

# Harris Nuclear Plant

## A Essential Services Chilled Water Compressor Inoperability



# Harris Team

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# Presentation Agenda

- **Problem Description**
  - ▶ Background
  - ▶ Causes
  - ▶ Actions
- **Safety Significance**
  - ▶ HNP Findings
  - ▶ SDP Phase III
- **Closing Comments**

# Background

- June 1, 2006 – The A train chiller compressor failed to start during a routine system startup
- Post event review
  - ▶ The compressor vane control shaft was not in the correct position for starting
  - ▶ The control shaft adjustment arm had slipped during chiller operation the previous week
  - ▶ The incorrect control shaft position prevented a starting interlock from being met

# Background

## ● Timeline

- ▶ 4/29/06 - Compressor was replaced
- ▶ 5/2/06 - Compressor vane control shaft was adjusted and installed on the compressor
- ▶ Compressor was started and stopped frequently during the next 3 weeks
- ▶ 5/25/06 – Control shaft slipped position while running. After shutdown, the interlock to allow a subsequent restart was not met
- ▶ 6/1/06 – Condition was discovered when the compressor failed to start

# Causes

- Root cause investigation results
  - ▶ The linkage arm slipped due to an improperly tightened cap screw
  - ▶ A vendor drawing requires this cap screw to be torqued to 75 ft-lbs
  - ▶ Proper torque was not applied to the screw
  - ▶ The procedure did not contain instructions to torque the cap screw (root cause)

# Corrective Actions

- Completed corrective actions
  - ▶ The linkage arm was adjusted and the cap screw was torqued to the required 75 ft-lbs
  - ▶ Revised the maintenance procedure for linkage adjustment
  - ▶ Revised the operations procedure to check vane positioning interlock upon unit shutdown

# Corrective Actions

- Completed corrective action
  - ▶ Maintenance personnel have been reminded of the need to identify torque values for fasteners on moving components
- Planned actions
  - ▶ Provide additional training
  - ▶ Continued focus on human performance



# Reliability Focus

- A modification is in progress to relocate the surge tanks
- Maintenance procedure upgrade is in progress

# Safety Significance

- NRC Inspection Report 2006003
  - ▶ Apparent violation (AV) for inadequate maintenance procedure
  - ▶ Not immediate safety concern due to the fully redundant B train ESCW system
  - ▶ Potentially greater than very low significance due to the length of time out of service

# Safety Significance

- NRC Inspection Report, “Choice Letter”
  - ▶ Preliminary White finding
    - ◆ Condition existed for approximately 8 days (primary contributor to risk increase)
    - ◆ Preliminary risk increase (Incremental Core Damage Probability) = 3.9 E-6
  - ▶ The risk assessment did not credit charging pump (CSIP) operation using the alternate cooling fan

# HNP Findings

- CSIP room heat up validation
  - ▶ Operated the A CSIP without the A chiller to validate the temperature response
  - ▶ Placed alternate cooling fan in service
  - ▶ Benchmarked the industry standard computer model with actual field data taken from the CSIP room
  - ▶ Adjusted model for accident assumptions

