Bottom Mounted Instrument Guide Tube Condition

STP Participants

Tom Jordan	VP, Engineering & Tech Services
Mark McBurnett	Manager, Quality & Licensing
Steve Thomas	Manager, Plant Design
Michael Lashley	Test Engineering Supervisor
Bill Humble	NSSS Supervisor
Ron Baker	Materials Specialist
Wayne Harrison	Licensing Engineer
Joe Loya	Design Engineer
Ulhas Patil	Design Engineer

INTRODUCTORY REMARKS

Mark McBurnett

Manager, Quality & Licensing

Agenda

Introductory Remarks	Mark McBurnett
Desired Outcomes and Background	Tom Jordan
Discovery and Initial Investigation	Steve Thomas
Cause Investigation Process	Steve Thomas
NDE Action Plan	Michael Lashley
Repair Options	Steve Thomas
Schedule and Milestones	Mark McBurnett
Concluding Remarks	Mark McBurnett

DESIRED MEETING OUTCOMES and BACKGROUND

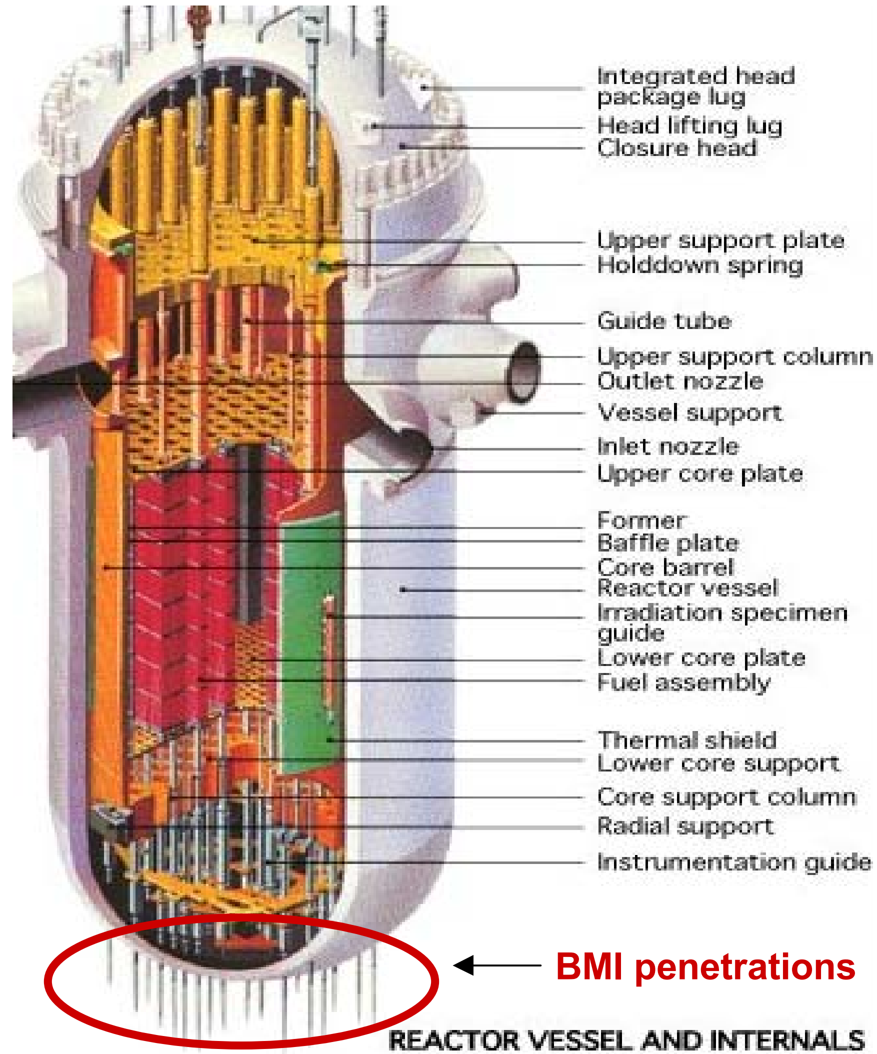
Tom Jordan
Vice President,
Engineering & Technical Services

Desired Meeting Outcomes

- NRC fully informed about condition and current status
- NRC understands current plans for NDE
- NRC understands current repair options
- NRC understands the cause investigation process
- Key stakeholders identified
- STP clearly understands NRC questions and has an action to provide responses

Opening Remarks

April 12 - residue found on two of the 58 Bottom Mounted Instrumentation (BMI) penetrations.



What we saw:

A small amount of residue had accumulated approximately 90 degrees around the guide tubes at vessel Penetrations #1 and #46.

The BMI guide tubes measure ~1.5 inches outside diameter.

The quantity of residue found on Penetration #1 is equivalent to about half of an aspirin (approximately 150 mg).

Penetration #46 had about 3 milligrams of residue.

Evaluation results

Our initial sample results revealed boron in the samples. We reported to the NRC that we had potential reactor coolant leakage from these two penetrations.

Eliminating other possibilities

Other sources such as leakage from the refueling cavity and the possibility of other materials containing boron (paint, etc.) were considered. After exhaustive chemical analysis, it was determined that the source of the residue was reactor coolant.

Our inspection process works

We inspect the exterior of our vessel each time we shutdown for a refueling outage. Previous inspections did not reveal indications of seepage.

Prompt, Comprehensive Response

- We are currently employing a team of experts to assist in the evaluation and development of corrective actions.

- The unit will not be restarted until the root cause is determined and the condition has been repaired.

- Unit 2 has been inspected in the last six months with no noted anomalies.

