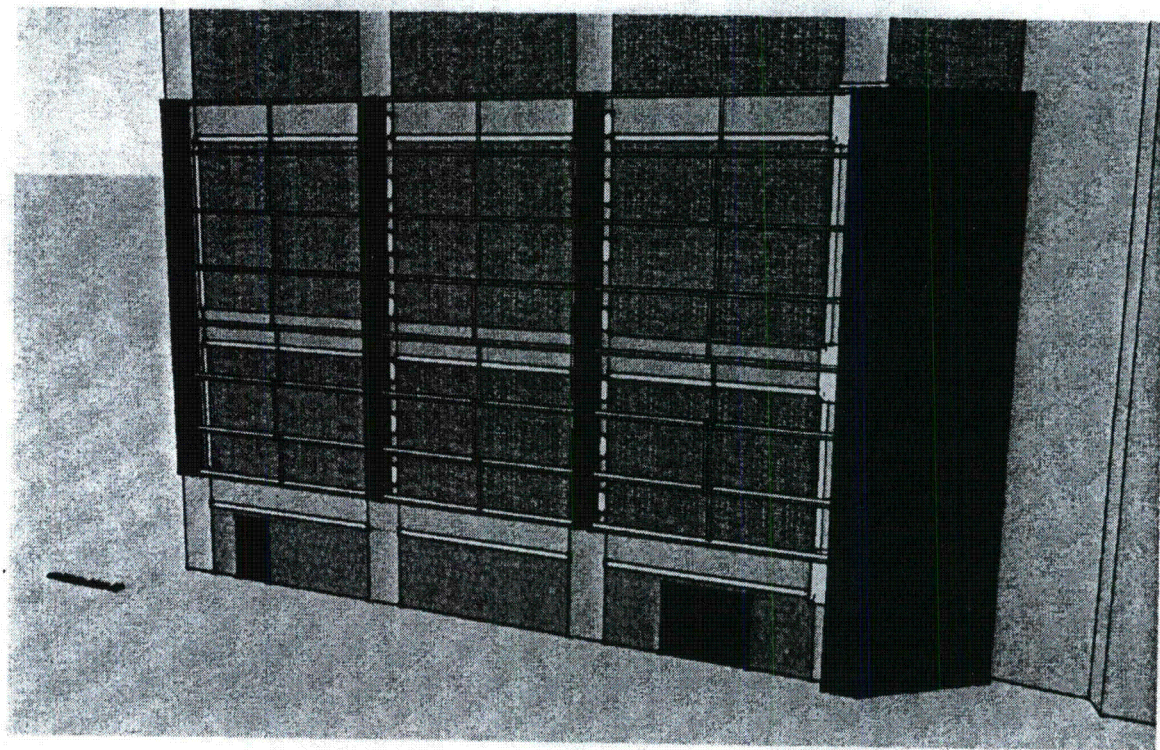






# **WALL SIDING & GIRT REINFORCEMENT PROJECT**

(This modification has been completed)

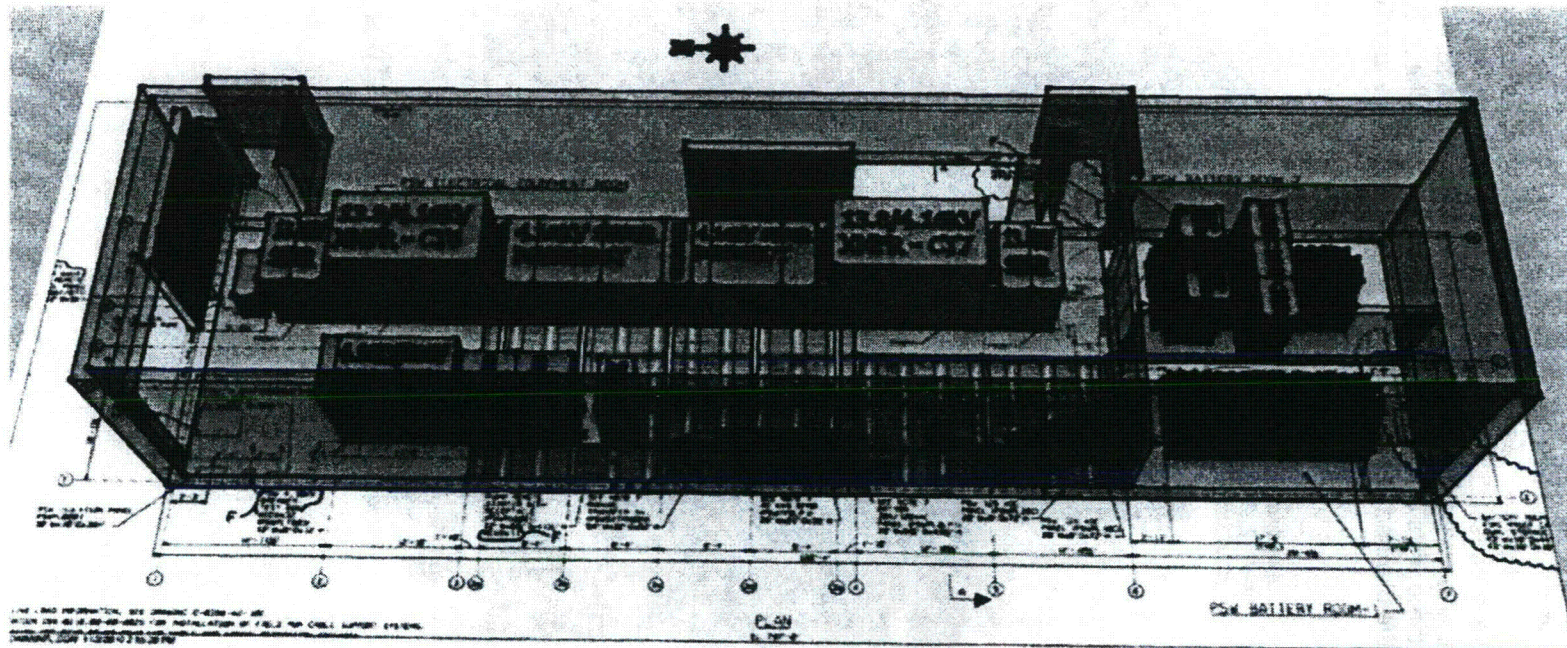




# PROTECTED SERVICE WATER BUILDING

(This modification is in progress, tie-in scheduled for April 2012)

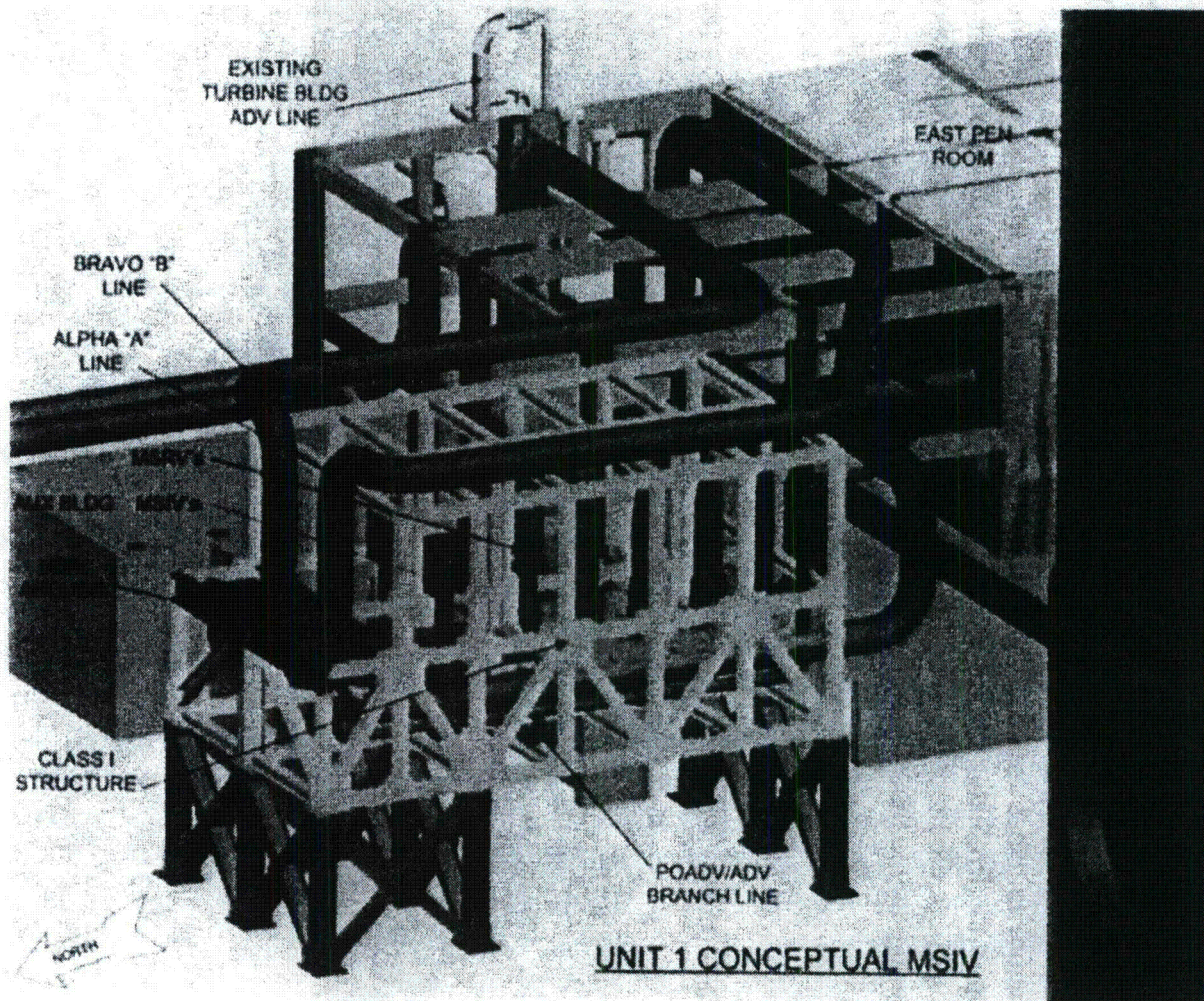
This is a new QA-1 structure that has been constructed on the South end of the protected area to house the electrical equipment needed to support the Protected Service Water project. It consists of a large open room containing switchgear and motor control centers, two separate battery rooms and a sub-basement containing the cabling coming from the Keowee power feed and offsite Fant line and going to the SSF and Auxiliary Building.





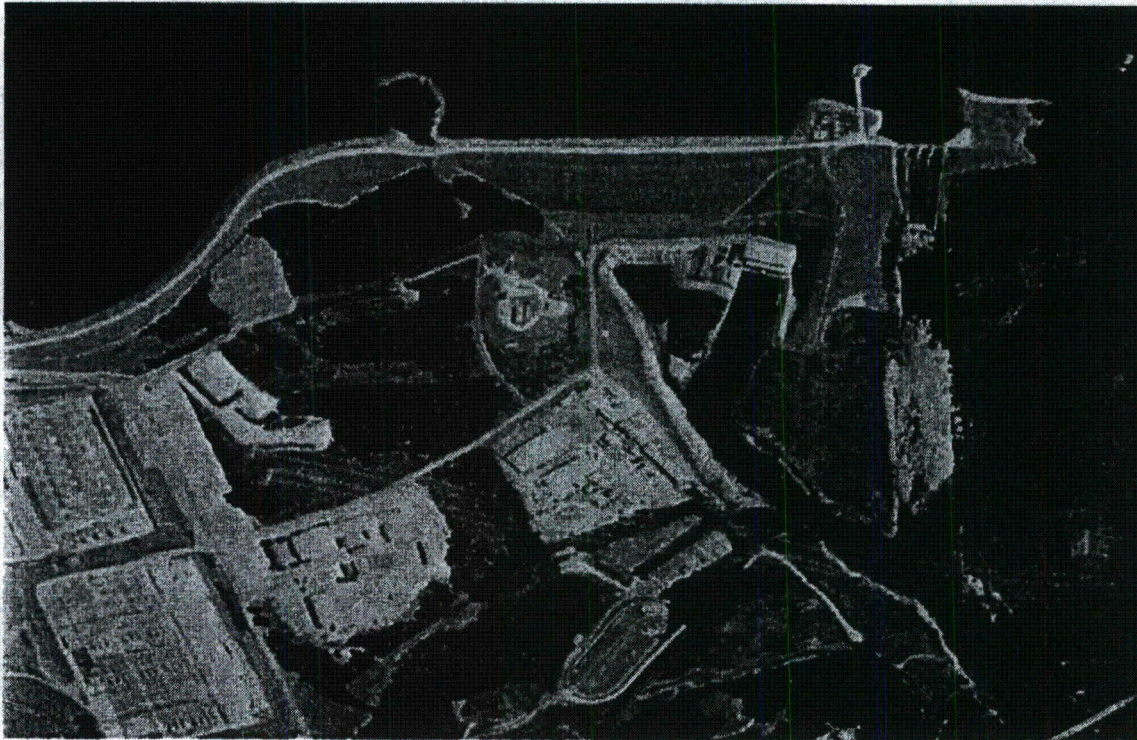
## MAIN STEAM ISOLATION VALVES

Oconee was initially licensed and built without Main Steam Isolation Valves on the main lines. On each unit, one of the two steam lines exits the side of containment and is routed to the Turbine Building. There is no isolation capability to prevent the blow down of a steam generator in the event the steam line is damaged nor isolate a HELB within the turbine building. The licensee will install MSIV's on all three units by the end of 2016 (Unit 1; 2014, Unit 2, 2015 and Unit 3, 2016). The sketch below shows the planned structure that will house the MSIV's and the re-routed steam lines.





## KEOWEE HYDRO STATION



The Keowee Hydro Station supplies emergency power to Oconee upon an Engineered Safeguards actuation or a loss of power. It is also able to supply peaking power to system grid. It consists of two units designated KHU-1 and KHU-2 that generate at 13.8 KV and produce a maximum output of 87 MWe per unit.

It can supply emergency power to Oconee through two power paths designated the Underground and the Overhead Power Paths.

- The Underground Power Path consists of a 4000 ft underground feeder to CT-4 to Standby Buses to Main Feeder Buses in the plant. It is rated to carry the full Engineered Safeguards loading of one Oconee unit plus the auxiliaries needed to maintain Hot Shutdown on the other two Oconee units.
- The Overhead Power Path goes through ACB-1 or ACB-2 to the Keowee Main Step-Up Transformer (13.8 to 230 KV) through the isolated 230 KV Yellow Bus to the Startup transformer of each Oconee nuclear unit.

There are Keowee Emergency Start switches in the shared Unit 1 / Unit 2 control room as well as the Unit 3 control room. A signal from either location sends signal to Emergency Start BOTH Keowee Hydro units.

