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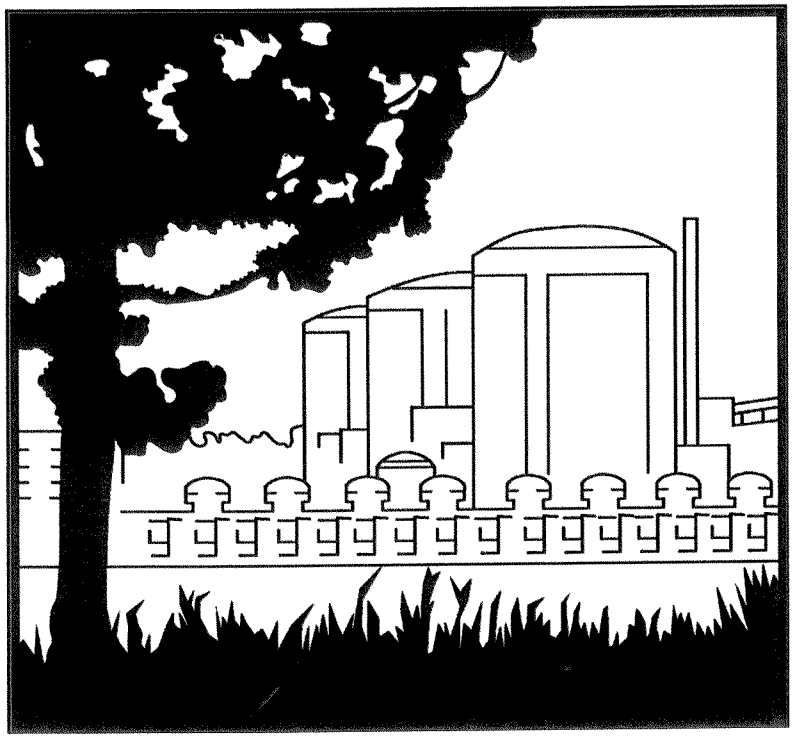

# Oconee Nuclear Station
# Regulatory Conference

## Atlanta, GA
## February 6, 2006



Enclosure 2

# Duke Participants

- Ron Jones, Nuclear Operations Senior Vice President
- Bruce Hamilton, Oconee Site Vice President
- Mike Glover, Oconee Engineering Manager
- Rich Freudenberger, Oconee Engineering Supervisor
- Dayna Herrick, Duke PRA Manager
- Lee Kanipe, Duke PRA Engineer
- Graham Davenport, Oconee RCG Manager

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# Agenda

- Introductions
- Opening Remarks
- Summary of Performance Deficiency
- Background Information
- Evaluation of NRC Issues
- Conclusions
- Closing Remarks

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# Opening Remarks

- This specific Design Basis issue is part of the overall Oconee tornado mitigation project currently underway.
- While corrective actions have not been timely, Oconee remains safe today due to very low probability of tornado strike and subsequent damage.
- Duke quantitative analysis supports this conclusion, and demonstrates overall delta core damage frequency ($\Delta$CDF) to be less than 1E-6, even with higher estimated missile inventories.
- Planned corrective actions are being promptly formulated and will be discussed later in this presentation.

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# Summary of NRC Significance Determination Process Issue

- The Oconee Nuclear Site (ONS) Unit 3 control room north wall is currently non-conforming with the tornado design basis as described in the UFSAR.
- NRC performed a qualitative risk evaluation using previously available information
- NRC concluded the absence of a hardened Unit 3 control room north wall could be of more than minor safety significance:
  - Risk previously determined to be high "E-7"
  - Wall construction not as robust as originally assumed
  - Missile inventory greater than assumed
  - Uncertainty with operator response to SSF during Tornado event

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# Background: North Wall TORMIS History

- 2003 – TORMIS calculation (Rev. 0) developed for a License Amendment Request (LAR) submittal.
  - Wall damage frequency estimated 4.4E-07 /year
  - Standard Review Plan (SRP) criterion is <1E-06/year.
- 2004 – Oconee's Plant Operations Review Committee (PORC) reviews the LAR.
  - Questioned the impact of site changes on missile inventory.
  - Engineering questions TORMIS damage model.
- 2005 – TORMIS calculation (Rev. 1) approved.
  - TORMIS issues resolved - missile damage freq. <5E-07/year.
  - Plant engineering concern of $\Delta P$ failure of wall's steel plate. Conservative $\Delta P$ failure estimate results in a CDF of 6E-07.