Cooperative approach

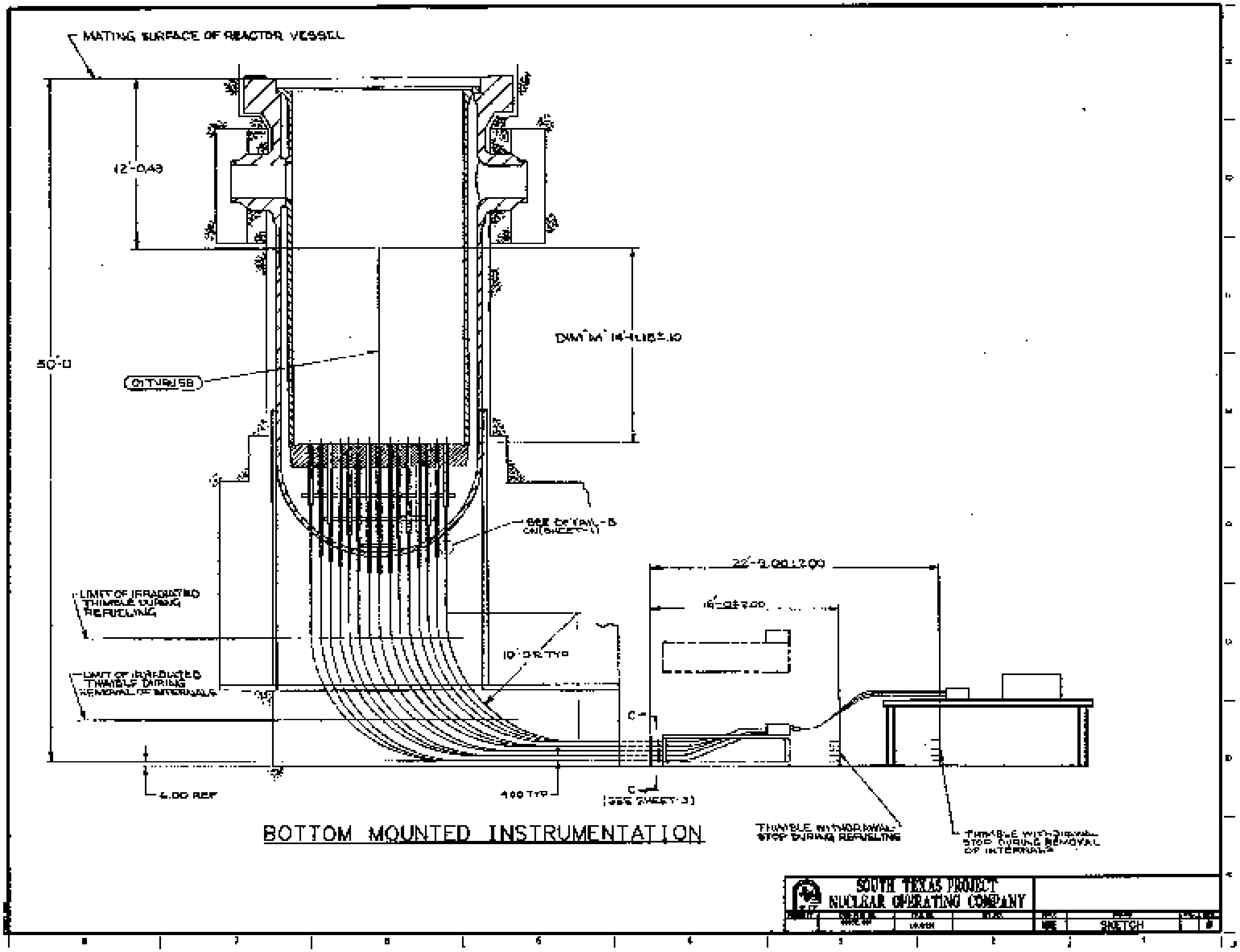
We will continue to work closely with the NRC, other stations' experts, specialty contractors, and industry agencies to complete our inspections, analyses, and repair development. We are confident that this cooperative effort will result in effective resolution of this issue and the resultant safe restart of Unit 1.

