May 22, 1997

CAL NO. 2-97-003

Duke Power Company
ATTN: Mr. J. W. Hampton
Vice President
Oconee Site
P. O. Box 1439
Seneca, SC 29679

SUBJECT: CONFIRMATORY ACTION LETTER (CAL NO. 2-97-003) UPDATE - RESTART OF OCONEE UNITS 2 AND 3

Gentlemen:

This letter is in response to your letter dated May 20, 1997, and confirms in writing, the Regional Administrator's concurrence for restart of Units 2 and 3. Your letter of May 20, 1997, notified the NRC that you have completed those items addressed in CAL NO. 2-97-003, dated May 5, 1997, necessary to restart Units 2 and 3. These items, which involved root cause determination and resultant corrective actions with respect to the High Pressure Injection (HPI) nozzle cracking concern and degradation of the Unit 3 HPI system, were discussed in a Management meeting at the Oconee Nuclear Station on May 16, 1997. At the conclusion of this meeting, the Regional Administrator's concurrence was given for the restart of Units 2 and 3 (pending final system readiness actions, including resolution of HPI pump minimum recirculation flow orifice degradation). This concurrence was based upon our review of the actions you had taken or committed to as discussed during the meeting and subsequently addressed in your May 20, 1997 letter. A list of meeting attendees and a copy of your presentation handout are enclosed.

In addition to addressing the restart readiness of Units 2 and 3, your May 20, 1997, letter also reiterated the related actions previously committed to in your letter dated May 16, 1997. Included in these committed actions are the shutdown of Unit 1 no later than June 14, 1997, in order to perform appropriate examinations of HPI nozzle components and make letdown storage tank level and pressure instrument modifications. Accordingly, as discussed during the aforementioned meeting, the Unit 1 compensatory actions addressed in actions (2) and (3) of the CAL will remain in effect until Unit 1 is shutdown.

In accordance with 10 CFR 2.790(a) of the NRC's "Rules of Practice", Part 2, Title 10, Code of Federal Regulations, a copy of this letter and its enclosures will be placed in the NRC Public Document Room.

ADD: ACRS 1/1
NRR/DSSA 1/1
Region 1/1

040022

1/1

IE36

Should you have any questions concerning this matter, please contact us.

Sincerely,

Original signed by:
Luis A. Reyes
Regional Administrator

Docket Nos. 50-269, 50-270, and
50-287
License Nos. DPR-38, DPR-47,
and DPR-55

Enclosures:
1. List of Attendees
2. Licensee Presentation Handouts

cc w/encls:
Mr. J. E. Burchfield
Compliance
Duke Power Company
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Seneca, SC 29679

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Duke Power Company
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Mr. Robert P. Gruber
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Mr. Robert B. Borsum
Framatome Technologies
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Washington, D. C. 20005

cc w/encls cont'd: (See page 3)

cc w/encls cont'd:
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South Carolina Department of Health
and Environmental Control
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County Supervisor of
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Walhalla, SC 29621

Manager, LIS
NUS Corporation
2650 McCormick Drive
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Duke Power Company
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B. Uryc, RII
C. Evans, RII
G. Tracy, OEDO
R. Carroll, RII
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J. Jaudon, RII
PUBLIC

NRC Resident Inspector
U.S. Nuclear Regulatory Commission
78128 Rochester Highway
Seneca, SC 29672

office	RII:DRP	RII:DRP	HQ:NRR	RII:DRP	RII: ORA	RII :DRS
signature						
name	RCARROLL	CCASTO	HBERKOW (w) DH	JJOHNSON	BSmallett	H. Christensen
date	05/21/97	05/21/97	05/21/97	05/21/97	6/2/97	5/21/97
COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY DOCUMENT NAME: G:\CAL29700.30C

LIST OF ATTENDEES

NUCLEAR REGULATORY COMMISSION

L. Reyes, Regional Administrator, Region II (RII)
C. Casto, Chief, Reactor Projects Branch 1, Division of Reactor Projects (DRP), RII
W. Holland, Chief, Maintenance Branch, Division of Reactor Safety (DRS), RII
E. Girard, Reactor Inspector, Special Inspection Branch, DRS, RII
M. Scott, Senior Resident Inspector, Oconee, DRP, RII

DUKE POWER COMPANY

J. Hampton, Vice President, Oconee Nuclear Station (ONS)
B. Peele, Station Manager, ONS
J. Davis, Engineering Manager, ONS
T. McConnell, Station Support Manager, Nuclear General Office

ENCLOSURE 1

Oconee Nuclear Station Restart Activities Meeting

NRC/Duke Meeting

May 16, 1997

Agenda

- Introduction - Jim Hampton
- Current Plant Status - Joe Davis
- RCS Leak - Joe Davis
  - » Overview, History, and Sequence of Events
  - » Root Cause
  - » Corrective Actions
- Loss of Suction to two HPI Pumps - Jack Peele
  - » Overview and Sequence of Events
  - » Root Cause
  - » Corrective Actions
- Confirmation of Action Letter Summary - Jack Peele
- Schedule/NRC Interface - Jack Peele
- Summary - Jim Hampton

3

Current Plant Status

- Unit 2:
  - » Progressing toward hot shutdown
  - » 2A1 RCS safe end, thermal sleeve, and pipe to 1st valve replaced
  - » Other HPI nozzle components examined and found acceptable
  - » Significant portions of root cause for RCS leak complete
  - » Monitoring equipment on HPI lines installed
  - » LDST instrumentation modifications complete

4

Current Plant Status

- Unit 3:
  - » Cold Shutdown
  - » Replaced 3A1 RCS safe end, thermal sleeve, and pipe to 1st valve
  - » Examination of HPI nozzle components complete
  - » Repairs of HPI pumps in progress
  - » LDST modifications in progress
  - » Significant portions of investigation of root cause of loss of suction to HPI pumps complete
  - » SEIT complete and AIT exited on 5/9
- Unit 1:
  - » Operating at 100% Full Power

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RCS Leak

- System Overview
  - » HPI System serves as high pressure makeup system to RCS
  - » HPI System has two normal and two emergency makeup paths
  - » HPI System interfaces with RCS piping via nozzle components
  - » Nozzle and safe end protected from thermal gradients by thermal sleeve

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RCS Leak

- History of Nozzle Component Failures
  - » Safe end to pipe weld and thermal sleeve failed resulting in RCS leak at Crystal River Plant in early 1982
  - » BWOG issued report in late 1982 with recommendations to owners regarding HPI nozzle components
  - » BWOG report generally recommended:
    - Inspect and repair/re-roll/replace damaged nozzle components
    - Implement an augmented examination plan for nozzle components
    - Perform analysis on improved designs
  - » Oconee committed to recommendations of BWOG report
  - » NRC endorsed recommendations of BWOG in GL 85-20
  - » GL 88-08 requirements met

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RCS Leak

- Oconee Actions per BWOG Report:
  - » Actions taken on HPI nozzle components for Units 2 and 3 prior to 1985:
    - 2A2, 3A2: Installed new safe end and thermal sleeve
    - 2B2: Replaced existing thermal sleeve with new design
    - 2A1, 3A1, 3B2: Left as originally installed
    - 2B1, 3B1: Rerolled original thermal sleeve

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RCS Leak

- Oconee Actions per BWOG Report:
  - » Placed general augmented examination requirements for HPI nozzle components in ASME Section XI ISI Plan per GL 85-20