# Background: North Wall TORMIS History (January 2006)

- Duke Initiates detailed Significance Determination Process (SDP) Risk Assessment
  - Address NRC analysis concerns
    - Determine sensitivity of CDF to missile inventory
    - Determine reliability of pre-staging the Oconee Standby Shutdown Facility (SSF) prior to potential tornado impact on site.
  - Estimate incremental CDF and large early release frequency (LERF)

# NRC Risk Issue #1

Risk previously determined to be high E-7

- NRC: *"In Problem Investigation Process (PIP) O-04-2365, updated on April 26, 2005, the licensee calculated a mean core damage frequency of 4E-7 and noted that with double the number of potential missiles the mean damage frequency would be 9E-7."*
- Duke Clarification: Completed on Sept. 30, 2004, PIP corrective action (CA) #3 states a "mean damage frequency of 4.4E-07 /yr."
- ★ This is a reference to missile damage frequency not to core damage frequency.

# NRC Risk Issue #2

## Block walls mischaracterized in TORMIS model

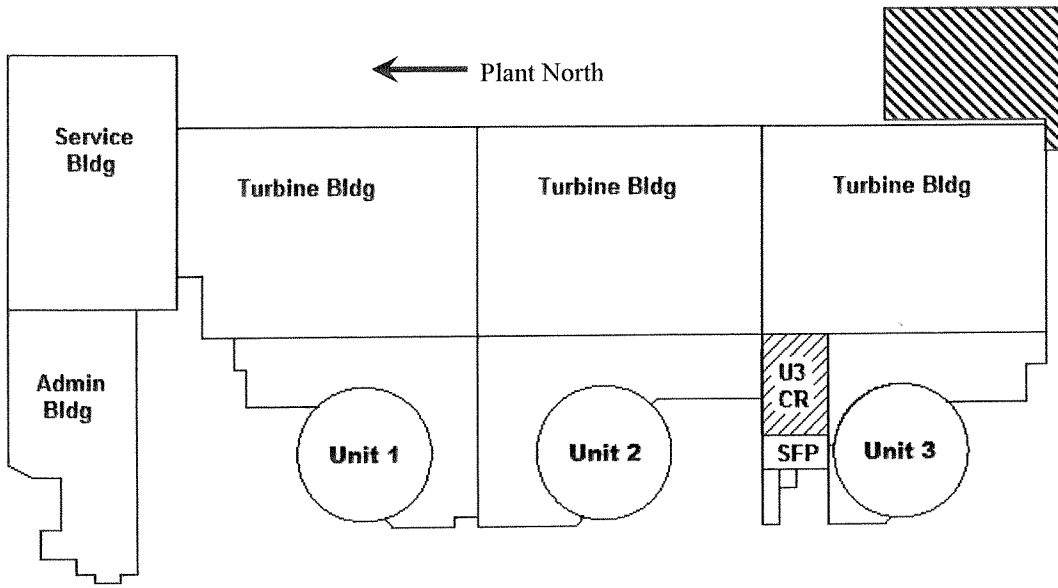
- Duke Clarification:
  - "Block wall issue" and other issues in the structural analyses were addressed in the updated evaluation in PIP O-01-2827 (June 2005).
  - CDF was conservatively estimated at 6E-07 /year

# NRC Risk Issue #3

Site Missile Inventory Higher Than Analyzed

- NRC: Inspectors estimated actual missile count to be 10 to 20 times higher than assumed in the TORMIS model, and would increase the likelihood of missiles striking the wall.
- Duke Clarification:
  - Materials observed in November 2003 were located at southeast corner of Turbine Building (away from the Unit 3 control room north wall)
  - Materials observed were used to support outage activities and not present continuously through the year

# NRC Risk Issue #3 (cont.)




TORMIS Assumption:

Zone 2 - 290 missiles

Inspector (10 to 20 times) = ~3000 to 6000 missiles

TORMIS Assumption for Site (All Zones): 33,434 missiles

- Missile inventory for the entire site did not increase by 10 – 20 times.