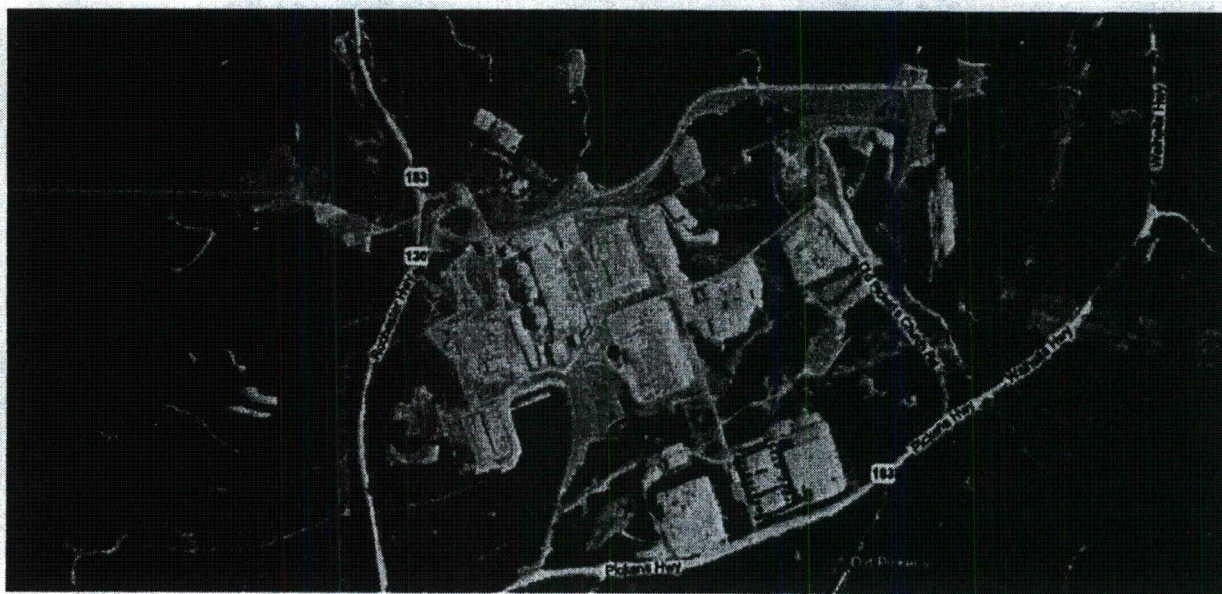


## TRITIUM IN GROUNDWATER AT OCONEE

Oconee detected levels of tritium in excess of the 20,000 pCi/l threshold in one (1) on-site sampling well and initiated the industry communication protocol in response to the identified levels. There are several possibilities for the source of the tritium and the licensee has not confirmed any source yet. Initially it was believed that the Radwaste discharge line (from the plant to the tail race below the Keowee dam) could have been the source but after digging numerous hand wells in the area of the piping as it leaves the protected area towards the nearby river, they have not found any indication of tritium that could explain the levels they had seen in the one well that was indicating above the 20,000 level prior to the 3Q 2011 sample. The licensee is continuing to investigate the issue and is working on identifying the source of the tritium. Additionally, the licensee has installed a recovery well near the well with the elevated levels of tritium in Feb. 2011, in order to determine if the elevated levels were caused by a historical leak, and to ensure the tritium is being released via a monitored pathway. This recovery well has decreased the concentration at this well to back below the 20,000 pCi/l threshold as of the 3Q 2011 sampling. At this point, no tritium has been found offsite through sampling conducted by the South Carolina Department of Health and Environmental Control (offsite sampling was performed around all South Carolina nuclear plants in 2008 – 2009).

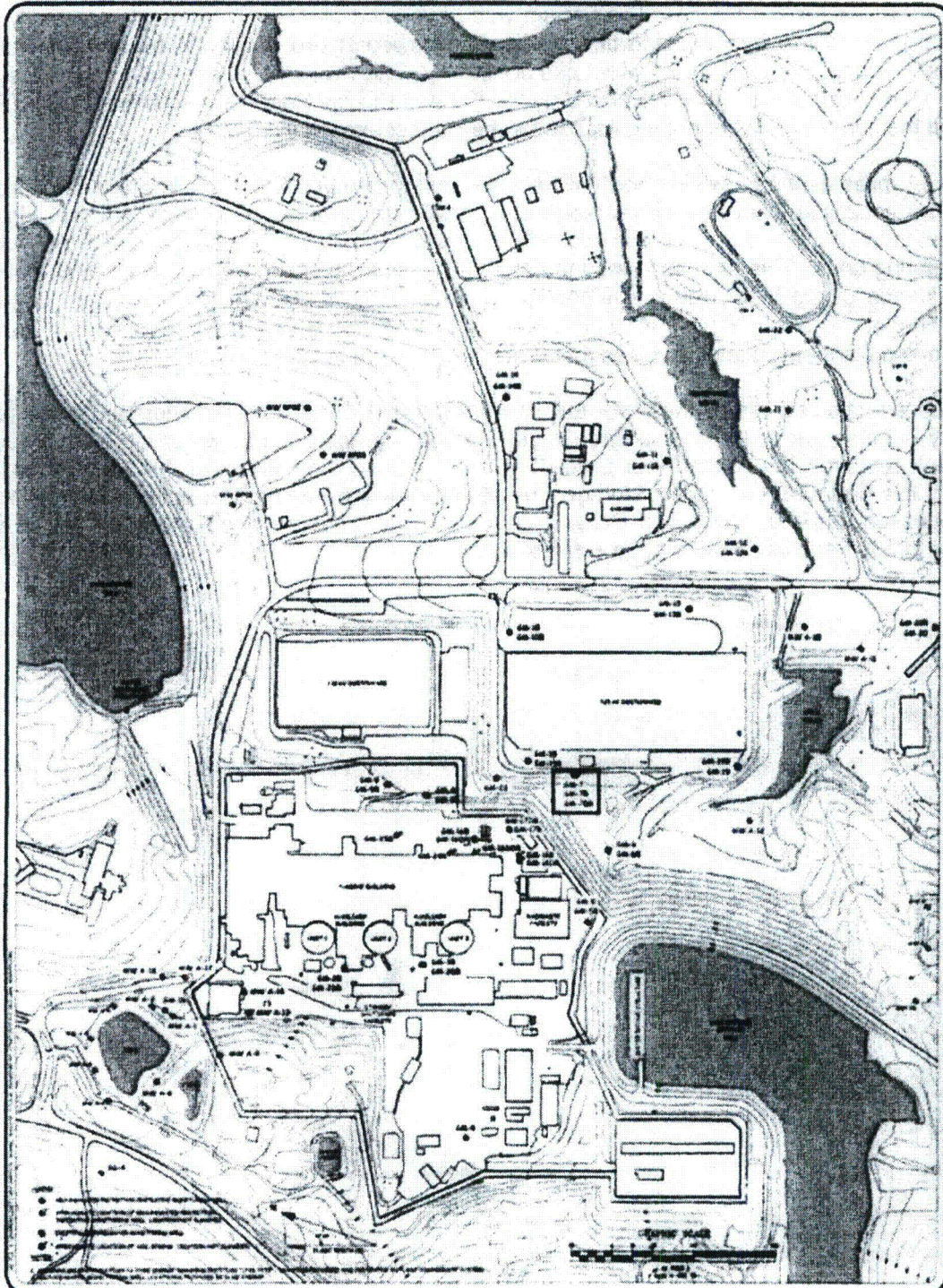
A total of 66 ground monitoring wells are currently installed at Oconee including 18 new wells installed since October 2009 to aid in quantifying the tritium plume on-site and aid in determining the source of the contamination. Most of the samples from monitoring wells are at or below the Minimum Detectable Activity (MDA) levels.

The location of the well that exceeded the 20,000 pCi/l value is indicated by the red dot below. The activity in Well 7R as of the 4th Quarter 2011 sampling was 10,600 pCi/l which is down from the previous reading of 19,400 pCi/l.





## Monitoring wells installed at the Oconee Nuclear Station



Monitoring wells are indicated by dots

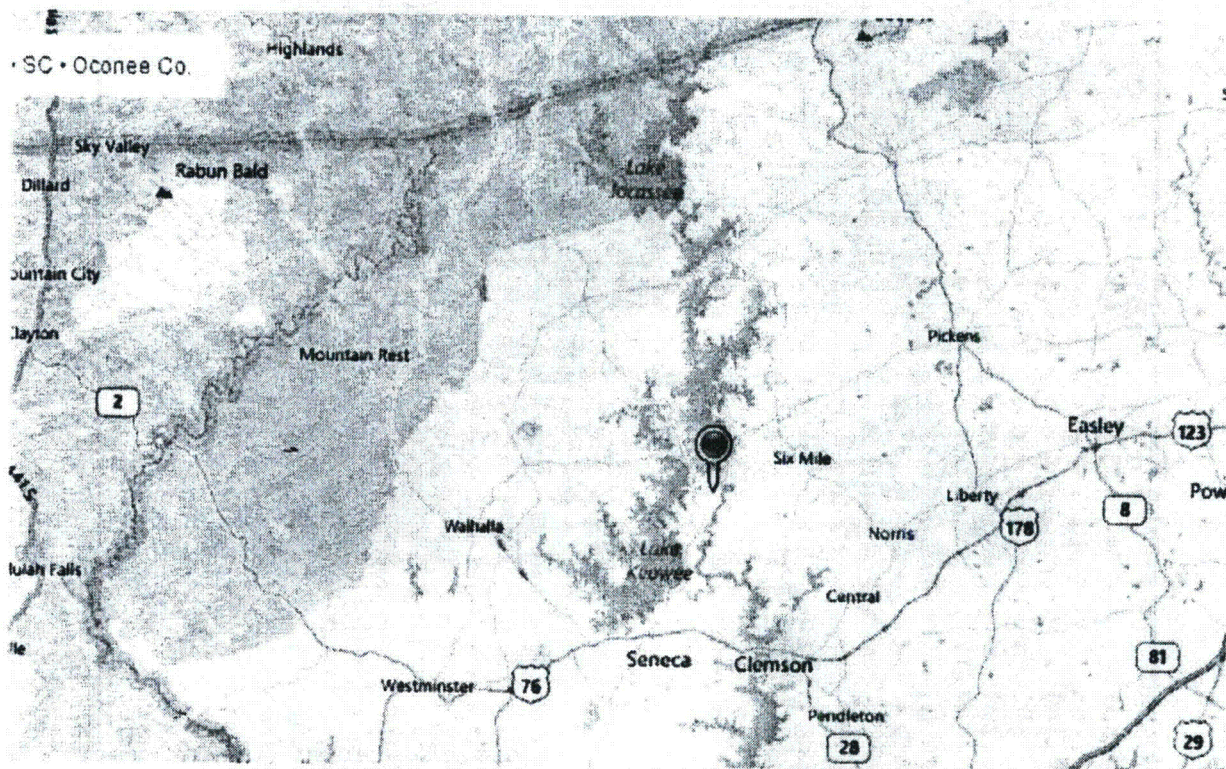


## **KEOWEE-TOXAWAY HYDRO-ELECTRIC PROJECT**

Duke Energy Carolinas, LLC owns and operates the Keowee-Toxaway Hydroelectric Project, located on the Keowee and Little Rivers. The Project was developed by Duke to generate electricity. The Project consists of two hydroelectric developments: Keowee Hydro Facility with Lake Keowee and Jocassee Pumped Storage Facility with Lake Jocassee. The Project provides 868 megawatts (MW) of power. The Project was initially licensed by the Federal Energy Regulatory Commission (FERC) in 1966 and the current FERC operating license for the Project expires in 2016.

Roughly 11 miles as the crow flies north of Keowee Dam located on the Oconee site is the Jocassee Dam. The Jocassee Dam is a zoned earth and rockfill structure approximately 385 feet high and 1,800 feet in length. The dam includes two circular structures with eight openings that direct water to the generating units. This dam impounds the 7980 acre Lake Jocassee with 92 miles of shoreline, at the confluence of the Whitewater, Thompson, Toxaway, and Horsepasture Rivers, and numerous creeks. The lake is about 340+ feet deep at the dam. The Jocassee project – which is a pumped-storage hydro plant - includes 4 turbines that produce 710 MWe in total.

Lake Jocassee also serves as the lower reservoir for the Bad Creek Pumped Storage Facility. When electricity is being generated at the Bad Creek Pumped Storage Facility, water stored in the upper Bad Creek reservoir is released into Lake Jocassee. During the refilling of the upper Bad Creek reservoir, the Bad Creek Pumped Storage Facility turbines are reversed to pump water back from Lake Jocassee into the upper Bad Creek reservoir. Bad Creek Pumped Storage Facility began operating in 1991 and its FERC license expires in 2027.



The Oconee Nuclear Station is shown at the pushpin icon and is located on Lake Keowee. Lake Jocassee is located due north of the plant site.



## **EXTERNAL FLOOD PROTECTION FOR THE SITE**

(b)(7)(F)

(b)(7)(F)



## **Standby Shutdown Facility (SSF)**

The SSF concept is unique to Duke nuclear facilities and at Oconee, it is a safety-related system. It is a single train, non-single failure proof system that has a high risk value to the station impacting all three units for most issues that arise as it is shared among the three units. Its function is to maintain all three units in Mode 3 (RCS  $\geq 525^{\circ}\text{F}$ ) for 72 hours following any of the following events:

- Appendix R Fire
- Turbine Building Flood
- Security Event
- Station Blackout (Turbine Driven EFW pump inoperable)
- Tornado

The SSF is designed to maintain minimum water level above core and the RCS filled sufficiently to ensure natural circulation cooling can be maintained (accomplished through the RC Makeup subsystem), maintain sufficient secondary side cooling (accomplished through the use of the ASW subsystem) and maintain available SDM  $> 1\%$  dK/K (using water from the spent fuel pool).

There are pressurizer heaters that can be controlled from the SSF which are designated as Bank 2; Group B and C. Group B heaters are controlled from the Unit control room OR the SSF control room (after breaker swap) while Group C heaters can only be controlled from SSF.

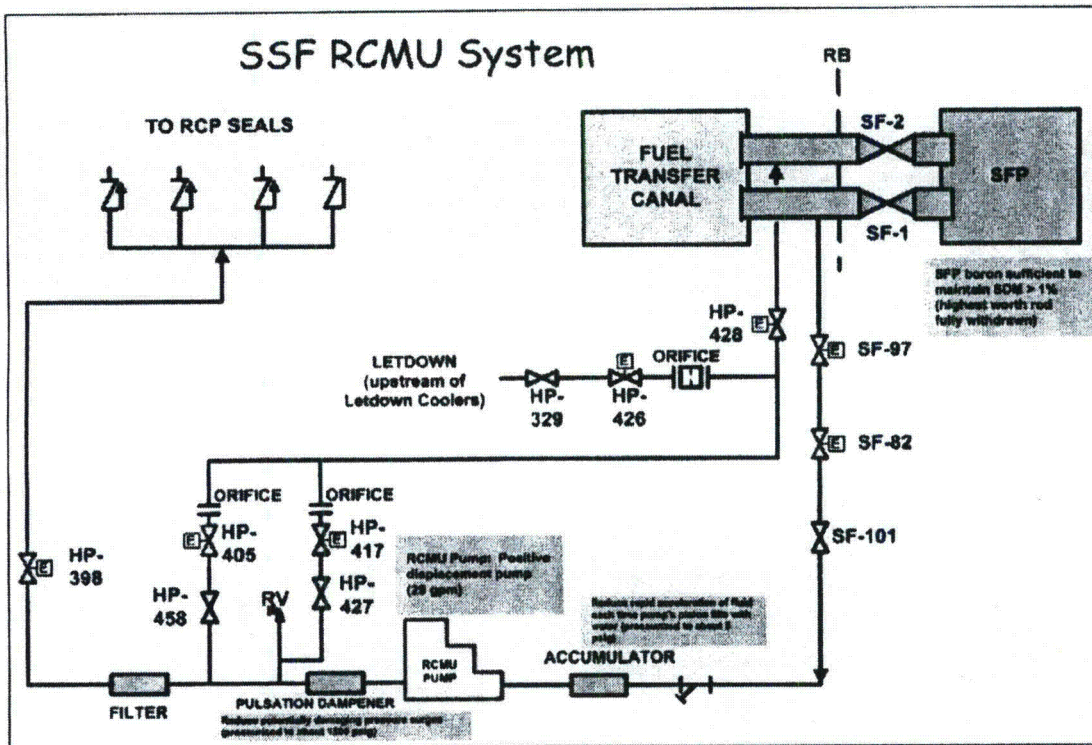
The ASW subsystem is designed to feed the steam generators and cool the RCS during a Station blackout (loss of MFDW and EFDW) and uses the circulating water inlet header as its suction source. A submersible pump is available to refill the inlet header if required. The ASW flow is to the secondary side of the OTSG's which in turn drives RCS pressure / temperature.

