SCE&G
A SCANA COMPANY

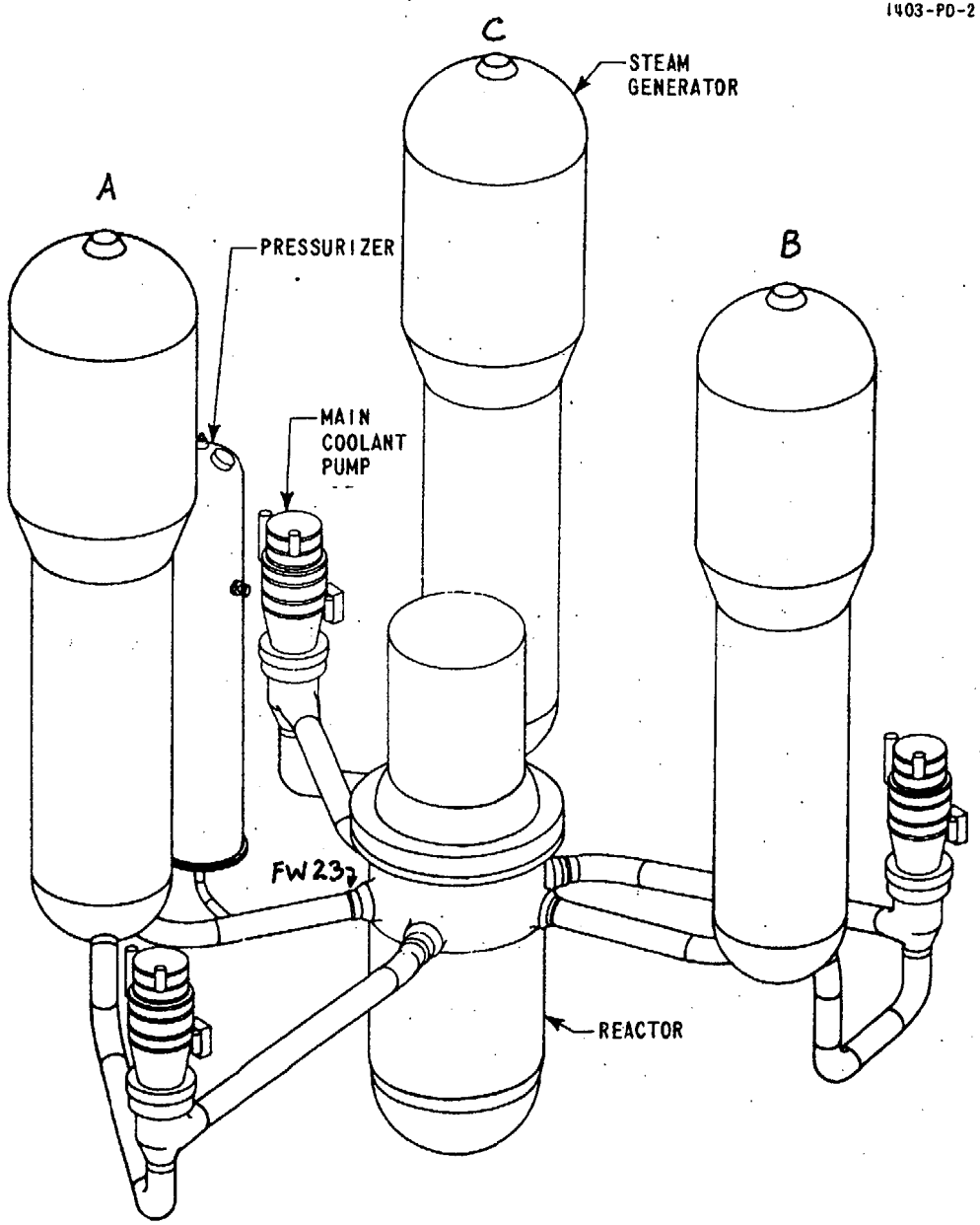
V. C. SUMMER NUCLEAR STATION
Alpha Hot Leg Evaluation and Repair

Presented to the Office of
Nuclear Reactor Regulation (NRR)
Rockville, MD
November 21, 2000

Agenda

- Introduction - Greg Halnon
- Characterization of Crack - Terry McAlister
- Repair Details - Framatome Technologies
- Root Cause Status and Schedule - Greg Halnon
- Closing Remarks - Steve Byrne

1403-PD-2


C
STEAM
GENERATOR
A
PRESSURIZER
B
MAIN
COOLANT
PUMP
FW23
REACTOR

History To Date

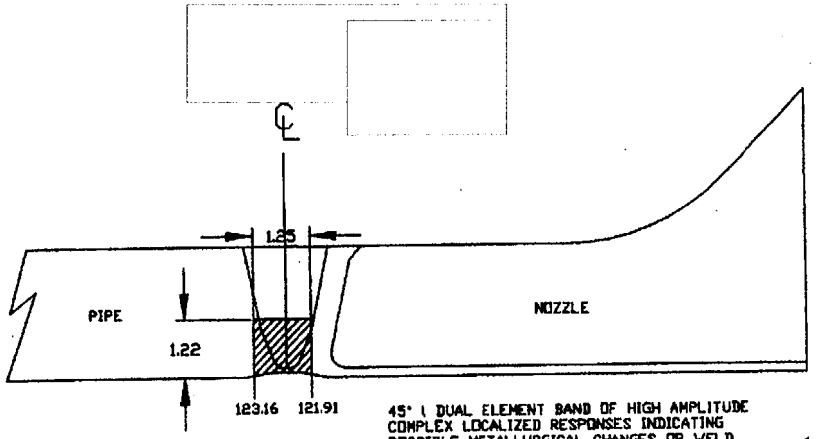
- Identified Boric Acid Deposits
- PT Identified Apparent External Crack
- Video From Reactor Vessel Shows Suspicious Circumferential Indication
- External UT Inconclusive
- External Crack Replication Shows No External Macro Crack
- Weep Hole Identified

Status to Date

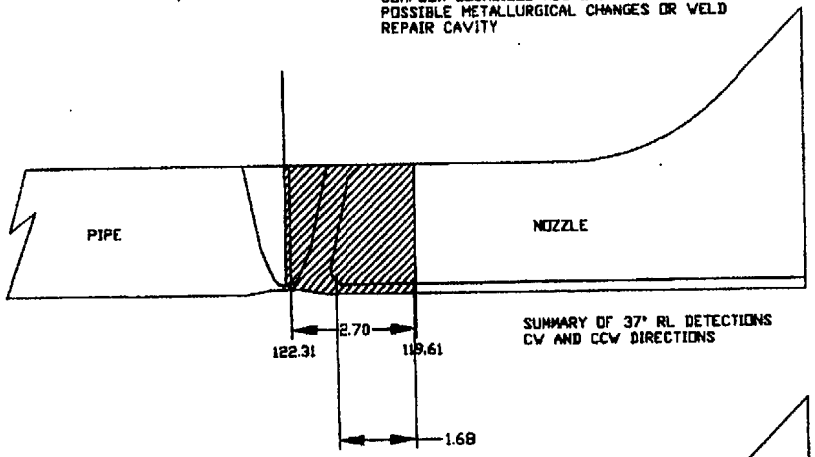
- Completed ID UT Examination On 11/5.
  - Shows 2.7" Axial Flaw ~ 9° Clockwise from TDC
  - Improved Visual results
- Completed ID Eddy Current Exam on 11/5.
- Completed External PT on 11/12.
  - No Axial Indications Identified
- Spartanburg NDE - RT, Eddy Current, Visual

Characterization of Flaw

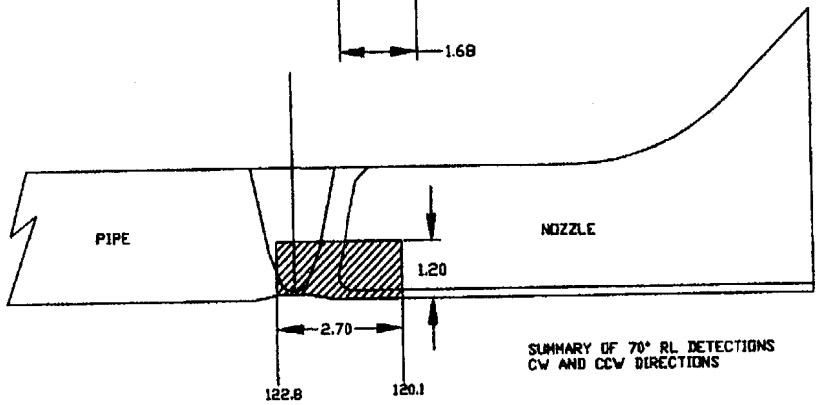
Terry McAlister



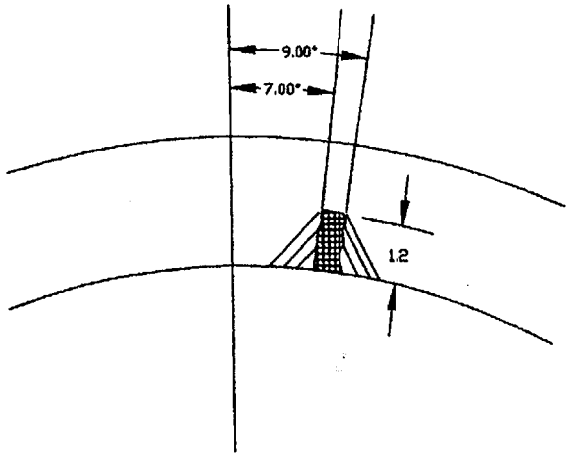
45° L DUAL ELEMENT BAND OF HIGH AMPLITUDE COMPLEX LOCALIZED RESPONSES INDICATING POSSIBLE METALLURGICAL CHANGES OR WELD REPAIR CAVITY

