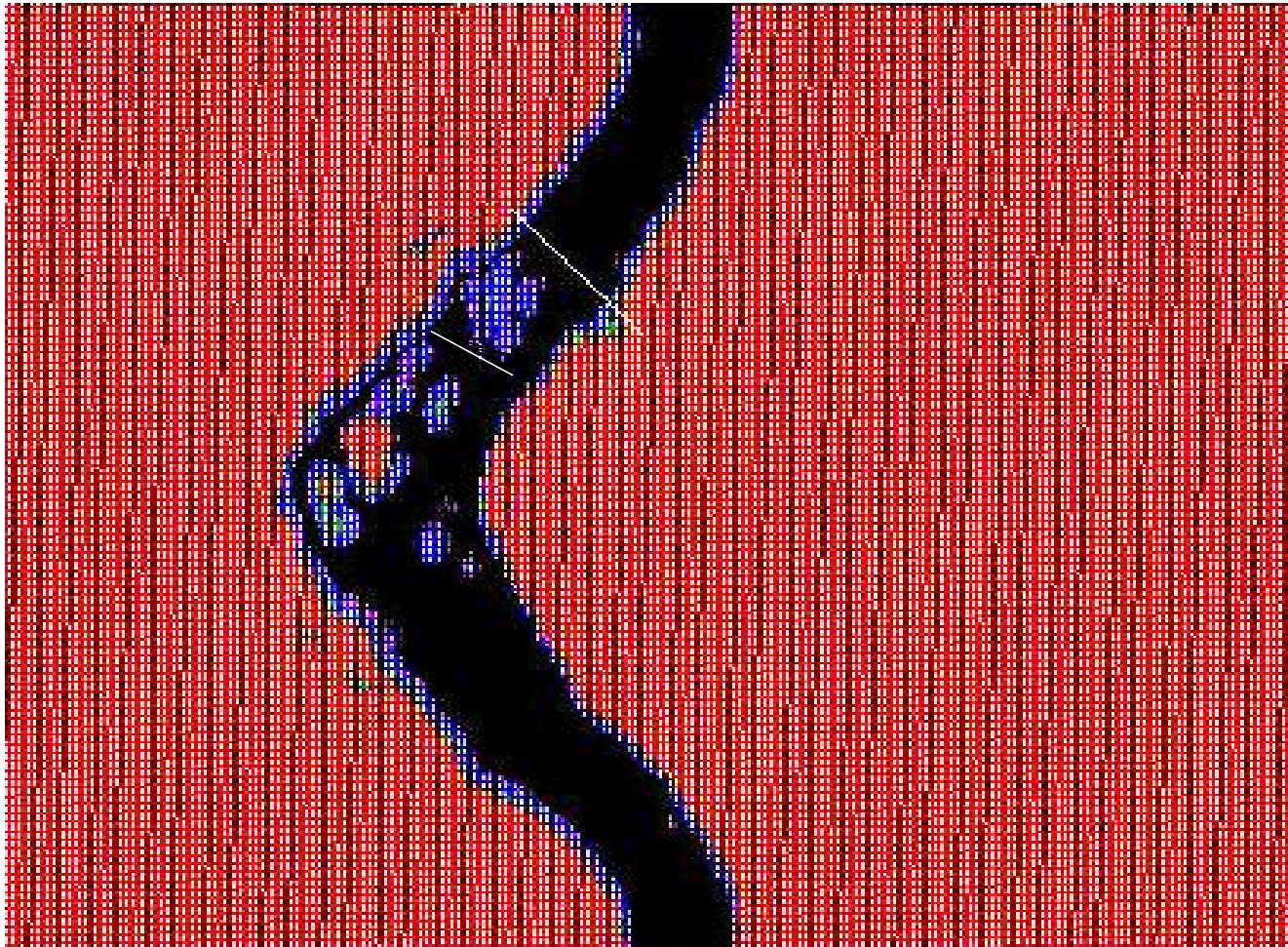


Conclusion

Coldworking is not a significant contributing factor

Axial Scan of Penetration 46 with Flaws Overlayed



8.11

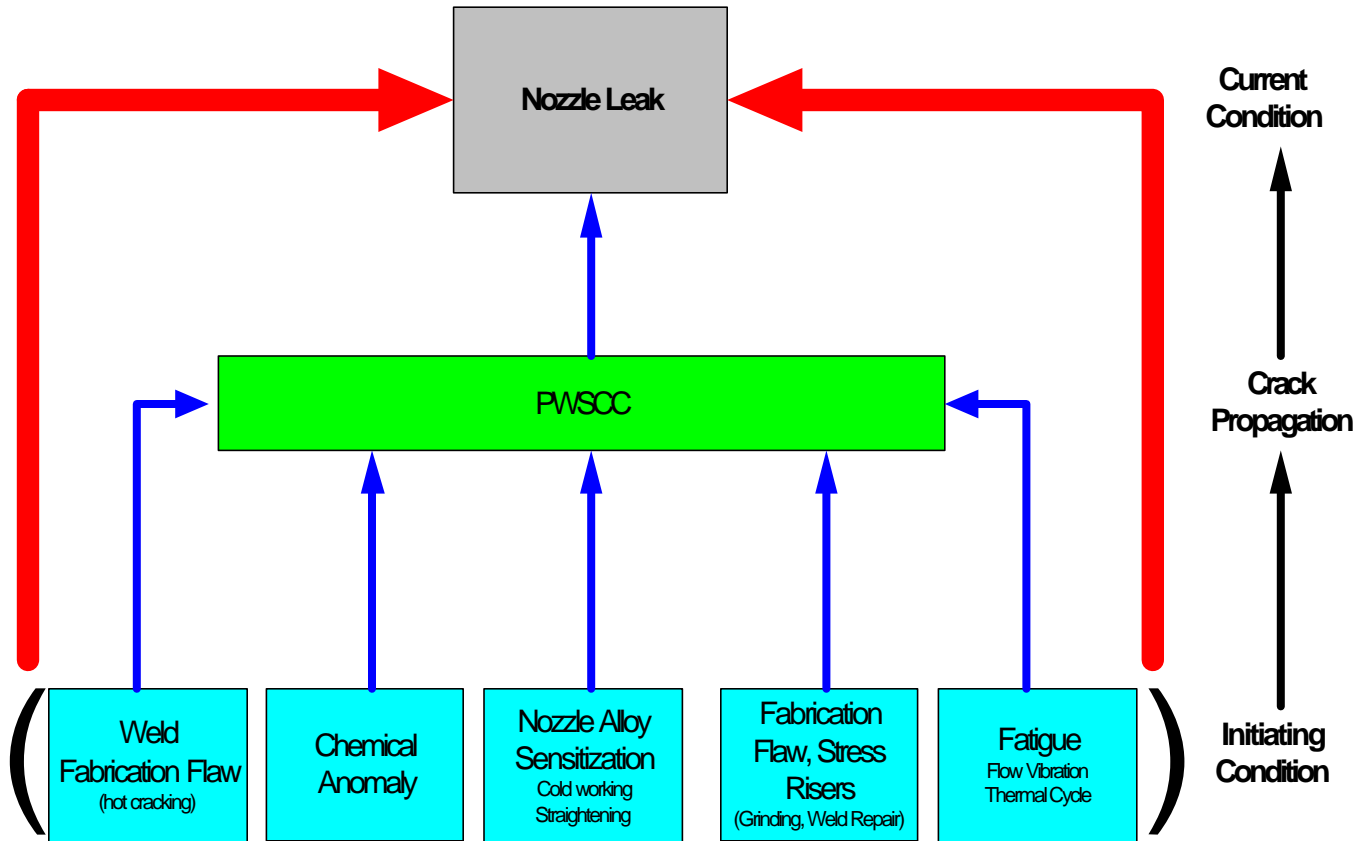
Z(in)

15.62

Most Likely Causes

- Residual fabrication stresses
 - J-groove weld grinding, welding, welding rework
- Lack of J-groove weld fusion to nozzle OD
- Weld cracking; fabrication defects / contaminants
- Combination of one or more with PWSCC

Root Cause Focus



Planned Additional Testing

- Volumetric UT of vessel around #1 and #46
- Helium test for #1 and #46 annulus
- Visually examine inside bore #1 and #46
 - Perform after nozzle capped and separated
 - Possibly detect irregularities
 - Look for known through-wall flaw in #1

Planned Additional Testing (cont'd)

- Eddy current profilometry of #1 and #46
 - Performed from the bottom after nozzle is capped and separated from guide tube
 - Captures data on ID characteristics like ovalization at J-groove weld zone
- Visual exam of vessel at #1 and #46 after portion of old nozzle removed

Planned Additional Testing (cont'd)

- Metallurgical analyses of removed nozzle ends
- Boat samples from #1 and #46 flaw zones

Repair and Startup Are Safe

- Inspections limit repair scope to the two leaking nozzles
 - Extensive NDE reveals no flaws in other nozzles

Repair and Startup Are Safe (cont'd)

- Regardless of final root cause, half-nozzle repair is the appropriate corrective action
 - Bounds potential causes
 - Establishes new ASME Code pressure boundary
 - Utilizes proven industry process
 - Upgrades material to Alloy 690