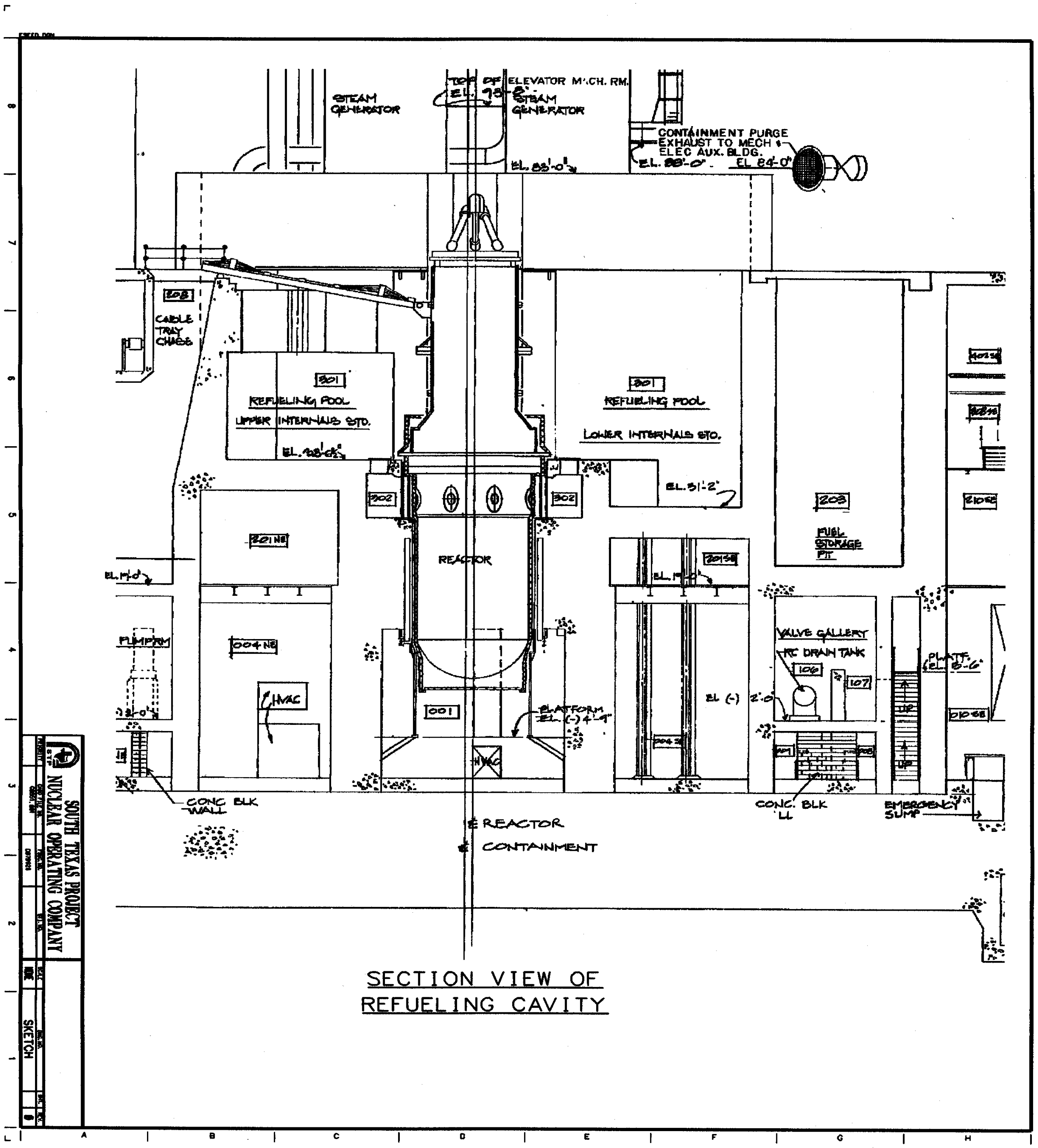
DISCOVERY and INITIAL INVESTIGATION

Steve Thomas

Manager, Plant Design

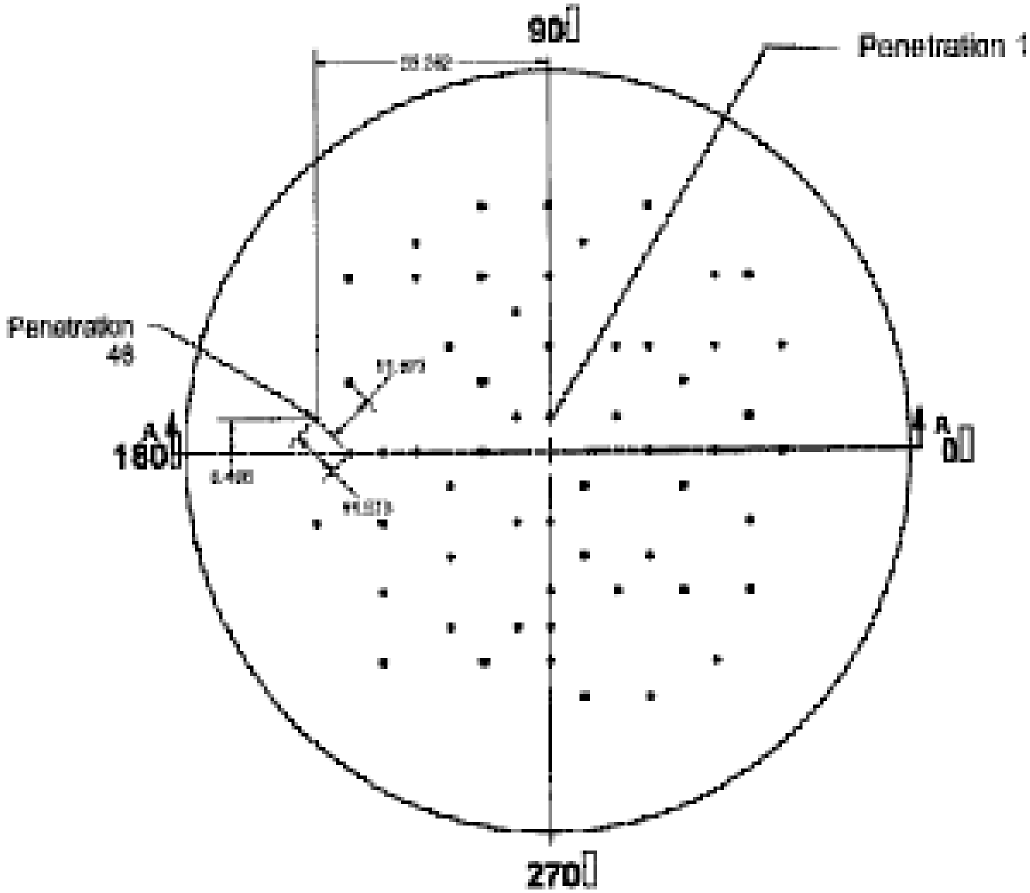
~ 12” Between Insulation and Head


MATING SURFACE OF REACTOR VESSEL
12'-0.43
50'-0
DIM "M" 14'-1.18±.10
SEE DETAIL-B
22'-9.00±2.00
16'-0±2.00
10'-3.5 TYP
6.00 REF
4.00 TYP
BOTTOM MOUNTED INSTRUMENTATION
SOUTH TEXAS PROJECT
NUCLEAR OPERATING COMPANY
SKETCH