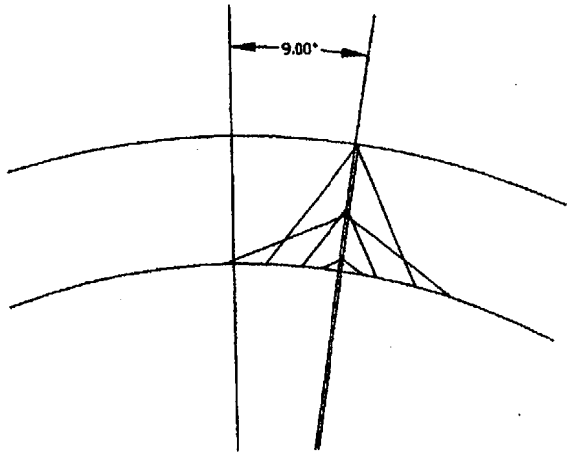


SUMMARY OF 37° RL DETECTIONS CW AND CCW DIRECTIONS



SUMMARY OF 70° RL DETECTIONS CW AND CCW DIRECTIONS



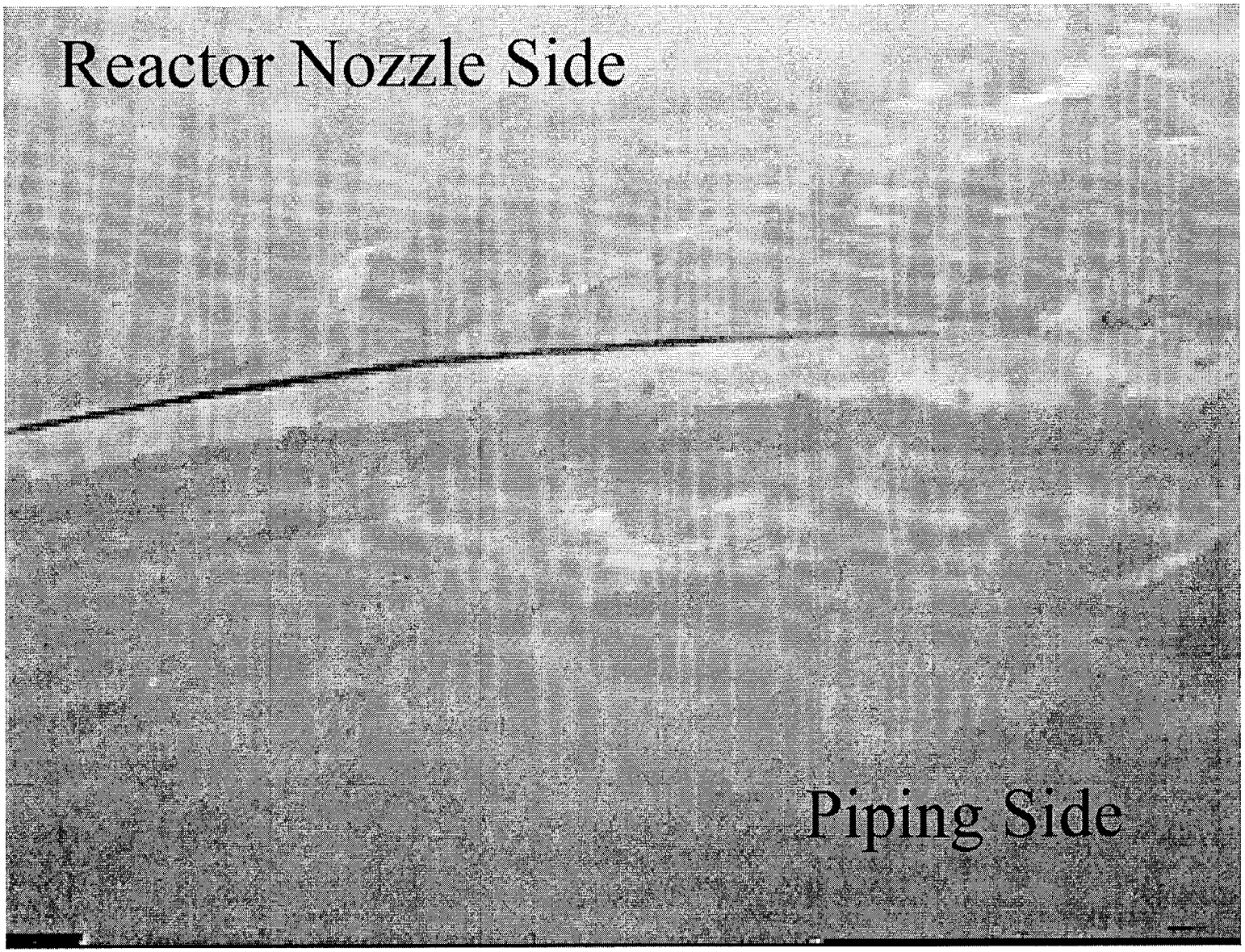


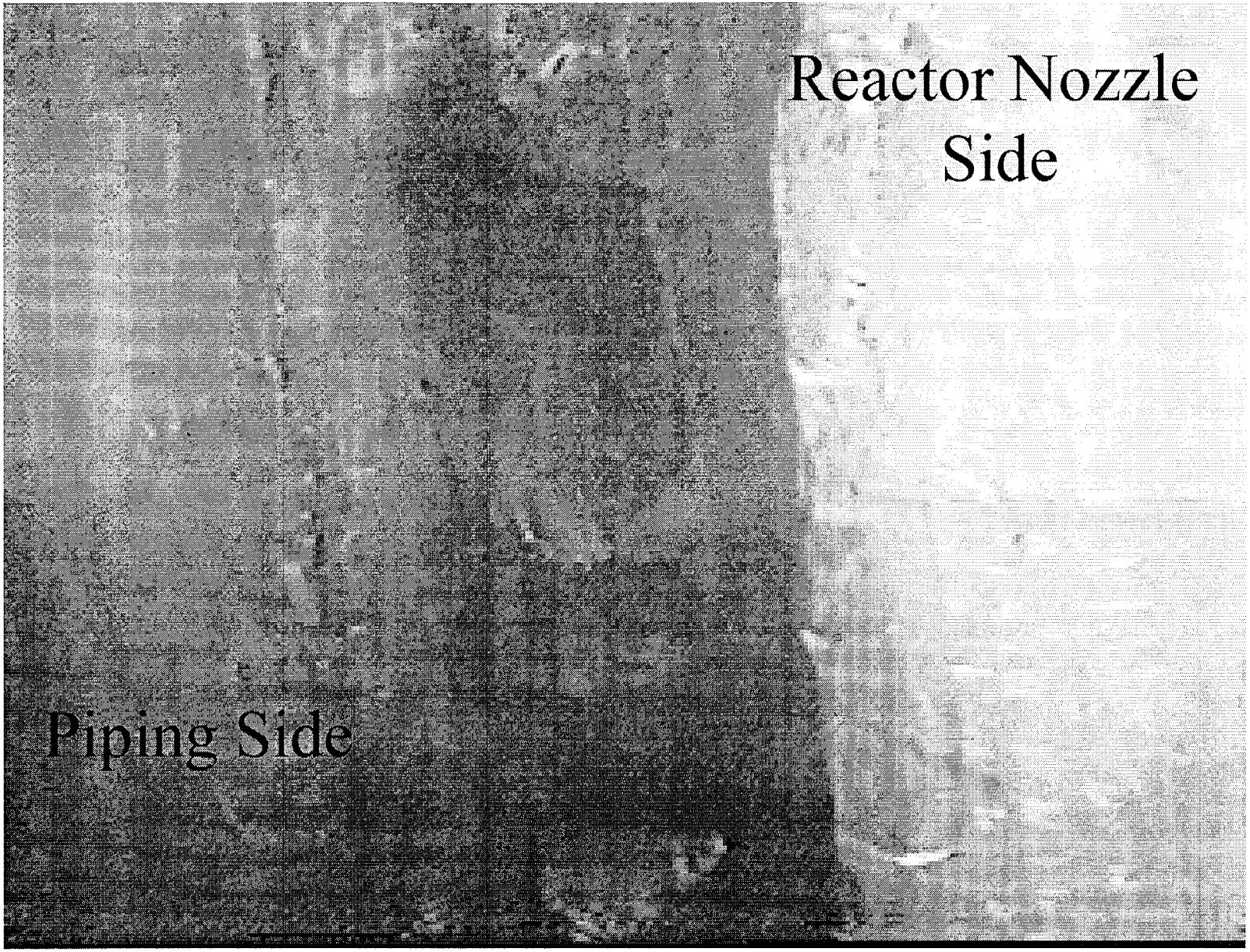
SUMMARY OF 37° AND 70° CW / CCW
OUTLET NOZZLE AT 25° VESSEL AZIMUTH

View From Reactor

Reconciliation of Information

OD UT Results	ID UT Results
Construction RT Results	
93 Inservice Inspection Results	00 UT & Eddy Current Results
87 UT	93 UT
Old Video	New Video