Repair and Startup Are Safe (cont'd)

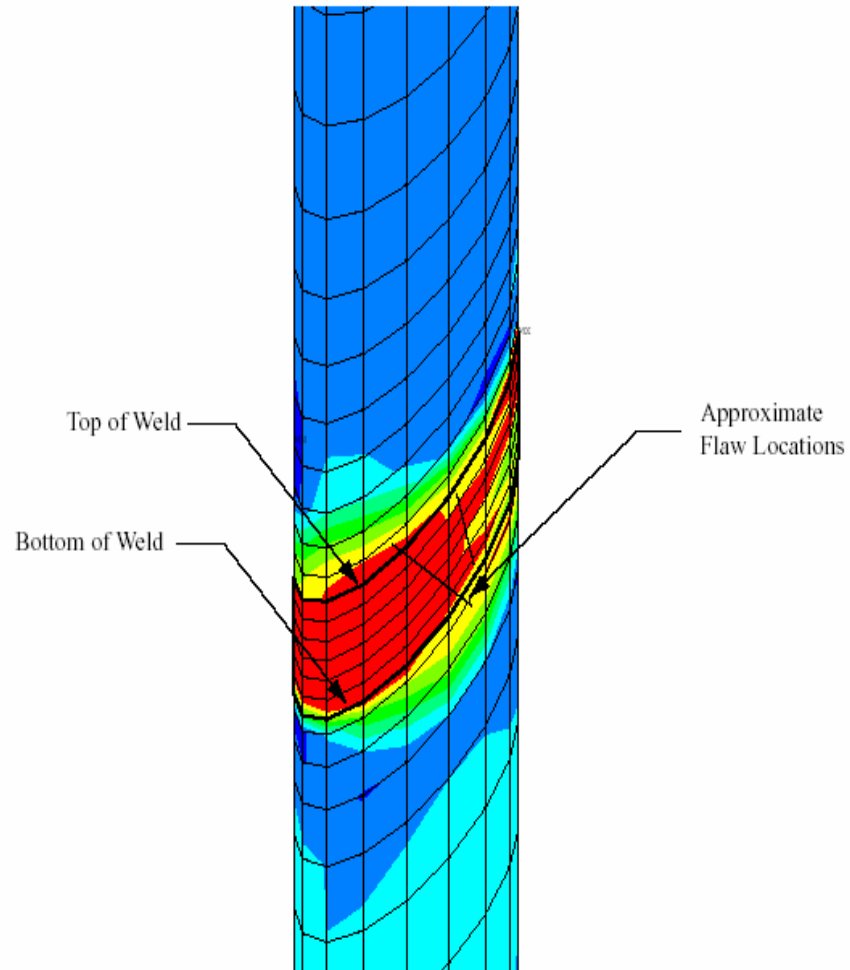
- Evaluation of evidence indicates minor nozzle leakage is worst potential consequence

Severe Consequences Not Likely

Small Break Loss of Coolant Accident (SBLOCA)