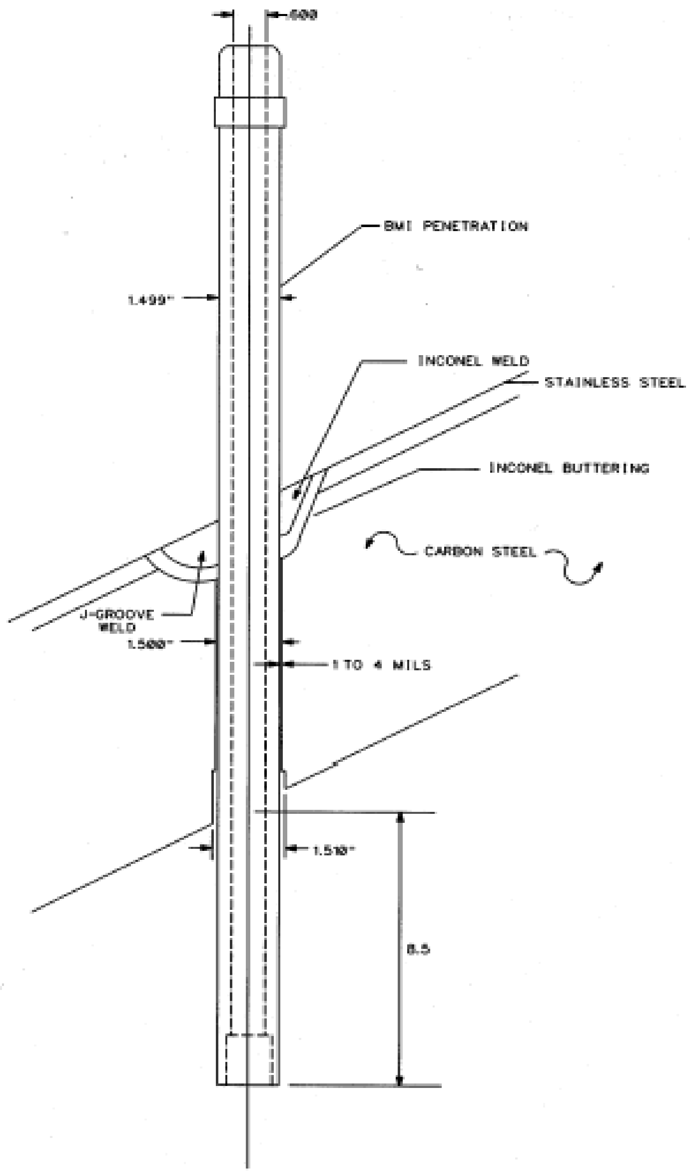


SECTION VIEW OF
REFUELING CAVITY

Penetration Locations



BMI Guide Tube



Guide Tube

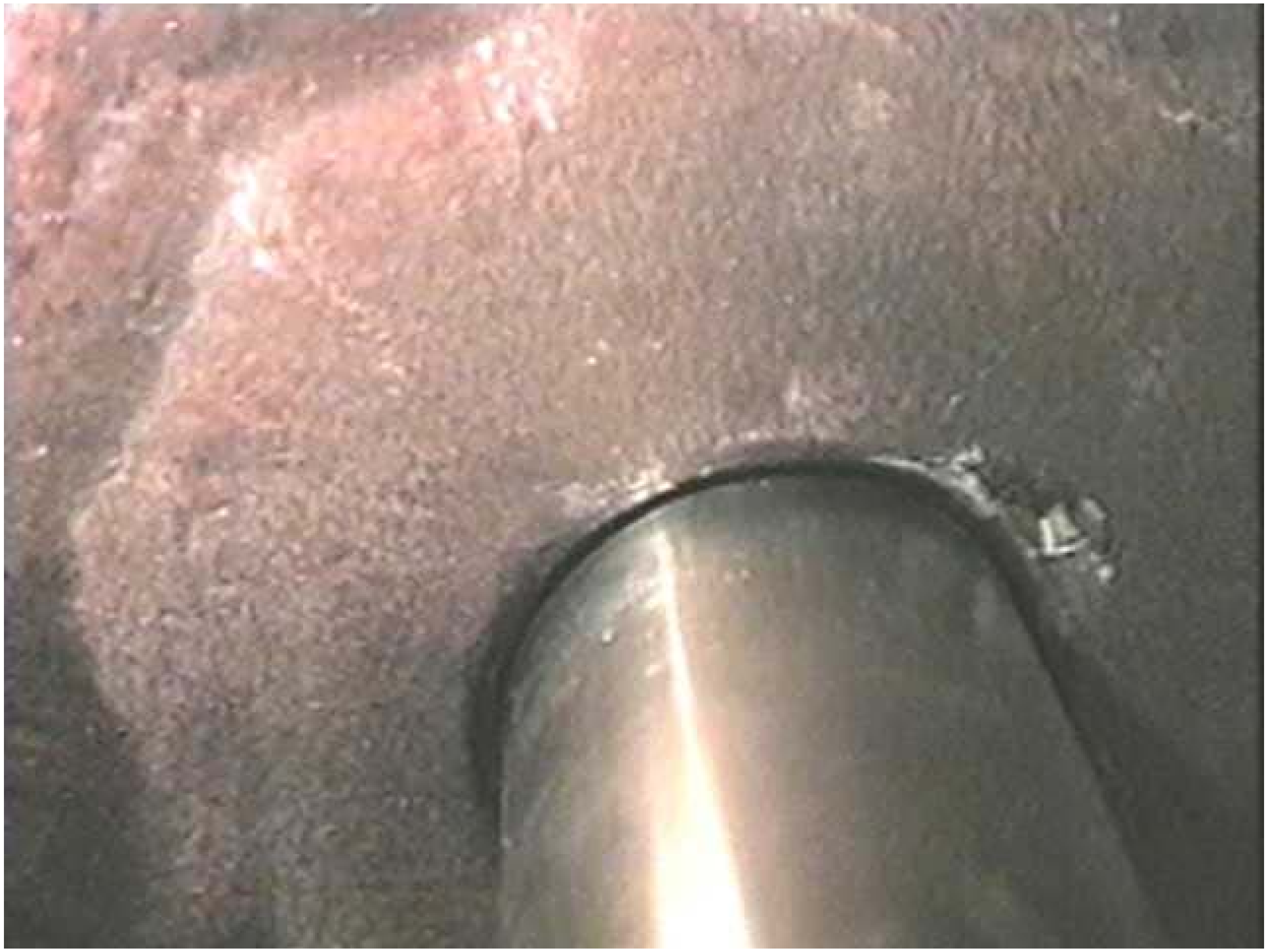
Planned Inspection

- Normal planned inspection
- Inspection is proceduralized
- Inspection specifically looks for this condition
- We have been inspecting regularly since initial plant startup

Penetration #1

Penetration #46

Penetration #1 After Cleaning



Initial Investigation

- All 58 guide tubes examined; no additional residue found
- Experts from four nuclear plants brought to STP
- EPRI experts contacted
- Samples tested at two independent offsite labs as well as onsite lab

Sample Analysis

The samples contained lithium and boron.