Reactor Nozzle Side
Piping Side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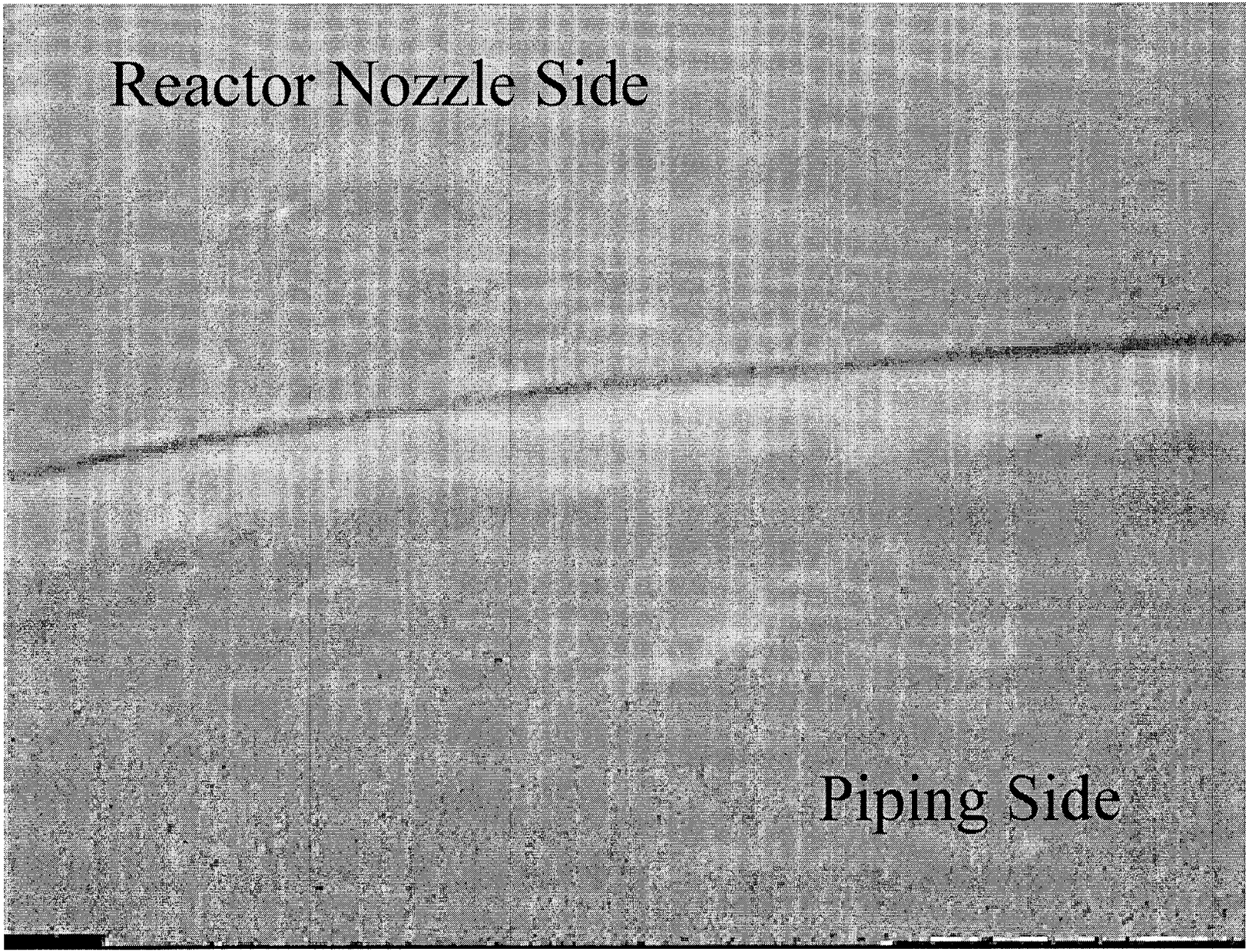
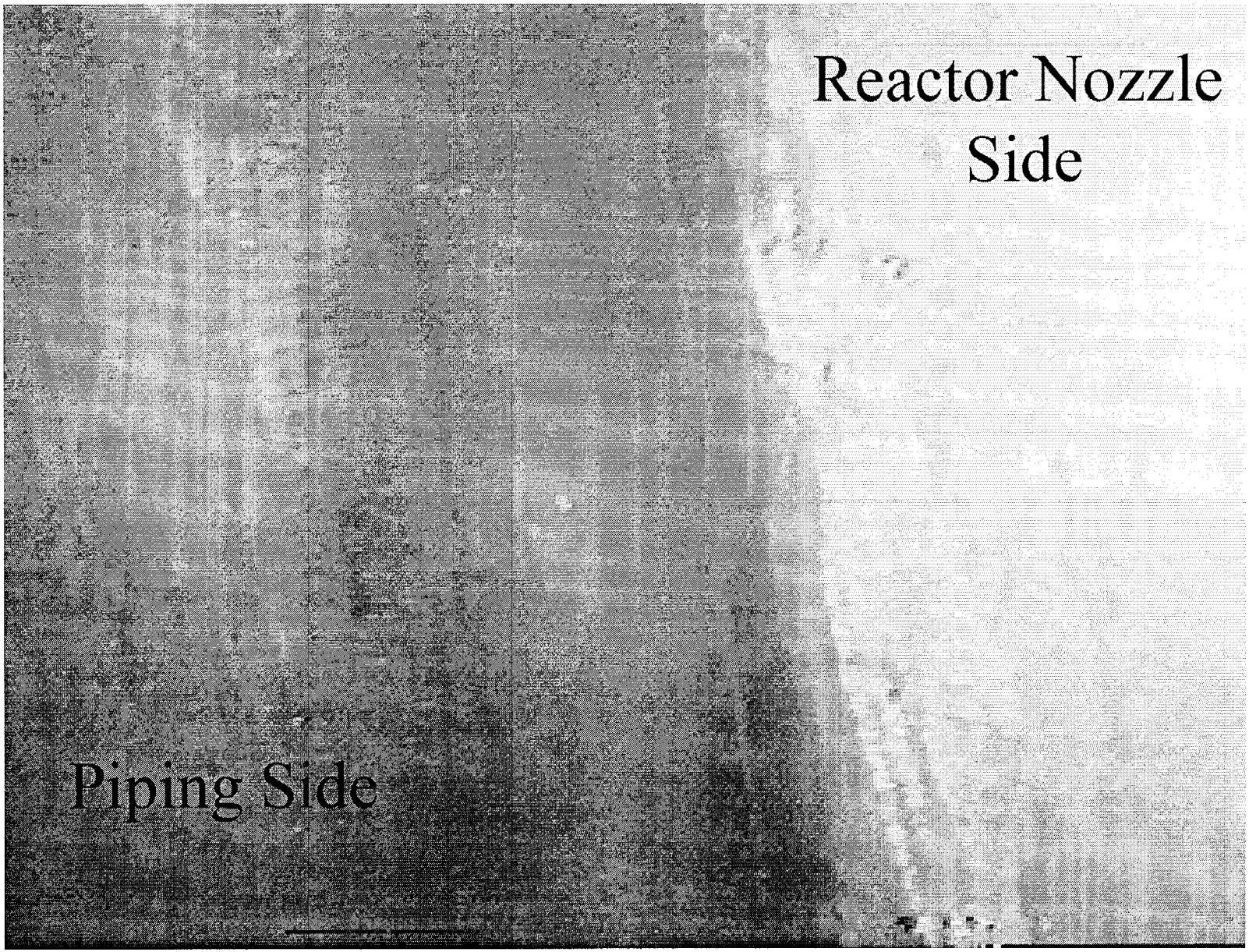
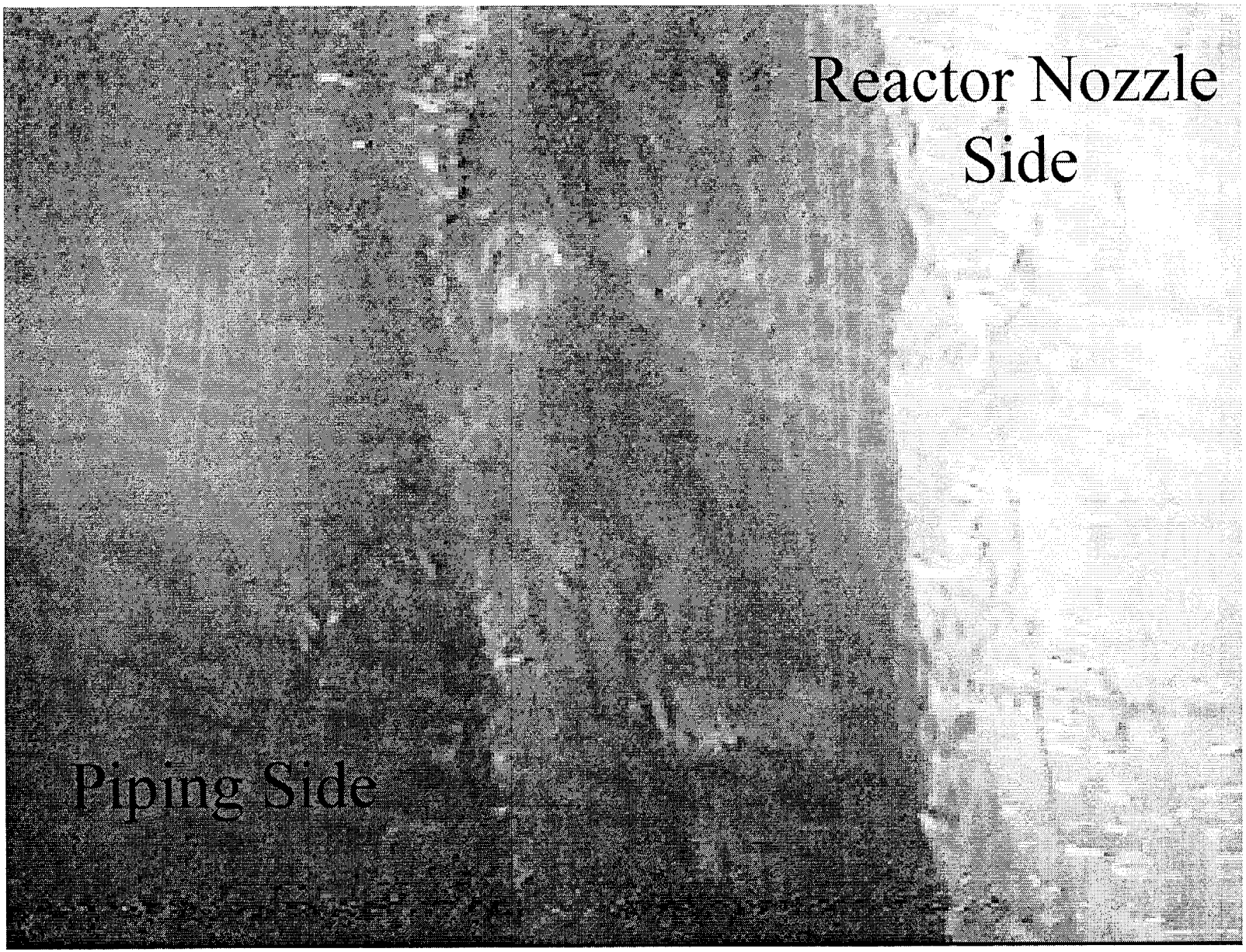
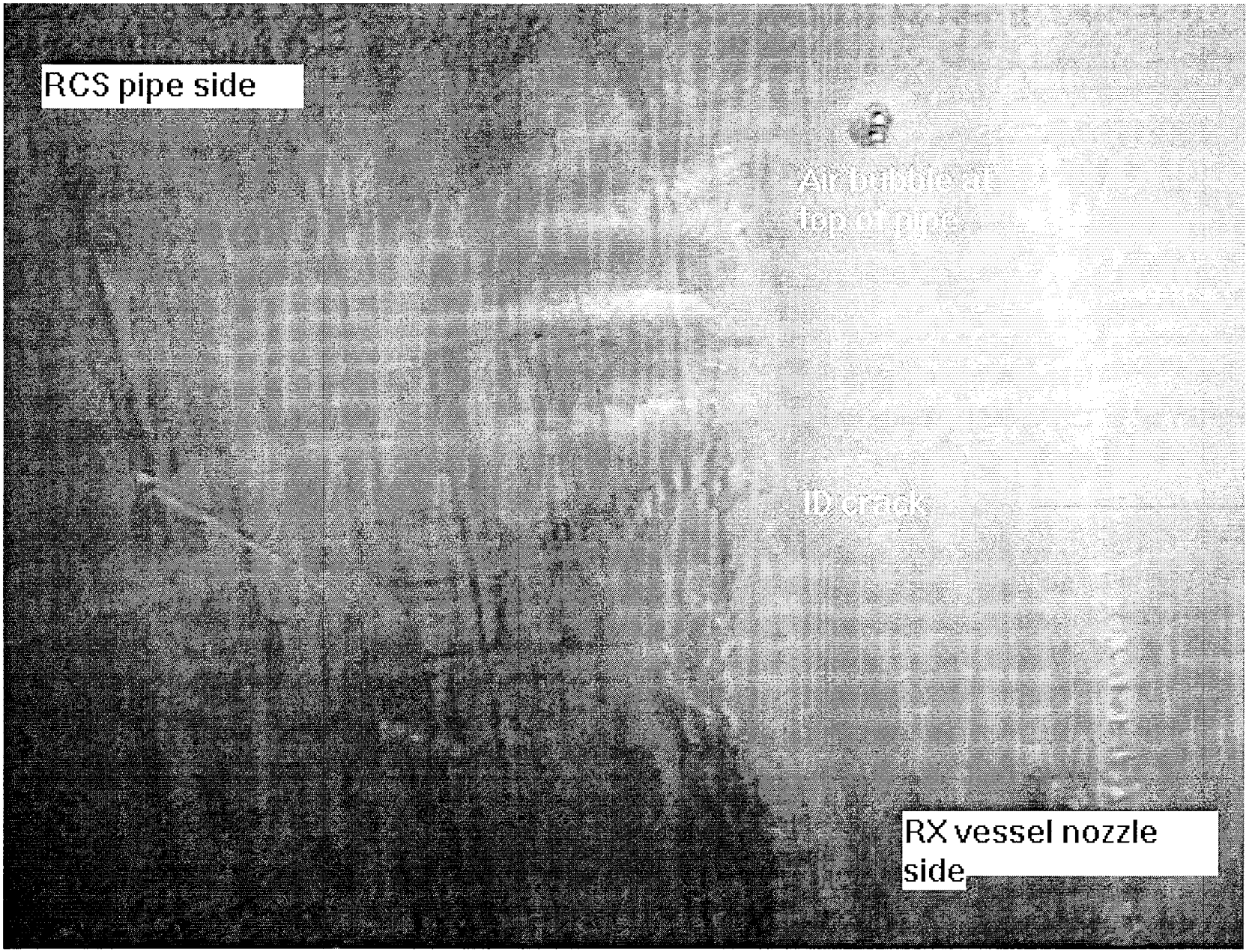
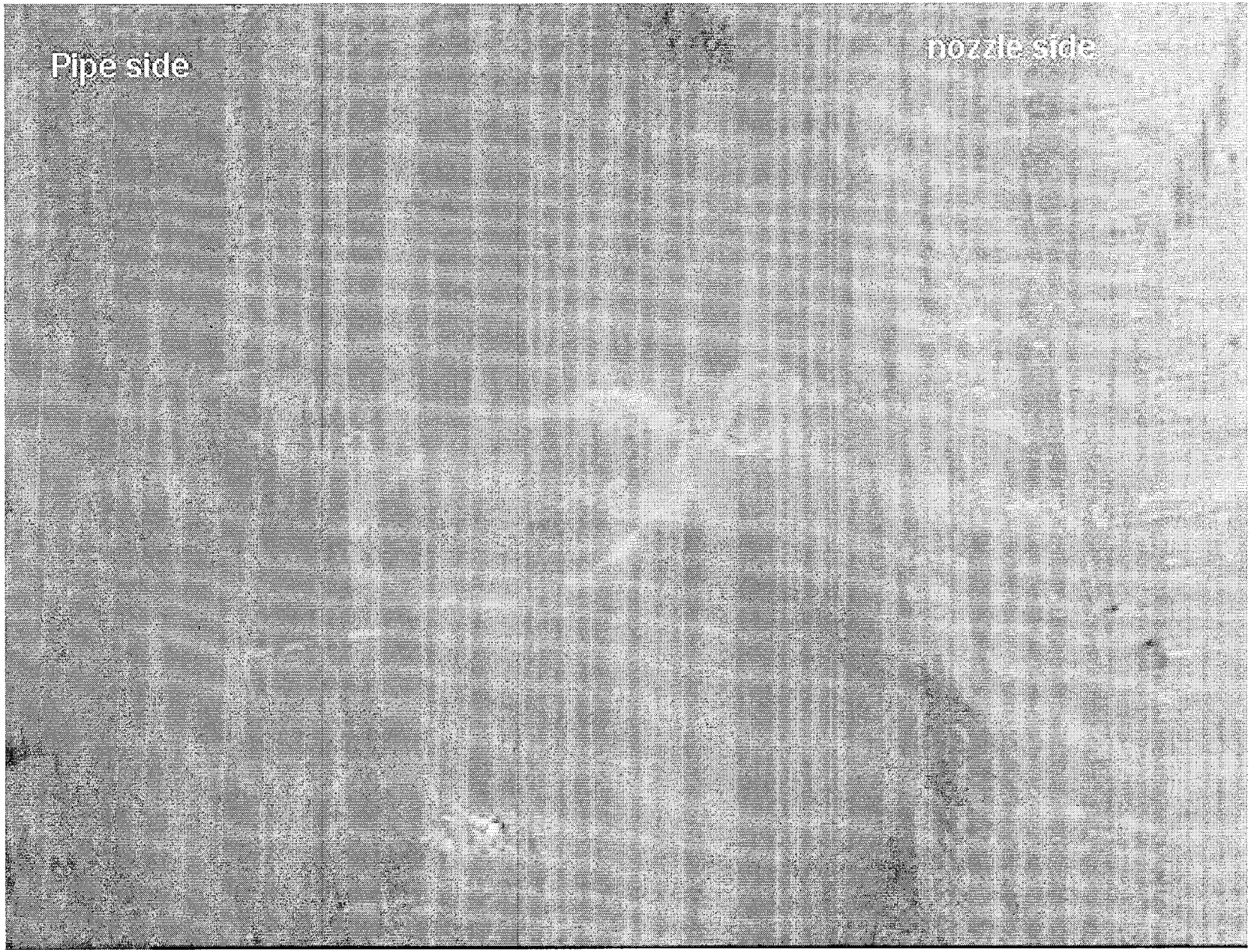
Piping Side


