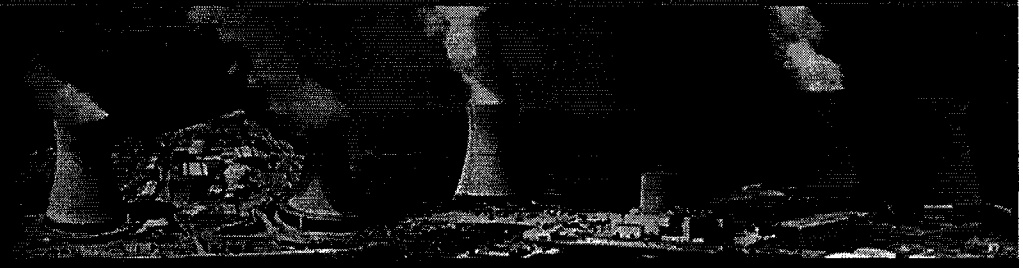
FENOC

FirstEnergy Nuclear Operating Company

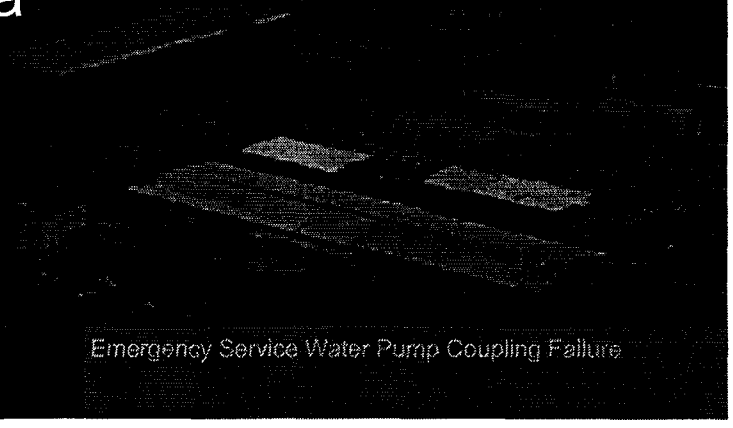


Perry Nuclear Power Plant
December 17, 2003

Emergency Service Water (ESW) Pump Coupling Failure

Topics Of Discussion

- Desired Outcome – Bill Kanda
- Background – Bill Kanda
- Cause Analysis – Tom Lentz
- Corrective Actions – Kevin Cimorelli
- Collective Significance – Tim Rausch
- Safety Assessment – Tom Lentz
- Concluding Remarks – Bill Kanda