The samples did not contain any iron.

Age of Deposits

- Co-58 not present, therefore > 1 year

- Ratio of Cs-134 to Cs-137 indicates
  ~ 4 years

CAUSE INVESTIGATION PROCESS

Steve Thomas

Manager, Plant Design

Cause Investigation Process

- Possible causes
  - Fabrication defect
    - » Lack of fusion
    - » Weld hot crack
  - Fatigue
    - » Mechanical
    - » Thermal
  - Stress corrosion cracking
- Investigation team adapted EPRI Materials Reliability Program FMEA model

Cause Investigation Process (cont'd)

- Failure scenario construction
- Root cause determination
- Identify generic implications for STP
- Identify corrective actions
  - Analysis
  - Repair
  - Monitoring

Cause Investigation Process (cont’d)

- Implementation
- Effectiveness Review

NDE ACTION PLAN

Michael Lashley

Test Engineering Supervisor

Action Plan

- Determine NDE priorities
  - Penetrations 1 & 46
    - » Determine throughwall leak path
    - » Find structurally significant flaws
    - » Find other flaws
    - » Assess wastage
  - Other penetrations
    - » Find structurally significant flaws
    - » Find other flaws
- Evaluate operating experience
  - Work by MRP on CRDM head penetrations
  - Worldwide experience

Action Plan (cont'd)

- Determine NDE capabilities
  - Identified three experienced vendors
  - Selected two vendors to demonstrate NDE capabilities
- Determine scope of inspections
  - Guide tubes/penetrations
  - Volumetric exam of tube
  - Visual exam of J-groove weld

Action Plan (cont'd)

- Develop the STP NDE approach
  - Select approach that satisfies NDE priorities
  - Select approach that is acceptable to the NRC
- Model EPRI MRP approach for CRDM inspections

EPRI MRP Approach for CRDM Inspections

- Define NDE objectives
  - Identify relevant flaw mechanisms
  - Define inspection locations and volumes
  - Define range of flaws to address
- Mockup design and procurement
- Demonstration protocol and schedule
  - Blind / non-blind
  - Detection / sizing / location
  - False calls

NDE Objectives

- Relevant flaw mechanisms
  - PWSCC, fatigue, fabrication defects, etc.
- Inspection locations and volumes
  - ID/OD of tube
  - Tube to weld interface
  - Weld surface
- Range of flaws
  - 10%- 100%TW
  - 0.25” - 0.50” length
  - Axial / circumferential