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RCS Leak

- Oconee Actions per BWOG Report:
  - » Performed augmented examinations:
    - – 1996 results on Unit 2:
      - 2A1 - thermal sleeve gap increasing
      - 2A2, 2B1, 2B2 - no thermal sleeve gap increase
    - – 1996 results on Unit 3:
      - 3A1 - thermal sleeve gap increasing
        - » 1984-1985- observed gap increase
        - » 1989-1996-observed gap increase
      - 3A2, 3B1, 3B2 - no thermal sleeve gap increase
    - – Failed to recognize indications of thermal sleeve gap increase A1 nozzles

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RCS Leak

- Sequence of Events

Time	Event
4/21/97 2245	Reactor Operator (RO) receives indications of a Reactor Coolant System (RCS) leak. Calculated RCS leakage ~ 1gpm
4/21/97 2337	RCS leakage exceeded Technical Specification Limits for unidentified RCS leakage.
4/22/97 0200	Calculated RCS leakage ~ 2.8 gpm
4/22/97 0215	Reactor Building entry to investigate leak source. Unable to determine exact source of RCS leak.

RCS Leak

- Sequence of Events

Time	Event
4/22/97 0352	Commenced Reactor Shutdown due to RCS leakage.
4/22/97 1300	Initiated FIP investigation.
4/22/97 1600	Declared Unusual Event on Unit 2 due to RCS leakage in excess of 10 gpm. Unit shutdown/cooldown in progress.
4/23/97 0547	Reactor Building entry determines source of leak from a crack in HPI 2A1 injection line on safe end to pipe weld.

RCS Leak

- Findings:
  - » A leak occurred in the pipe to safe end connection weld at the 2A1 HPI nozzle
  - » Crack in weld was circumferential, with a portion being through-wall
  - » Crack propagated slowly
  - » Details of crack described in JCO for Unit 1

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RCS Leak

- Root Cause(s)
  - » Ineffective examination program for HPI nozzle components
    - – Inadequate examination procedures
    - – Unclear acceptance criteria
  - » Related finding:
    - – Examination commitments inadequately controlled by the ISI program

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RCS Leak

- Failure Mechanisms
  - » High cycle low / stress thermal fatigue initiated failure in weld
  - » Flow induced vibration contributed to thermal sleeve failure after loosening

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RCS Leak

- Completed Corrective Actions:
  - » Replaced thermal sleeve and safe end with new design for 2A1 HPI normal injection line
  - » Examined other Unit 2 HPI nozzle components
  - » Shut down Unit 3 to examine nozzle components
  - » Replaced thermal sleeve and safe end with new design for 3A1 HPI normal injection line
  - » Installed temporary instrumentation for monitoring of Unit 2 nozzles
  - » Installing instrumentation on Unit 3

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RCS Leak

- Completed Corrective Actions (Continued)
  - » Heightened awareness to RCS leakage rate on Unit 1
  - » NRC commitments reviewed to identify all augmented inspection requirements
  - » Augmented examinations completed on Units 2 & 3 exceed GL 85-20 requirement

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RCS Leak

- Long Term Corrective Actions
  - » Shut down Unit 1 and perform appropriate examinations
  - » Evaluate warming line flow to reduce effects of thermal stress
  - » Review of Operations procedures to minimize HPI nozzle component thermal stress and fatigue

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RCS Leak

- Long Term Corrective Actions
  - » Improve nozzle component examination program
    - – Develop tracking system for augmented examinations
    - – Develop specific examination procedures for augmented examinations
    - – Improvements complete by September 1997 refueling outage

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RCS Leak

- Other Corrective Actions
  - » Inspections during the upcoming Unit 1 maintenance outage will include UT and RT of nozzle components
  - » Specific UT/RT plans and schedules will be submitted by 30 days prior to the U1EOC17 Refueling Outage

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RCS Leak

- Summary
  - » Unit 2 weld failed due to thermal fatigue
  - » Thoroughly investigated the event
  - » Reviewed augmented examinations
  - » Augmented examination program improvements will assure integrity of the system is maintained
  - » Instrumented injection lines will aid in understanding of thermal phenomena

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Loss of Suction to HPI Pumps

- Agenda
  - » Brief System Description
  - » Sequence of Events
  - » Root Causes
  - » Contributing Factors and Observations
  - » Corrective Actions Complete
  - » Corrective Actions prior to Restart
  - » Long Term Corrective Actions
  - » Summary

22

Loss of Suction to HPI Pumps

- Initial Conditions
  - » Unit 3 being shut down to investigate HPI nozzle components
  - » Decay Heat Removal (3C LPI Pump) in service
  - » Approaching end of Unit 3 cooldown, lost suction to 3A and 3B HPI pumps

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Loss of Suction to HPI Pumps

- System Description
  - » 3 HPI Pumps, 300 gpm at 3,100 psig
  - » Provides normal makeup and seal injection from LDST
  - » Provides emergency makeup from BWST
  - » Normal Operation is one pump on, one in standby
  - » Standby pump auto starts on low seal injection flow or after some loss of power scenarios
  - » All three pumps start on ES signal
  - » LDST level and pressure manually controlled in band
  - » LDST level instrumentation not used for accident mitigation

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Loss of Suction to HPI Pumps

- Sequence of Events

Time	Event
(Initial Conditions)	Unit 3 shut down, cool down in progress, 3B HPI pump in RUN, 3A HPI pump in STBY, RCS< 250 F / 300 psig.
5/3/97 0700-0745	RCS cooldown. Indicated LDST level decreases, indicated pressurizer level decreases
5/3/97 0745-0912	RCS cooldown. Indicated LDST level constant, indicated pressurizer level decreases
5/3/97 0913	Low HPI pump discharge pressure alarm
5/3/97 0915	3A HPI pump auto starts (low seal injection flow) and runs intermittently for 17 minutes

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Loss of Suction to HPI Pumps

- Sequence of Events

Time	Event
5/3/97 0917	3B HPI pump secured. 3A HPI pump continues to run.
5/3/97 0921	Opened HP-24 (BWST supply).
5/3/97 0928	Closed HP-24.
5/3/97 0932	3A HPI pump secured. Operators make up to LDST to indicated level of 92". Letdown from RCS isolated. Entered AP for Loss of HPI Makeup.
5/3/97 ~1030	Completed AP for Loss of HPI Makeup. Unit status: RCP running, LPI pump in decay heat removal mode, letdown isolated. Began development of procedure to use 3C HPI pump for RCS makeup.

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Loss of Suction to HPI Pumps

- Sequence of Events

Time	Event
5/3/97 ~1030	Site VP requests SEIT Team investigation. FIP investigation initiated.
5/3/97 1504	Unusual Event declared.
5/3/97 1515	LDST level instrument reference leg discovered to be empty by I&E. I&E entered procedure to recalibrate instrument and refill reference leg.
5/3/97 1547	NRC notified of event.

