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

MAY 27 1982

Docket No. 50-286

LICENSEE: Power Authority of the State of New York

FACILITY: Indian Point Unit No. 3

SUMMARY OF MEETING HELD ON MAY 20, 1982 TO DISCUSS SHELL WELD PROBLEMS IN THE INDIAN POINT 3 STEAM GENERATORS

On May 20, 1982 a meeting was held with representatives of the Power Authority of the State of New York (PASNY) and the NRC. A list of attendees is given in enclosure 1.

The NRC invited PASNY to the meeting to discuss the shell weld problems in the Indian Point 3 (IP-3) steam generators. The slides presented by PASNY during the meeting are enclosed as Enclosure 2. PASNY presented the results of the inspections conducted to date, the weld and heat treatment history as known thus far, and a comprehensive and thorough repair program. PASNY stressed that the presentation represents preliminary findings and may be subject to change.

Approximately 170 defects have been found so far at the girth weld in the four steam generators; about 30 of the defects are subsurface and the remainder are surface defects. Other weld areas of the steam generators were inspected and no defects were found.

A "boat" sample, approximately 1" deep and 4" long was removed and is undergoing analysis which should be completed in about two weeks. PASNY also plans to remove an 8" diameter sample for additional analysis.

PASNY is still attempting to obtain the complete weld and heat treatment history of the steam generators. NRC noted that the IP-3 may have been the only series 44 steam generators that were welded in Tampa, Florida.

The NRC staff said they would like to closely monitor the analysis of the samples and possibly send a representative to the testing laboratory (Lucius Pitkin, Inc.) to witness some of the inspection. In addition, the NRC asked for another meeting to discuss PASNY's repair program after the inspection has been completed. PASNY agreed to both of these. PASNY also said they would welcome any suggestions the NRC has regarding the inspection and repair.

L. Olshan, Acting Project Manager
Operating Reactors Branch #1, DL

Enclosure: As stated

cc w/enclosure: See next page

OFFICE	ORB#1:DL	ORB#1:DL					
SURNAME	LOlshan:ds	SVarga					
DATE	05/ /82	05/ /82					

MEETING SUMMARY
OPERATING REACTORS BRANCH NO. 1
DIVISION OF LICENSING

Docket File
NRC PDR
Local PDR
ORB 1 File
J. Heltemes, AEOD
B. Grimes
S. Varga
Project Manager
OELD
OI&E (1)
ACRS (10)
NRC Participants
NSIC

cc: Licensee with
Service List

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Environmental Protection Bureau
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Buchanan, New York 10511

Ronald C. Haynes
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King of Prussia, Pennsylvania 19406