SSF Diesel Generator serves as a Standby AC Power Source for the SSF in the event 4KV Power is not available from the Oconee Unit 2 Main Feeder Bus which is the normal power supply path. There are two diesels connected on a common shaft to a single generator (a 16 cylinder and a 12 cylinder diesel). The generator is rated for 4160 Volts and 3500 KW.

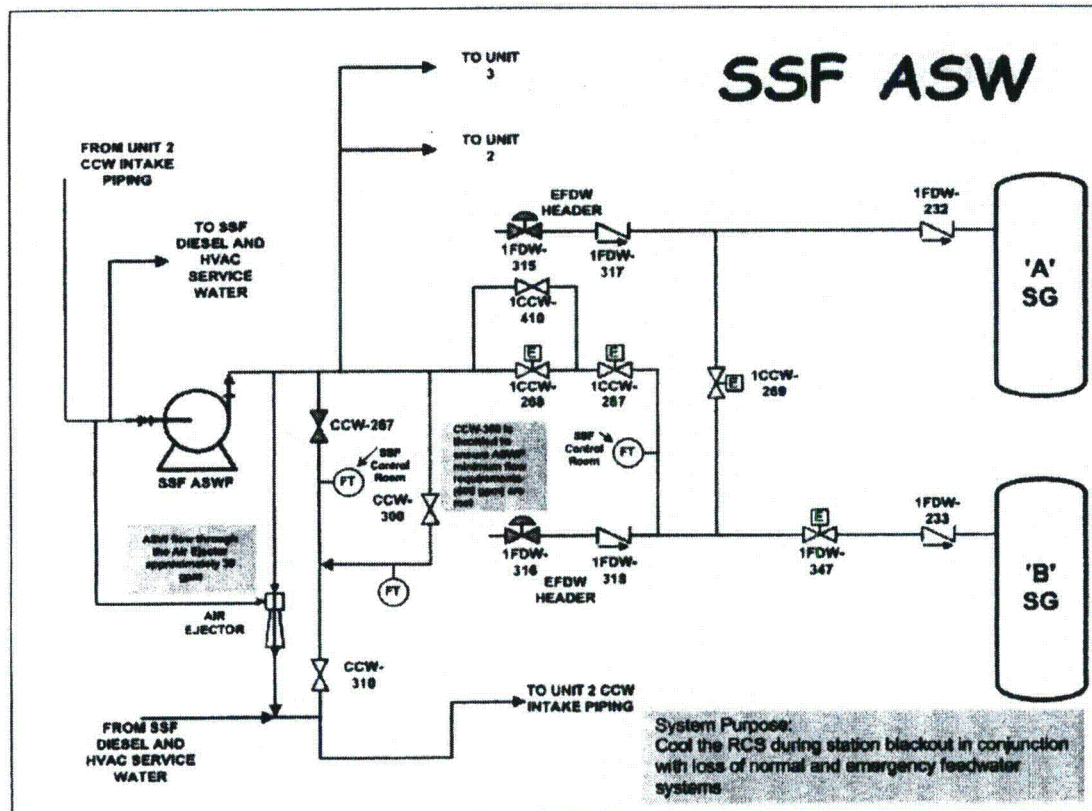
The 125 VDC system associated with the SSF is designed to provide a reliable source of continuous power for controls, instruments, annunciators, inverters, DC motors, backup lighting, etc. for the SSF and an uninterruptible source of power for security systems. Each battery sized to supply required SSF and security loads for a minimum of one hour.



## SSF RCMU System



## SSF ASW



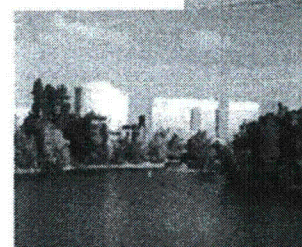
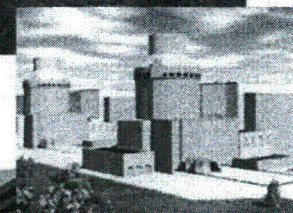
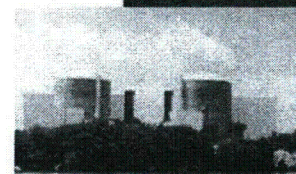
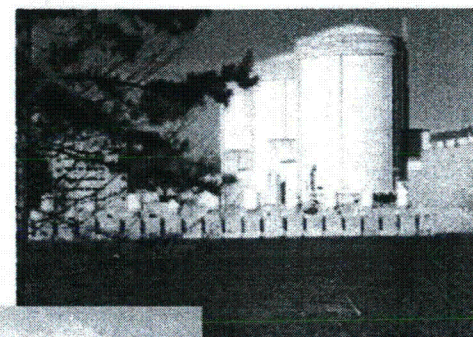




# Commissioner Apostolakis

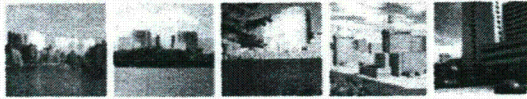
## *Site Visit Oconee Nuclear Station*

September 13, 2011



E/M





## Presentation Outline

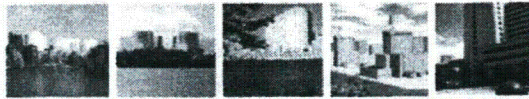
---



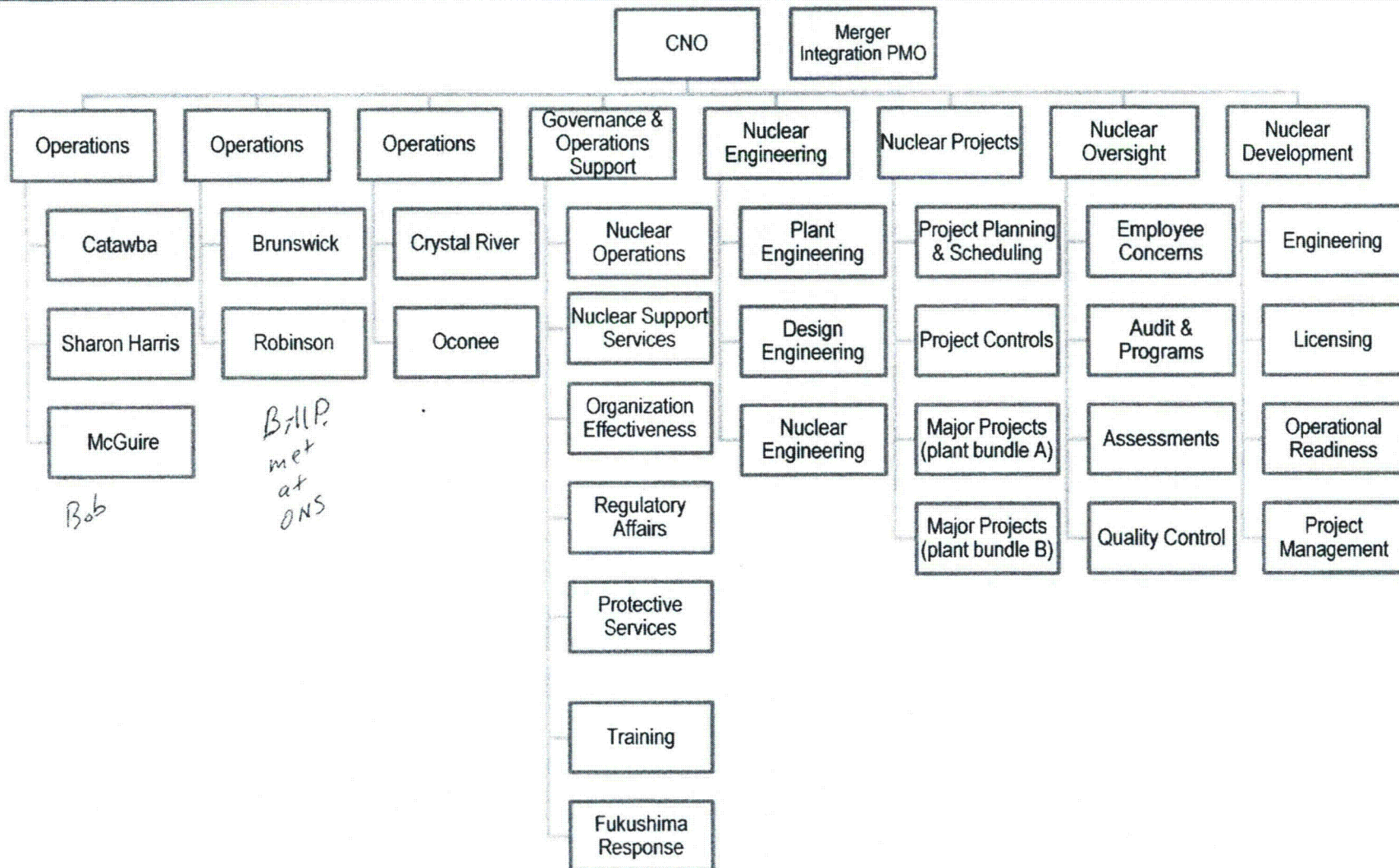
- Oconee Performance and NGD Direction - **Gillespie**
- Major Investments to Enhance Safety, Improve Reliability - **Freudenberger**
- Site Actions to Improve Organizational Effectiveness - **Guy**
- Roundtable Discussion - **All**