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Loss of Suction to HPI Pumps

- Sequence of Events

Time	Event
5/4/97 1030	Contingency plan for Unit 3 shutdown using 3C HPI pump, and backup contingency plan for using no HPI pumps completed and approved.
5/4/97 1124	Unit 3 cooldown commenced using 3C HPI pump for makeup.
5/5/97 1943	Status: Unit 3 cooldown essentially complete. 3C HPI pump secured.
5/5/97 1946	Secured Unusual Event.
5/5/97 2135	HPI system realigned

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Loss of Suction to HPI Pumps

- Root Cause of Event:
  - » Design weakness of a common reference leg for LDST level instruments combined with a leaking instrument fitting that resulted in inaccurate LDST level indication
  - » Failure of Control Room team to properly monitor and detect the inaccurate level indications given the existing plant conditions.
- Contributing Cause:
  - » Failure to adequately apply available operating experience

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Loss of Suction to HPI Pumps

- Cause of Fitting Leak:
  - » Scratches on seating surfaces
  - » Over torquing cap

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Loss of Suction to HPI Pumps

- Other Issues:
  - » Procedure Problems
    - – Usefulness of AP
    - – Inventory Guidance during Cooldown
    - – Coverage during Contingency Planning
    - – 3C HPI pump procedure omission
  - » Modification Selection

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Loss of Suction to HPI Pumps

- Other Issues continued:
  - » Configuration and Labeling of Root Valves
  - » Operator Training
  - » Mixed Vendor Fittings / Calibration Practices
  - » Philosophy on Abnormal Procedure Use / Knowledge vs. Rule Based

32

Loss of Suction to HPI Pumps

- Completed Corrective Actions:
  - » Initiated Detailed (FIP) and General (SEIT) event investigation teams
  - » Activated support organizations (OSC, TSC) as necessary to assist plant recovery
  - » Recalibrated and refilled reference leg on LDST level instrument
  - » Re-established operable HPI makeup path
  - » Completed Unit 3 cooldown and depressurization
  - » Revised Unit 1 AP to include 1HP-5 closure

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Loss of Suction to HPI Pumps

- Completed Corrective Actions:
  - » Completed FIP and SEIT investigations
  - » Established heightened awareness of monitoring of Control Room instrumentation
  - » For Unit 1, verify LDST reference leg weekly; check reference leg tubing fittings for leaks each shift
  - » Reported Unit 3 HPI system past inoperability

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Loss of Suction to HPI Pumps

- Corrective Actions Prior to Restart:
  - » Perform Modifications on Units 2 and 3 to:
    - add separate reference legs for LDST level transmitters
    - add a redundant LDST pressure transmitter
  - » Repair, inspect, flush, and test Unit 3 HPI system as required
  - » Assess applicability of this event to other tank level instruments
  - » Short-term Operations training on this event, and on LDST modifications
  - » Improve Abnormal Procedure on Loss of HPI makeup

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Loss of Suction to HPI Pumps

- Long Term Corrective Actions:
  - » Perform modifications on Unit 1 to:
    - – add separate reference legs for LDST level transmitters
    - – add a redundant LDST pressure transmitter
  - » Review and benchmark applicable procedures and make necessary improvements
  - » Review modification selection process to assure proper prioritization in light of this event
  - » Operator simulator training on loss of LDST level
  - » Perform reliability study of HPI System

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Loss of Suction to HPI Pumps

- Long Term Corrective Actions:
  - » Improve foreign material and damage inspection work practices for tubing caps and fittings
  - » Modify work practices and develop action plans for addressing "mixed" fittings
  - » Expand our root valve position verification program to include critical root valves outside containment where position is not self-revealing
  - » Examine removed 3A and 3B HPI pumps
  - » Perform root cause of failure to adequately apply OE

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Loss of Suction to HPI Pumps

- Operator Tools to Respond to Events:
  - » Commit-to-Memory Items
  - » Stabilizing the Plant/Skill-of-Operator
  - » Alarm Response Guides
  - » Abnormal Procedures
  - » Emergency Operating Procedures

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Loss of Suction to HPI Pumps

- Operating Experience Program
  - » Prior to 1986:
    - – OEP managed at each site
    - – NRC documents administered by NGO
  - » 1986:
    - – OEP coordinators centralized at NGO to gather, assess, and disseminate operating experience

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Loss of Suction to HPI Pumps

- Operating Experience Program
  - » 1994 and later:
    - – Dedicated staffing with operational focus to provide daily screening of operating experience
    - – Significant item ownership and monitoring
    - – Corrective actions assigned where appropriate
    - – Significant items tracked to completion by owner
    - – OEP database available to site personnel by PC
    - – Corrective action program requires OE review of appropriate items
    - – Daily OE updates to NGD
    - – Daily OE reviews by site management

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Loss of Suction to HPI Pumps

- Summary:
  - » HPI pumps failed due to loss of suction
  - » Thorough investigations completed, root cause well understood
  - » Corrective actions are comprehensive:
    - – Address all three units
    - – Address other similar instrumentation
    - – Focused on prevention of recurrence

Confirmation of Action Letter Summary

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» RCS weld leak actions

» HPI System degradation actions

- Weekly level accuracy checks

» Impact on continued operation of Unit 1

- Enhanced leakage detection and make-up flow guidelines
- JCO
  - working closely with NRC staff
  - various commitments in place
  - conclude safe to continue to operate
  - will shut down NLT June 14th

» Conditions of CAL met

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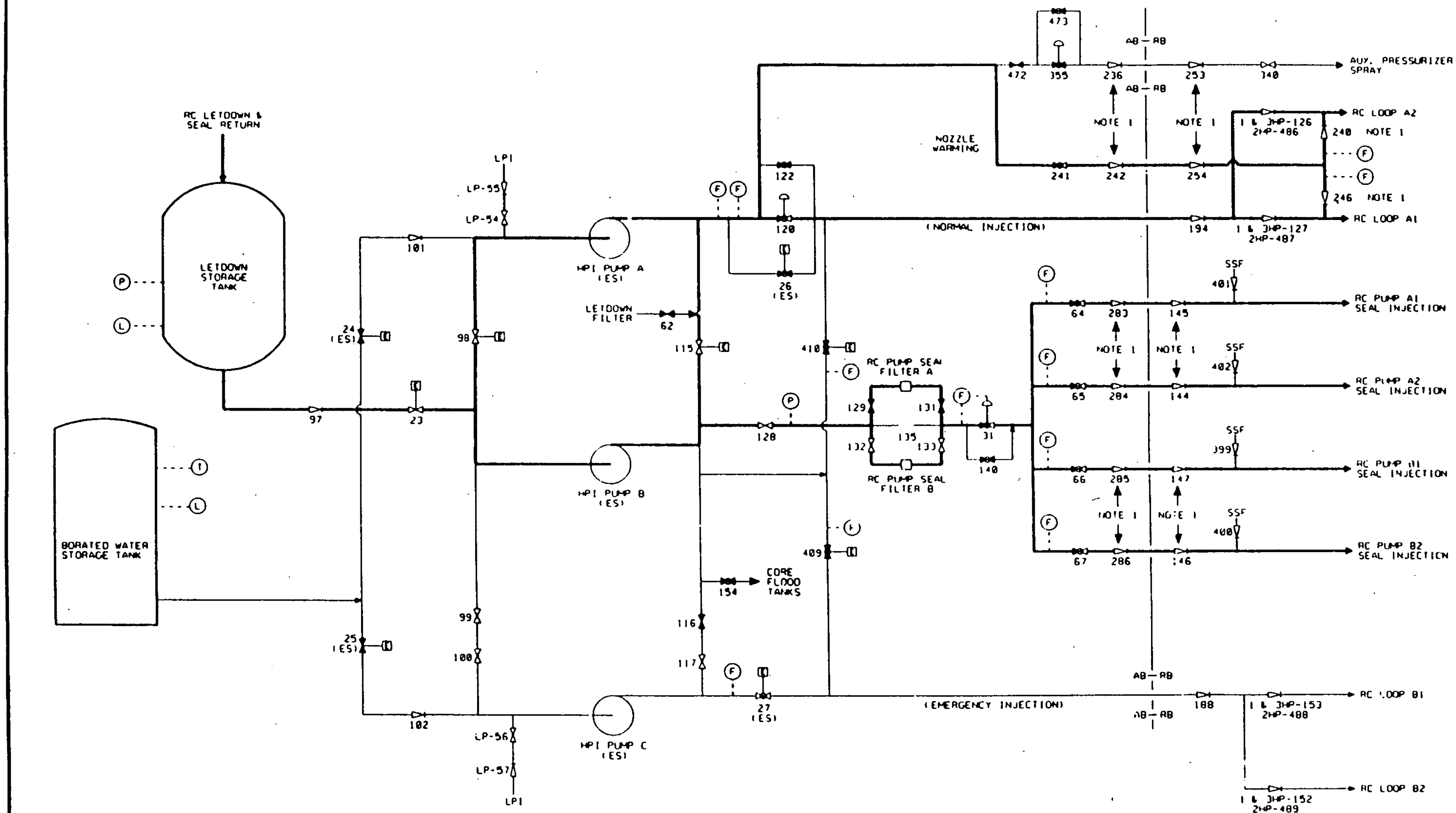
Schedule/NRC Interface

