

Vogtle Unit 2

RHR Bypass Line Leaks

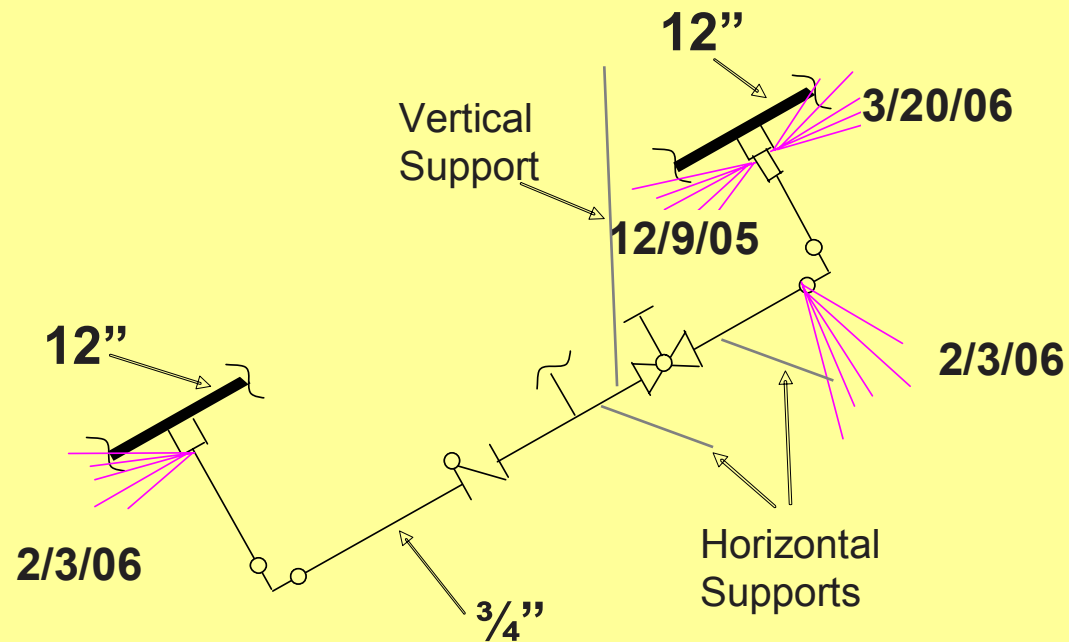
Root Cause Investigation

May 2006

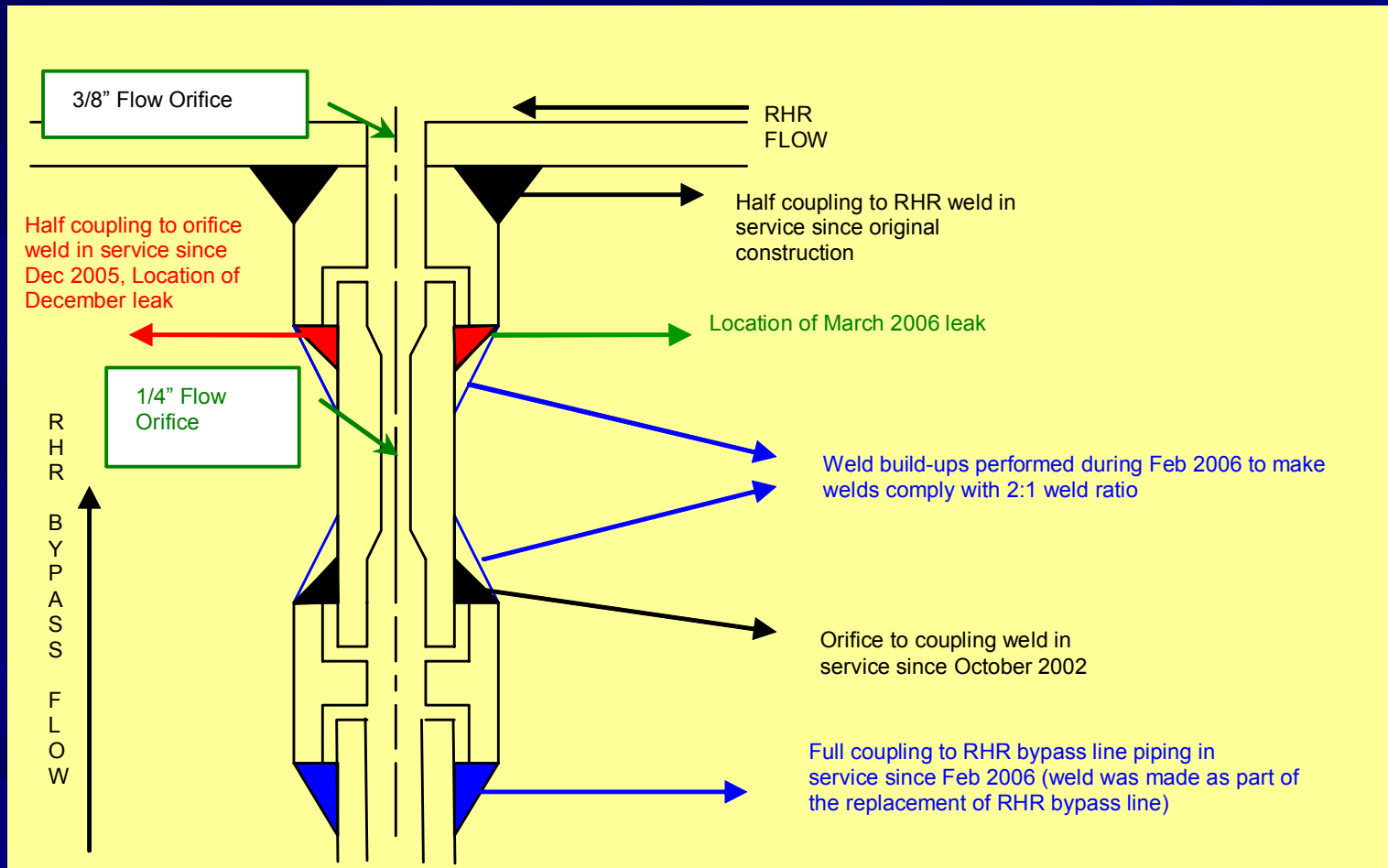
# Root Cause Investigation Team

Vice President–SNC Corporate Engineering–Event Team Leader  
Project Manager–SNC Corporate Engr–Root Cause Team Leader  
Engineer–SNC Corporate Materials and Inspection Services  
Engineering Supv–SNC Farley Engineering Support  
Training Supv–SNC Vogtle Training  
Shift Support Supv–SNC Vogtle Operations  
Engineering Supv–SNC Vogtle Engineering Support  
Engineer–SNC Vogtle Performance Analysis  
Principal Engineer–SCG Maintenance Planning- Vibration Instrumentation  
Engineer–SCG Maintenance Planning- Vibration Instrumentation  
Principal Engineer–Westinghouse Systems  
Principal Engineer–Westinghouse Pipe Stress  
Senior Associate–Structural Integrity Associates  
Associate–Structural Integrity Associates  
Engineer-Bechtel–Water/Steam Hammer & Fluid Flow Expert  
Project Engineer–Bechtel–Pipe Design and Support  
Engineer-Bechtel–Pipe Design and Support