Desired Outcome

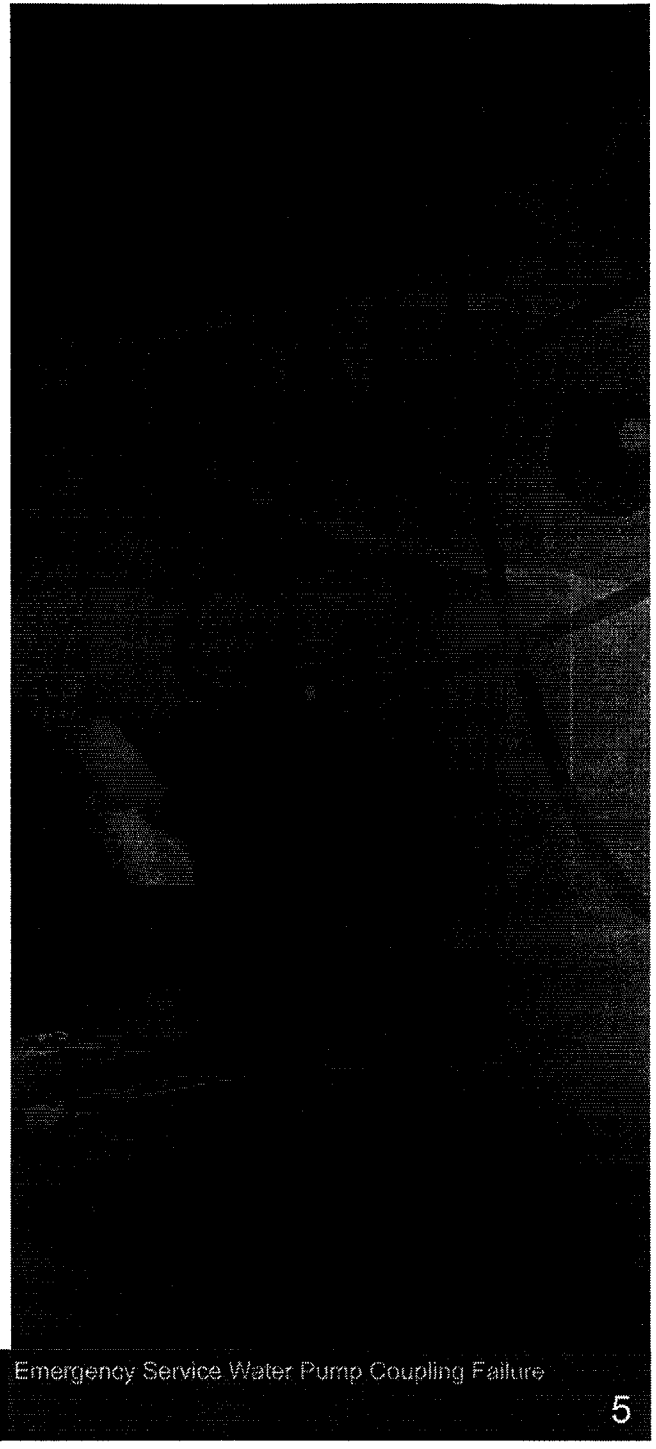
- Ensure a consistent understanding of the issue
- Present the causes and corrective actions
- Discuss further actions
- Present results from updated safety assessment

Background

