



# FENOC

*FirstEnergy Nuclear Operating Company*



Perry Nuclear Power Plant  
December 17, 2003

## Emergency Service Water (ESW) Pump Coupling Failure

EA-03-197

# 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

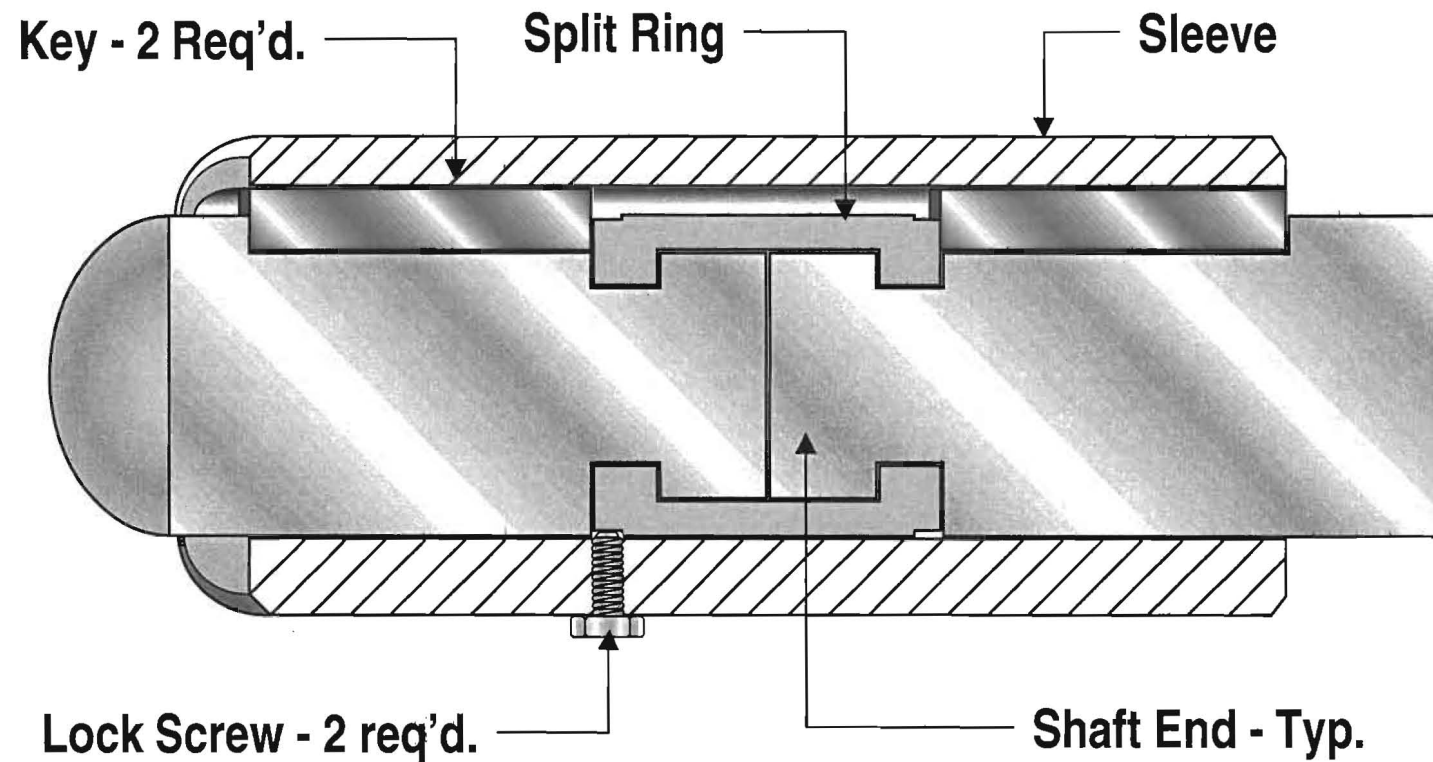
- Emergency Service Water (ESW) Pump “A” coupling failed
- Enforcement discretion requested and granted (no net increase in risk)
- Repairs completed well within the discretionary period