Reactor Nozzle Side
Piping Side


Reactor Nozzle
Side
Piping Side


Reactor Nozzle
Side
Piping Side


RCS pipe side
Air bubble at top of pipe
ID crack
RX vessel nozzle side


Pipe side
nozzle side

Repair Method

Greg Halnon

Repair Method

- Spool Piece
  - Advantages
    - Flaw Preservation Maximized
    - Weld Removal Maximized for Study
    - Validate UT & Eddy Current Results
    - Extent of Condition Better Understood
    - Utilizes Technology From SG Replacements
    - Parallel Work Optimized From Early On

Repair Method

- Spool Piece
  - Challenges
    - Two Large Welds on Large Piece of Steel
    - Weld Shrinkage Effect on RCS
      - Branch Line Effects
      - Steam Generator Bracing
    - Volumetric Examinations
    - Limited Space in Sandbox
    - Dose, Time

Repair Method

- Initial spool piece decision based on:
  - circumferential flaw
  - poor weld contour
  - flaw limited to weld
- Acquired information:
  - axial flaw, approximately 2.7 inches long
  - some extension into the nozzle
- Re-addressed repair decision
  - Local repair alternative assessed and eliminated
    - Advantages: time, dose, eliminates SG movement and weld shrinkage questions
    - Challenges: Weld not removed, flaw preservation, technical justification difficult

Repair Details

FRAMATOME
TECHNOLOGIES

Code Applicability - Welding

- ASME Section XI, 1989 Edition, No Addenda
- Construction Code, ASME Section III, 1971 Edition, w/Add. through W'71
- ASME Section XI Code Case N432 - Machine GTAW Temperbead
- Regulatory Guides
  - RG 1.31 - Control Of Stainless Steel Welding
  - RG 1.44 - Control Of The Use Of Sensitized Stainless Steel

RV Nozzle Repair Process

- STEP 1 - SPOOL PIECE REMOVAL
  - Block Piping & Steam Generator
  - Sever Spool at the RV Nozzle
  - Sever Spool on SG Side
  - Rig Out Spool Piece
  - Debur & Clean ID Surfaces
  - Install Shielding Plugs
  - Machine Counterbore

RV Nozzle Repair Process

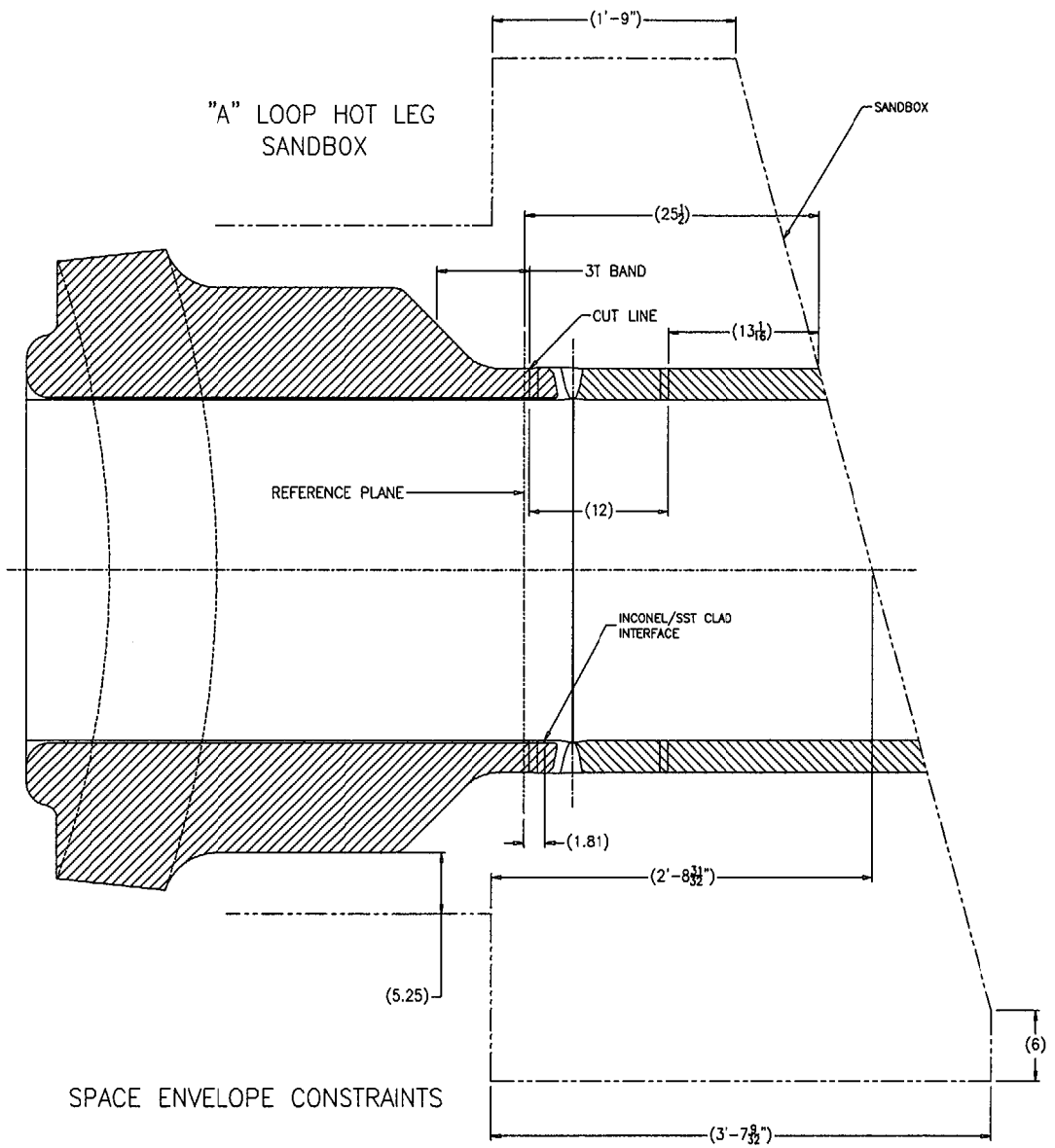
- STEP 2 - BUTTER NOZZLE
  - Preheat
  - Deposit Counter Bore & ID Buildup
  - Deposit OD Buildup
  - Deposit Buttering on Nozzle
  - PWHT
  - Machine Face for NDE