- Unit 2
  - » Restart projected for third week of May
- Unit 3
  - » Restart projected for end of May
- Unit 1
  - » Continuing Operation under JCO until Units 2 and 3 return to steady state power operation
  - » Maintenance outage to perform LDST level inst mod and HPI nozzle inspections
  - » Refueling outage scheduled for early September, 1997
- Coordinate closure of restart issues with Senior Resident Inspector prior to restart



NOTES:

1. CONTAINMENT ISOLATION STOP CHECK VALVES MAY REPRESENT CHECK/GLOBE VALVE COMBINATIONS.

TYPICAL FOR UNITS 1, 2, & 3.
ALL VALVES "HP" EXCEPT AS NOTED.

LEGEND

- SHUTOFF VALVE
- FLOW CONTROL VALVE
- CHECK VALVE (ALL TYPES)
- RELIEF VALVE
- NORMALLY OPEN
- NORMALLY CLOSED
- NORMALLY THROTTLED
- E-ELECTRIC
- H-HYDRAULIC
- P-PISTON (PNEUMATIC)
- S-SOLENOID
- DIAPHRAGM (PNEUMATIC)
- F-FLOW
- L-LEVEL
- P-PRESSURE
- T-TEMPERATURE
- (ES)-RECEIVES ENGINEERED SAFEGUARD SIGNAL

THIS DRAWING IS A SUMMARY FLOW DIAGRAM. FOR COMPLETE SYSTEM DESIGN INFORMATION REFER TO FLOW DIAGRAMS LISTED BELOW.

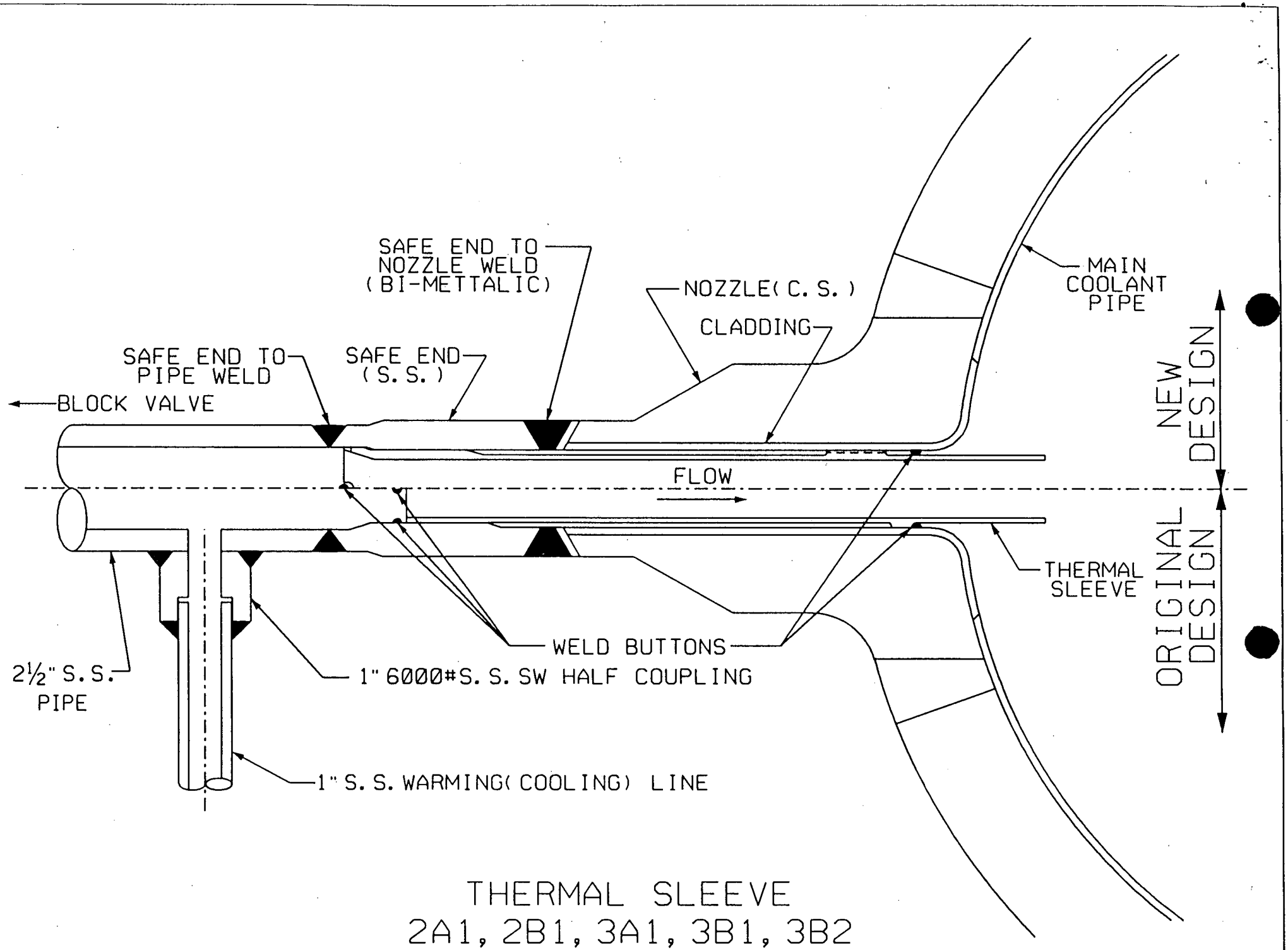
OFD-101A-1.2, 2.2, 3.2 LETDOWN STORAGE TANK
OFD-101A-1.3, 2.3, 3.3 HPI PUMPS
OFD-101A-1.4, 2.4, 3.4 HPI TO RC SYSTEM
OFD-101A-1.5, 2.5, 3.5 SSF PORTION
OFD-102A-1.1, 2.1, 3.1 BWST & LPI
OFD-100A-1.1, 2.1, 3.1 REACTOR COOLANT SYSTEM
OFD-100A-1.3, 2.3, 3.3 REACTOR COOLANT PUMPS