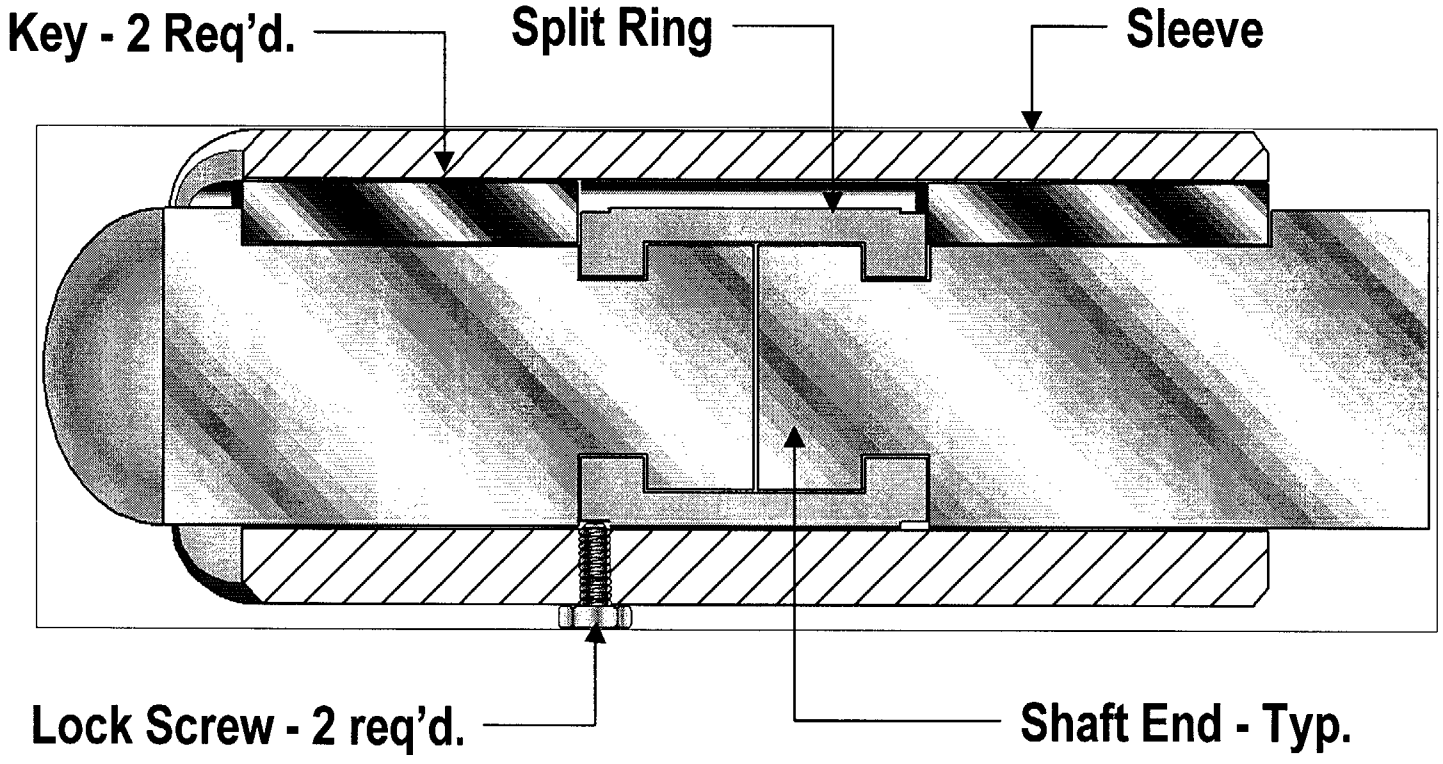
- Emergency Service Water (ESW) Pump "A" coupling failed
- Enforcement discretion requested and granted (no net increase in risk)
- Repairs completed well within the discretionary period