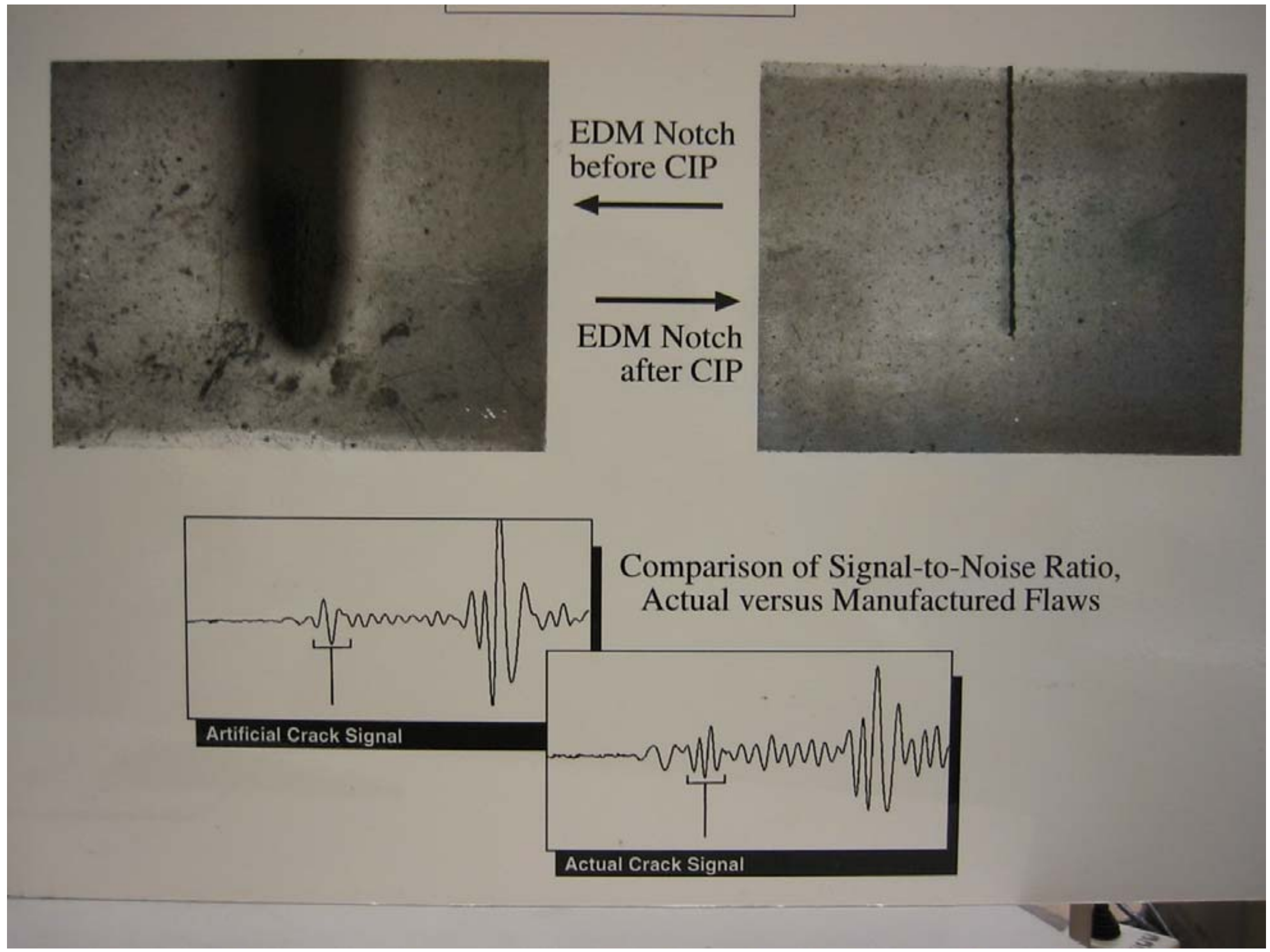
Mockup Design and Procurement

- Full scale mockup
  - Simulate outer periphery location
  - Guide tube machined from Alloy 600 to match design
  - Curved vessel dropout with machined penetration / J-groove
- Demonstration standards
  - Simulate the inspection volume
  - Contain range of ID/OD flaws

Mockup Design

CIP-Cold Isostatic Processing

- **Compresses the notch to produce crack-like defect**
- **Accurately controlled size, location, orientation**
- **Qualified to produce realistic ET and UT simulations**
- **Used in all MRP VHP NDE demonstrations**



Demonstration Protocol

- Scope
  - Detection and sizing of axial and circumferential flaws in the tube
    - » Isolated flaws
    - » Axial and circumferential flaws in conjunction
    - » ID and OD flaws
  - Discrimination of flaws from sources of false calls
  - Flaw locations relative to component geometry

Demonstration Protocol (cont'd)

- Process - follows MRP process for VHP demos
  - Phase 1 (open/non-blind)
    - » Allow refinement of procedures under realistic, controlled conditions
    - » Allow analysis of results to determine and improve capabilities of individual techniques within the procedure
      - Detection, sizing, location
  - Phase 2 (monitored/blind)
    - » Demonstrates capability
      - Detection, sizing, location

Demonstration Protocol (cont'd)

- Reporting
  - Performance of inspection organizations will be documented to record the following parameters:
    - » Procedure identification, including essential variables
    - » Detection performance
    - » False call performance
    - » Sizing performance
    - » Flaw location performance

Demonstration Schedule

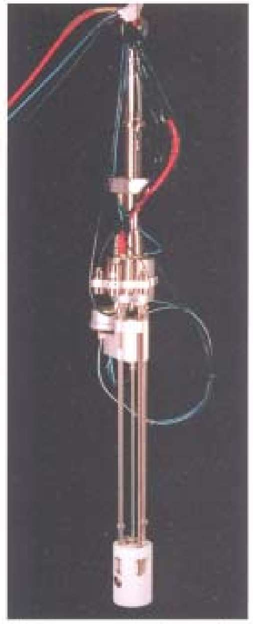
- Schedule
  - Procure/fabricate mockups
    - » Standards - in progress 5/1
    - » Mockup - in progress 5/9
  - Phase 1 (open/non-blind)
    - » Vendor A 5/2 - 5/5
    - » Vendor B 5/2 - 5/5
  - Phase 2 (monitored/blind)
    - » Vendor A (US home office) 5/6 - 5/7
    - » Vendor B (US home office) 5/8 - 5/9

Inspections

- Penetration 1 & 46
  - UT and/or ET from guide tube ID
  - Enhance visual exam of J-groove weld surface
  - Volumetrically interrogate vessel base metal for wastage
- Remaining penetrations
  - UT and/or ET from the guide tube ID
  - Enhance visual exam of J-groove weld surface

Inspection Equipment

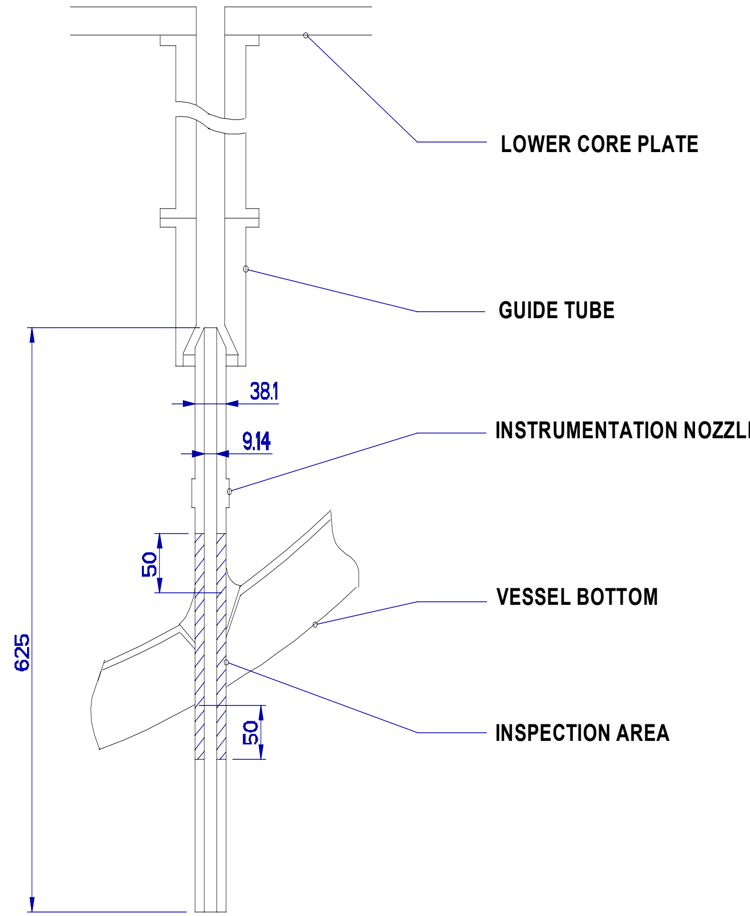
The scanning manipulator is positioned on the nozzle with a ridgid pole system.



Bottom nozzle inspection manipulator

The manipulator positioned on a nozzle.