NO.	REVISIONS	DRN	DATE	CKD	DATE	APP	DATE
4	AS-BUILT PER NSM ON-22979/00						
3	REV. PER AS-BUILT CONDITIONS						
2	[illegible]						
1	REVISED PER NSM ON-[illegible]						
	ISSUED FOR INFORMATION						

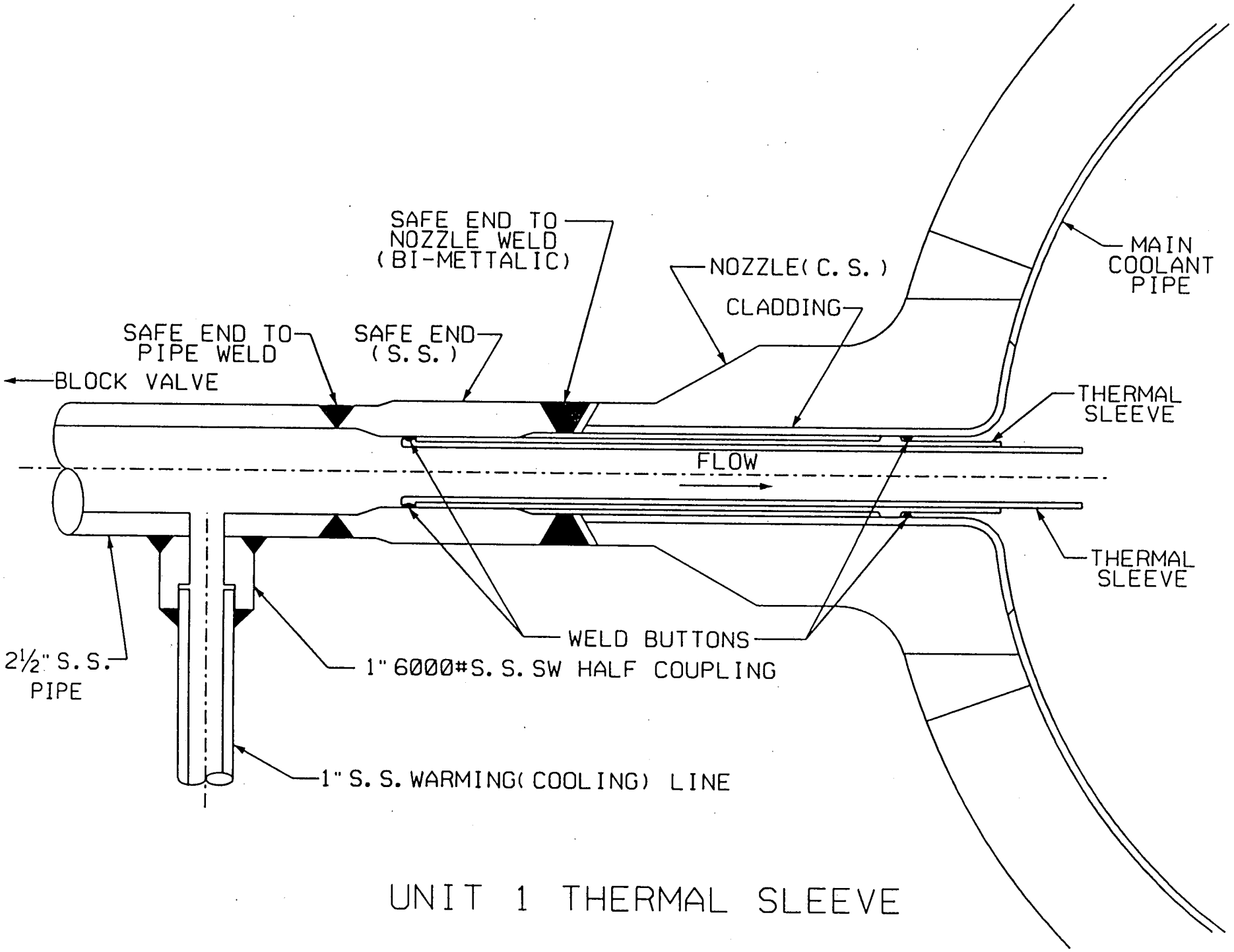
DUKE POWER COMPANY
OCONEE NUCLEAR STATION
SUMMARY FLOW DIAGRAM OF HIGH PRESSURE INJECTION SYSTEM (INJECTION PORTION)