For Information Only





# Nuclear Generation Organization Design

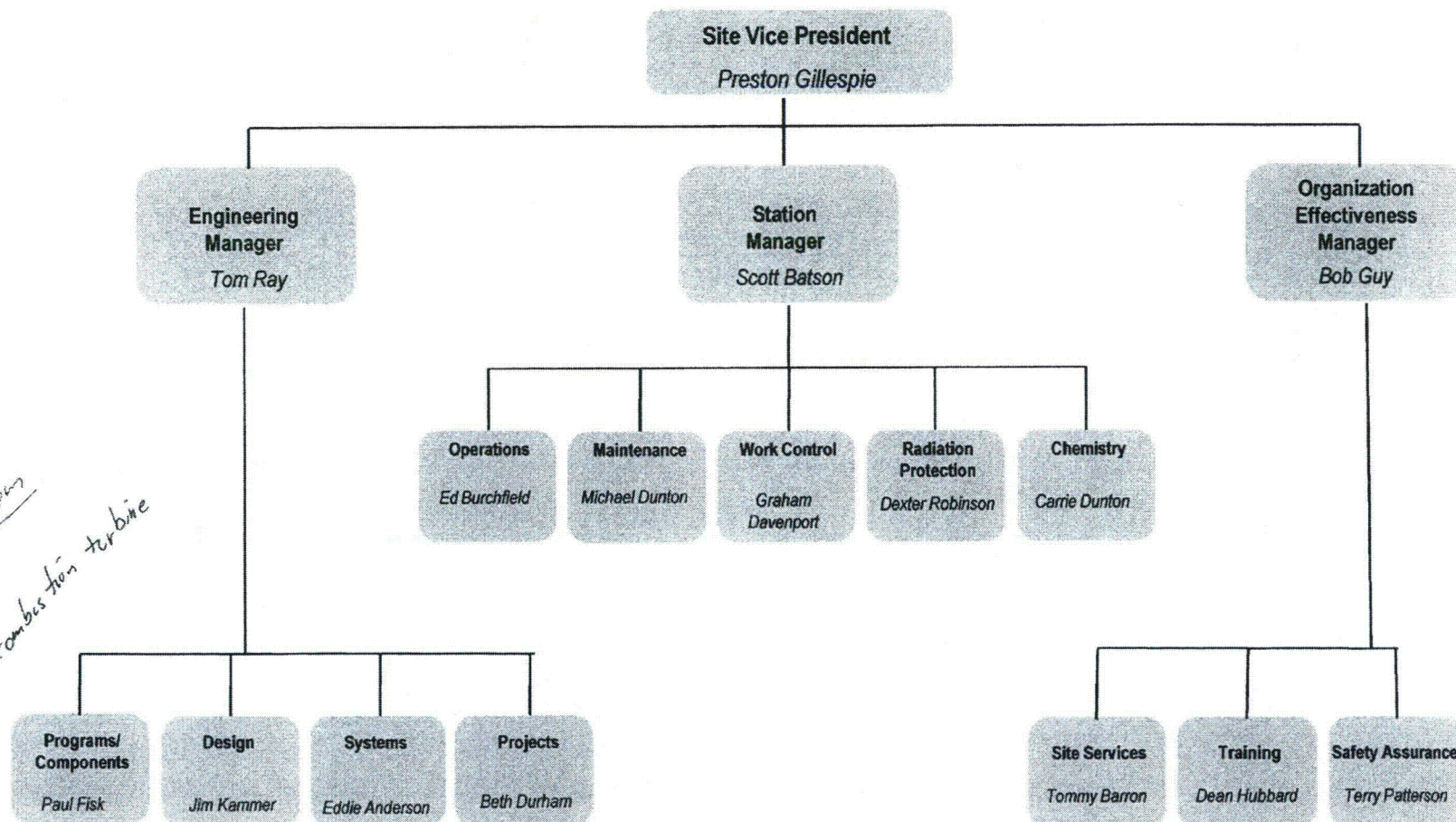


For Information Only





# ONS Leadership

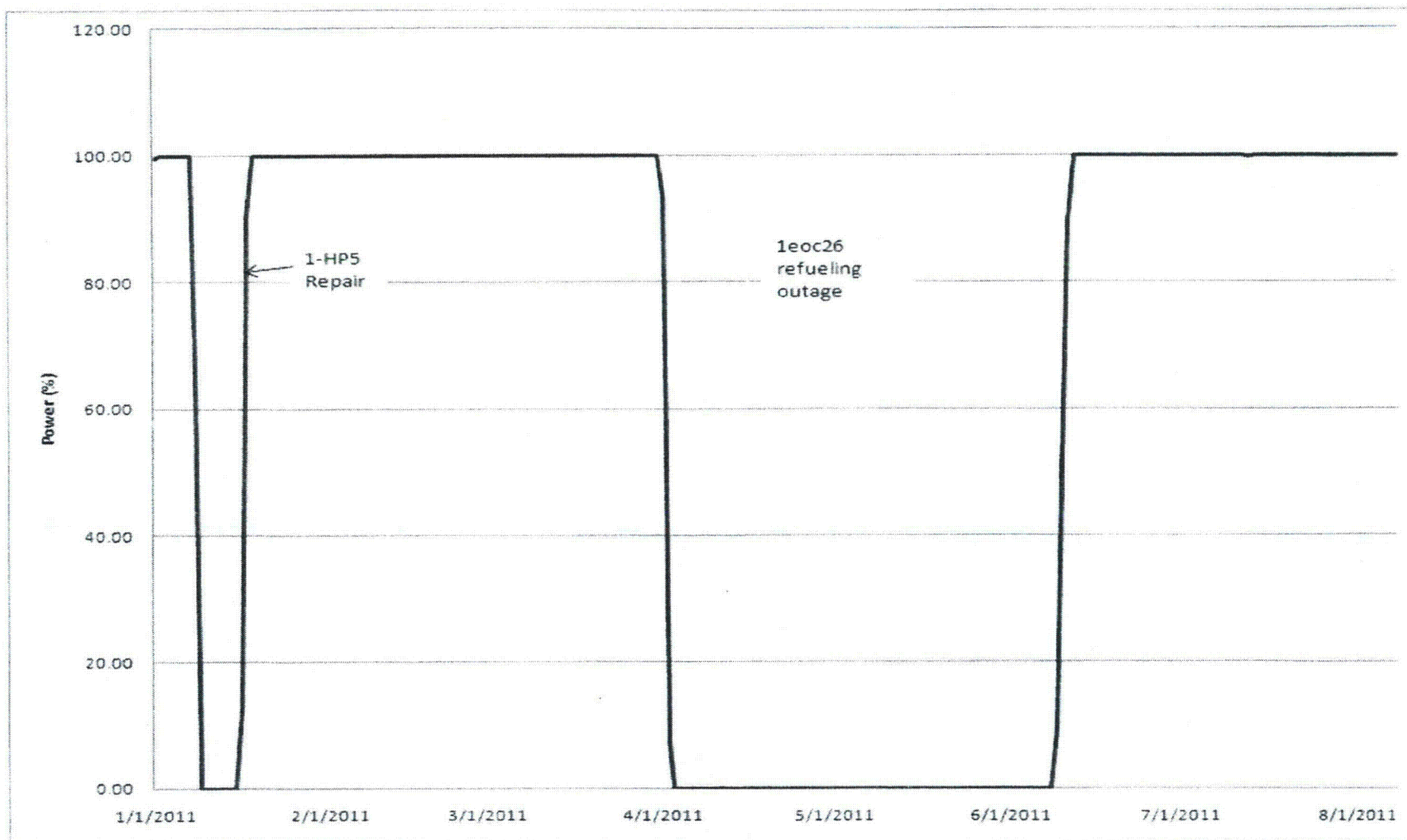


For Information Only





# Unit 1 - Power History Curve

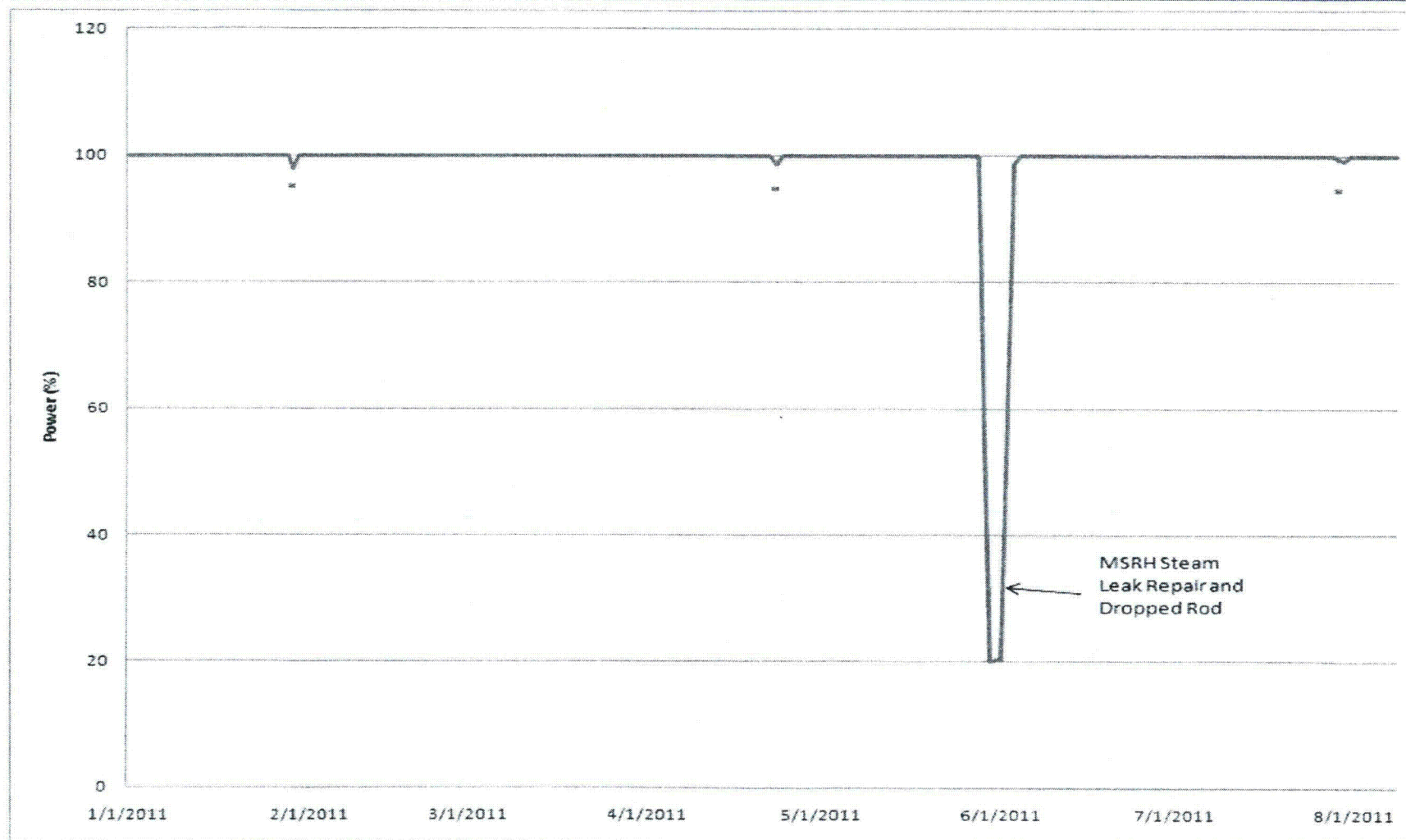


For Information Only





## Unit 2 - Power History Curve

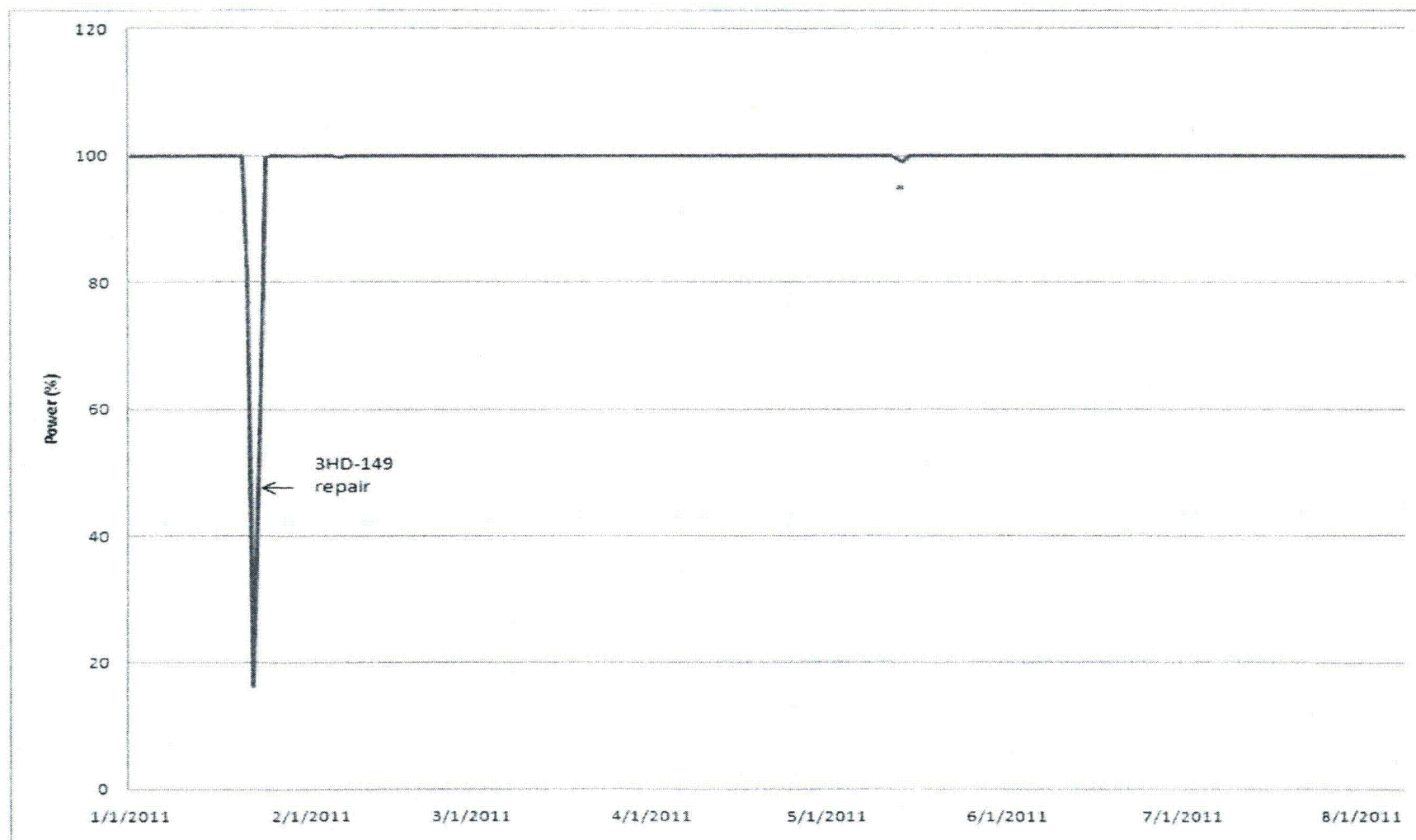


For Information Only



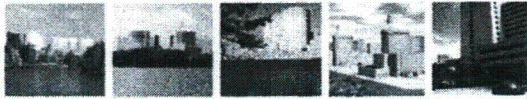


## Unit 3 - Power History Curve

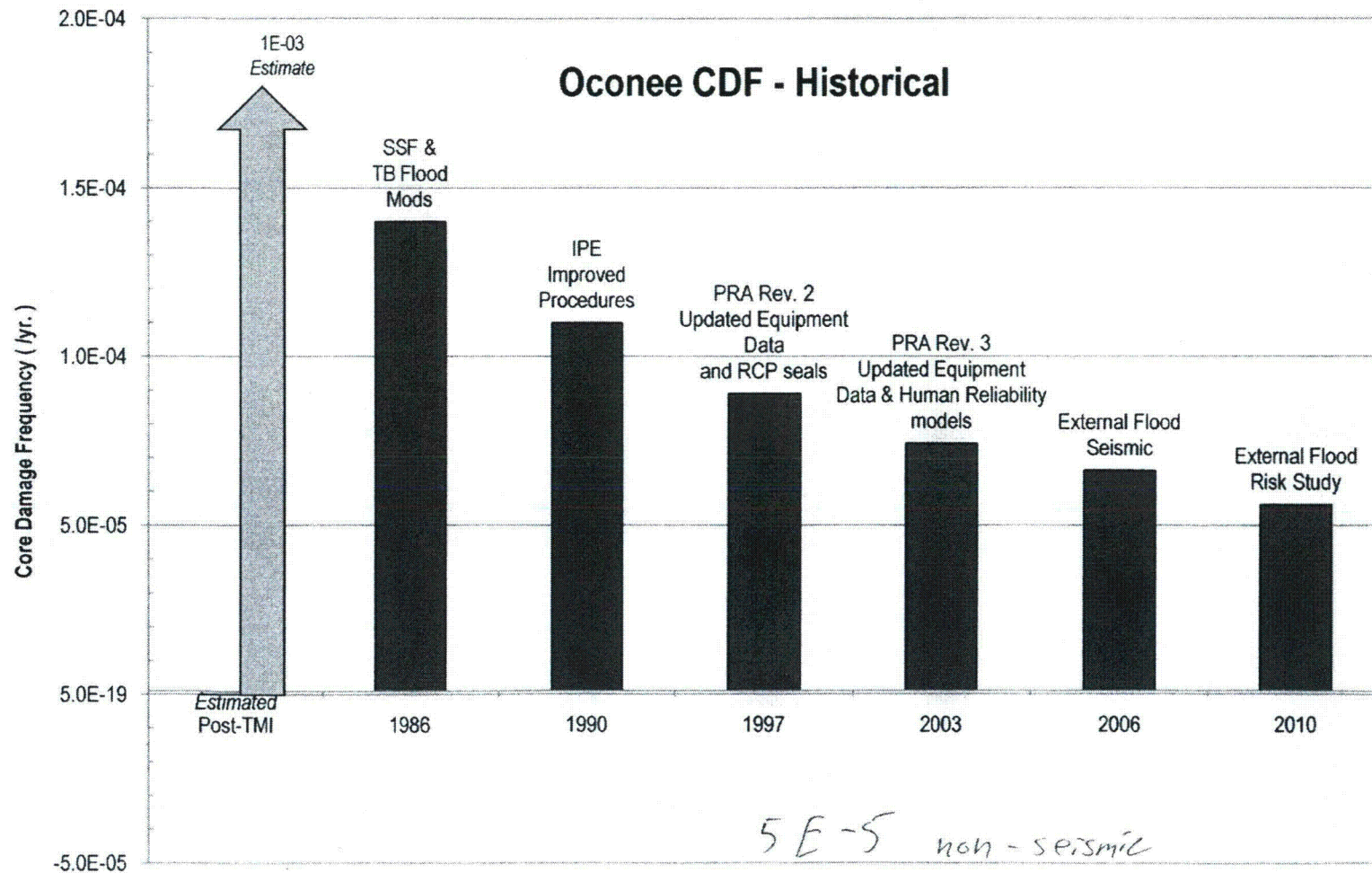


For Information Only





# Risk Improvement Historical



For Information Only





# Risk Improvement Projected

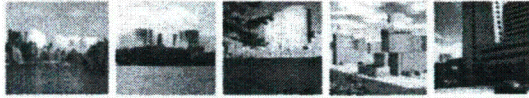


<i>Risk Reduction Project</i>	<i>CDF Reduction</i>	
<b>PSW</b> (Protected Service Water)	<b>LARGE</b> ( $\sim 1\text{E-}05$ / yr) (actual risk improvement)	\$ 750 M
<b>External Flood Risk Study &amp; Flood Mitigation Strategies</b>	<b>MEDIUM</b> ( $\sim 5\text{E-}06$ / yr)	\$ 400 M
<b>NPBS *</b> (Natural Phenomena Barrier System)	<b>SMALL</b> (Low $\text{E-}06$ / yr)	\$ 500 M
<b>MSIVs</b> (Main Steam Isolation Valves)	<b>VERY SMALL</b> ( $< 1\text{E-}06$ / yr)	

\* NPBS includes walls around lower portion of BWSTs and West Penetration Room wall reinforcement.