- Residual stresses favor axial crack orientation
- No circumferential cracks

Flaw Locations and Stresses

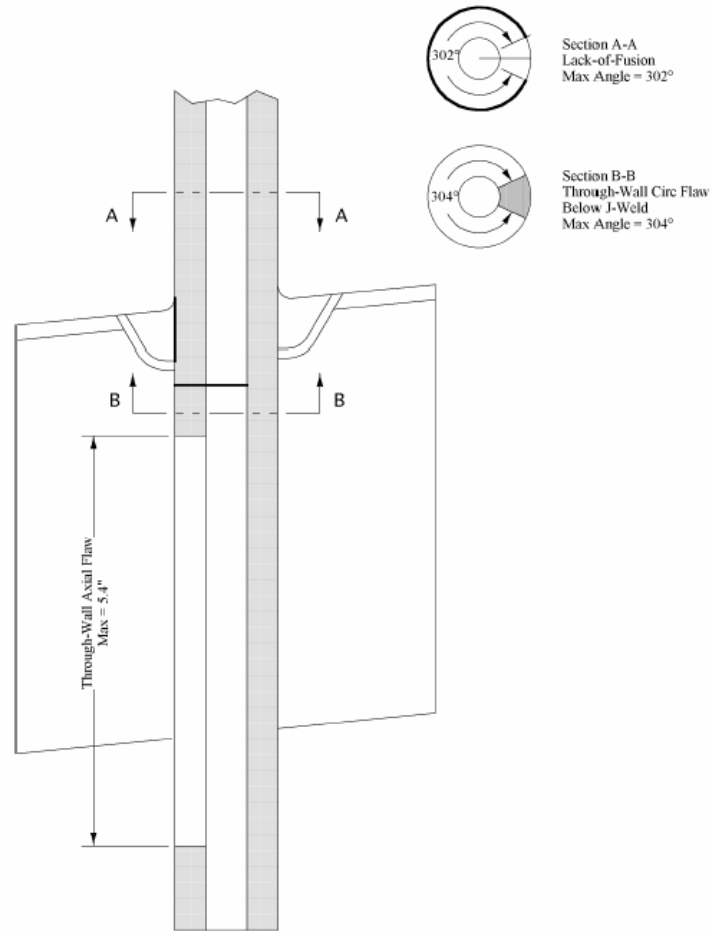


Severe Consequences Not Likely (cont'd)

Small Break Loss of Coolant Accident (SBLOCA)

- Residual stresses favor axial crack orientation
- No circumferential cracks
- Robust design
- Limiting flaw size

Limiting Flaw Size



Locations of Analyzed Axial and Circumferential Flaws

Severe Consequences Not Likely (cont'd)

Small Break Loss of Coolant Accident (SBLOCA)

- Residual stresses favor axial crack orientation
- No circumferential cracks
- Robust design
- Limiting flaw size
- Very large safety factor
- Bare metal inspection
- Leak before break

Severe Consequences Not Likely (cont'd)

No evidence of vessel wastage

- No significant iron in residue
- No wastage residue
- No visual indication
- Confirmed by UT

Severe Consequences Not Likely (cont'd)

Loose Parts

- No flaws above weld
- No circumferential flaw
- Residual stresses favor axial crack orientation

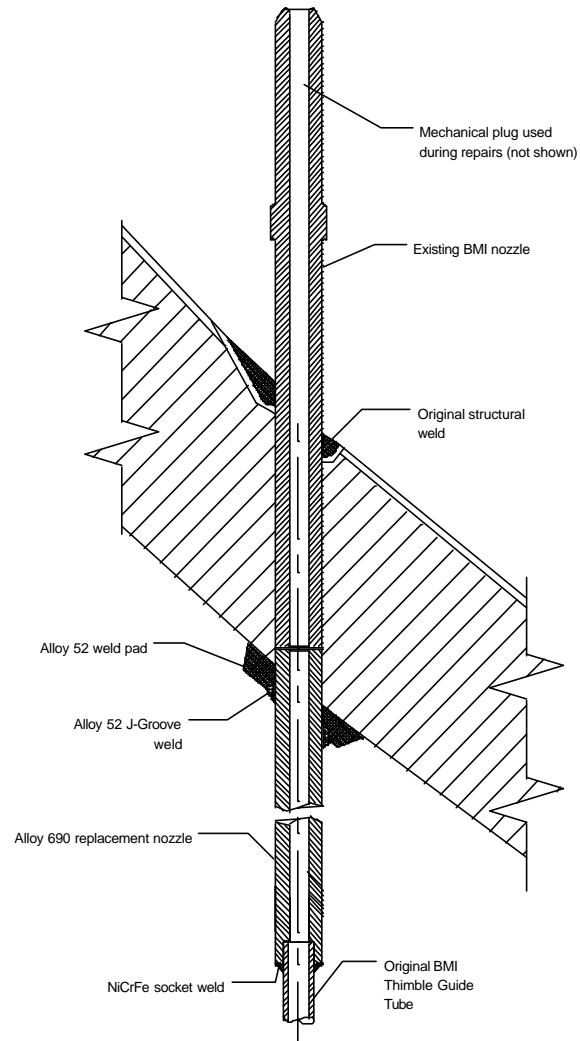
Conclusions

- We have good data
- Repair scope limited to #1 and #46
- Repair bounds likely causes
- Root cause will determine monitoring plan