DWG. NO. OSFD-101A-1

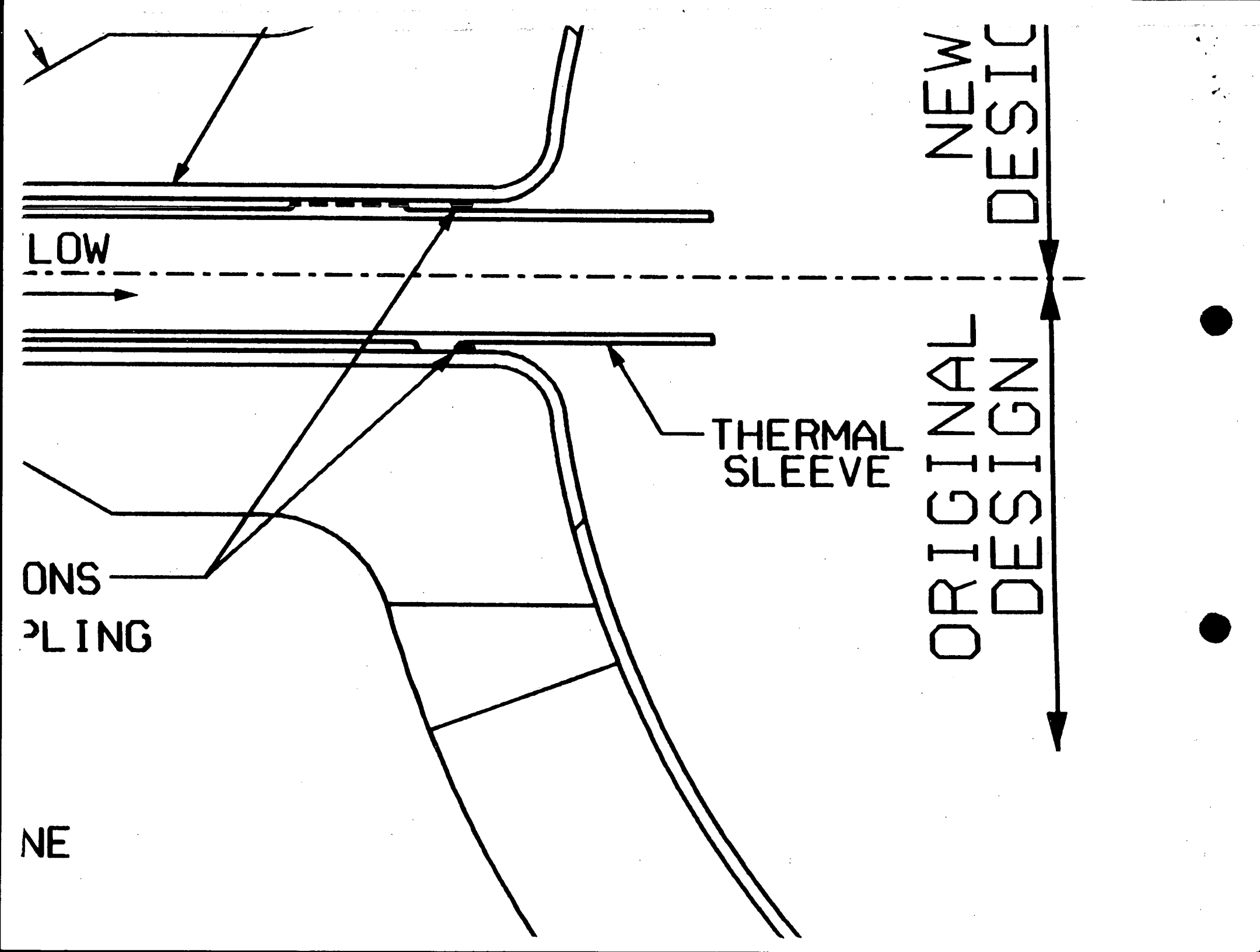
ERN: OX00177Y



THERMAL SLEEVE
2A1, 2B1, 3A1, 3B1, 3B2



UNIT 1 THERMAL SLEEVE


LOW
THERMAL
SLEEVE