Cause Analysis

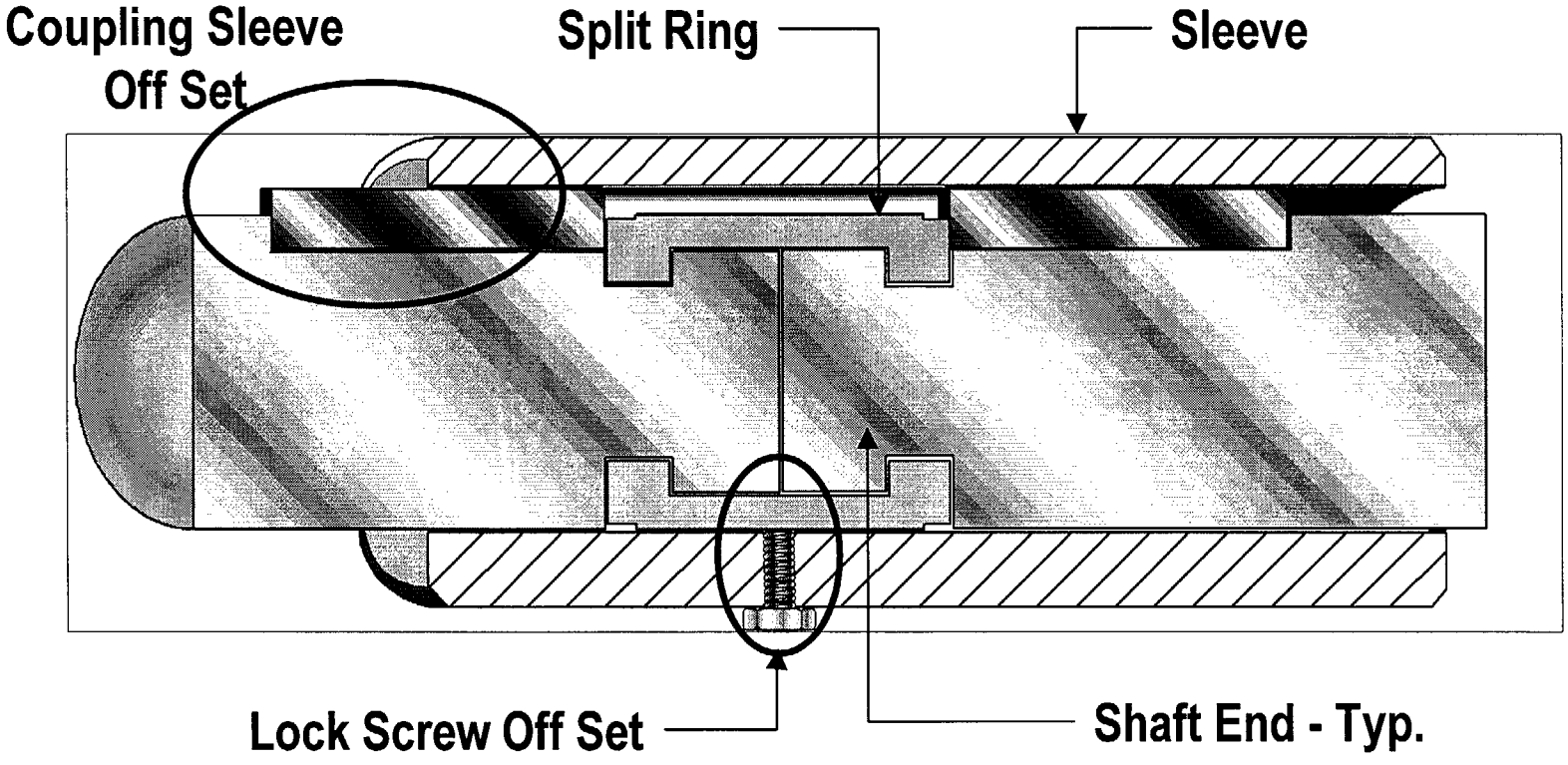
Tom Lentz
Director of Engineering



Properly Installed Coupling



As Installed Coupling



Root Cause Evaluated

- Evaluated the environment/application
- Conducted a detailed laboratory analysis
- Performed a detailed stress analysis
- Fracture mechanics were evaluated