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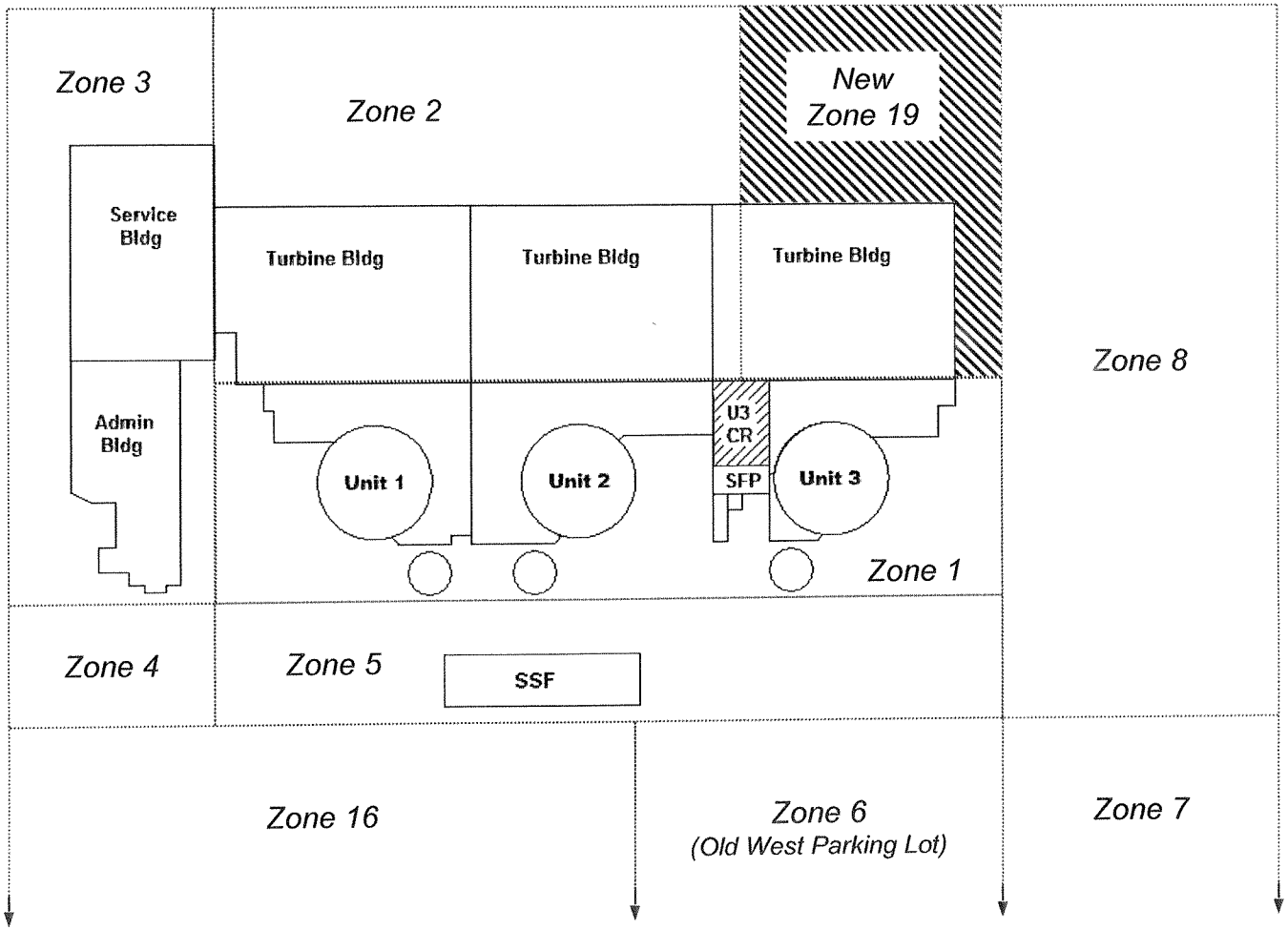
# Duke Response

## Determine sensitivity of missile inventory assumptions

- TORMIS sensitivity case
  - Increased inventory observed by inspectors was modeled in new "Zone 19".
  - Sensitivity case intended to represent "bounding" case analysis.
    - Approximately 50 times base in same area (versus inspector's estimate of 10–20 times)
    - Other potential storage/staging areas were increased by similar amount (Zones 6 & 8).