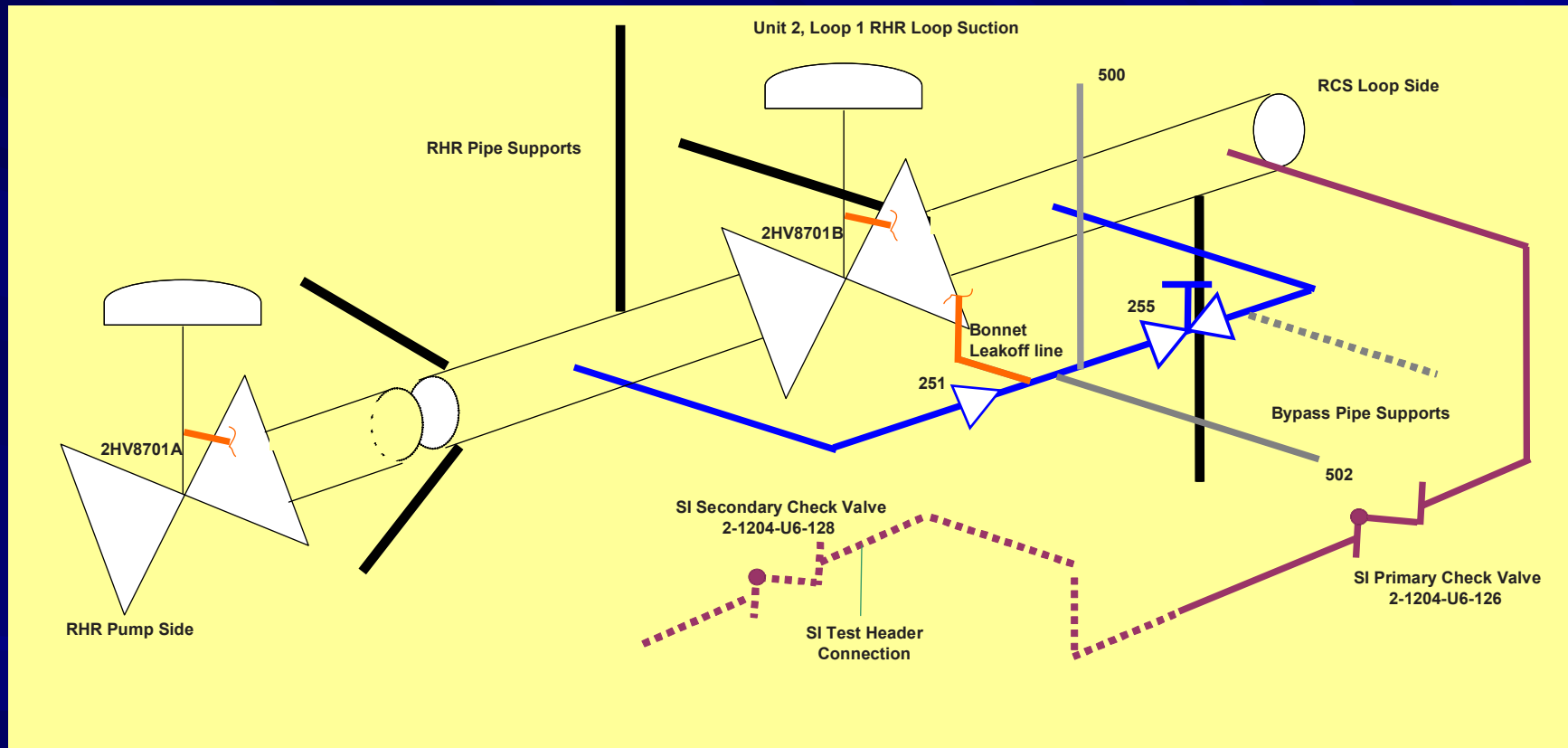
# RHR Bypass Line Leak Locations



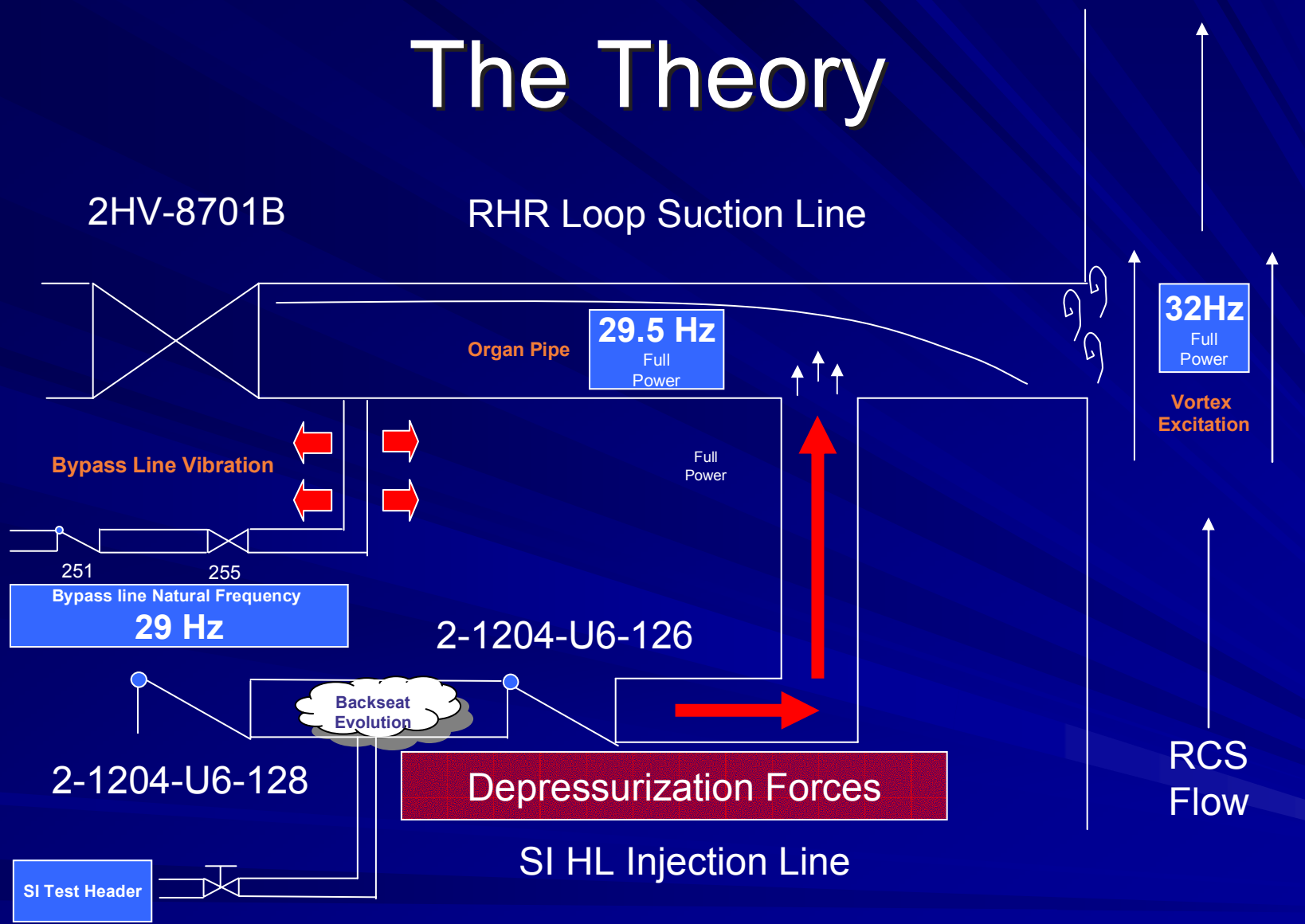
# Weld Repair History for 2HV-8701B flow-restrictor



# Loop 1 RHR Schematic



# The Theory



When frequencies align, resonance occurs.

## 7 Factors causing RHR bypass line cracks (based on measurements and observations in Feb 2006)

1. RCS Vortex Shedding Frequency across RHR nozzle at RCS
- +
2. Acoustic Frequency of Loop 1 RHR piping
- +
3. Structural Frequency of RHR Bypass Line
- +
4. No Axial Support of Bypass line => Relatively flexible bypass line amplifies RHR piping movement
- +
5. Leaking Safety Injection Primary Check Valve
- +
6. Leaking AOV's in SI Test Header Line (accumulators filling up)
- +
7. SI Check Valve Reseat Procedure = Creates Impulse at Bypass line and  $\frac{3}{4}$ " Check Valve, resulting in valve chatter and higher vibration

The factors contributing to the root causes of the cracks can be condensed into two primary causes.

1. The bypass line was flexible and not axially restrained, and
2. High vibration at power due to resonance at about 30 Hz, and  $\frac{3}{4}$ " check valve chatter



# Other Bypass Lines

What's different on the other RHR bypass lines that they haven't cracked?

- Loop 4 of each Unit is not near a resonance condition
- SI hot leg check valve reseal not performed on Unit 1

# Ongoing Actions

- Monitoring
- Investigating
- Benchmarking
- Broadness