# HNP Findings

- Model correlation

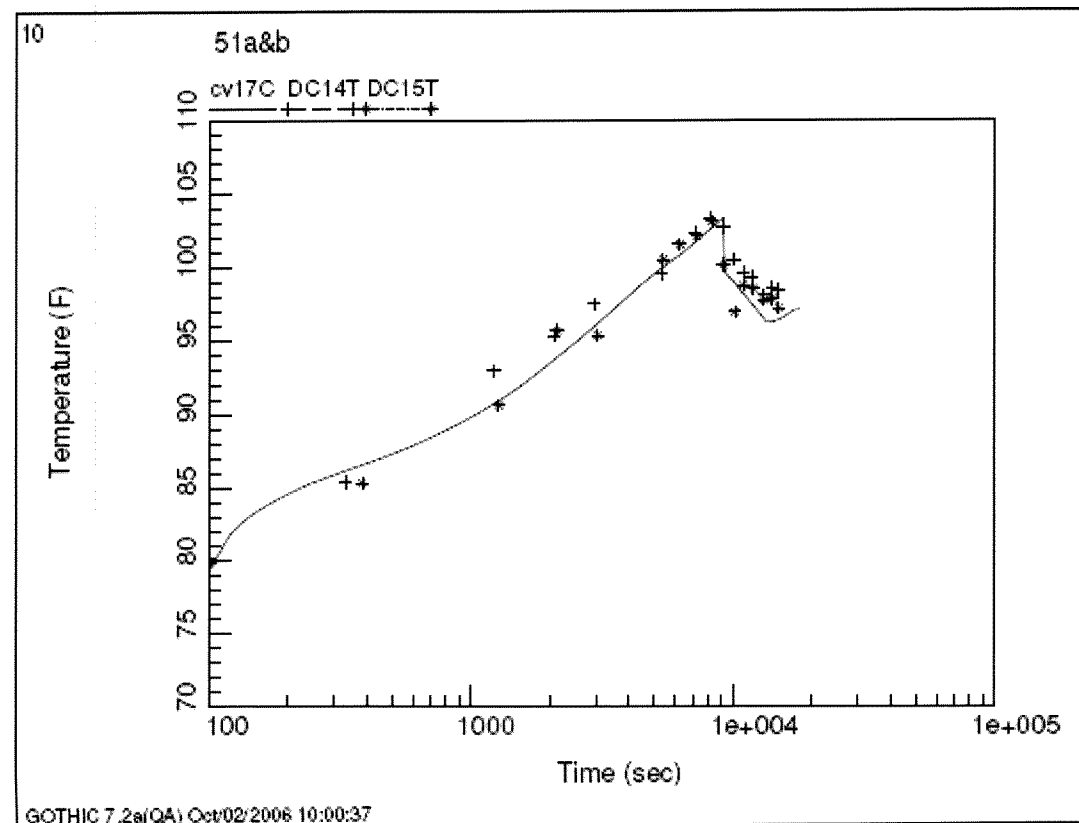


Figure 3: Location 51 (W. motor endbell) test and model temperatures

# HNP Findings

- CSIP motor temperature response
  - ▶ Limiting component is motor bearing
  - ▶ Reduced oil viscosity slows bearing temperature increase as room heats up
  - ▶ A CSIP specific bearing data was used
  - ▶ Motor bearing will remain below maximum temperature limit for 24 hours

# HNP Findings

- CSIP room temperature control
  - ▶ Placing the alternate fan in the open doorway is a simple operator action
  - ▶ The use of the alternate fan has been in procedures since February 2005 and is implemented during chiller maintenance
  - ▶ The alternate fan is permanently staged in the RAB near the CSIP rooms
  - ▶ The model supports fan effectiveness

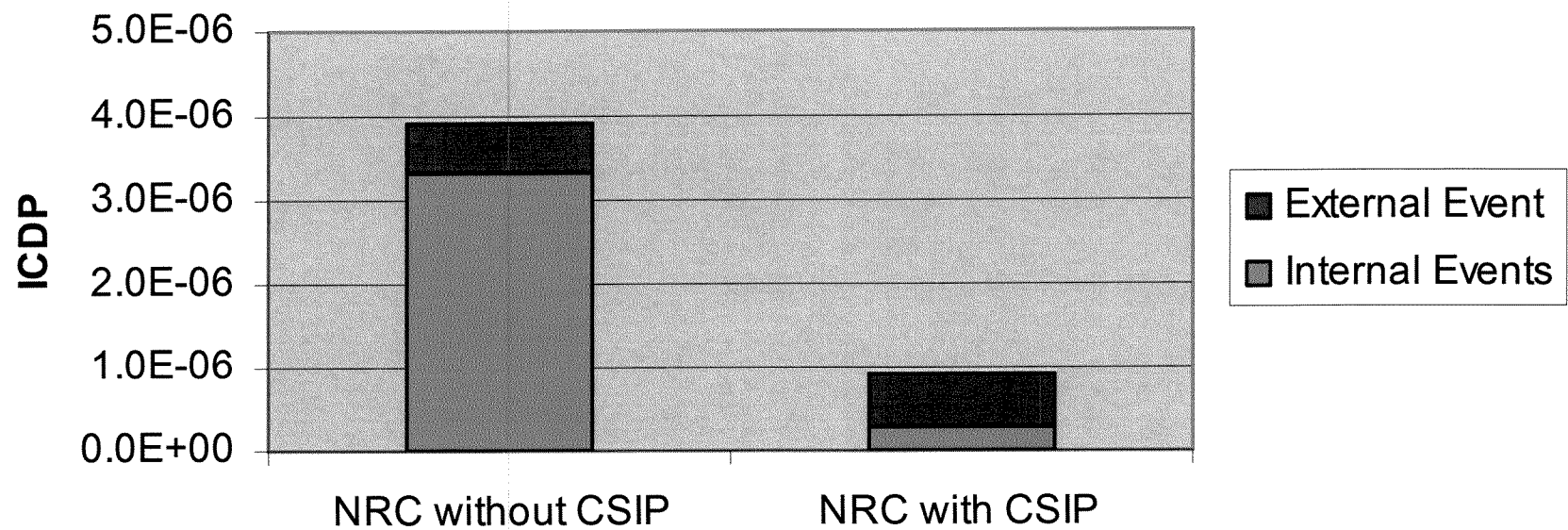
# SDP Phase III

- NRC risk assessment preliminary risk assessment
  - Risk increase is White with no credit given for the CSIP
  - NRC Risk increase is Green with credit for CSIP alone with no other considerations



# SDP Phase III

## NRC ICDP Results for HNP Chiller



# SDP Phase III

- Additional PSA inputs that show risk reduction (not included in NRC analysis)
  - ▶ Plant specific fire ignition frequency
  - ▶ Loss of emergency bus frequency
  - ▶ “Protected train” assumption

# SDP Phase III

## HNP Chiller Comparison of ICDP Results