RV Nozzle Repair Process

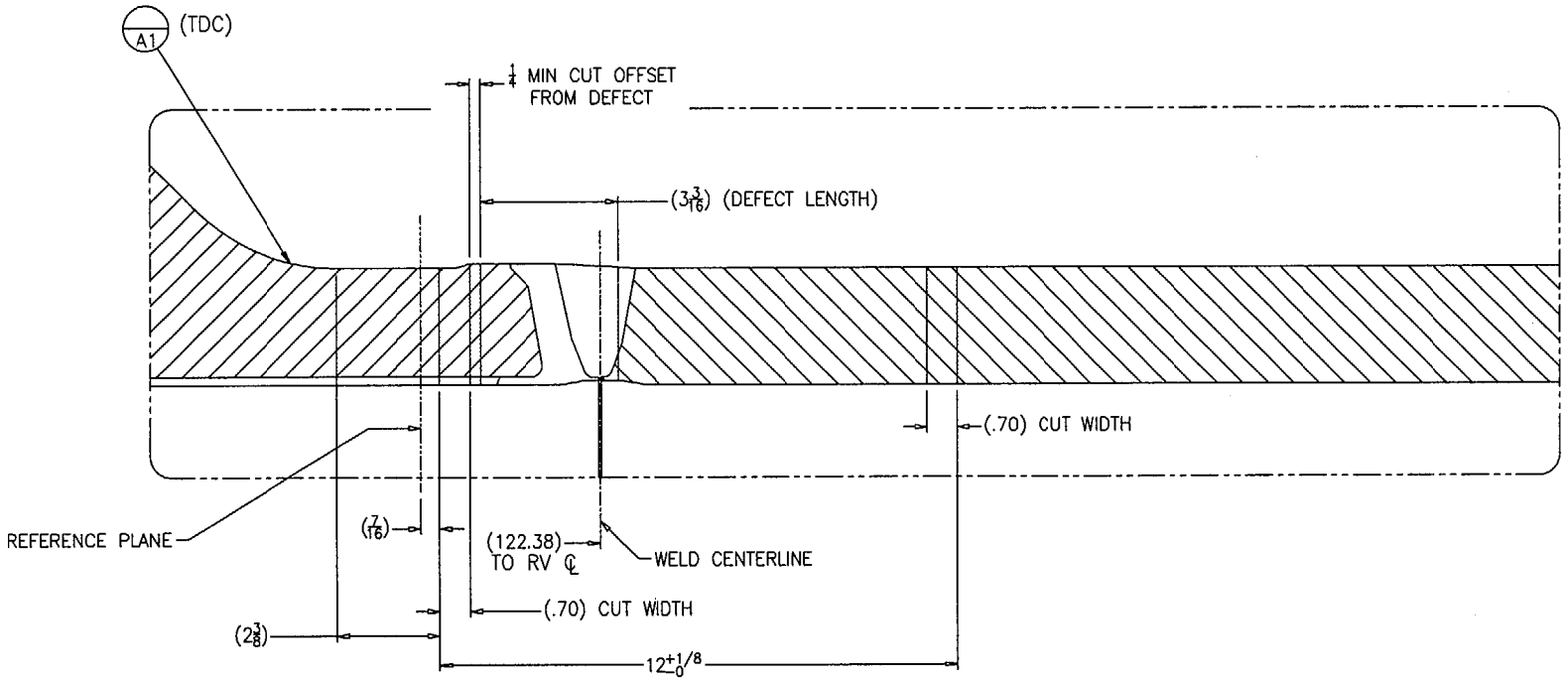
- STEP 3 - MACHINE WELD PREPS
  - Machine Buttered Spool Piece End on Shop Lathe
  - Machine Existing Pipe Prep Using Split Lathe
  - Machine Nozzle Prep Using Split Lathe
  - Survey Photogrammetrically & Perform Association
  - Cut Spool Piece to Length
  - Machine Final Spool Piece Prep on Shop Lathe

RV Nozzle Repair Process

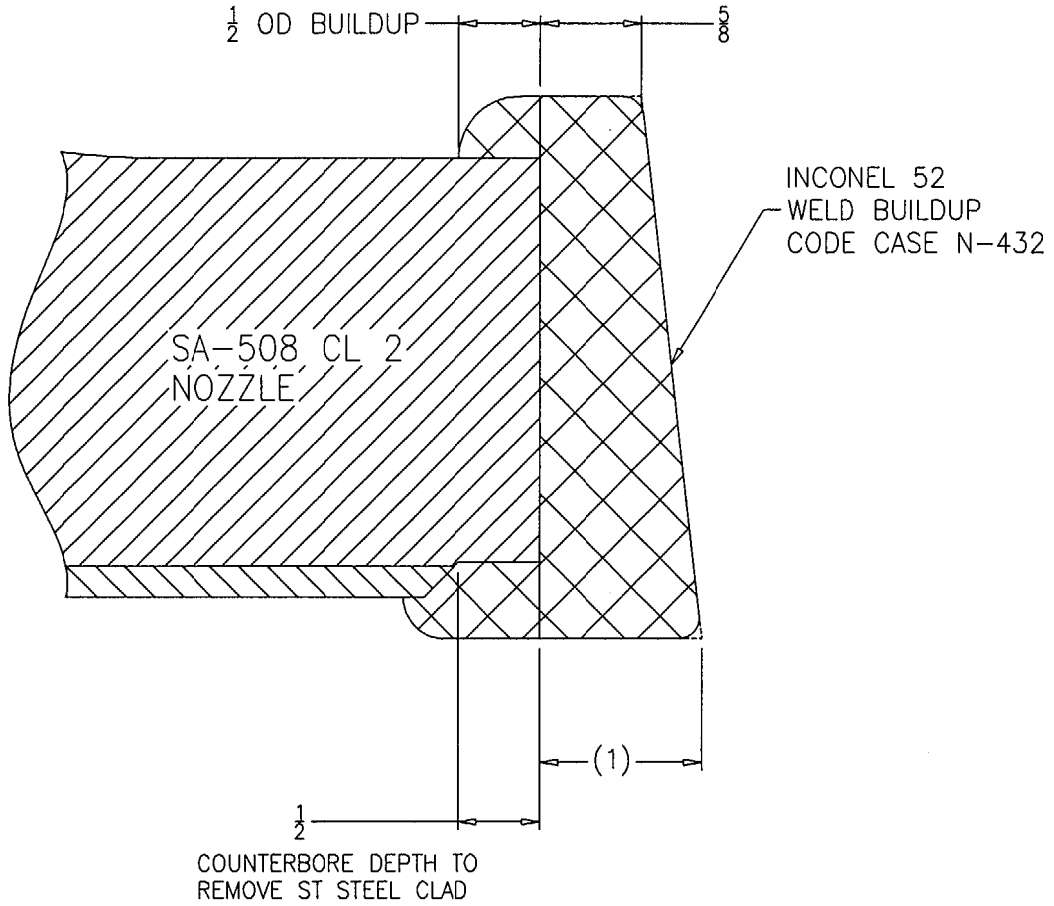
- STEP 4 - INSTALL REPLACEMENT SPOOL PIECE
  - Fit Spool Piece
  - Install Purge Device & Purge ID
  - Progressively Tack and Weld Both Spool Welds to 3/4" Deposit
  - UT Root Area
  - Complete Alloy 52 Weld
  - Complete 308L Weld