ENCLOSURE 1

INDIAN POINT 3 SHELL WELD PROBLEMS

MAY 20, 1982

LIST OF ATTENDEES

PASNY

J. Brons
L. Gwynn
R. Hansler
J. Lamberski
W. Spataro
H. Thielsch

OTHER

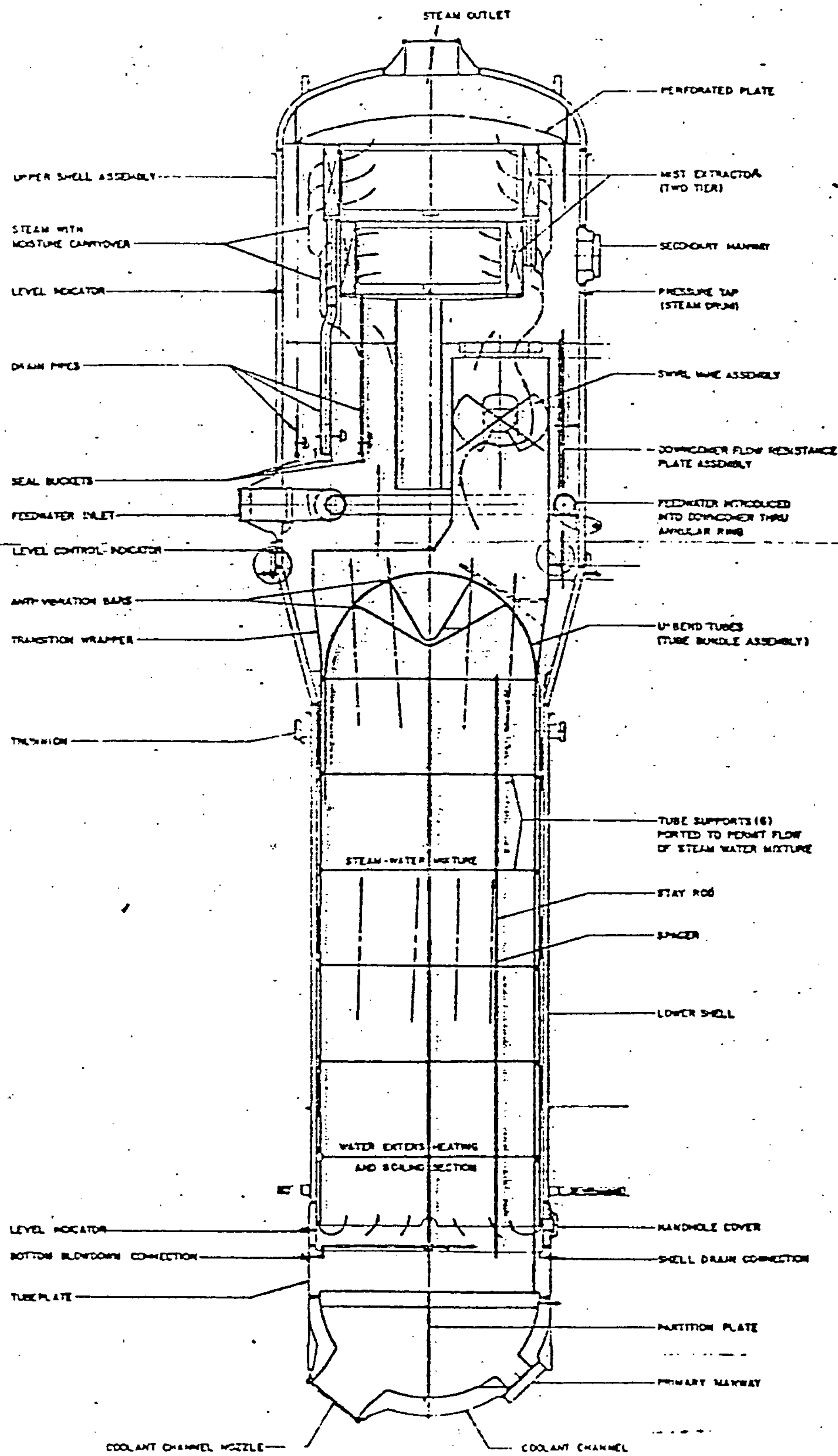
M. Kamimura, Japanese Government
W. Spezialetti, Westinghouse
J. Weeks, Brookhaven