ET / UT probe for defect detection (left)
UT pulse echo probe for socket weld inspection
UT TOFD probe for defect sizing (right)



Ultrasonic and Eddy Current Probes

Inspection Tool and Operating Station

Inspection Tool

REPAIR OPTIONS

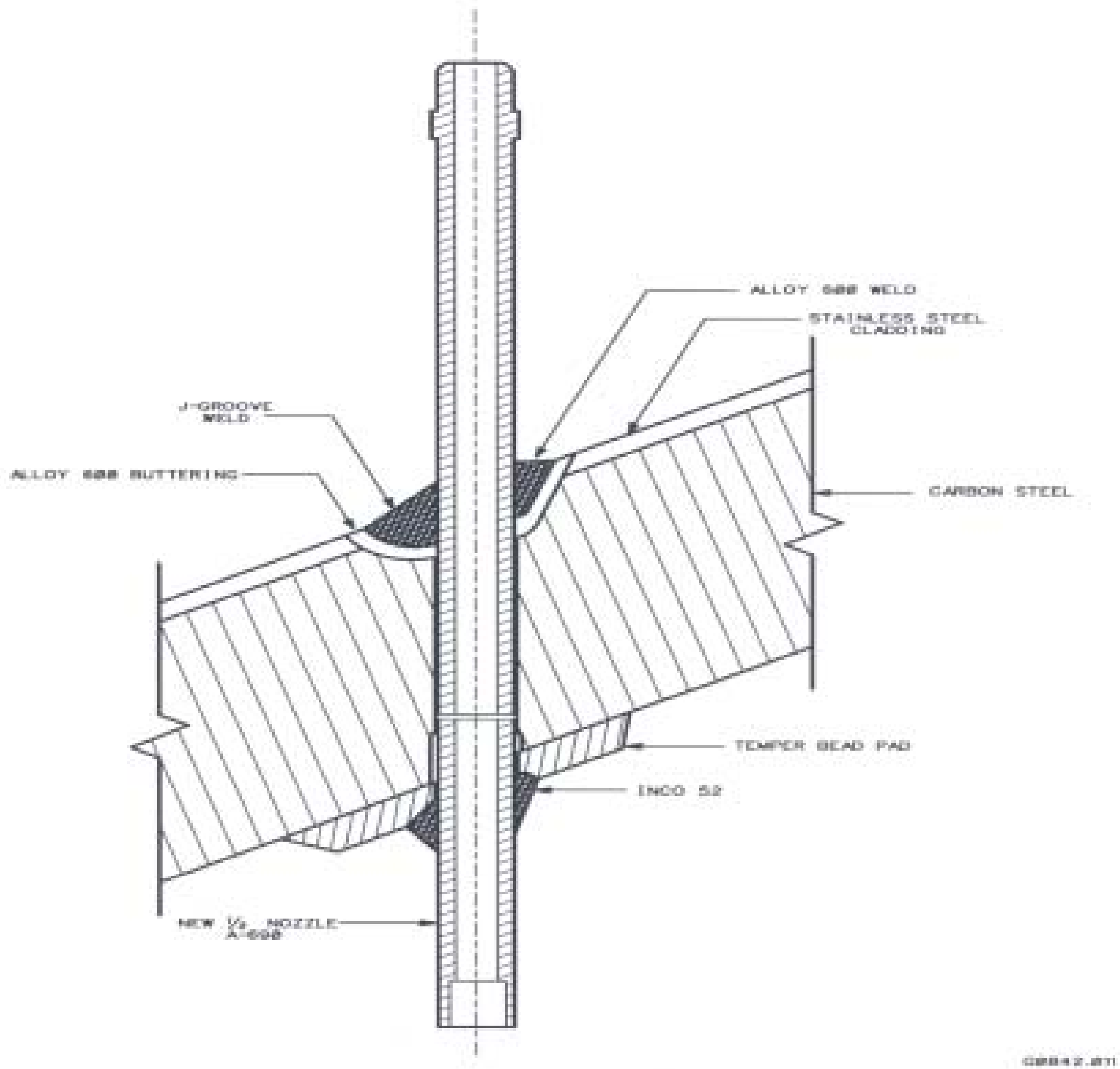
Steve Thomas

Manager, Plant Design

Repair Options

- Half-nozzle
- Mechanical Nozzle Seal Assembly (MNSA)
- Encapsulation / Capped

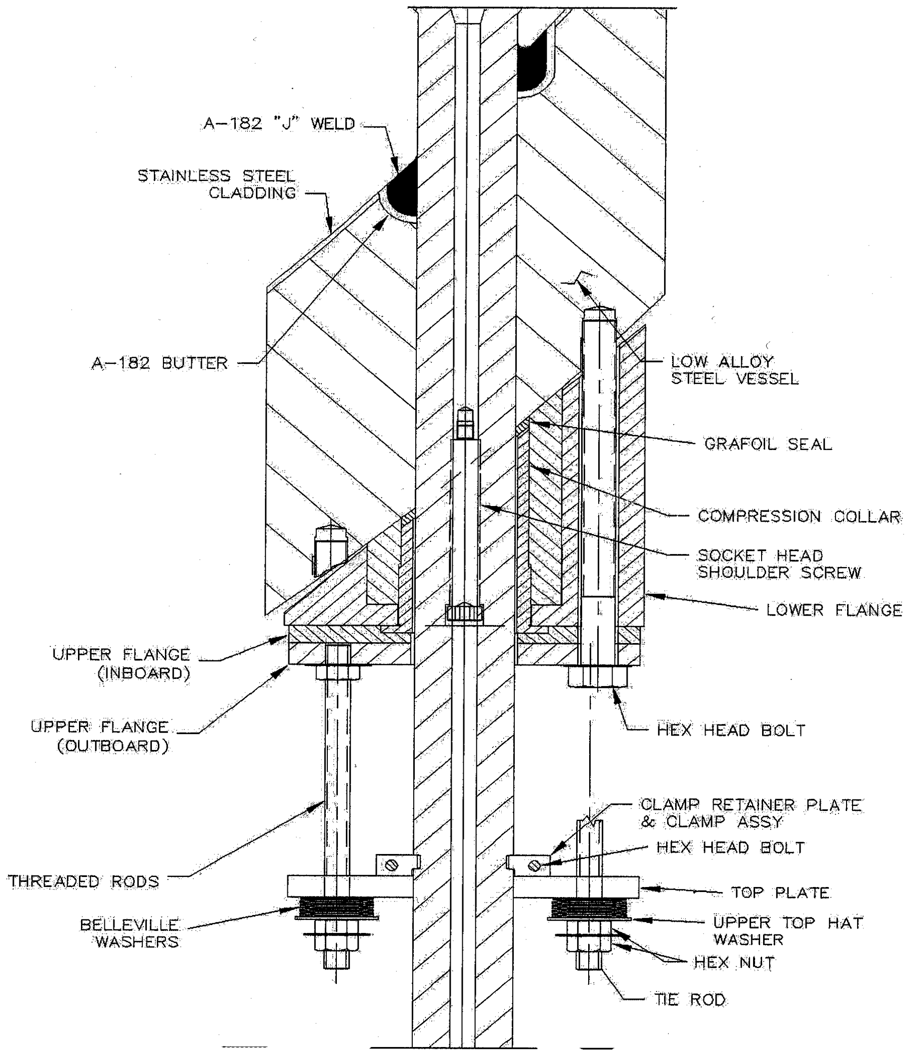
Half-Nozzle Repair Method



Half-Nozzle

- New Alloy 690T nozzle
- Alloy 600 material no longer pressure boundary
- Temperbead pad
- Core offloaded with lower internals removed
- Thimble removed for repair
- Remote machining

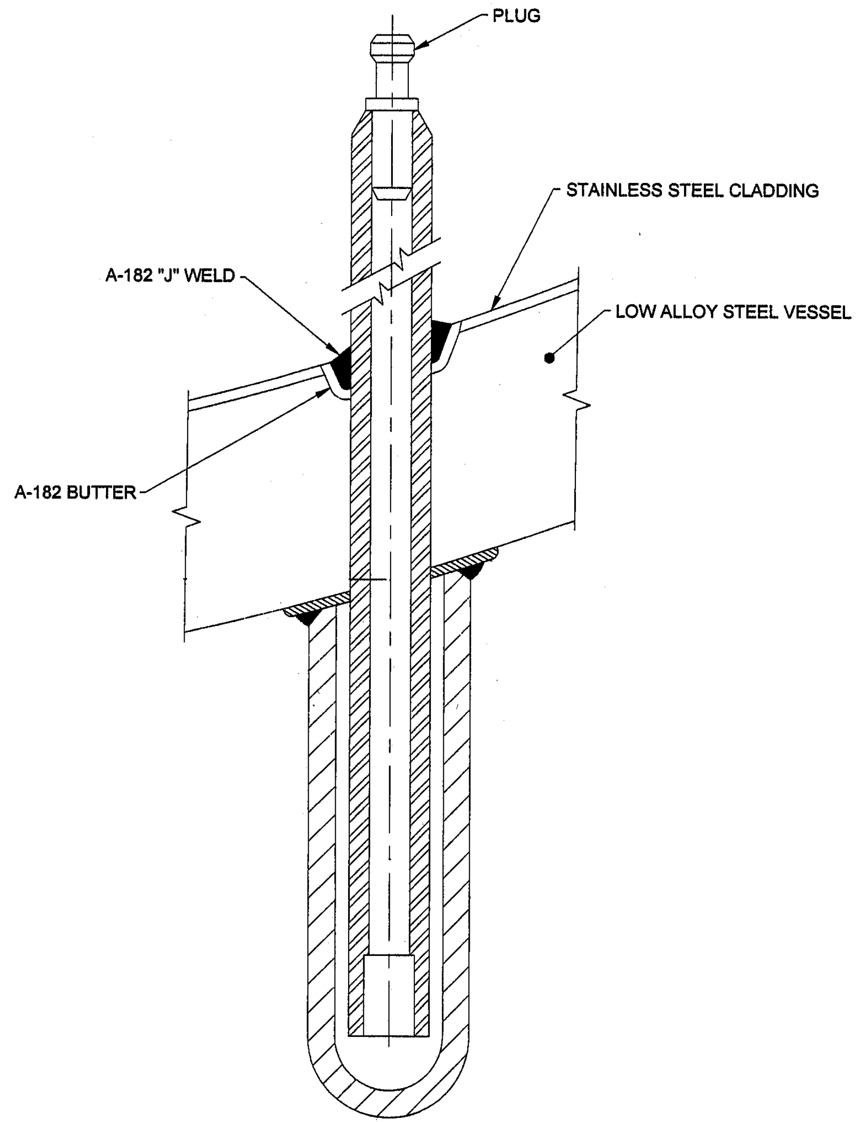
MNSA Repair Method



MNSA

- No core impact
- Machine groove in Alloy 600 tube
- Restrains existing J-groove weld
- Drill/tap pressure vessel
- High “hillside” angle difficult to seal and induces bending moments

Encapsulation / Capped Repair Method



Encapsulation / Capped

- Thimble removal required
- Limited scope repair
- Nozzle function lost
- Requires Temperbead pad and weld

Regulatory Review

- Use 10CFR50.59 to determine if license amendment required
- Relief request
- Code cases
  - N-638, ambient Temperbead
  - N-2142-1, nickel base weld metals

SCHEDULE and MILESTONES

Mark McBurnett
Manager, Quality & Licensing

Outage Milestones

- Reactor disassembled; core offloaded - mid-May
- Complete NDE and analysis - late May
- Design approval; relief request submittal - early June
- Commence repairs - mid-June
- Final breaker closure - late Summer

Future Plans and Action Items

- Meetings with NRC - next one proposed for week of May 26
- Weekly conference calls with NRC
- NRC inspections

CONCLUDING REMARKS

Mark McBurnett

Manager, Quality & Licensing