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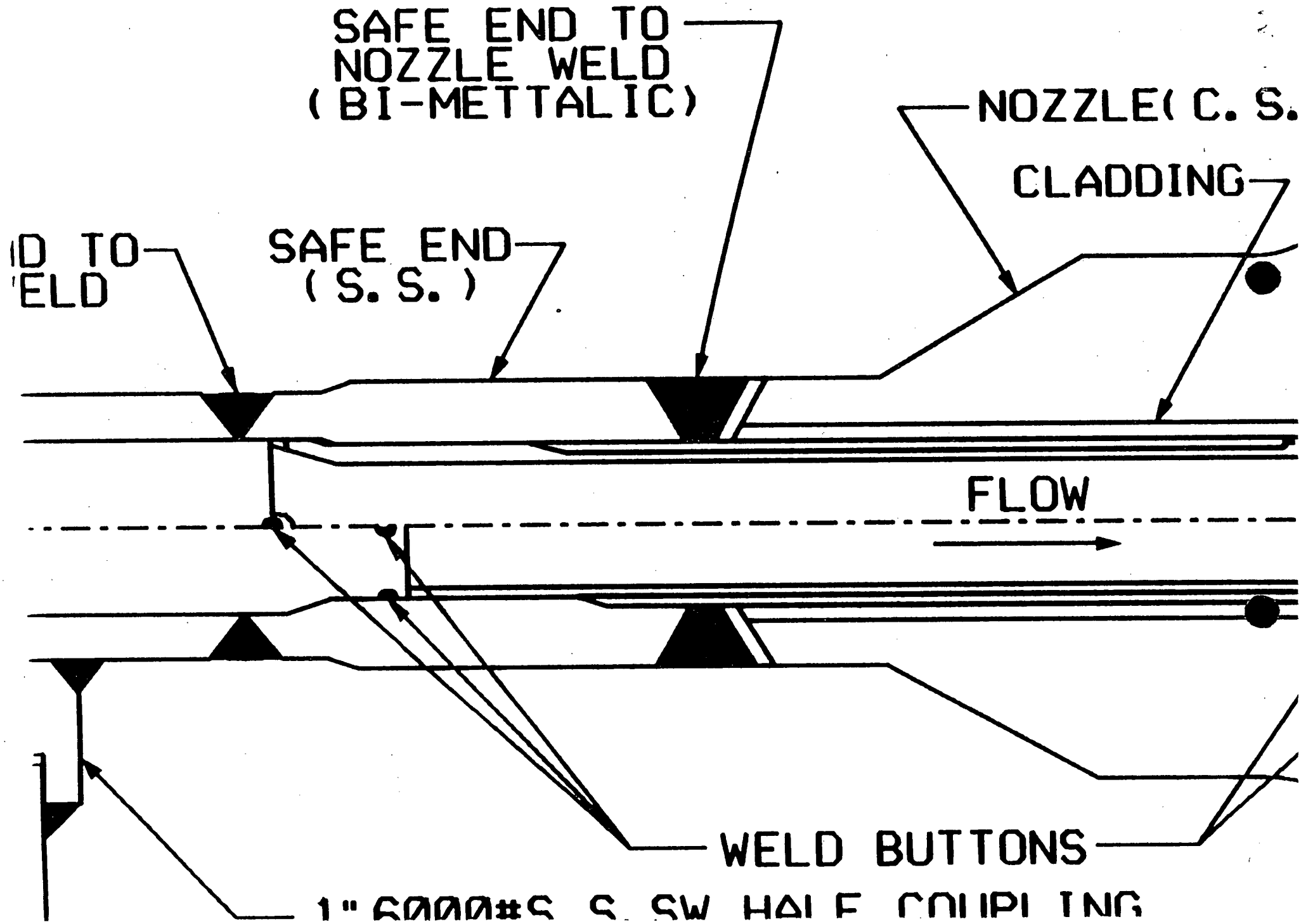
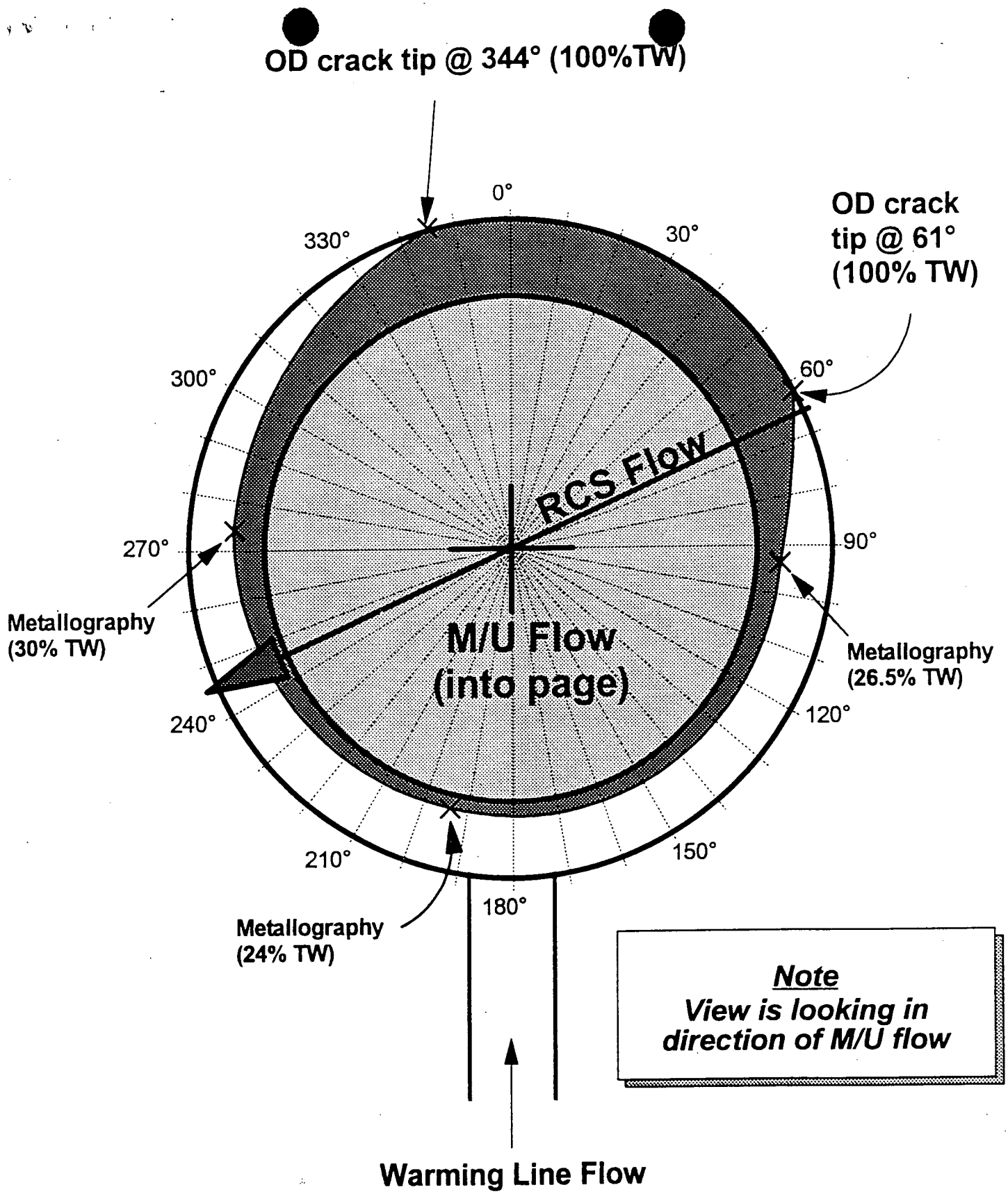
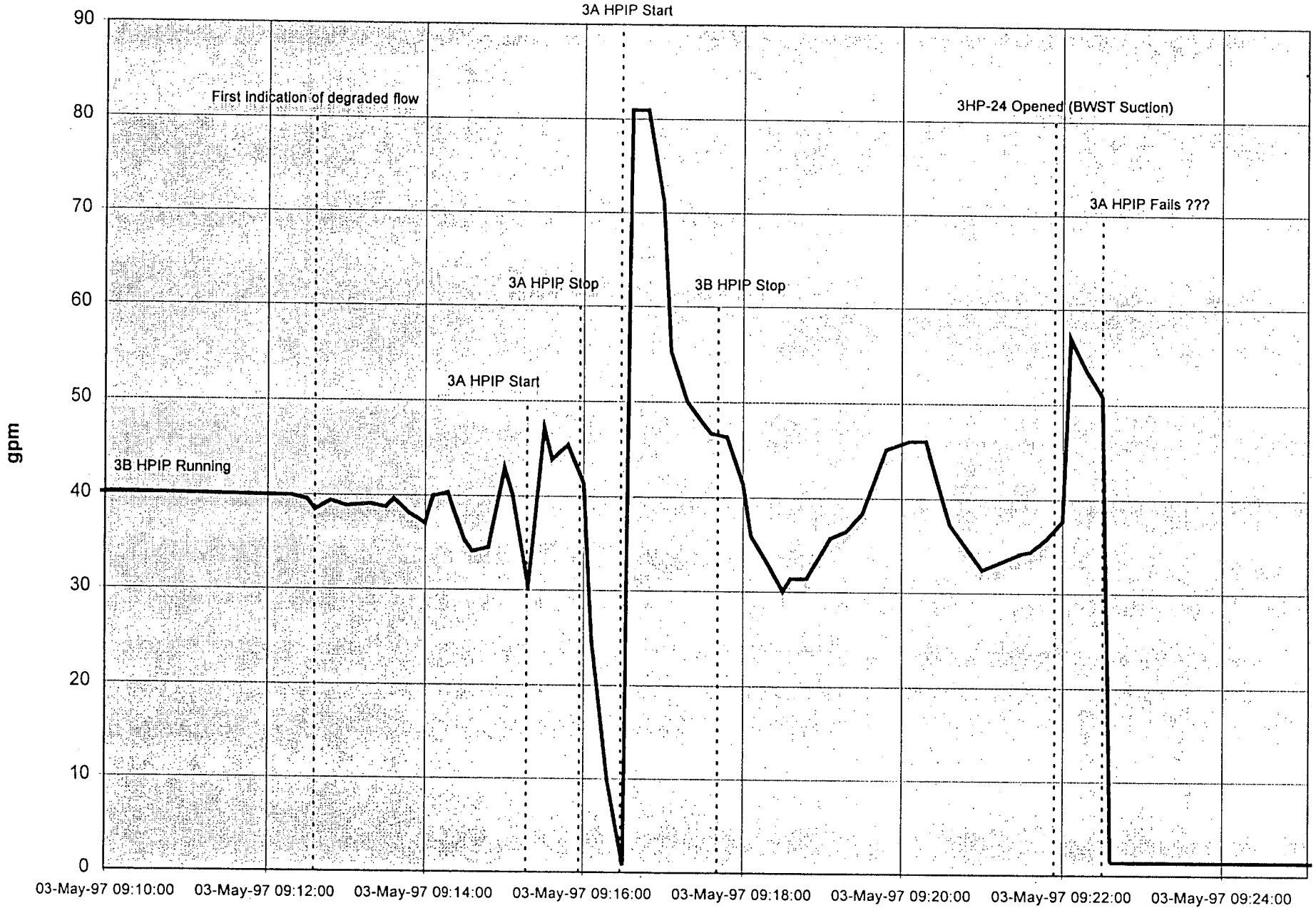
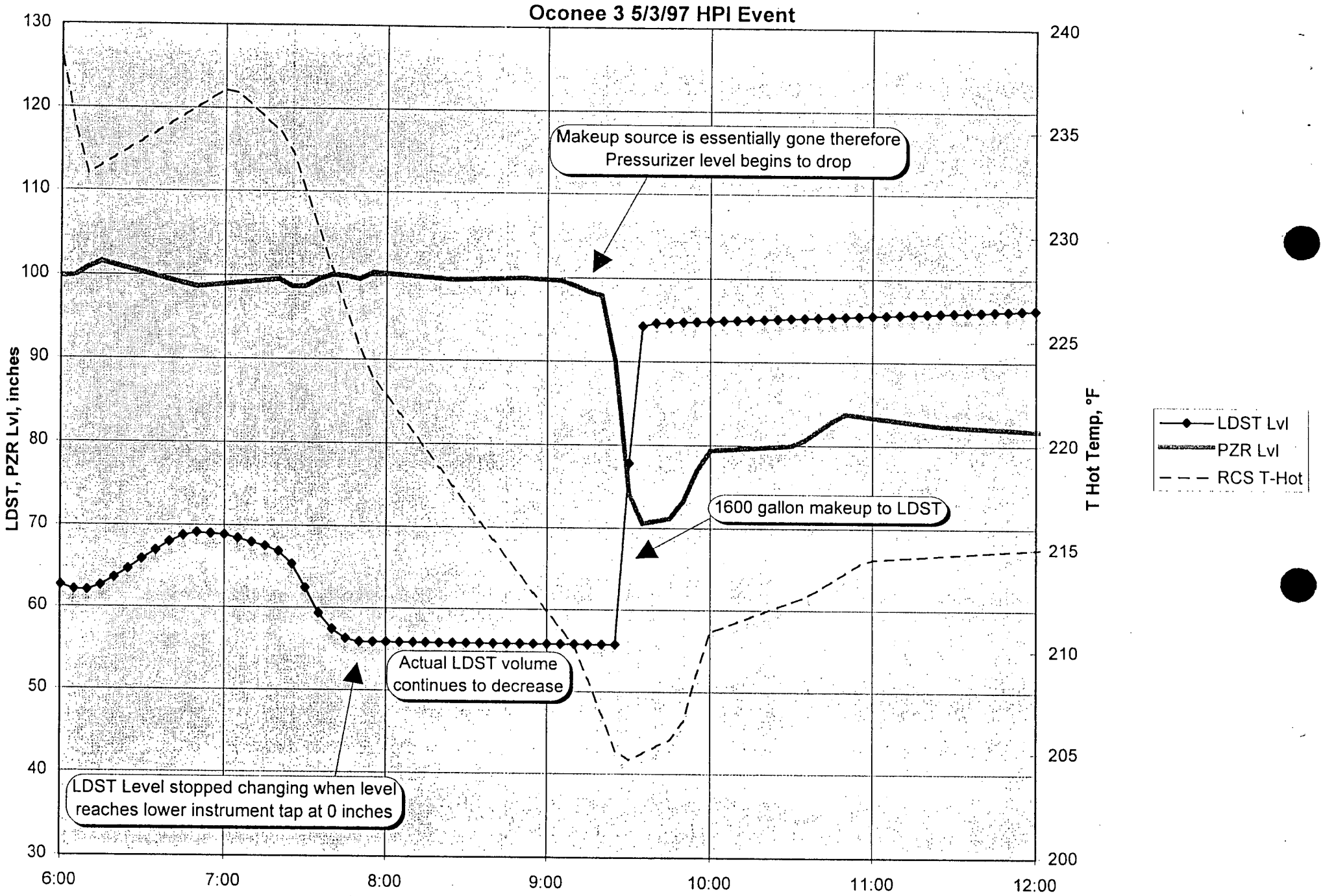
NE