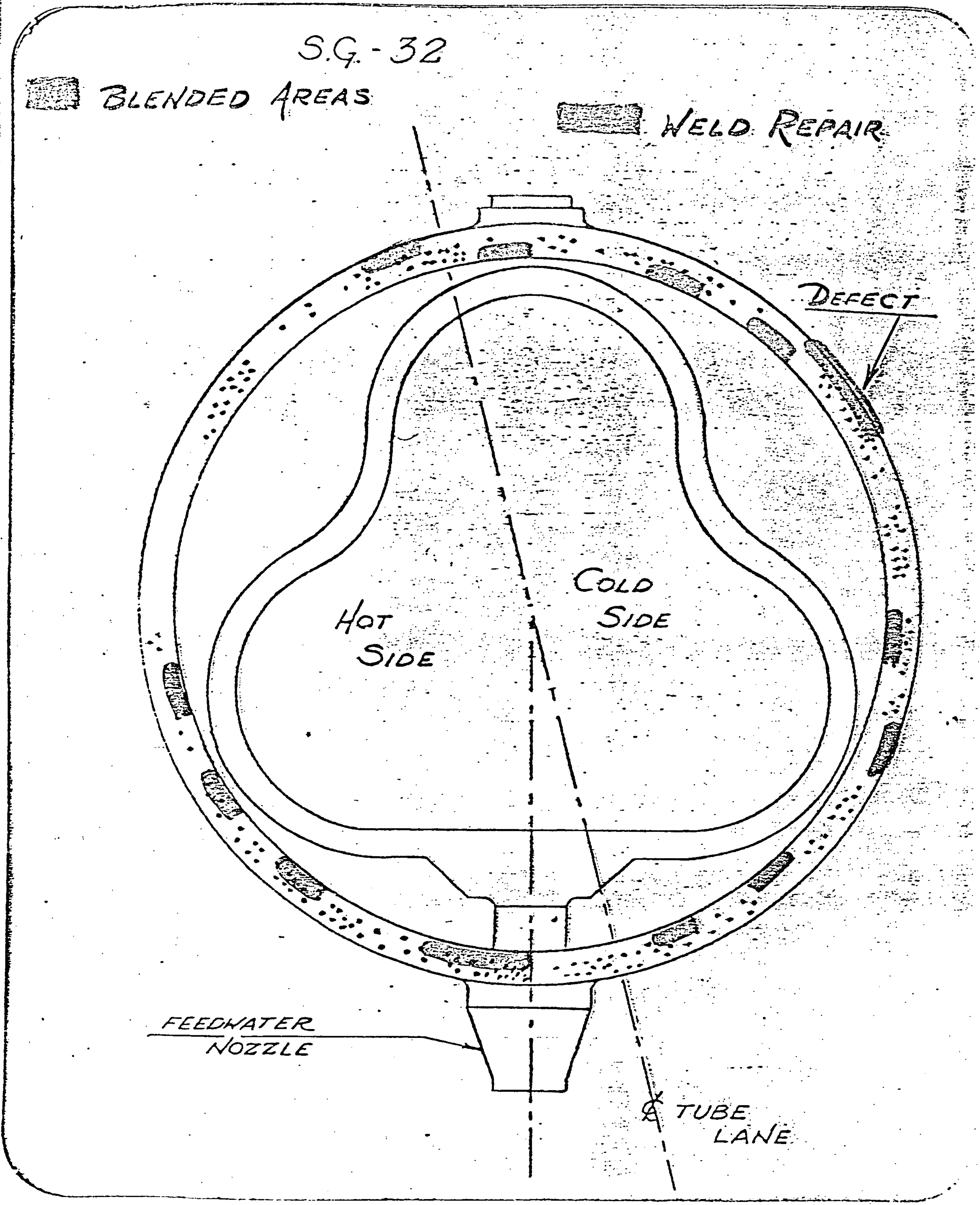
NRC

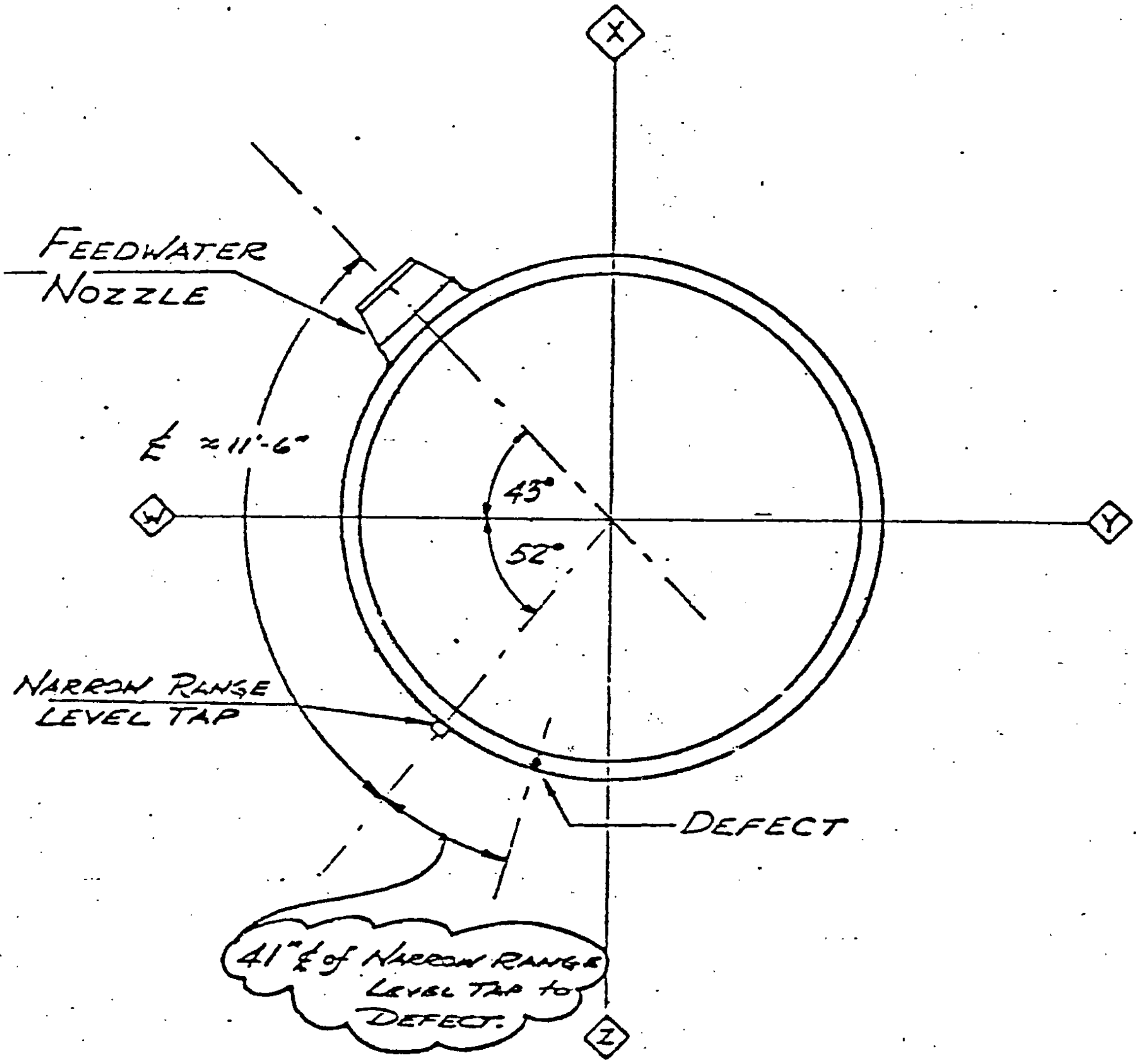
E. Brown
C. Y. Cheng
W. J. Collins
J. Gleim
H. Gray
T. Ippolito
W. Johnston
R. Klecker
L. Olshan
A. Patton
P. N. Randall
C. D. Sellers
R. Senseney
D. Smith
A. Taboada
S. Varga
J. Villadoniga
K. Wichman