Root Cause Conclusion

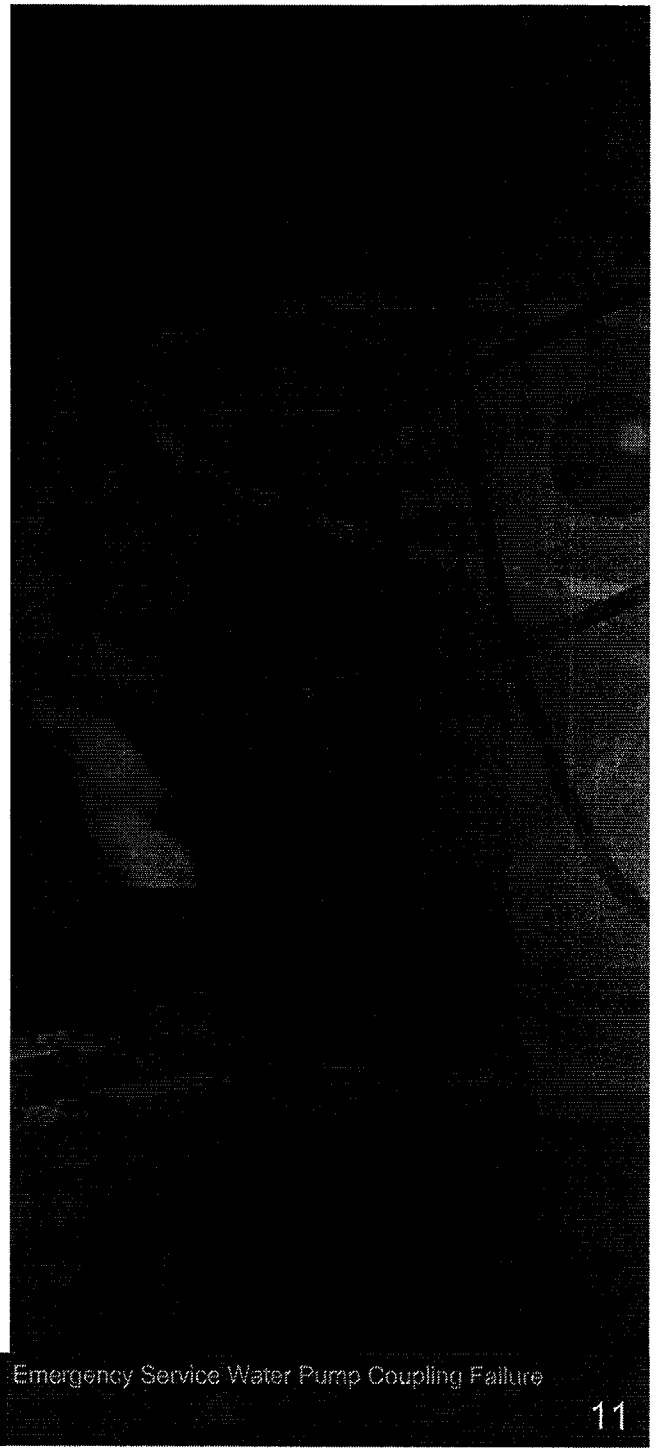
- Stress corrosion cracking is the root cause
  - Improper installation due to inadequate procedure
  - Susceptible material
  - Environment considered in design/operation
- Corrective actions address both installation and material