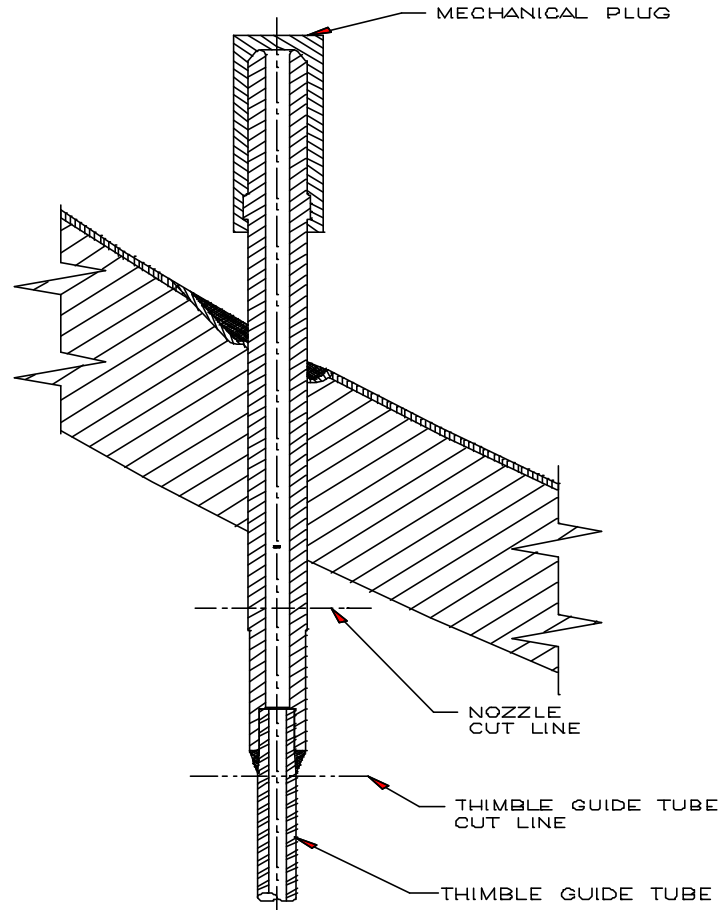
REPAIR PLAN

Steve Thomas
Manager, Plant Design

Half-Nozzle Repair



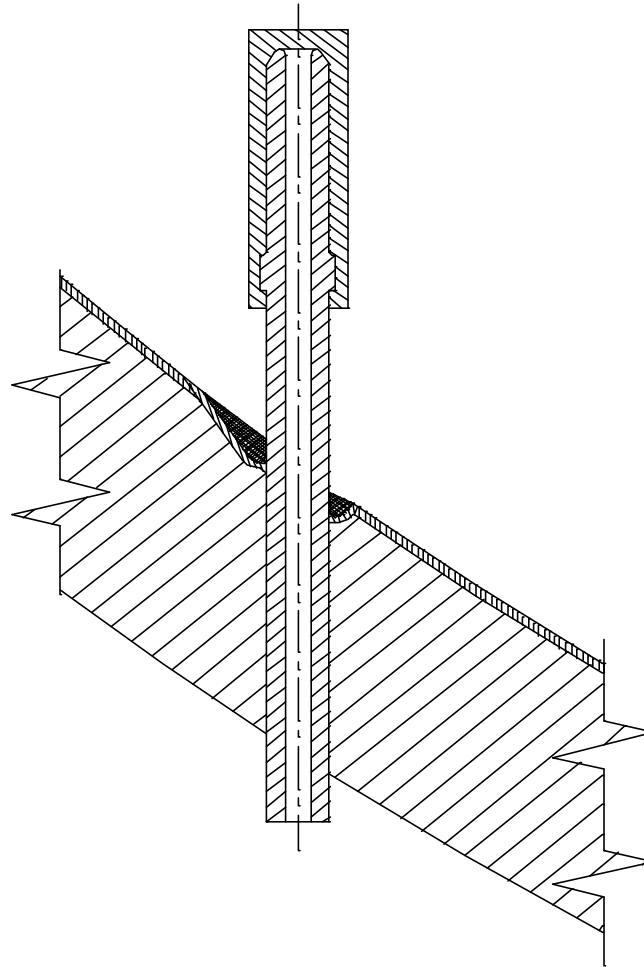
Deploy Plug; Cut Guide Tube / Nozzle



STEP 1

DEPLOY MECHANICAL PLUG
SEVER THIMBLE GUIDE TUBE