# TORMIS Missile Zones



# TORMIS Sensitivity Analysis

## Missile Inventory Comparison

| Location | Base Case | Bounding Case | Change |
|---|---|---|---|
| Zone 6 | 1038 | 15,600 | 15 X |
| Zone 8 | 333 | 16,650 | 50 X |
| Zone 19 | - | 14,500 | 50 X Zone 2 |
| All Zones | 33,434 | 78,813 | 2.36 X |

# TORMIS Sensitivity Results

## Unit 3 Control Room North Wall - TORMIS Comparison

- Base Case - Normal Site Inventory
  - Missile Impact Frequency = 9.2E-06
  - Missile Damage Frequency = 4.7E-07
- Bounding Case - Increased Inventory
  - Missile Impact Frequency = 1.3E-05
  - Missile Damage Frequency = 8.0E-07

★ These values are not core damage frequency.

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# TORMIS Sensitivity Results (cont.)

- Increased missile inventory in the evaluated storage areas are small contributors to the control room north wall missile strike frequency due to geometry.
- Overall missile damage frequencies are relatively insensitive to increases in missile inventory in these particular zones.

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# NRC Risk Issue #4

## Pre-staging operators at the SSF prior to tornado

- NRC: Failure to pre-stage operators in the SSF during a tornado warning could adversely impact SSF human reliability.
  - "High uncertainties are associated with even well defined human actions."
  - "Without more data this human reliability analysis term is a source of high uncertainty."

# Duke Response

- Duke developed an event tree analysis to evaluate affects of tornado warning time.
  - The ONS natural disaster procedure (AP/6) dispatches operators to the SSF upon receipt of tornado warning notification.
    - Average response time 3.6 minutes.
    - Travel time to SSF is 4 minutes.
  - Based on National Weather Service (NWS) data, average tornado warning time is 13 minutes.

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# Human Reliability Analysis

★ Minimal impact on overall SSF reliability

- ❑ Assumptions:
  - ➢ National Weather Service Warning received: > 90% of the time
  - ➢ Operator Response: 94% Success Rate
  - ➢ SSF operators pre-staged: 84% of the time
  - ➢ Human error probability: ~4E-03 increase

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# Risk Quantification

- Accident Sequence
  - Initiating Event (Tornado Missile Penetrates CR)
  - Core Cooling Failure (SSF Failure)

- Included:
  - Revised SSF Human Reliability
  - Baseline and Bounding Case Missile Inventory

# Incremental Risk Results

- Base Case
  - Normal Missile Inventory (33,434 missiles)
    - ΔCDF = 1.8E-07 /yr
    - ΔLERF = 1.8E-09 /yr
- Bounding Missile Inventory Case
  - Increased Missile Inventory (78,813 missiles)
    - ΔCDF = 3.0E-07 /yr
    - ΔLERF = 3.0E-09 /yr

★ Bounding case demonstrates that the risk impact is very low.

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# Conservative Assumptions

- The bounding case missile inventories assumed for Zones 6, 8, and 19 are very conservative.
- The area immediately next to the north wall is used for offices and storage (non-vital).
- No credit is taken for the block walls as a missile barrier.
- If a steel plate is penetrated, or if a block wall is impacted by a missile, all Control Room functions for EFW, HPI, and Station ASW are assumed to fail.
- Steel Plates for 3 center panels are assumed to fail in F-3 winds (158 mph). Ultimate capacity is even higher.

# Risk Analysis Conclusions

- Risk impact is very low (Green).
  - ΔCDF <3.0E-07 /yr
  - ΔLERF <3.0E-09 /yr
- Duke risk assessments were conservative.
- TORMIS modeling issues had minimal risk impact and were addressed in March 2005.
- Increased missile inventory has minimal impact on final risk results.
- Impact of tornado warning time on SSF human reliability is minimal.

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# Closing Remarks

- Duke plans to modify the Unit 3 North Control Room Wall
  - Deterministic rather than probabilistic solution.
  - After modification Duke will be in full compliance with its LB.
  - Proposed modification described in January 31, 2006 letter to the Staff.
    - Fortify wall for tornado wind, $\Delta P$, and missiles.
    - Complete modification by December 31, 2007.