# ***Cause Analysis***

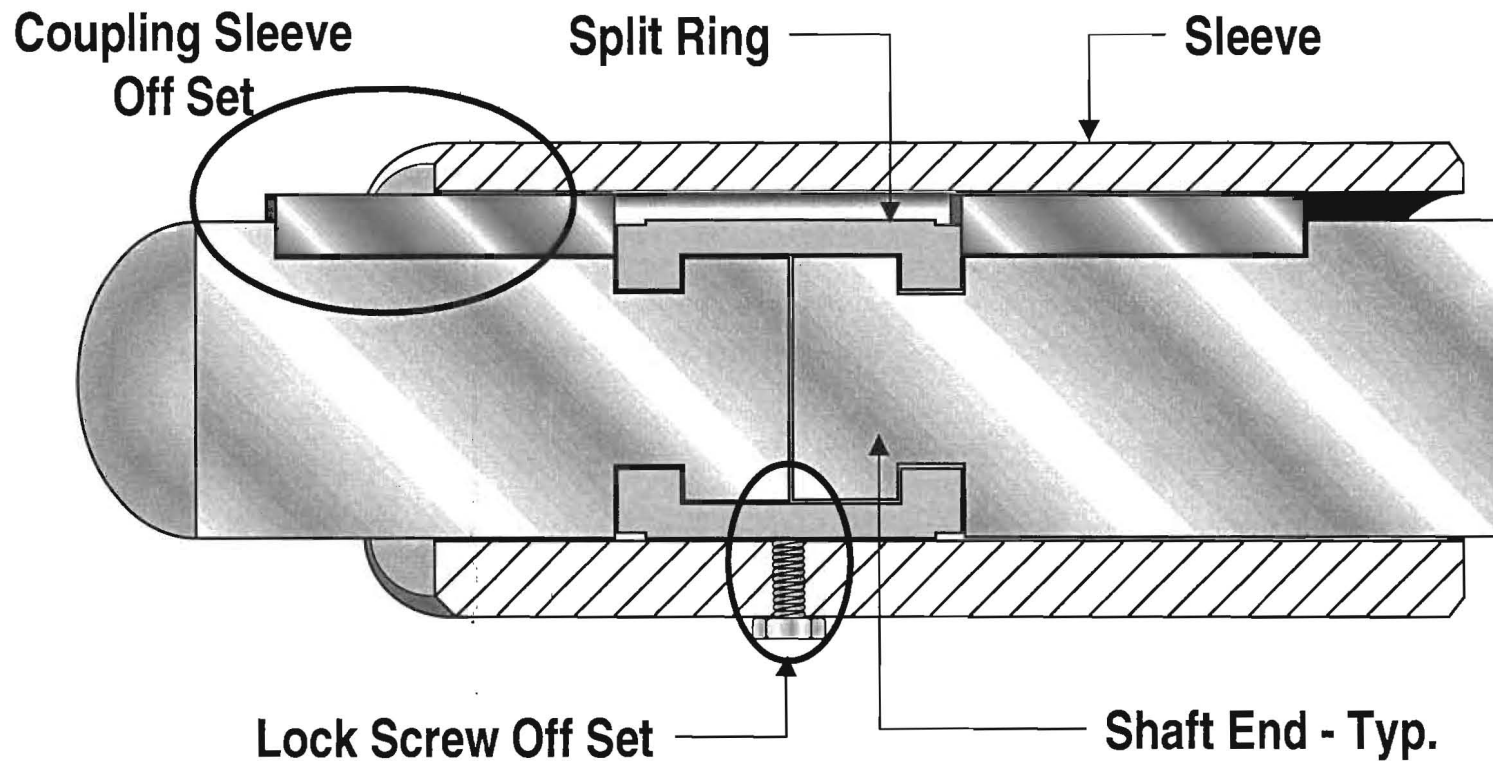
Tom Lentz  
Director of Engineering



# 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

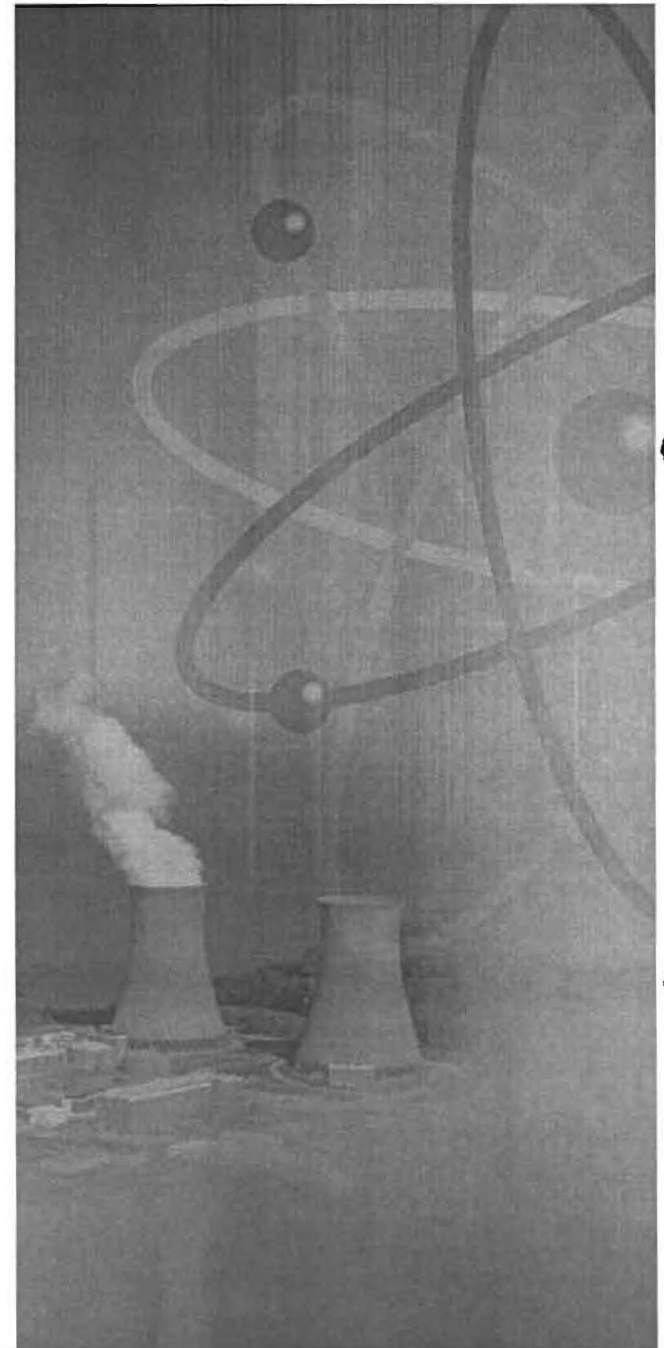
- Stress corrosion cracking is the root cause
  - Improper installation due to inadequate procedure
  - Susceptible material
  - Environment considered in design/operation
- Corrective actions address both installation and material