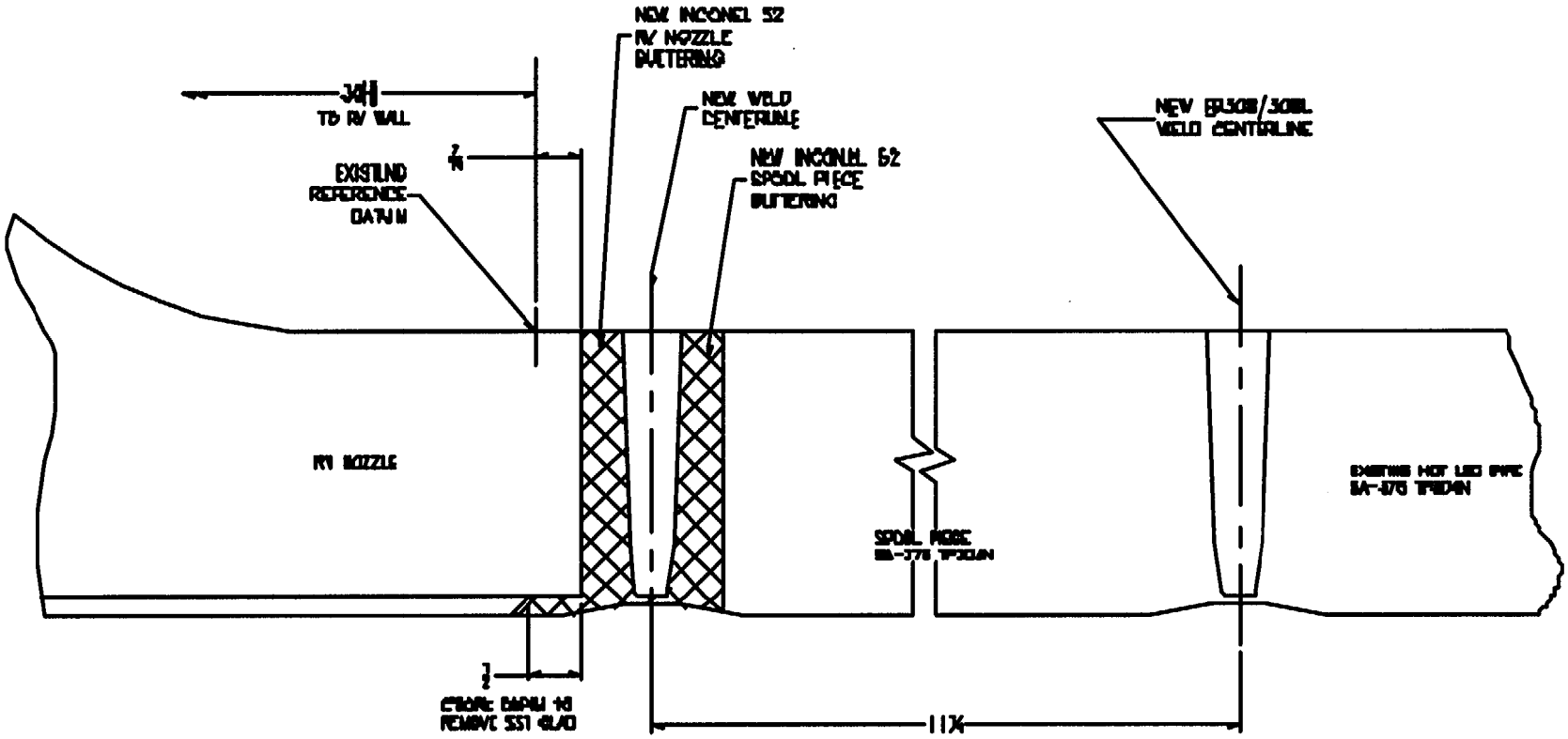
SPACE ENVELOPE CONSTRAINTS



SPOOL PIECE REMOVAL



RV NOZZLE BUTTERING



SPOOL PIECE INSTALLATION

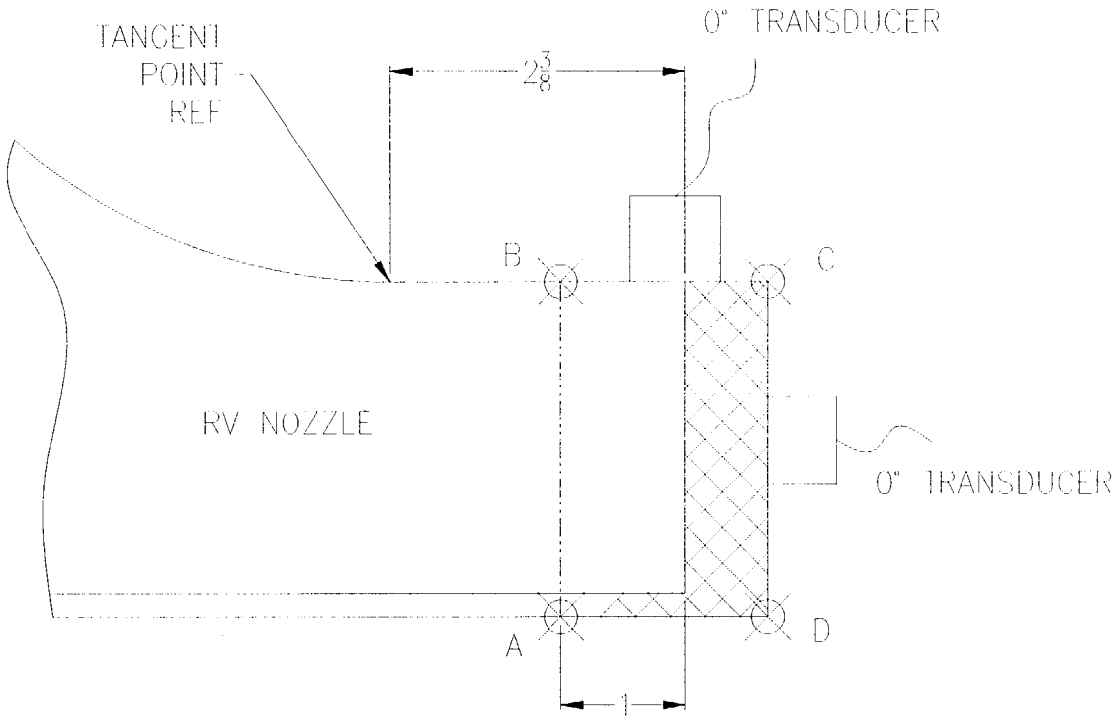
NG Welding Advantages

- Uniform Weld Quality
- High Performance Reliability
- Less Filler Material
- Shorter Welding Time
- Lower Radiation Exposure
- Less Shrinkage
- No ID Welding Required
- No ID Grinding

Nozzle Buttering NDE

- PT nozzle end and ID region after severing to ensure complete flaw removal
- PT final buttering and cladding
- UT final buttering from the OD surface and buttering face
- PT buttering after the weld prep has been machined

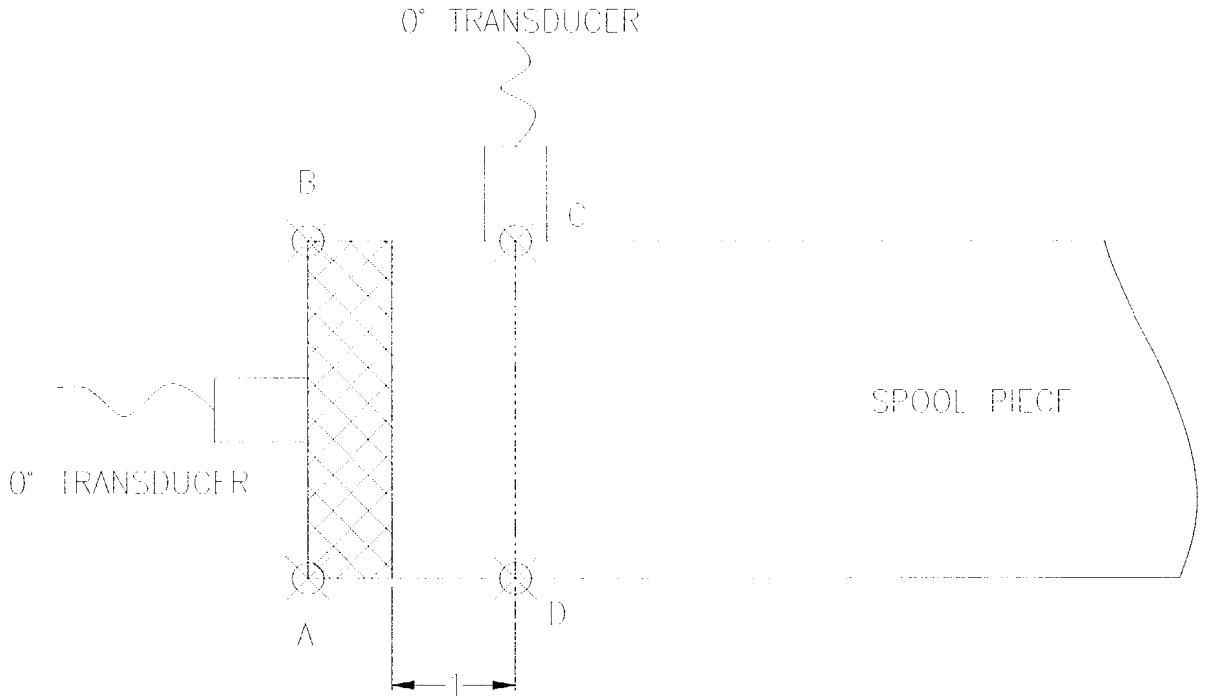
Nozzle Buttering Examination Technique



Spool Piece Buttering NDE

- PT prior to buttering
  - Complete ID surface,
  - OD for 2.0" from end to be buttered
  - End to be buttered
- PT first layer of buttering
- PT and UT the buttering face at ½ the buttering thickness
- PT final buttering
- UT final buttering from the OD surface and buttering face
- PT buttering after the weld prep has been machined

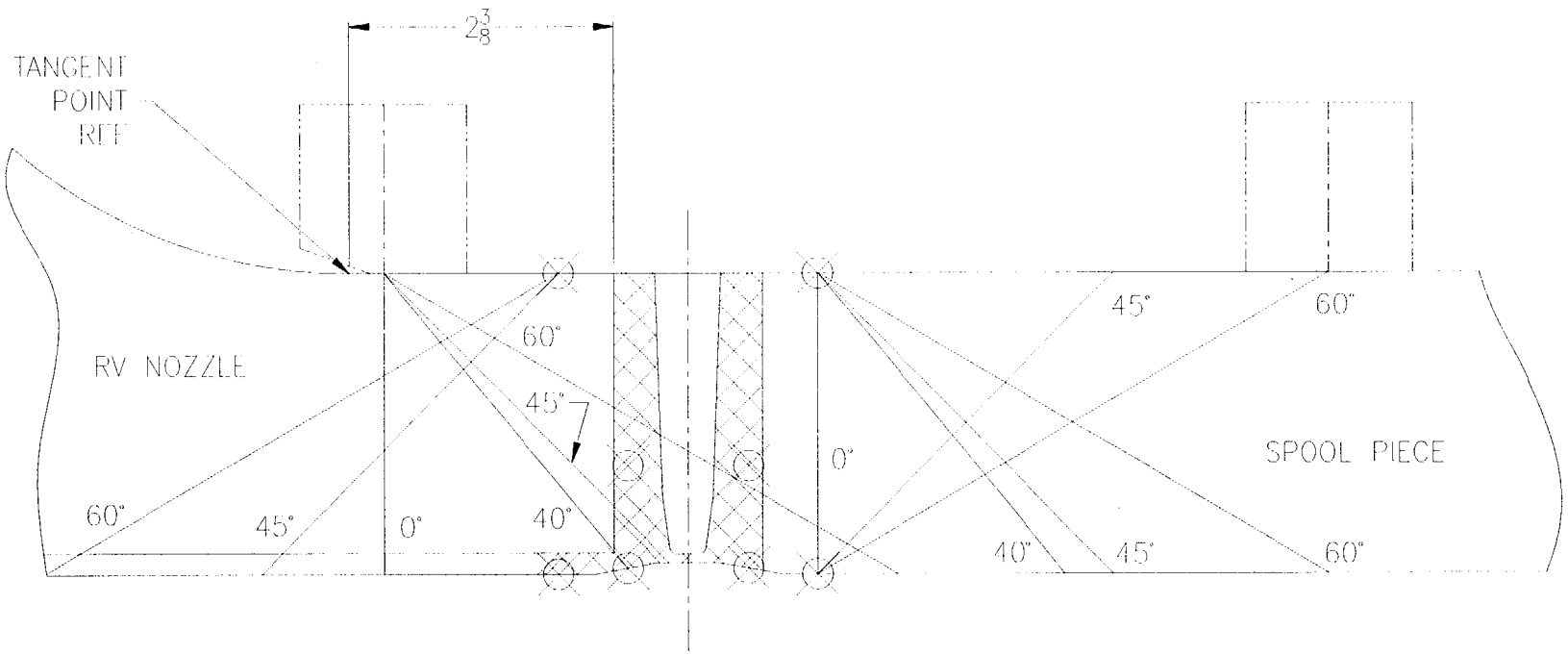
Spool Piece Buttering Examination Technique



Nozzle to Pipe Weld NDE

- Intermediate UT at ¾" weld thickness
  - Manual examination to ensure weld root integrity
  - Technique developed and demonstrated on partial weld mockup
- PT examination after final welding and surface prep
- Final UT after surface examination
  - Automated examination from the OD surface
  - Examination to satisfy the Section III and Section XI requirements
  - Examination based upon PDI qualified procedure, techniques, and equipment
  - Procedure includes the use of refracted longitudinal wave
  - Scan plans and examination angles developed to provide 100% coverage of the Section III and Section XI examination volumes
  - Procedure capabilities to be demonstrated on EPRI dissimilar metal weld mockup