For Information Only





## Oconee Projects



---

### Completed Projects with Regulatory Interest

- Emergency Core Cooling Systems / Emergency Operating Procedure Improvements
  - High Pressure Injection Pump recirculation flow
  - Low Pressure Injection cross-tie / flow restrictors
  - Reactor Building Spray
- Other Upgrades – examples
  - Emergency Feedwater Control Valve Instrument Air Upgrades
  - Battery Replacements: Vital, Power, Standby Shutdown Facility, & Keowee
  - Keowee Underground Cable Replacement
  - Electrical Penetration Replacements
  - 600 V Electrical Distribution System Upgrades
  - Security System Upgrades
  - Reactor Building Sump Strainers (~100 ft<sup>2</sup> to ~5000 ft<sup>2</sup>)
- Steam Generator / Rx Vessel Head Replacements
- Combined Cost: \$1.3 Billion





## Oconee Projects



### ■ Current Projects with Regulatory Interest

- Digital Reactor Protective System / Engineered Safeguards Protective System
- Fire Protection transition to NFPA 805
- Tornado
- High Energy Line Break
- External Flood

### ■ Actions to provide additional focus

- Created Regulatory Support Manager position
- Periodic projects meeting with NRR & Region II
  - Next meeting scheduled 10/13/2011 at ONS

For Information Only





# Oconee Projects



- Digital RPS/ES
  - “First of a Kind” licensing action
  - Regulatory Status
    - NRC Safety Evaluation Report (SER) issued 1/30/2010
  - Project Status
    - Unit 1 installation – Complete - Spring 2011
    - Unit 2 installation - Fall 2013
    - Unit 3 installation - Spring 2012
- Fire Protection transition to NFPA 805
  - Involved in industry pilot licensing effort
    - NRC Safety Evaluation Report issued December 29, 2010
    - Transition Period ends December 31, 2012
  - Credits Protected Service Water (PSW) Modification

For Information Only





# Oconee Projects

---



- High Energy Line Break (HELB)
  - Resolves licensee basis issues
    - LARs submitted: Unit 1 6/2008, Unit 2 12/2008, Unit 3 6/2009.
  - Credits Protected Service Water (PSW) Modification
  - Credits Main Steam Isolation Valve Modification
- Tornado
  - Resolves licensing basis issues
    - Tornado LAR submitted June 26, 2008
  - Credits Natural Phenomena Barrier Modifications – Functionally Complete
  - Credits Protected Service Water (PSW) Modification
  - Credits Main Steam Isolation Valve Modification





# Oconee Projects



## ■ External Flood

- Interim Actions in place; enforced by CAL
- Self Assessment of Interim Actions completed in May 2010
- NRC Inspection of Interim Actions completed in June 2010
- NRC Safety Evaluation of Site Inundation Study Results completed January 2011
- Modification descriptions and schedule submitted April 29, 2011
  - Plan to build flood wall to protect the site
- Next Action – Response to questions due 10/3/2011
  - Meeting to discuss planned response – 9/21/2011 at NRR
  - Timely resolution of modification QA Condition needed

*and seismic justification*

For Information Only

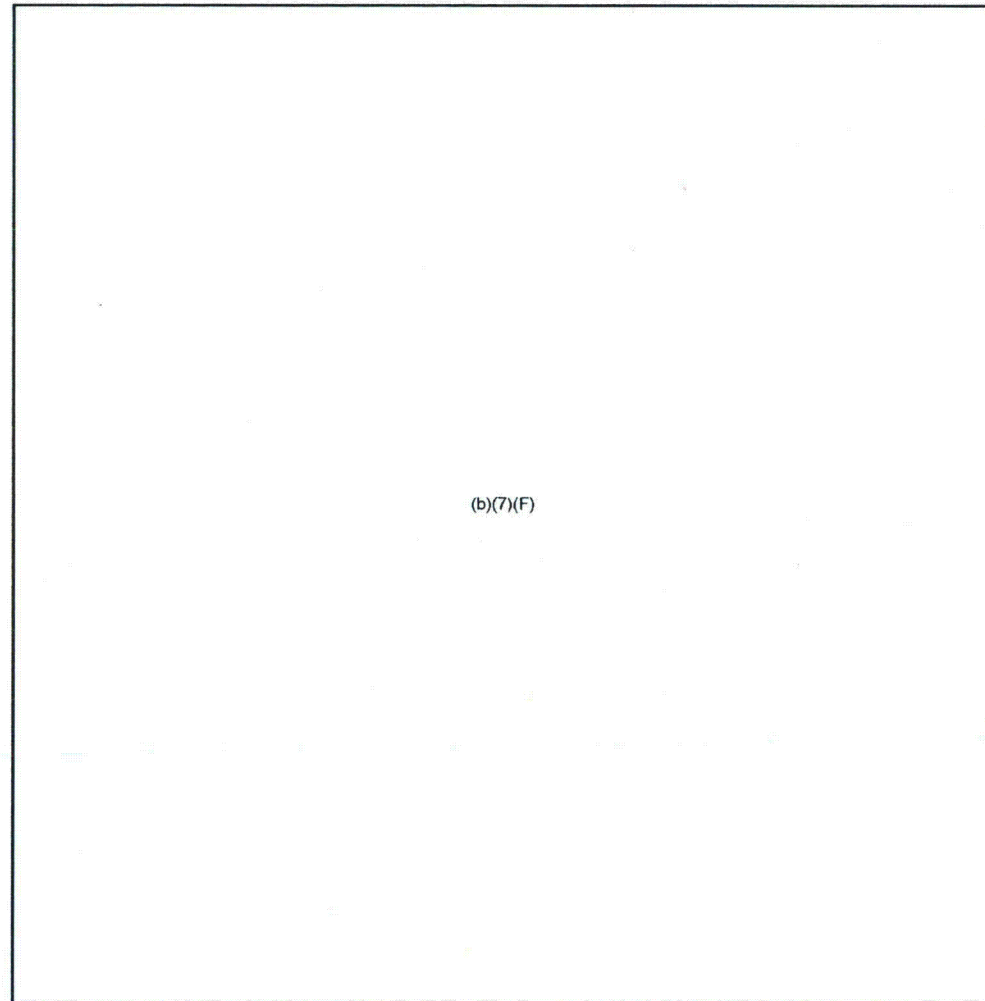




# Oconee Projects



## ■ Proposed Wall



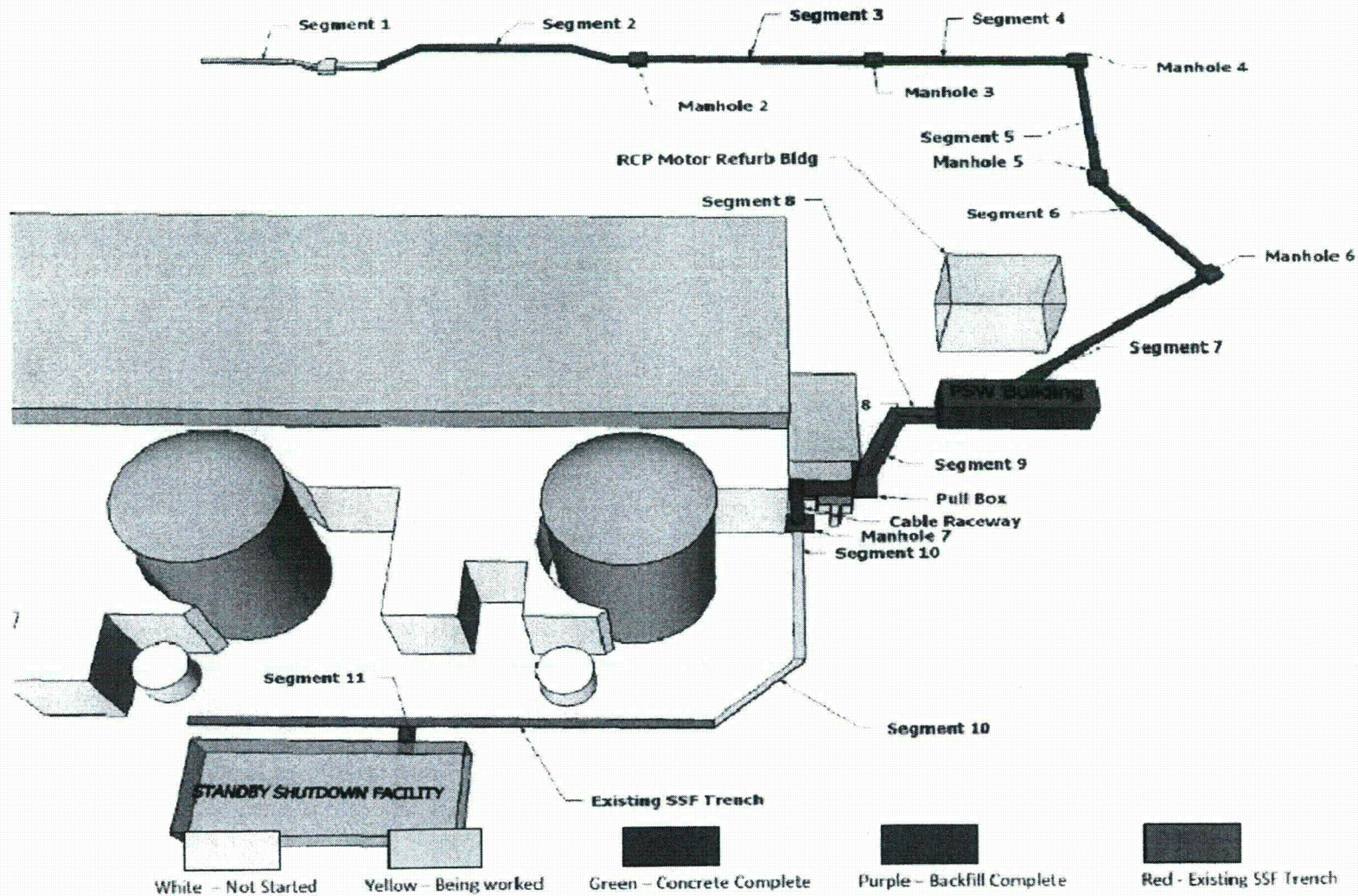
(b)(7)(F)





# Protected Service Water

## Project Status Overview



For Information Only

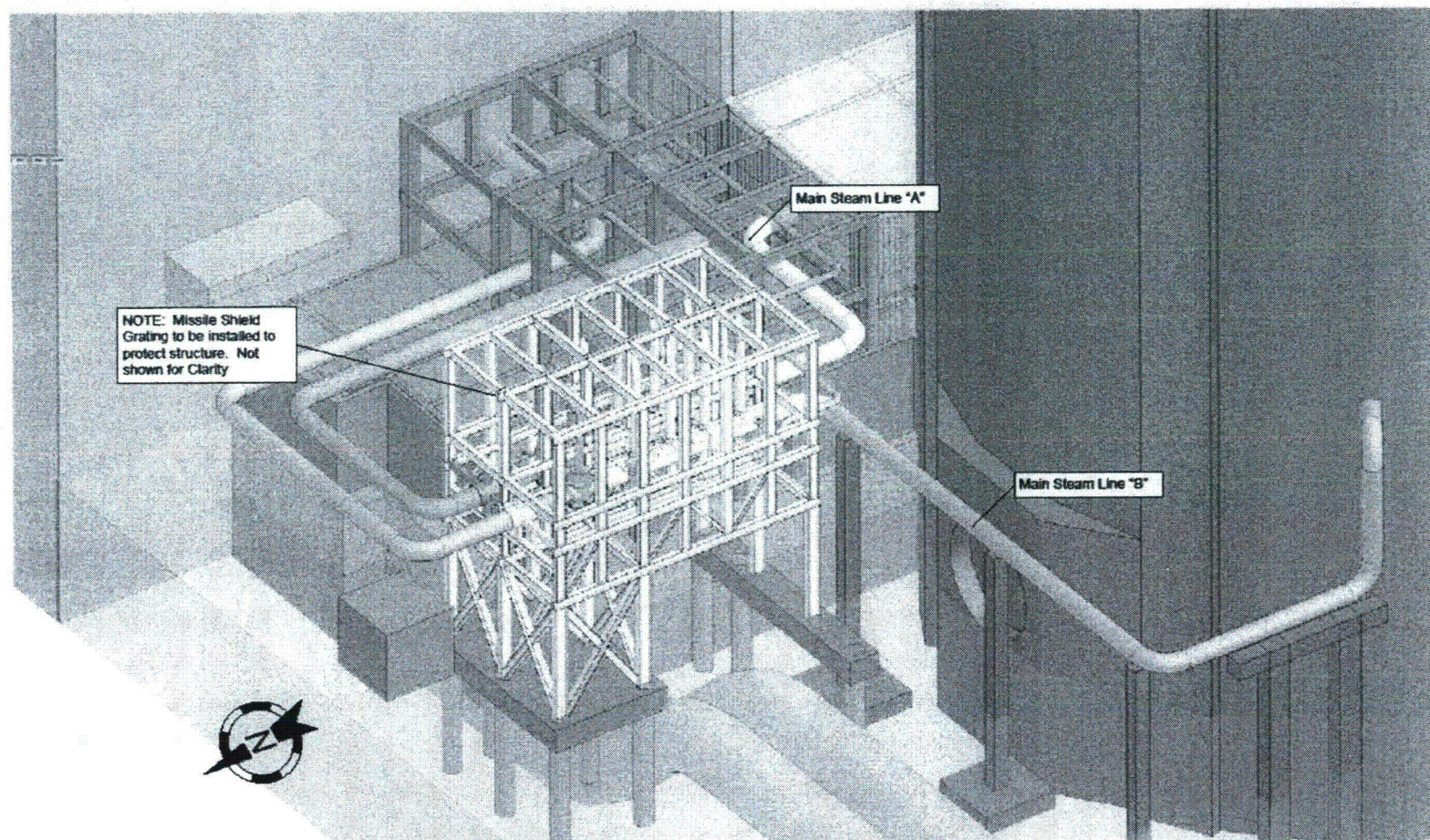




# Main Steam Isolation Valves



## Conceptual Design



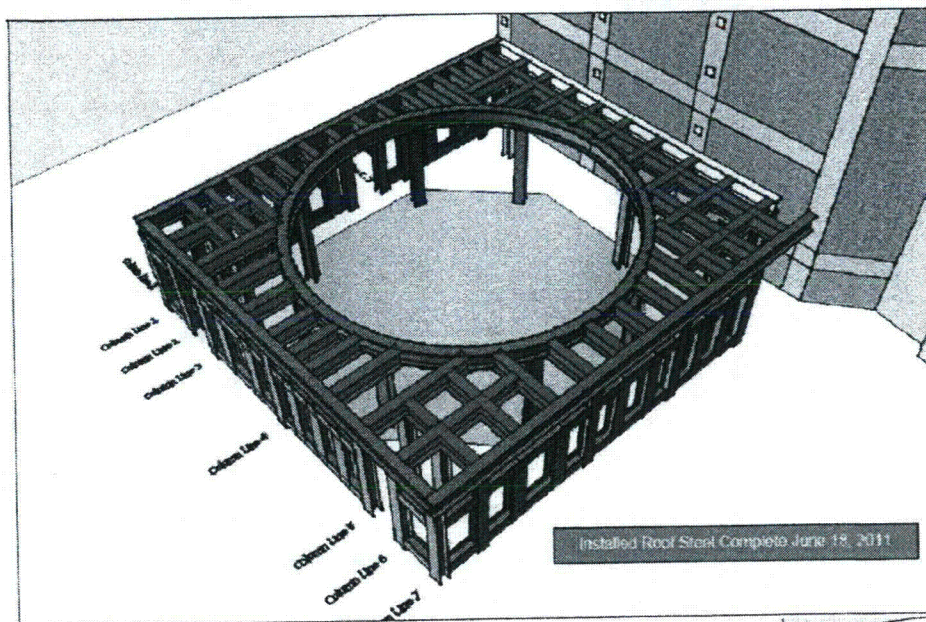
Unit 1 Conceptual MSIV Design (8/18/11)