INITIAL NOZZLE CUT

Inspect for Leaks

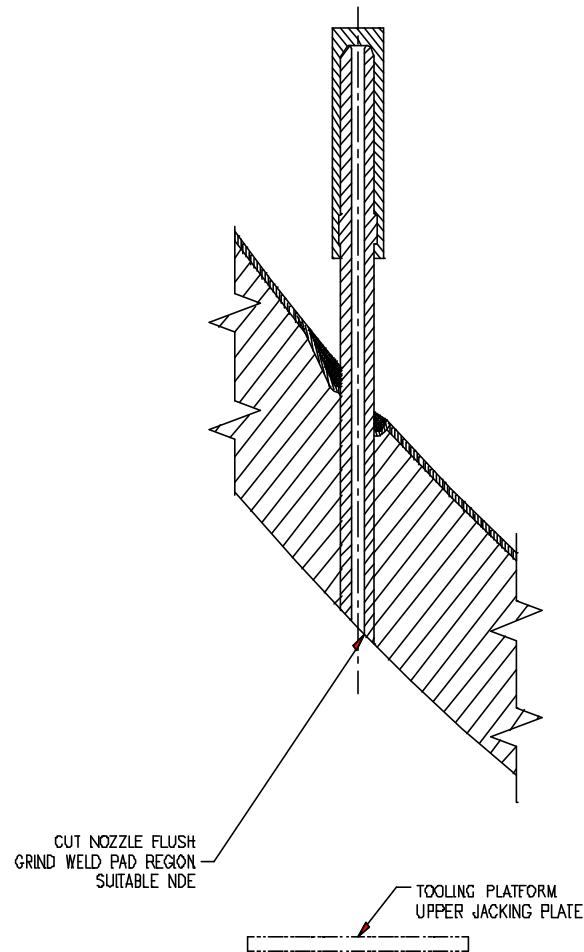


6/5/03

STEP 2
INSPECT FOR LEAKS

76

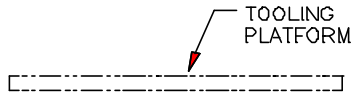
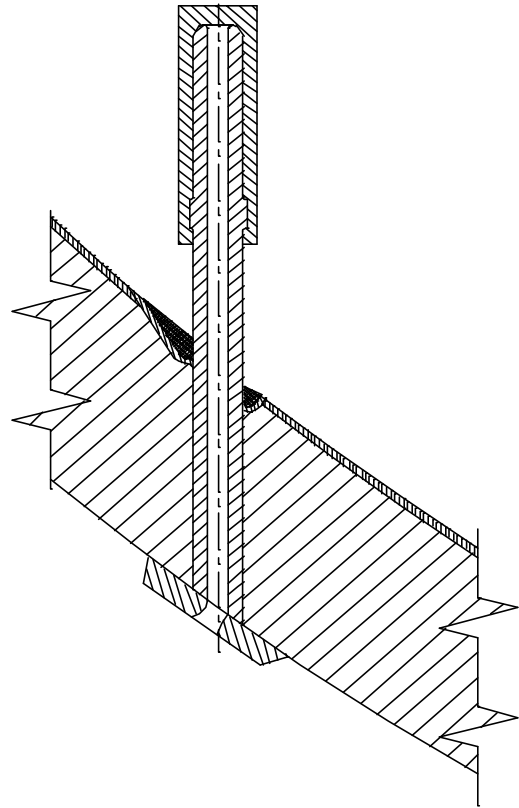
Cut Nozzle Flush with Head