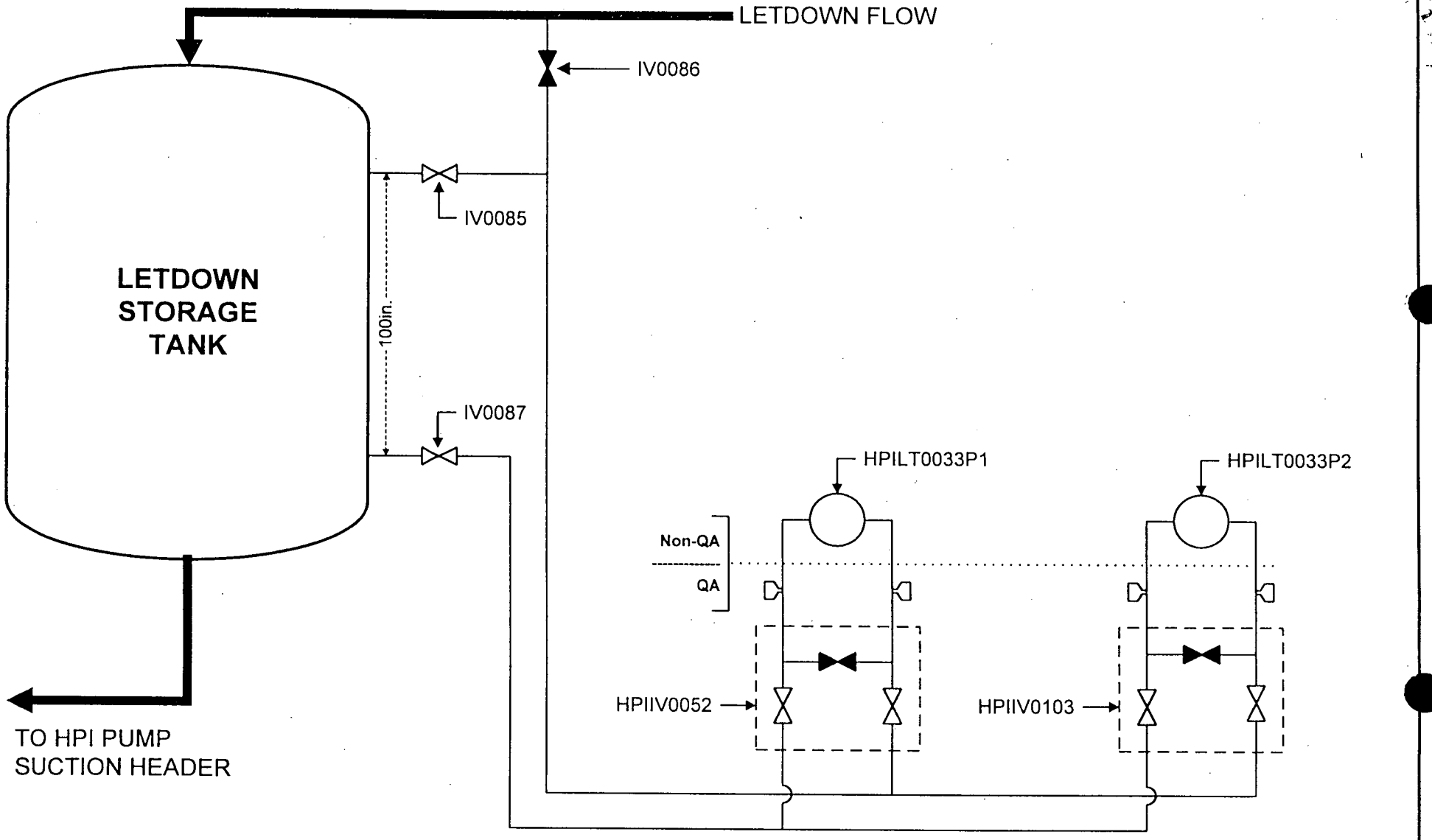

SAFE END TO
NOZZLE WELD
(BI-METTALIC)
NOZZLE(C. S.
CLADDING
D TO
ELD
SAFE END
(S. S.)
FLOW
WELD BUTTONS


OD crack tip @ 344° (100%TW)
OD crack tip @ 61° (100% TW)
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
RCS Flow
M/U Flow (into page)
Metallography (30% TW)
Metallography (26.5% TW)
Metallography (24% TW)
Note
View is looking in direction of M/U flow
Warming Line Flow

Oconee 3 HPI Event HPI Total RCP Seal Injection




Oconee 3 5/3/97 HPI Event
LDST, PZR Lvl, inches
T Hot Temp, °F
130
120
110
100
90
80
70
60
50
40
30
240
235
230
225
220
215
210
205
200
6:00
7:00
8:00
9:00
10:00
11:00
12:00
Makeup source is essentially gone therefore Pressurizer level begins to drop
1600 gallon makeup to LDST
Actual LDST volume continues to decrease
LDST Level stopped changing when level reaches lower instrument tap at 0 inches
LDST Lvl
PZR Lvl
RCS T-Hot



NOTE:
SKETCH FOR INFORMATION ONLY

OCONEE NUCLEAR STATION - UNITS 1, 2, & 3		
LETDOWN STORAGE TANK LEVEL INSTRUMENTATION SKETCH		
MAY 12, 1997	FILE: LDSTSKCH.VSD SHEET 1 OF 1	REV. 0