For Information Only



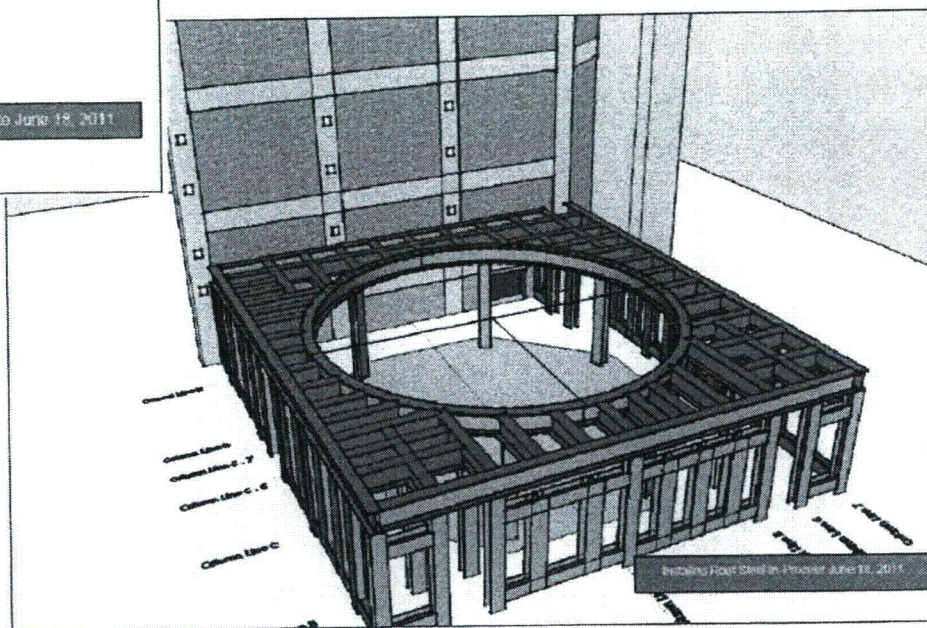


# Natural Phenomena Barrier System



Unit 1 Superstructure Steel

*6.18 tons  
of steel*

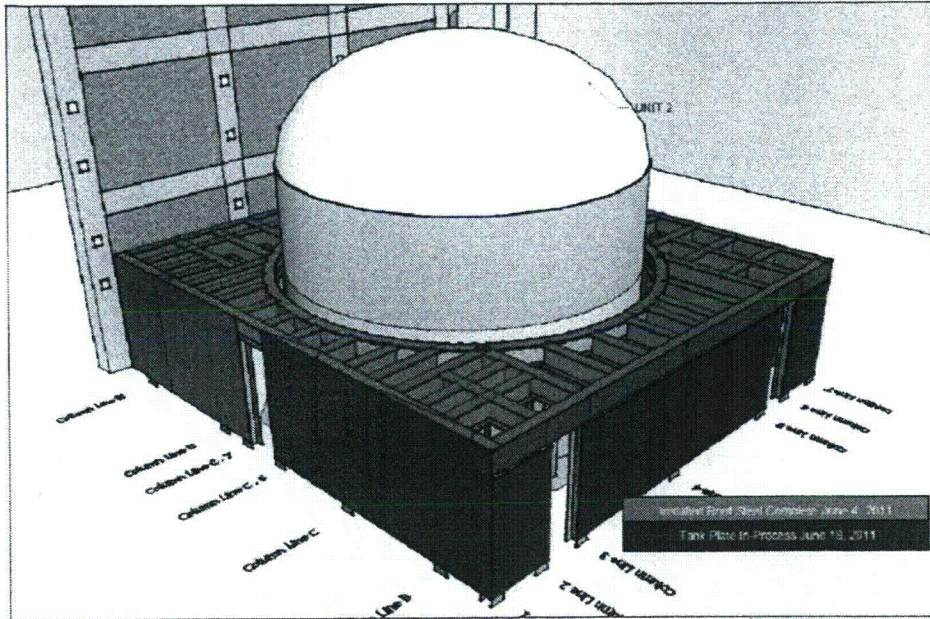


Unit 3 Superstructure Steel



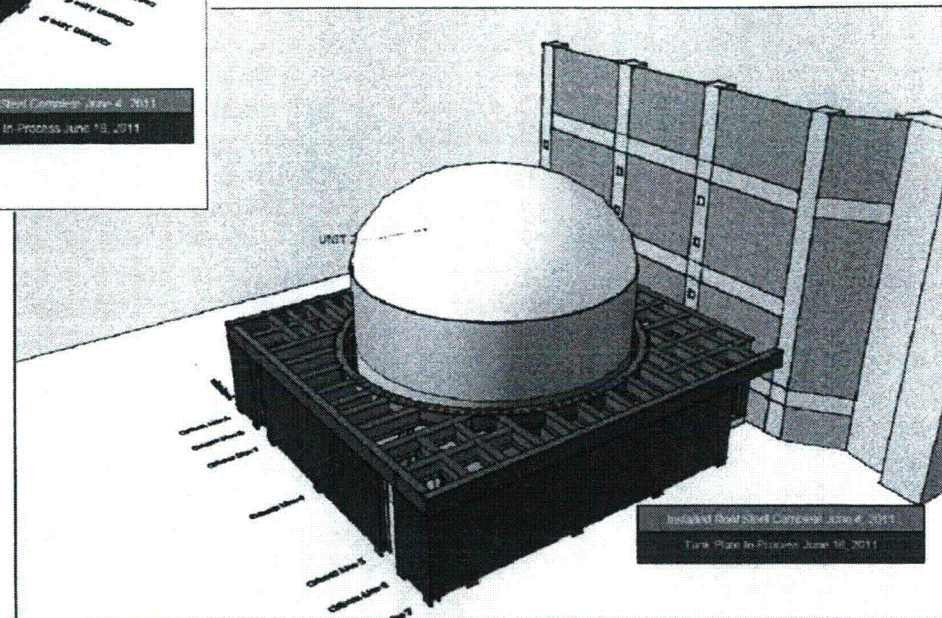


# Natural Phenomena Barrier System



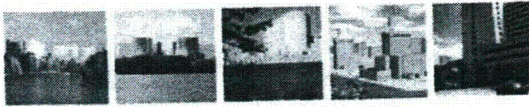
Unit 2 BWST North & West Wall Plates

13,100 ft of welds

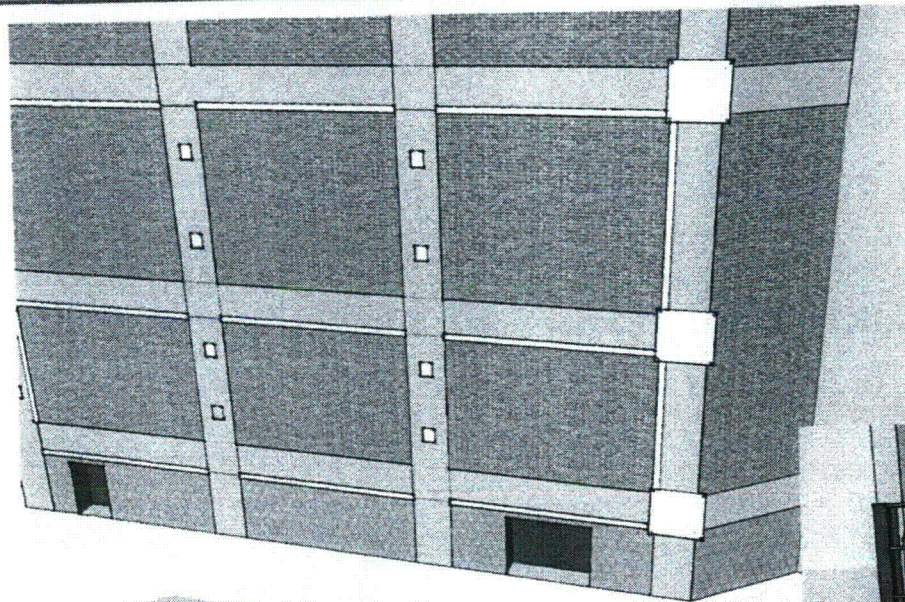


Unit 2 West & South Wall Plates



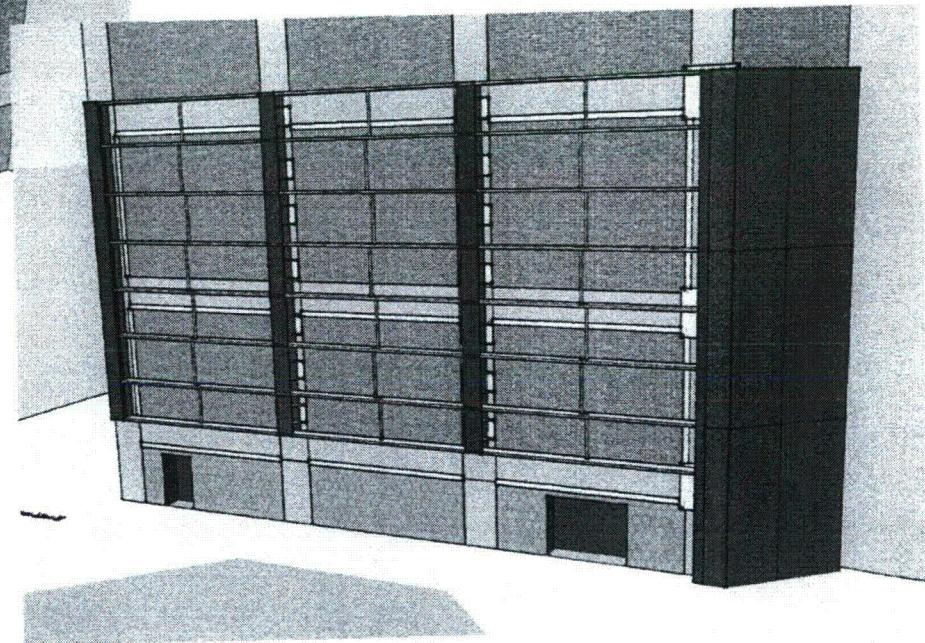


# Natural Phenomena Barrier System



Tie Plates and Shear Plates

*Fiber  
reinforced polymer  
11,300 ft<sup>2</sup> of fiber wrap  
original is black wall*