Extent of Condition Examined

- Safety and non-safety related pumps were included
- Similarities in configuration, couplings, and maintenance instructions were examined
  - ESW Pump "B" – found to be identical
  - ESW Pump "C" – similar

Corrective Actions

Kevin Cimorelli
Director of Maintenance



Comprehensive Corrective Actions

- ***Emergency Service Water Pumps***
- ***Maintenance Procedures***
- ***Materials***

Corrective Actions

ESW Pumps

- Pump operability has been assured
- Further actions will be taken to assure continued reliability
  - ESW Pump "A" rebuild in 2004
  - ESW Pump "B" inspect in 2004, rebuild in 2007
  - ESW Pump "C" rebuild in 2004

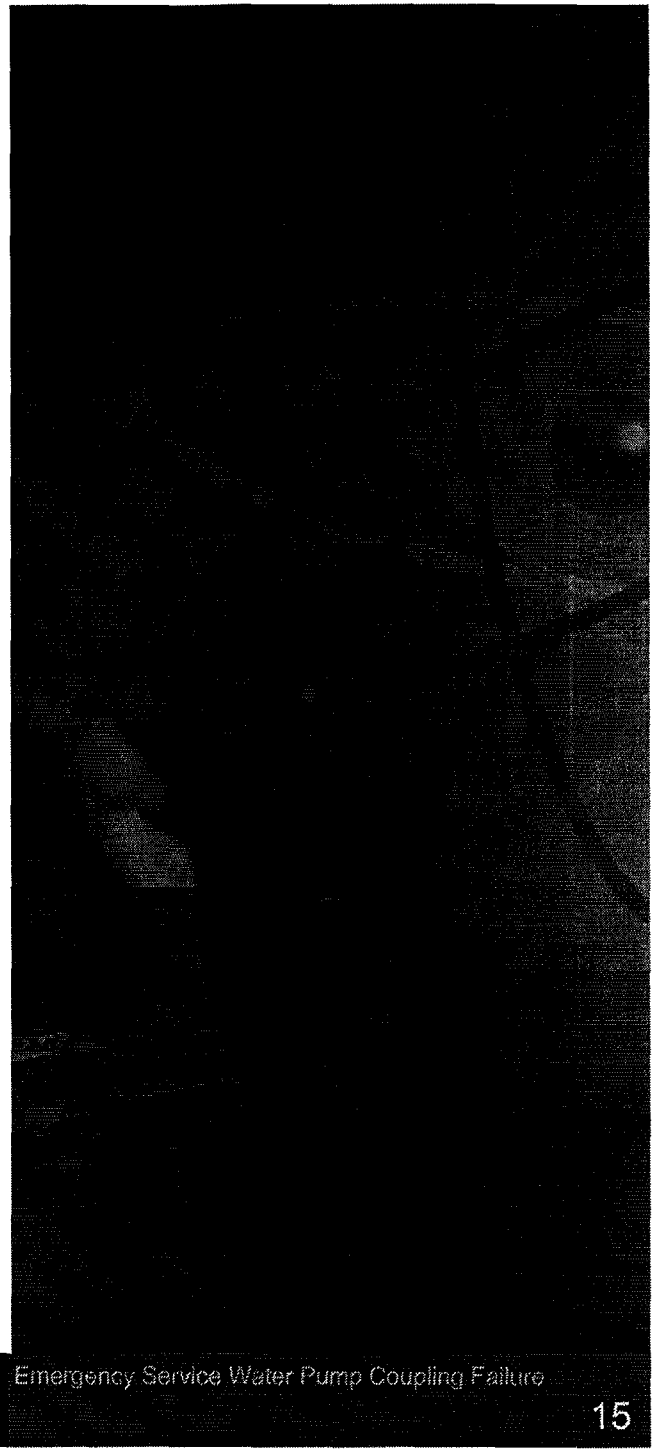
Corrective Actions

Procedures and Material

- Revision of procedures for ESW pumps
- Material upgrades for all ESW pumps
  - New requirements for heat treatment, hardness, and documentation
  - 100% NDE of coupling sleeves

Collective Significance

Tim Rausch
Plant Manager



Collective Significance Review Process

- Systematic evaluation of a collection of documented events or conditions
- Multidiscipline Review Team formed November 3, 2003
- Scope includes four mitigating system equipment failures over last year

Collective Significance Review - Matrix

Matrix used - Categories/Facts

- Problem category examples:
  - Procedure guidance
  - Training
  - Material deficiencies
  - Design deficiencies

- Problem fact examples:
  - Event type
  - Organization
  - Cause code

Collective Significance Review - Results

Areas for Improvement

- Two collective issues identified during common cause evaluation
  - Electrical/Mechanical maintenance instruction deficiencies
  - Procedure "use" categories not pre-determined

Content of Procedures

Conclusion:

- Procedures were root or contributing causes

Actions:

- 75 maintenance instructions will be systematically assessed
- Results of assessment will determine need for comprehensive procedure upgrade
- Interim - Safety related procedures will be reviewed as part of the work planning

Use of Procedures

Conclusion:

- Procedure use categories not assigned

Actions:

- Interim - maintenance instructions will be "In-Field Reference"
- "Use" category will be identified in maintenance instructions