6/5/03

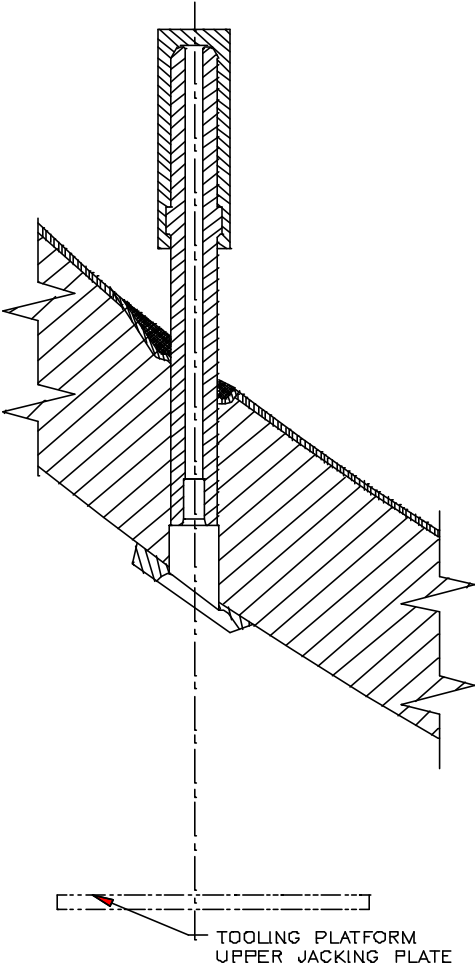
STEP 3
CUT PIPE FLUSH
TO LOWER HEAD,
MT WELD PAD REGION

Form Weld Pad and NDE



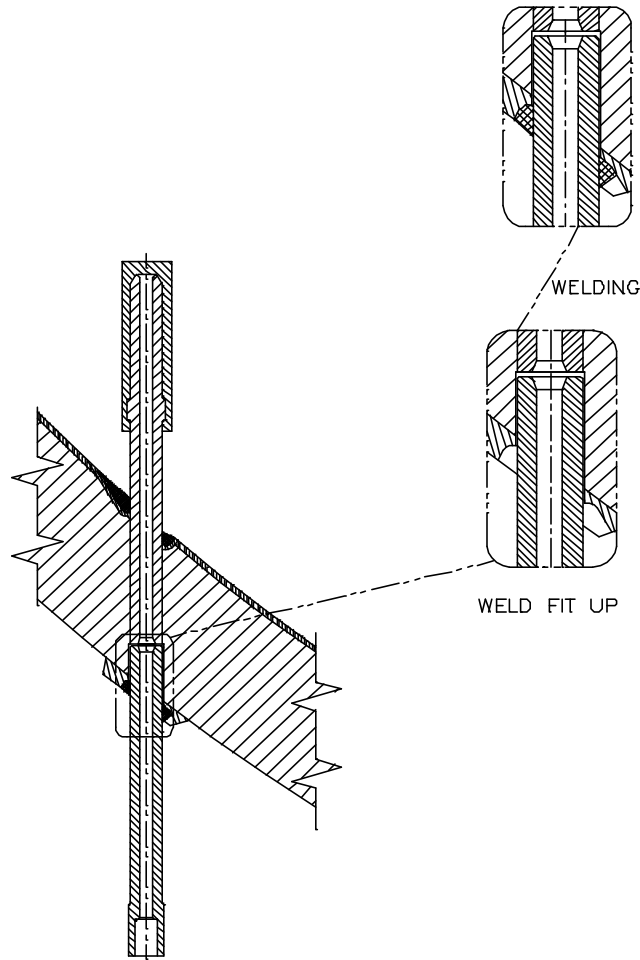
STEP 4
WELD PAD,
NDE

Machine Bore and Form Weld Prep



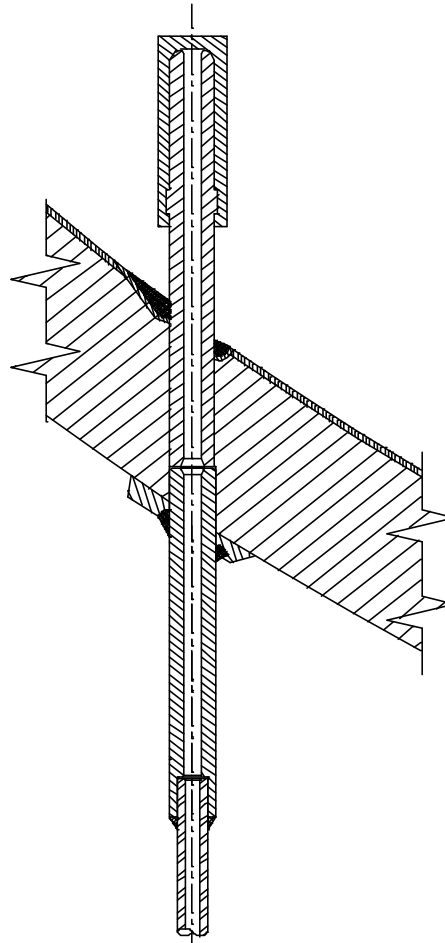
STEP 5
MACHINE BORE
FORM WELD PREP

Install Nozzle; Weld; NDE



STEP 6
INSTALL REPLACEMENT NOZZLE,
WELD, NDE

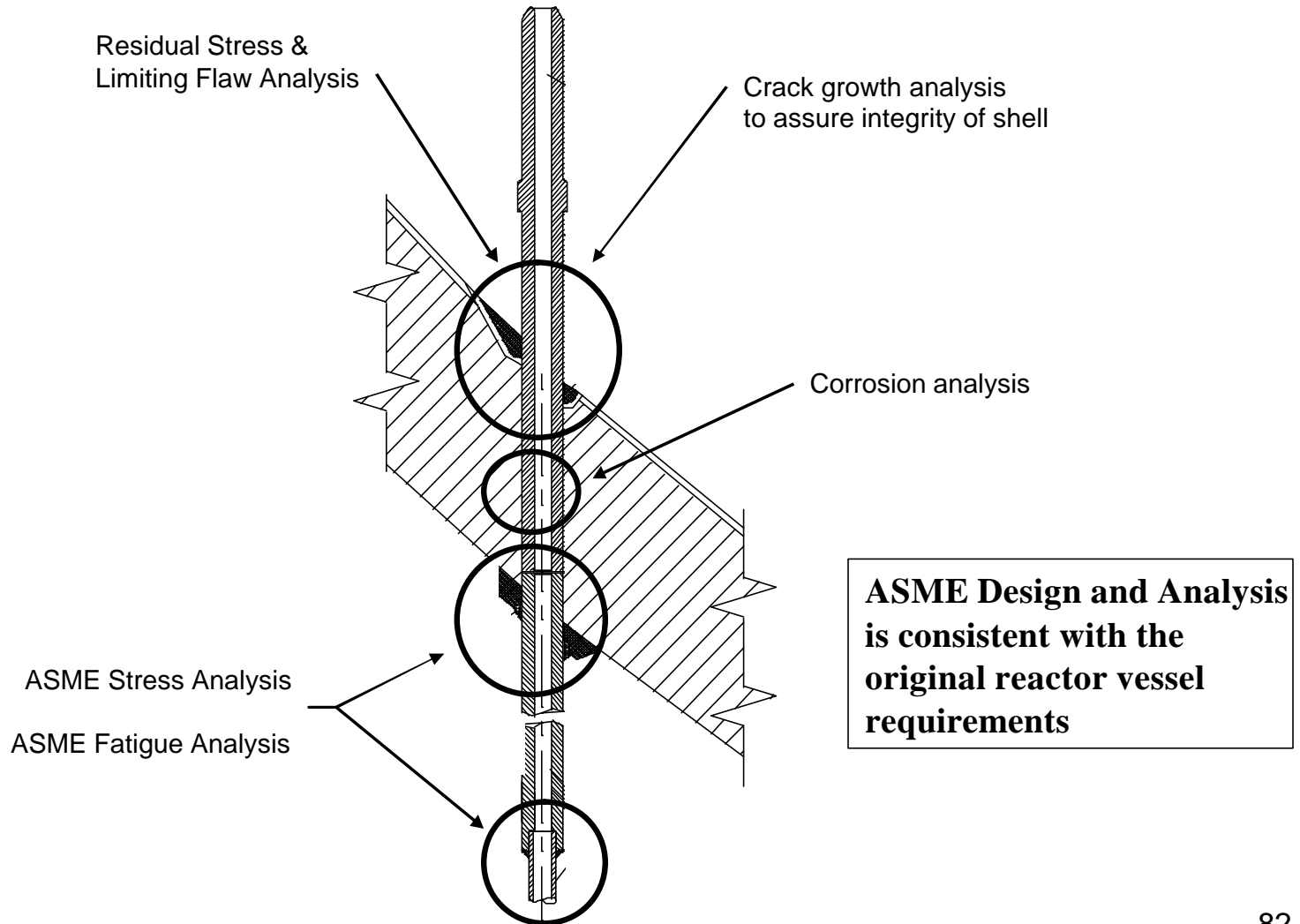
Install Tube; Weld; NDE; Remove Plug



STEP 7

INSTALL THIMBLE GUIDE TUBE,
WELD, NDE REMOVE MECHANICAL
PLUG

Analyses Supporting Repair



CORROSION ASSESSMENT

Rick Gangluff
Manager, Chemistry

Half-Nozzle Replacement Corrosion Assessment

- Small gap between Alloy 600 remnant and new Alloy 690 nozzle
- Carbon steel (SA 533B) in annulus region exposed to primary coolant
- No mechanism to concentrate boric acid
- Corrosion rates are very low (~1.5 mil/yr)

Corrosion Rates Addressed by CEOG for Nozzle Replacement

- SER issued for Rev. 0 of CEOG Report
- NRC found CEOG report methods and analyses to be acceptable
- STP plant-specific analyses in accordance with SER nearing completion

BMI General Corrosion Acceptable

- Corrosion rate identified in report acceptable for STP based on projected capacity factors
- Lifetime increase in diameter
 - 24 years 0.073”
 - 44 years 0.135”
 - Less than most limiting nozzle

CONCLUDING REMARKS

Mark McBurnett
Manager, Quality & Licensing

Deliverables

Nozzle finite element stress analysis	Avail.
Flaw size limits to prevent net section collapse	Avail.
NRC site review visit	TBD
Submit LER	6-12
NDE inspection report	6-14
Design change (Section III, Section XI, corrosion)	6-14
Annulus dilation analysis	6-15
Submit temper bead relief request	6-17
Nozzle inservice acceptability analysis	6-30

Deliverables (cont'd)

Preliminary cause report (FMEA summary, bounding cause, safety significance, corrective action, monitoring plan)	7-12
Rockville meeting (cause report)	-
Public meeting at STP	-
Relief request approval	-
Half-nozzle lab analysis report	9-21
Boat sample analysis report	9-21
Submit LER supplement (final cause report summary)	10-12

Conclusions

- NDE campaign successful
- Condition/repair scope known
- Repairs enable safe return to operation
- Continued close cooperation with industry and NRC on cause analysis