# 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

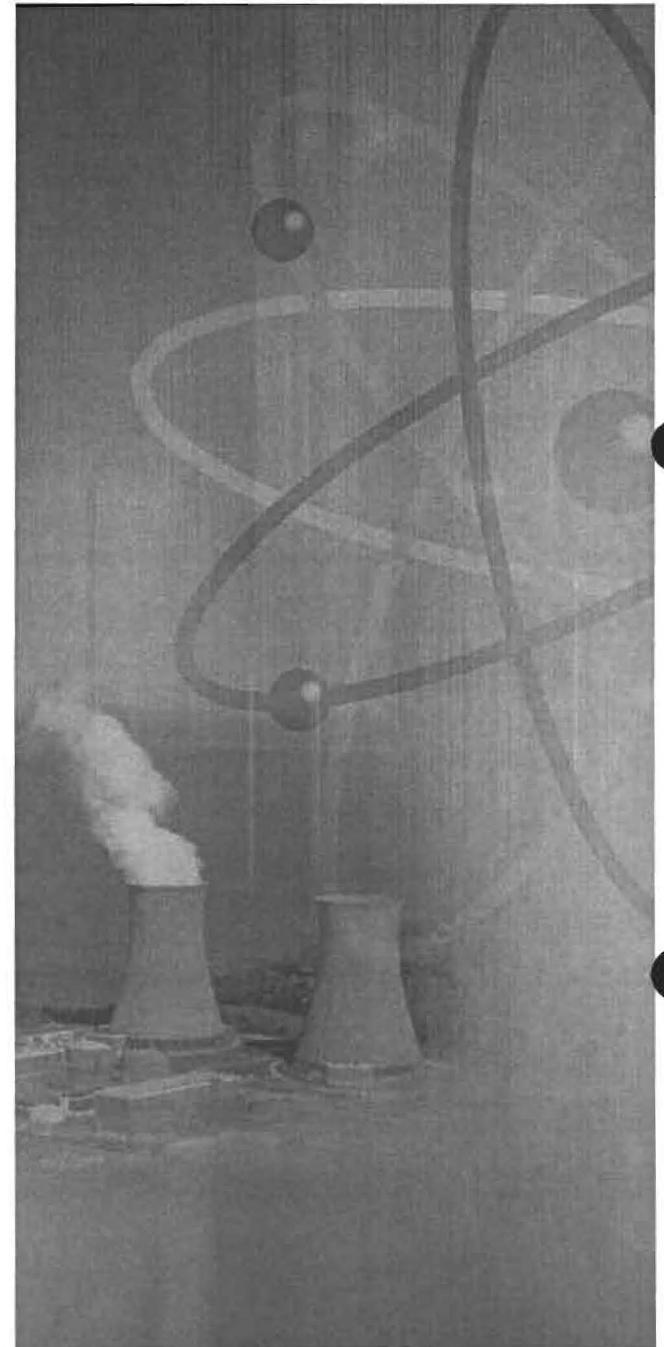
# Corrective Actions

## ***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
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## ***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
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## ***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
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## ***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***