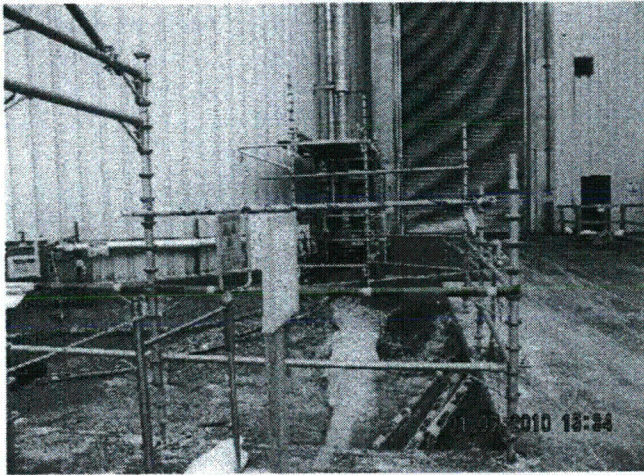


Wind Posts, Girts and Shield Plates

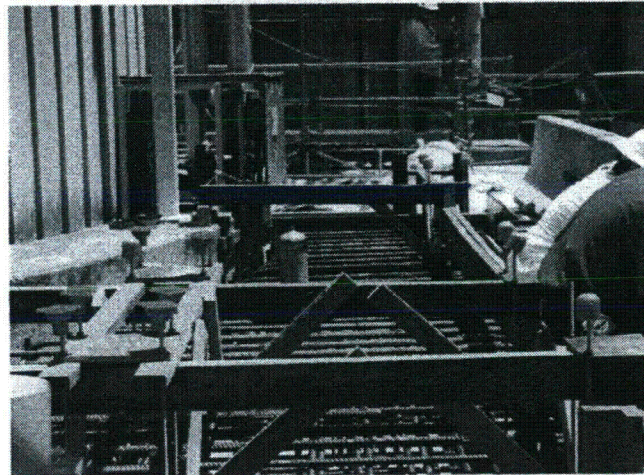




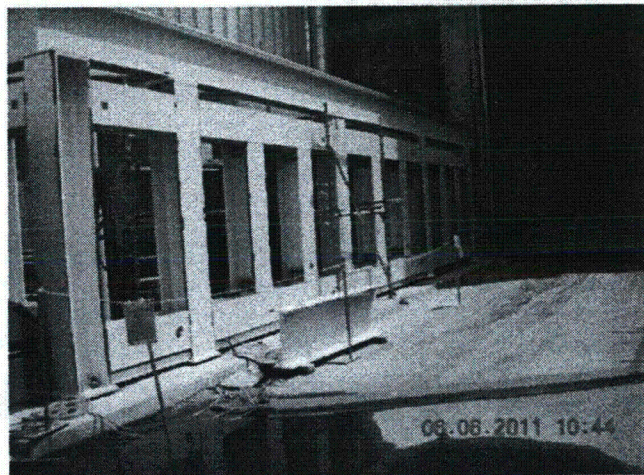
# Natural Phenomena Barrier System



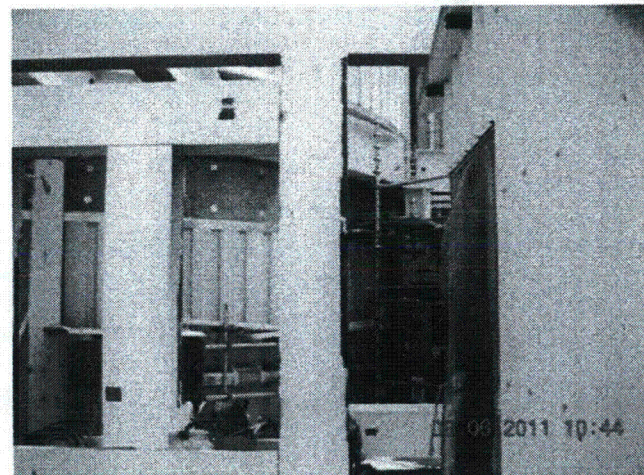
Unit 1 South Side



South Side of Tank - Rebar and Forms



South Superstructure Support Wall at Unit 1

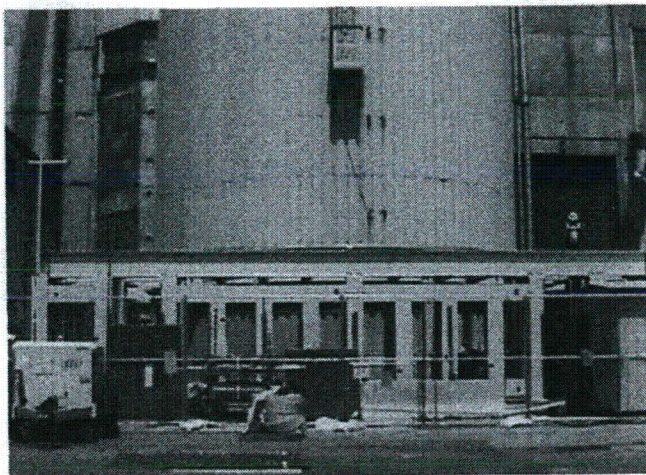


Southwest Corner at Unit 1

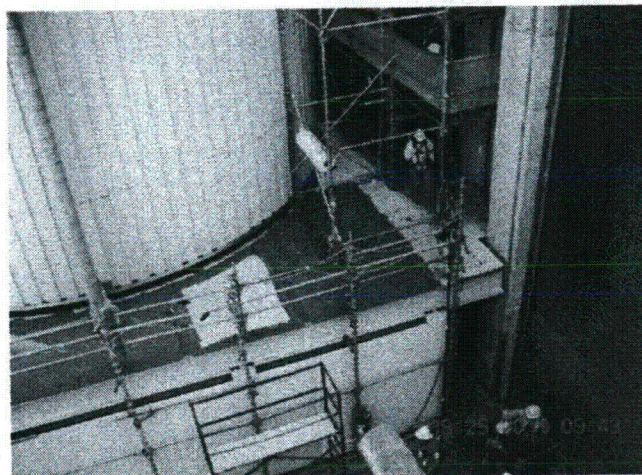




# Natural Phenomena Barrier System



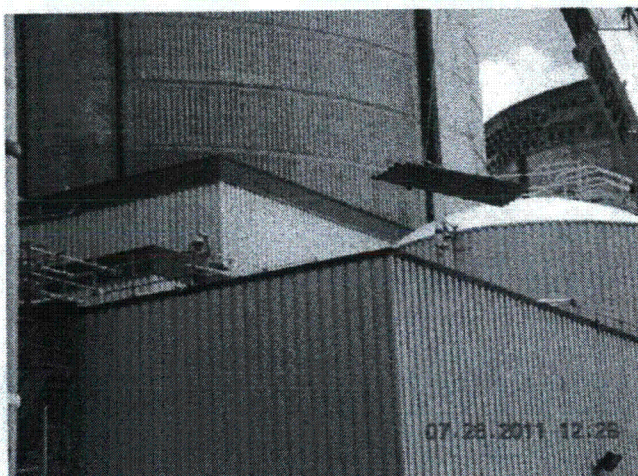
Unit 1 BWST



Unit 1 Superstructure Roof Southeast Corner



Lift of Ring Beam at Unit 2



Unit 2 North Wall Siding

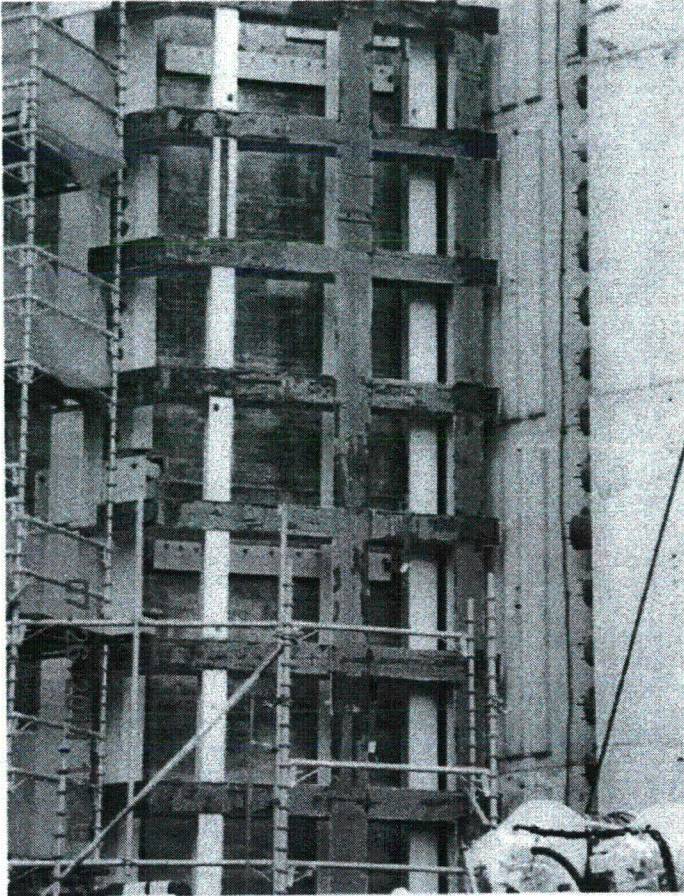
2800 l.f.t.s  
around operating  
facility

For Information Only





# Natural Phenomena Barrier System



Unit 2 Wall Assembly



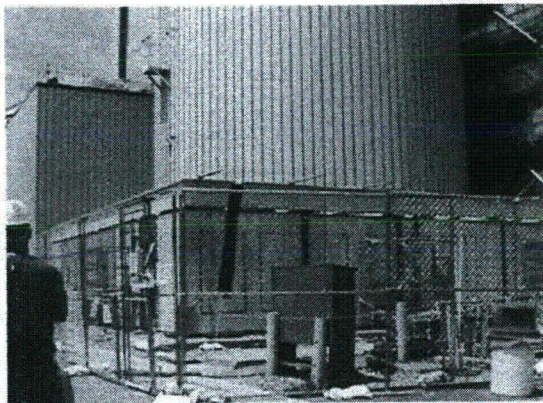
Unit 2 West Wall Shield Plates

For Information Only

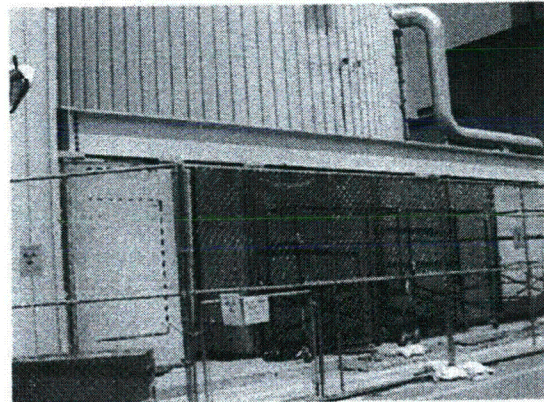




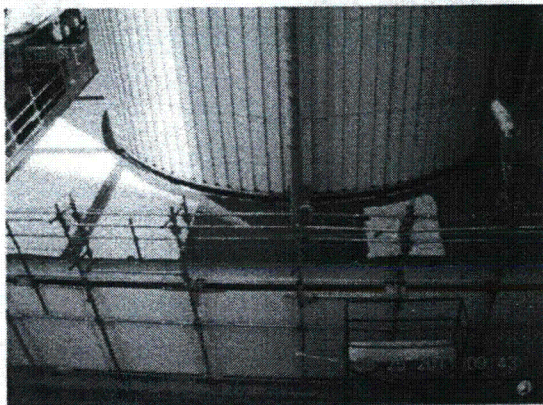
# Natural Phenomena Barrier System



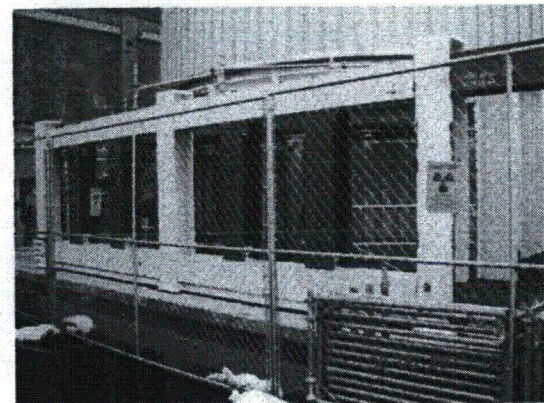
Unit 2 BWST Area



Unit 2 BWST



Unit 2 Superstructure Room South End



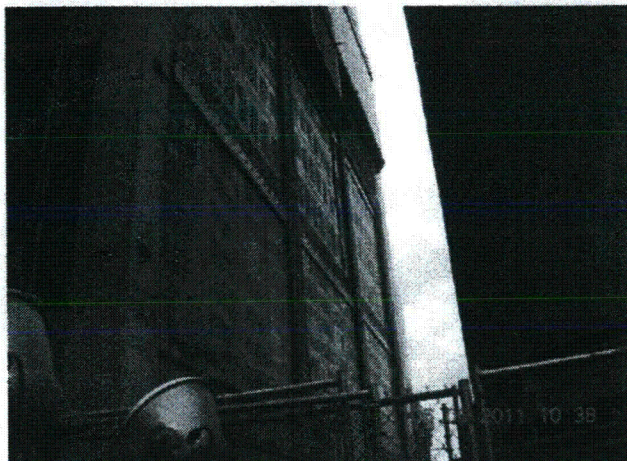
Superstructure Supports at Unit 3

For Information Only

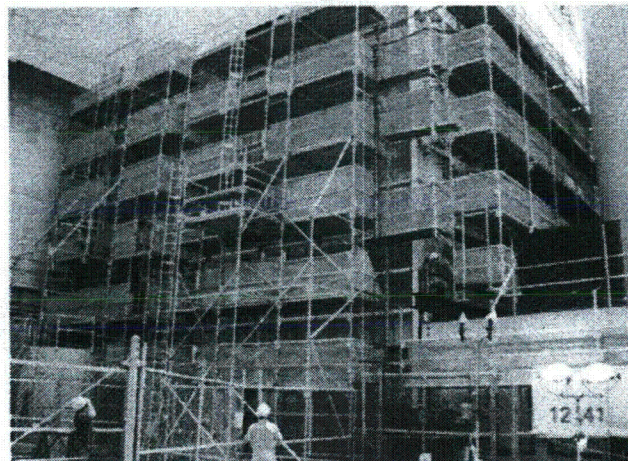




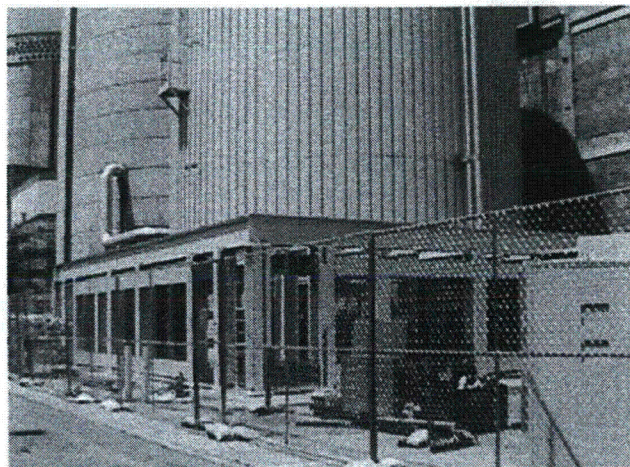
# Natural Phenomena Barrier System



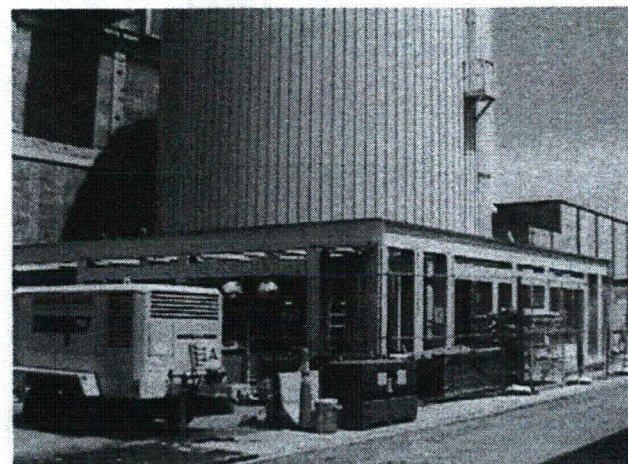
Unit 3 West Wall Fibrwrap and Shear Plates