Collective Significance Review - Summary

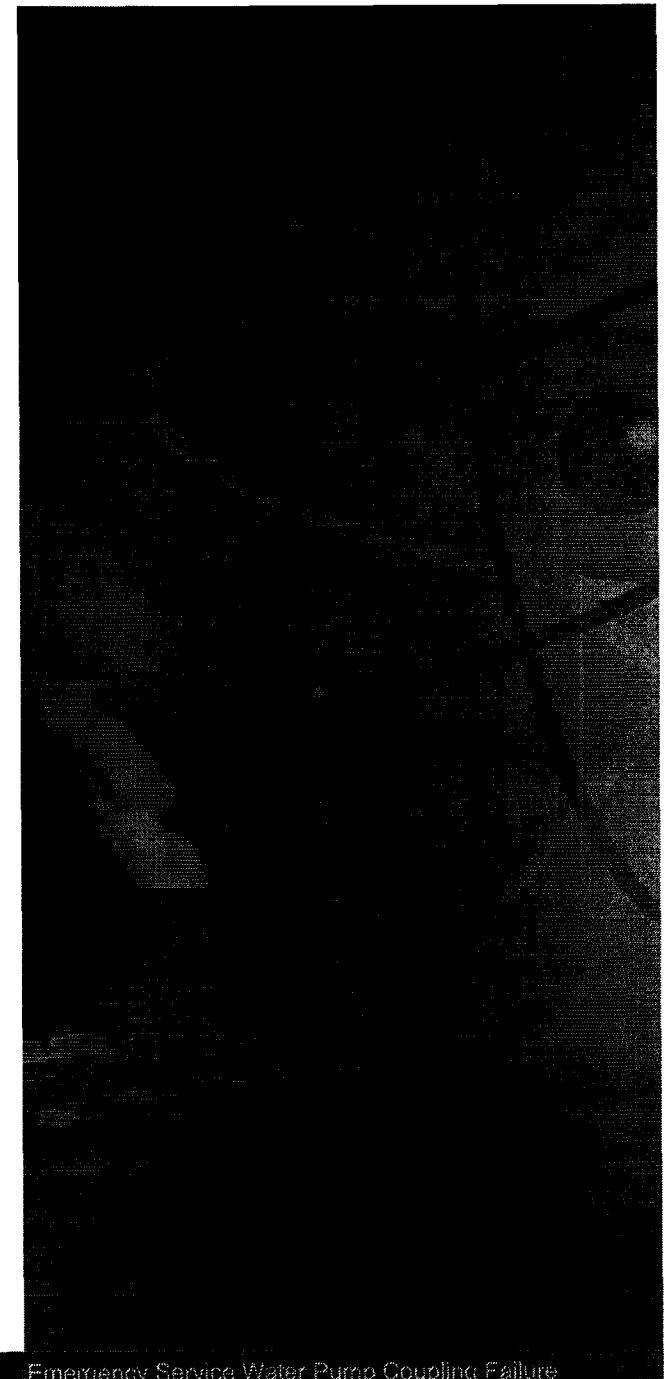
- Common causes are understood
- Comprehensive actions are being taken
- Systematic assessment will be used to adjust scope and timeliness

Summary – Cause and Corrective Actions

- Root and contributing causes are understood
- Corrective actions are comprehensive
- Extent of condition and extent of cause are being addressed

Safety Assessment

Tom Lentz
Director of Engineering



Initial Safety Assessment

Initial characterization of incremental core damage and large early release probabilities (ICCDP and ICLERP)

- ICCDP (including internal events) = **2.03E-6**
- ICCDP (seismic, fire, and external flooding) = **negligible**
- ICLERP = **1.56E-7**

Safety Assessment

Basis for Initial Assessment

- Level 1 PSA model used
  - Includes all failure modes
  - Simplified assumptions due to model and computer capabilities (no time dependence between event failures)
  - No consideration given to the time dimension relative to the ESW Pump "A" coupling failure

Basis for Updated Assessment

- The 24 hour mission time was partitioned
- Only the applicable scenarios based on this event were considered
- Human Reliability Analysis (HRA) was performed

Results of Updated Safety Assessment

Updated characterization of incremental core damage and large early release probabilities (ICCDP and ICLERP)

- ICCDP (including internal events) = **8.5E-7**
- ICCDP (seismic, fire, and external flooding) = **1.2E-7**
- ICLERP = **<1.0E-7** (qualitatively)

Conclusion:

- ICCDP (including external events) = 9.7E-7
- ICLERP <1.0E-7 (qualitatively)

Low safety significance using a more detailed and accurate evaluation method

Safe Operation Will Be Ensured

- We understand the root and contributing causes
- We have examined the extent of condition
- We will take action to prevent recurrence
- We have taken a broader look at equipment failures

SAFETY ASSESSMENT:
Low safety significance