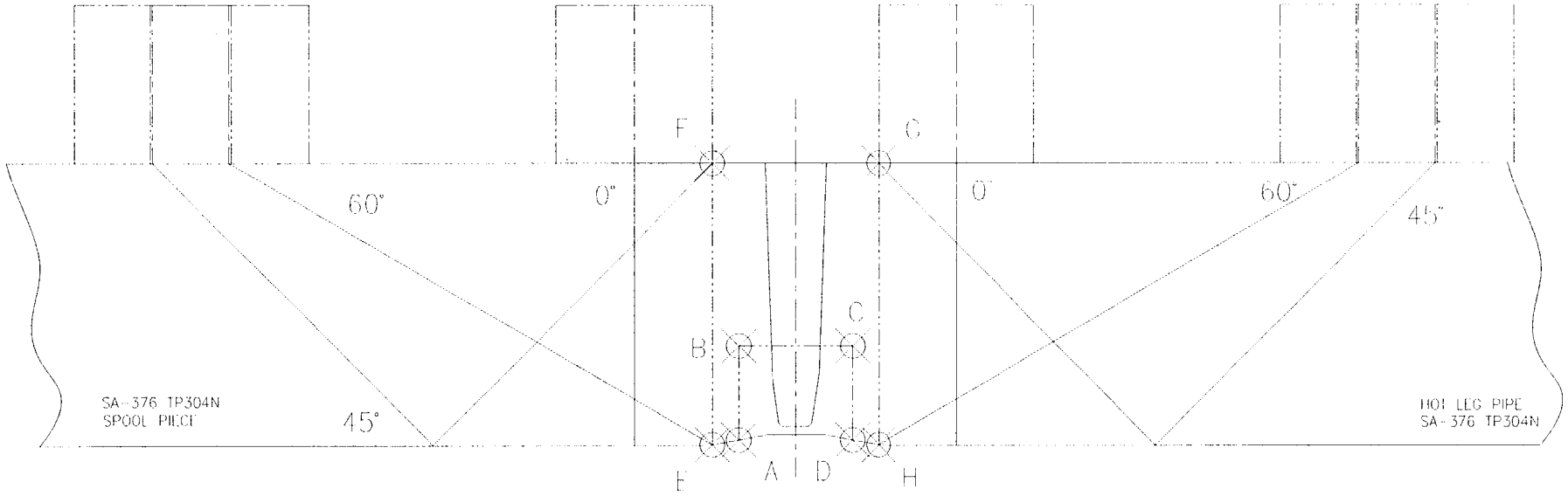
Nozzle to Pipe Weld Examination Coverage



Pipe to Pipe Weld NDE

- PT examination of the weld prep prior to welding
- UT in lieu of RT
- Intermediate UT at ¾" weld thickness
  - Manual examination to ensure weld root integrity
  - Technique developed and demonstrated on partial weld mockup
- PT examination after final welding and surface prep
- Final UT after surface examination
  - Manual examination
  - Examination performed with procedures, equipment, and personnel qualified to Appendix VIII, Supplement 2 requirements in accordance with the PDI program
  - Procedure modified to include the requirements to satisfy the Section III full volume requirements
  - 100% coverage of the Section III and Section XI examination volumes

Pipe to Pipe Weld Examination Coverage



NDE Code Compliance

- Nozzle to Pipe Weld
  - Examinations performed in accordance with the 1992 Edition of ASME Sections III and XI

- Pipe to Pipe Weld
  - Examinations performed in accordance with the 1992 Edition of ASME Section III and the 1995 Edition with 1996 Addenda of ASME Section XI

NDE Demonstration/Qualification

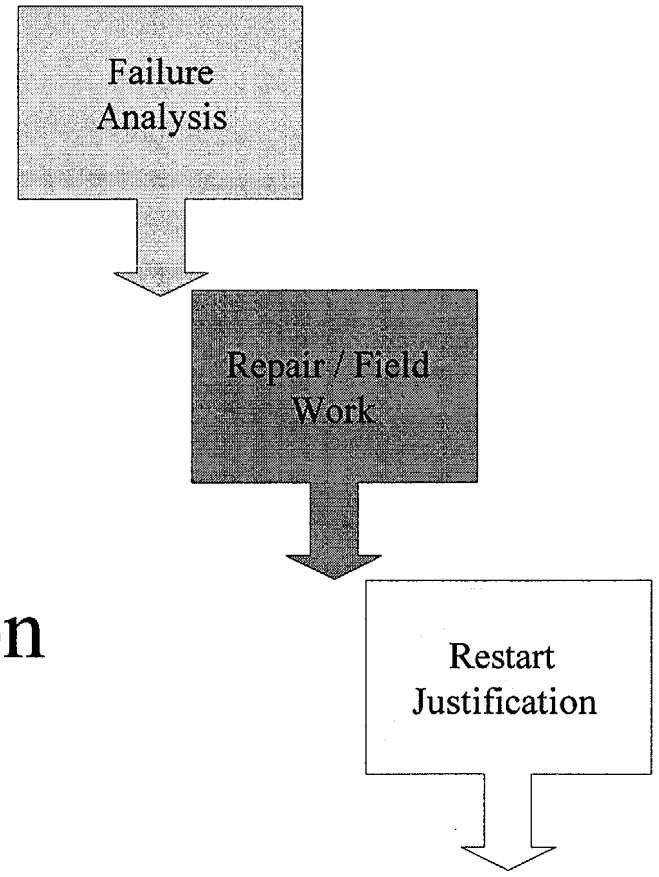
- Intermediate UT at ¾" Weld Thickness
  - Mockup welded to ¾" weld thickness
  - Machined reflectors to represent lack of fusion at root and along face of weld to ¾" thickness
- Final Nozzle to Pipe Weld NDE
  - Procedures based on PDI qualified techniques
  - EPRI dissimilar metal weld mockup
    - Demonstrate ability to detect cracks in buttering
    - Demonstrate ability to detect cracks in weld metal
- Final Pipe to Pipe Weld NDE
  - PDI qualified procedures