North Wall at Unit 3



Unit 3 BWST Area



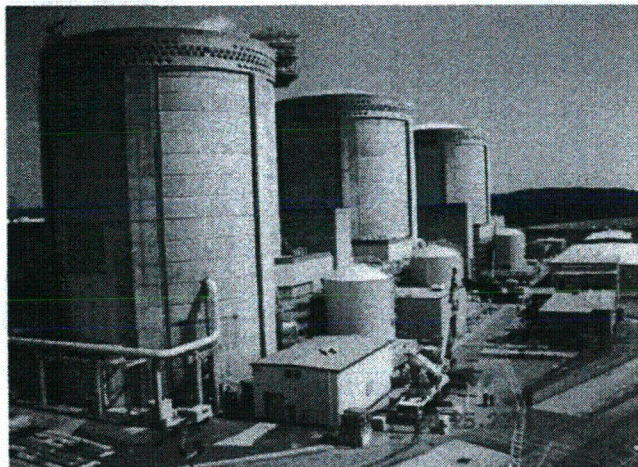
Unit 3 BWST Area

For Information Only

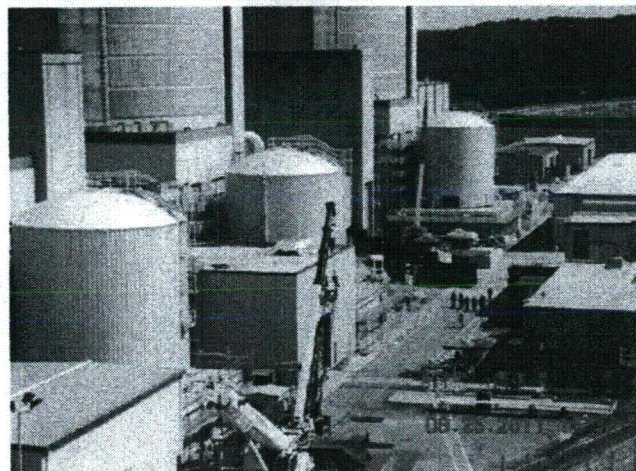




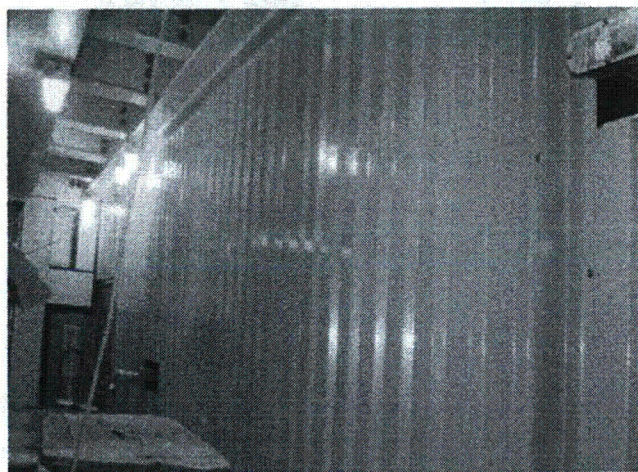
# Natural Phenomena Barrier System



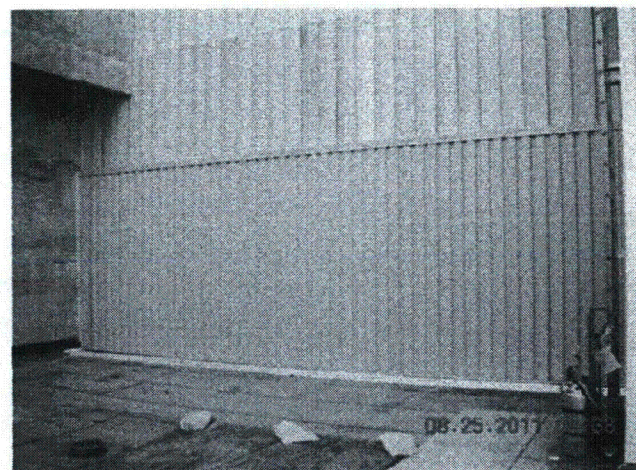
Overview of Work Area



Overview of Work Area



Finished Product - Unit 1 West Wall Inside Superstructure



Finished Product - Unit 2 North Wall

For Information Only

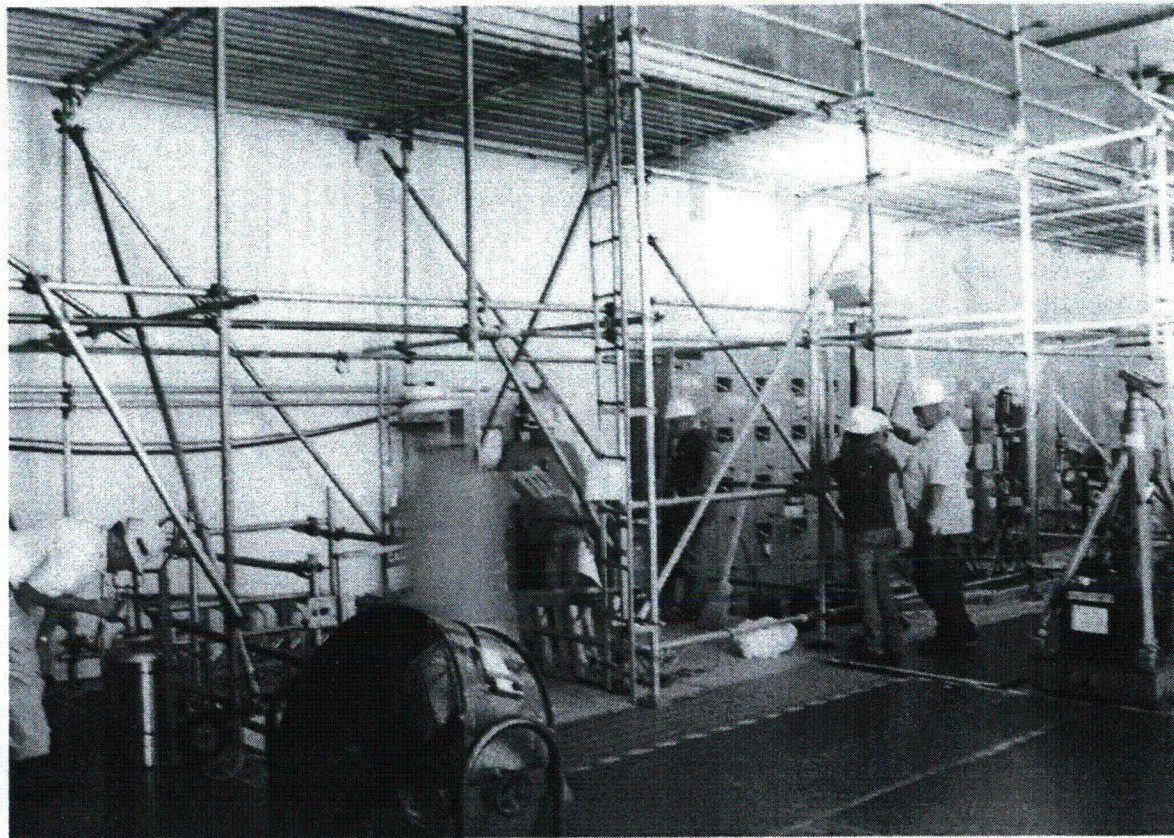




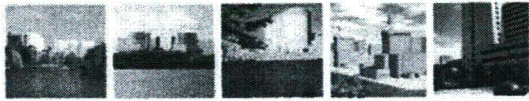
# Protected Service Water



## ■ PSW Building



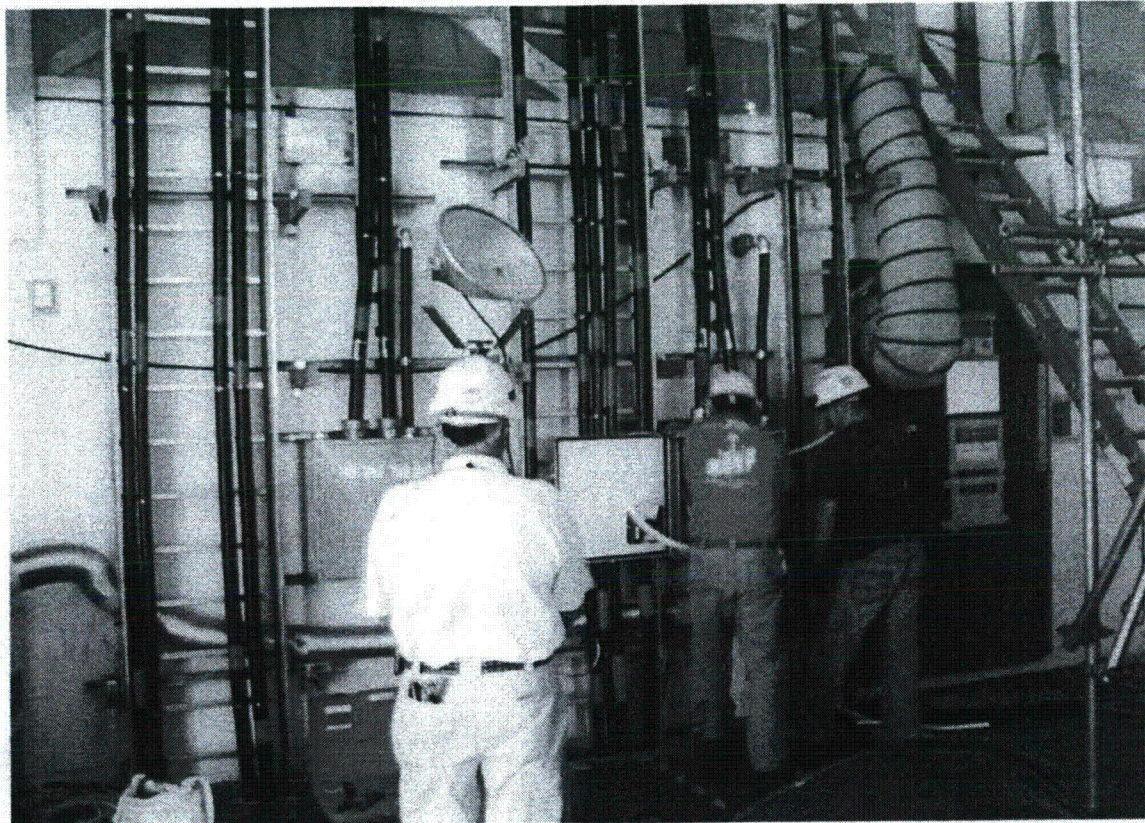




# Protected Service Water



## ■ PSW Building



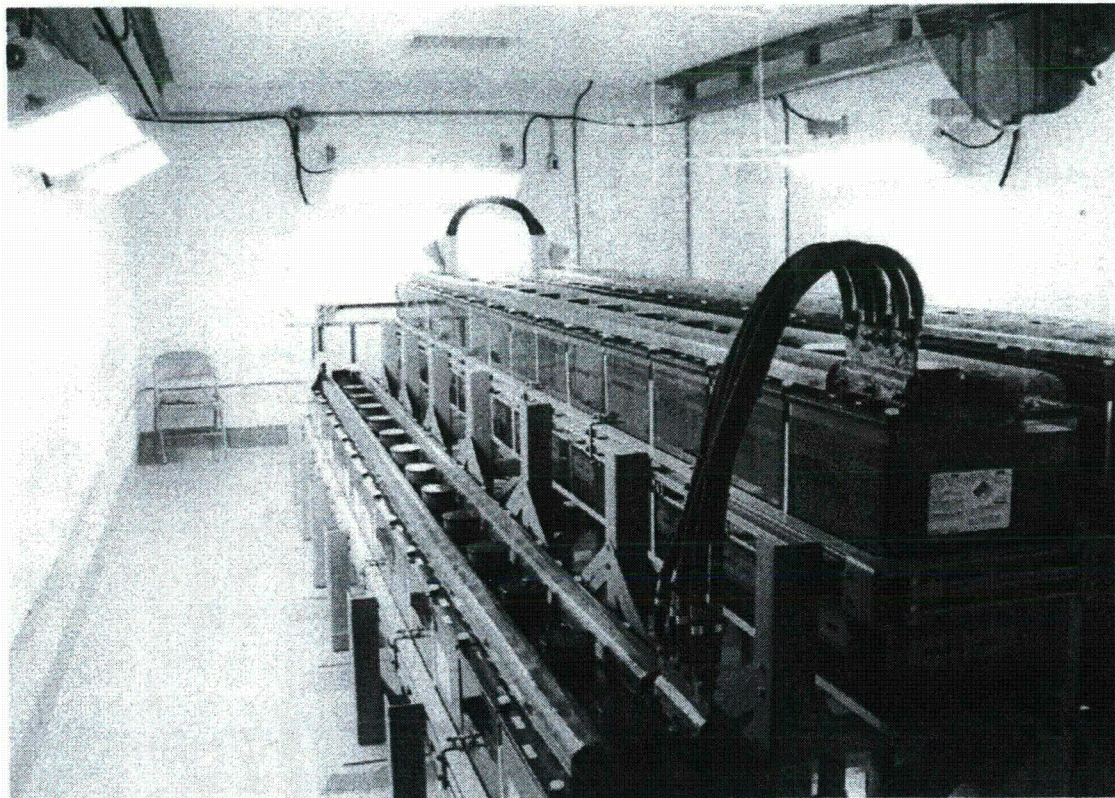




# Protected Service Water



## ■ PSW Building





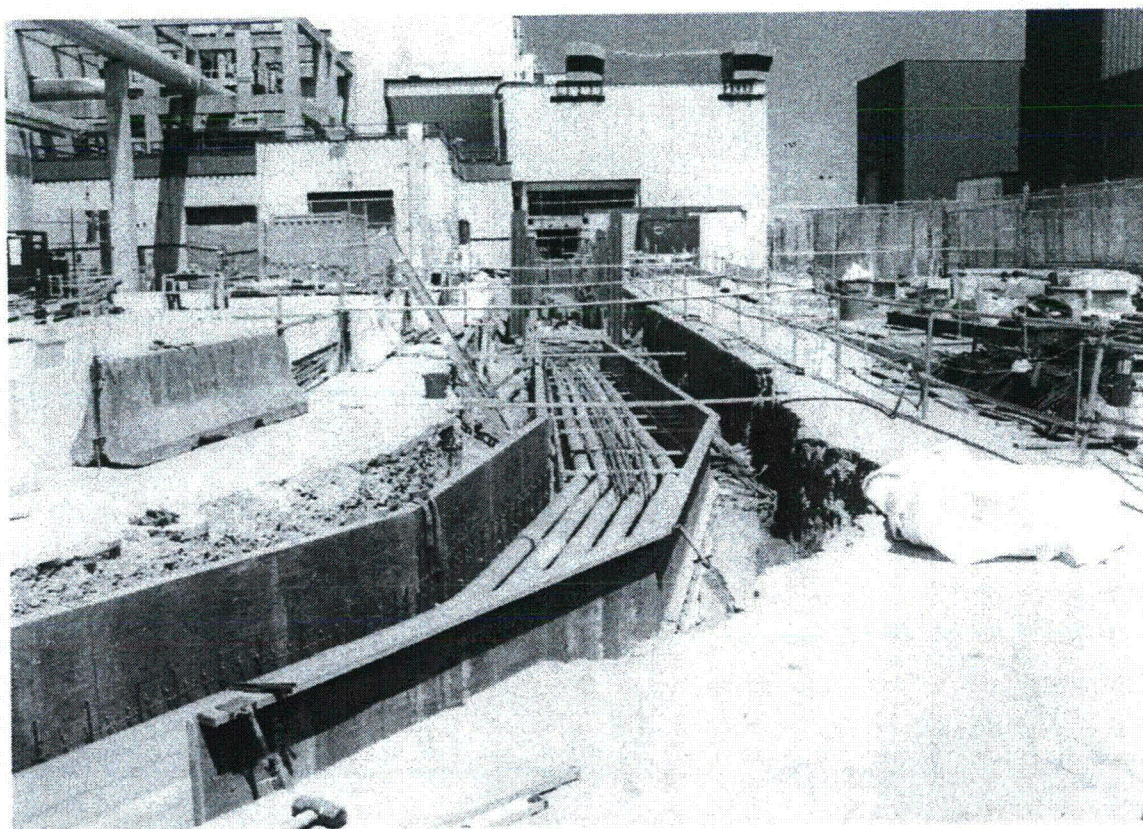


## Protected Service Water

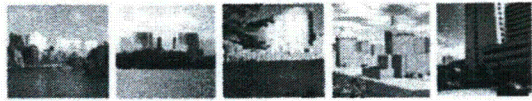


### ■ PSW to SSF Cable Trench

Power from  
Keowee or  
Lee line  
+ 3<sup>rd</sup> method  
from CT4







## Oconee ROP - Issues



### ■ Standby Shutdown Facility (SSF) Pressurizer (PZR) Heaters

- Latent design problem identified on 6/1/11
  - Breakers in containment could trip due to high temps
- SSF determined operable following breaker replacement
- Replacement Breakers failed LOCA testing
- SSF determined operable
  - Based on water solid system natural circulation
- NRC SIT the week of 7/5/11 — *4 findings*
- SSF declared inoperable on 7/8/11
  - RETRAN not approved for application
- Modification completed to install fuses that are designed for the high temperature environment





## Oconee ROP - Issues

---



### ■ Security Issue

- Identified during security inspection 08/2010
  - Improvements made based on inspector input
- Revisited during FOF pre-week inspection 02/2011
  - Issue identified and corrected during pre-week inspection
- Greater than Green Finding
- Will not be contested





## Oconee ROP - Issues



*procedure use and adherence*

### ■ Substantive Cross-cutting Issue (H.4.b – follow procedures)

- Common cause analysis identified a site gap in procedure adherence, especially administrative procedures
- Corrective Actions
  - Develop an accountability model for standards and expectations
  - Improve and strengthen the ONS Human Performance Process

*identified through CAP (performance metric)*





## Nuclear Safety Excellence Plan

---



- Captures strategy to address significant ONS and Fleet corrective actions resulting from the Root Causes conducted in response to SSF Letdown Strainer issue
- Addresses three significant areas for improvement
  - CAP Improvement Plan
  - Safety Culture Improvement Plan
  - ODP Improvement Plan
- Includes Communication and Training Integration Plans
- Includes organization, roles / responsibilities, accountability model and resource strategy
- Provides independent means to track and resource load the significant volume of corrective actions
- Major components of the plan were completed by 6/30/2011

For Information Only





## ONS Core Values



- Risk Recognition
- Fundamentals and Standards Adherence
- Honoring Commitments
- Accountability

*Since 2007  
4 industry significance events  
each had risk recognition component  
(what is the worst that can happen)*

For Information Only