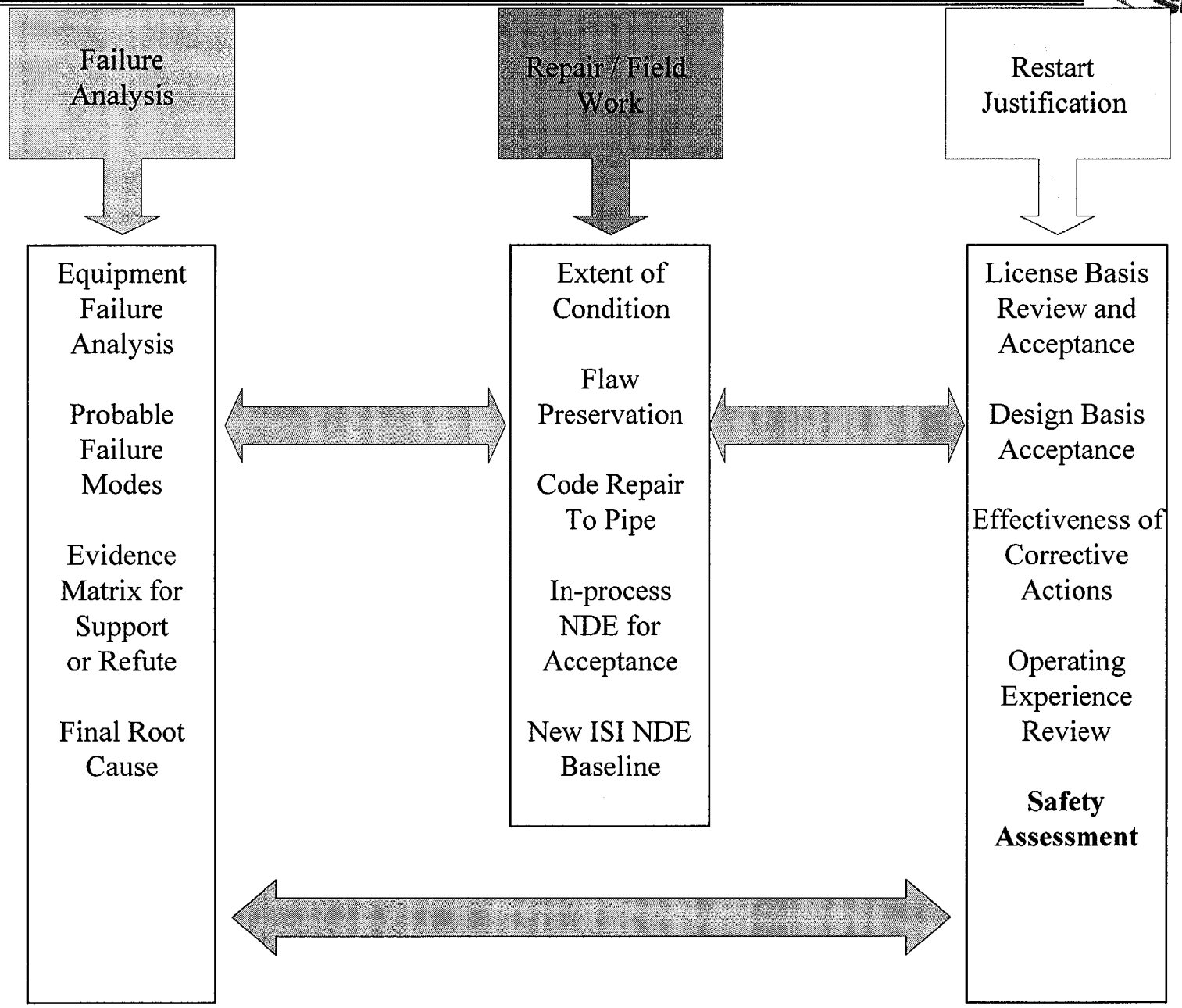
Integrated Strategy

Greg Halnon

Integrated Strategy

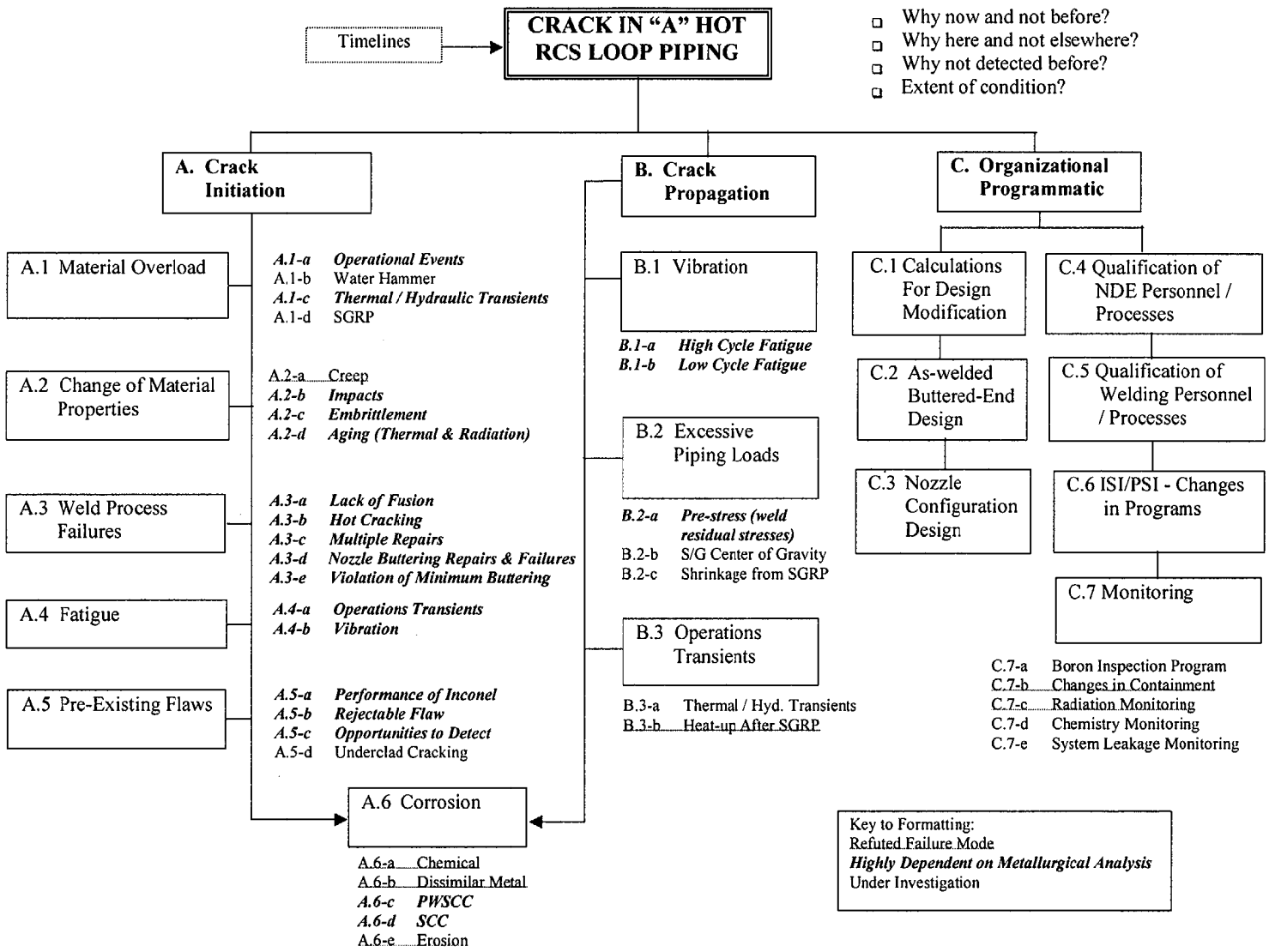
- Three Key Areas of Resolution
  - –Root Cause
  - –Repair
  - –Restart Justification




Failure Analysis
Repair / Field Work
Restart Justification
Equipment Failure Analysis
Probable Failure Modes
Evidence Matrix for Support or Refute
Final Root Cause
Extent of Condition
Flaw Preservation
Code Repair To Pipe
In-process NDE for Acceptance
New ISI NDE Baseline
License Basis Review and Acceptance
Design Basis Acceptance
Effectiveness of Corrective Actions
Operating Experience Review
Safety Assessment

Root Cause Status

Rev. 9 - 11/16/00



Root Cause Approach

- Main Areas of Investigation
  - Crack Initiation
  - Crack Propagation
  - Organizational/programmatic
- Much Is Waiting on Fracture Analysis
- Schedule
  - First Week in December for Preliminary Report
  - Expect Specimen Arrival at Hot Cell This Week

Westinghouse Analysis

- As Received ID & OD Surface Examinations
- X-Ray, UT, and Eddy Current Non-Destructive Examinations.
- Destructive Examination Including
  - Metallographic Examinations
  - Fractographic Examinations
  - Chemistry Evaluations
  - Mechanical Property Examinations

Extent of Condition

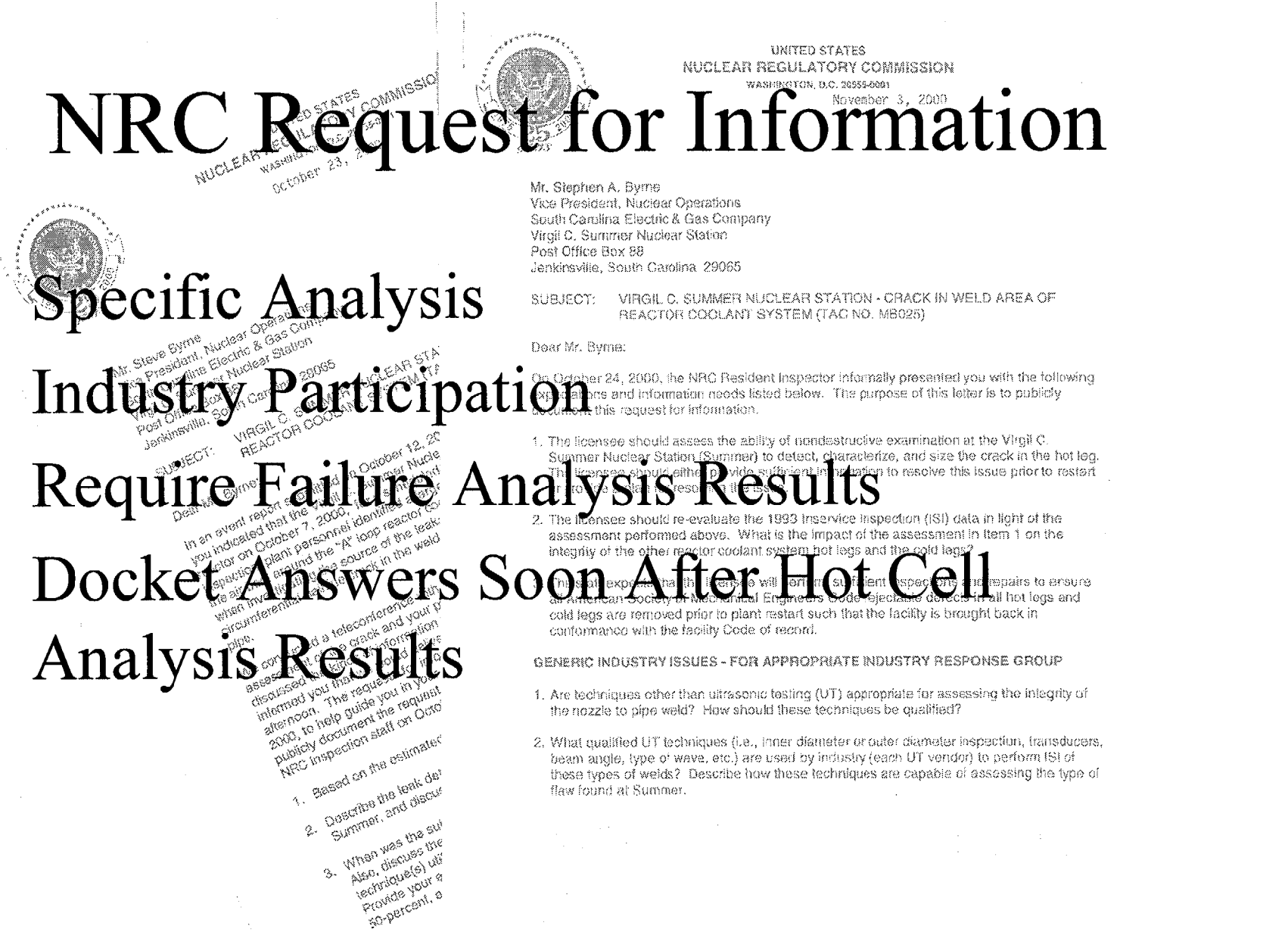
- Weld Is Unique
  - First Weld During Construction
  - Extent and Method of Repairs During Construction
    - Complete ID Removal Combined With OD Weld
    - Made This Weld Similar to Ringhals Configuration
  - Materials Properties of Weld
    - Videos Show Extensive Cold Working of Material
    - Extensive Hand Grinding

Extent of Condition

- Other Legs
  - All Local Repairs. No Significant Concerns With Weld Techniques
  - Welds Reflect Original Design
  - Cold Legs Are Lower Stress and Lower Temperature Environment
  - No Other Indications of Leakage
- UT Of All Other Legs Have No Indications
  - 93 UT and 2000 UT Showed No Detectable Flaws
- Eddy Current Results Under Study

NRC Request for Information

- Specific Analysis
- Industry Participation
- Require Failure Analysis Results
- Docket Answers Soon After Hot Cell Analysis Results



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 3, 2000

Mr. Stephen A. Byrne
Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
Jenkinsville, South Carolina 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - CRACK IN WELD AREA OF REACTOR COOLANT SYSTEM (TAC NO. MB025)

Dear Mr. Byrne:

On October 24, 2000, the NRC Resident Inspector informally presented you with the following questions and information needs listed below. The purpose of this letter is to publicly document this request for information.

1. The licensee should assess the ability of nondestructive examination at the Virgil C. Summer Nuclear Station (Summer) to detect, characterize, and size the crack in the hot leg. The licensee should either provide sufficient information to resolve this issue prior to restart or [illegible]

2. The licensee should re-evaluate the 1993 inservice inspection (ISI) data in light of the assessment performed above. What is the impact of the assessment in Item 1 on the integrity of the other reactor coolant system hot legs and the cold legs?

[illegible] expand the scope of its current inspections and repairs to ensure the American Society of Mechanical Engineers Code rejectable defects in all hot legs and cold legs are removed prior to plant restart such that the facility is brought back in conformance with the facility Code of record.

GENERIC INDUSTRY ISSUES - FOR APPROPRIATE INDUSTRY RESPONSE GROUP

1. Are techniques other than ultrasonic testing (UT) appropriate for assessing the integrity of the nozzle to pipe weld? How should these techniques be qualified?

2. What qualified UT techniques (i.e., inner diameter or outer diameter inspection, transducers, beam angle, type o' wave, etc.) are used by industry (each UT vendor) to perform ISI of these types of welds? Describe how these techniques are capable of assessing the type of flaw found at Summer.

Schedule Milestones

DATE	ACTIVITY
This Week	Ship Weld to Westinghouse
Complete	STEP 1: Spool Piece Removal & Counterbore
This Week	STEP 2: Rebuttering of Nozzle
1st Week Dec	STEP 3: Machine Weld Preps
2nd Week Dec	STEP 4: Install Replacement Spool Piece
Early Dec	Data From Hot Cell Analysis
Mid Dec	Complete NDE on New Hot Leg Welds
Mid Dec	Normal Startup Sequence

Summary

- Industry Experts to Augment VCSNS Staff
- 3rd Party Reviews to Ensure:
  - Comprehensive Strategy
  - Technical Adequacy
  - Regulatory Compliance
- Failure Will Be Understood and Repaired Prior to Restart
  - Safety Foremost
  - Actions to Prevent Recurrence
  - Extent of Conditions Addressed

Closing Remarks

Steve Byrne

Vice President Nuclear Operations Division