ENCLOSURE 2

NRC COPY ①



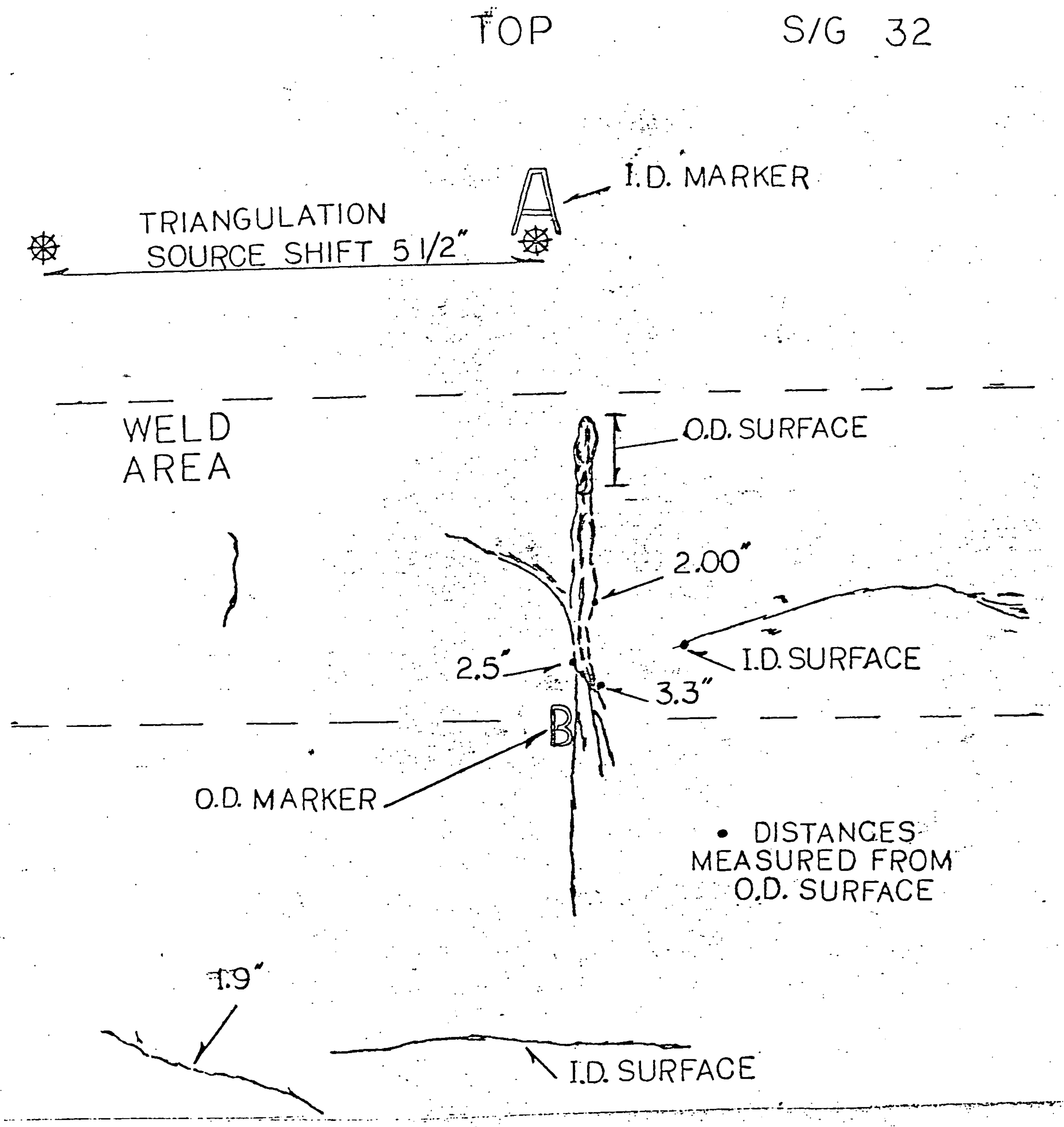

S.G. - 32
BLENDED AREAS
WELD REPAIR
DEFECT
HOT SIDE
COLD SIDE
FEEDWATER NOZZLE
℄ TUBE LANE

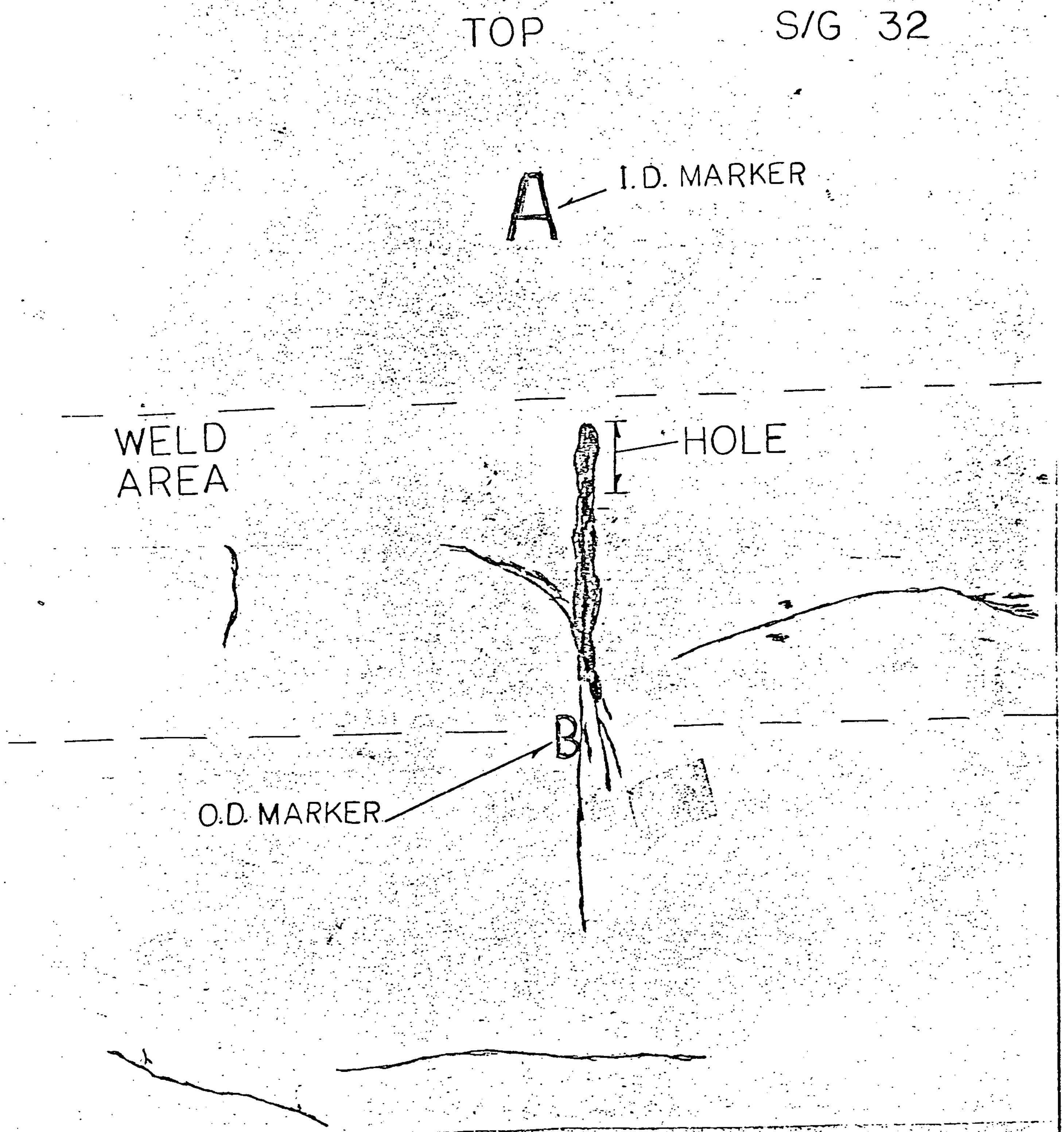


STEAM GENERATOR - 32

DEFECT IN RELATION TO NARROW RANGE LEVEL TAP ORIENTATION.

D.C. 4-6-82


TOP
S/G 32
I.D. MARKER
TRIANGULATION
SOURCE SHIFT 5 1/2"
WELD
AREA
O.D. SURFACE
2.00"
I.D. SURFACE
2.5"
3.3"
O.D. MARKER
• DISTANCES
MEASURED FROM
O.D. SURFACE
1.9"
I.D. SURFACE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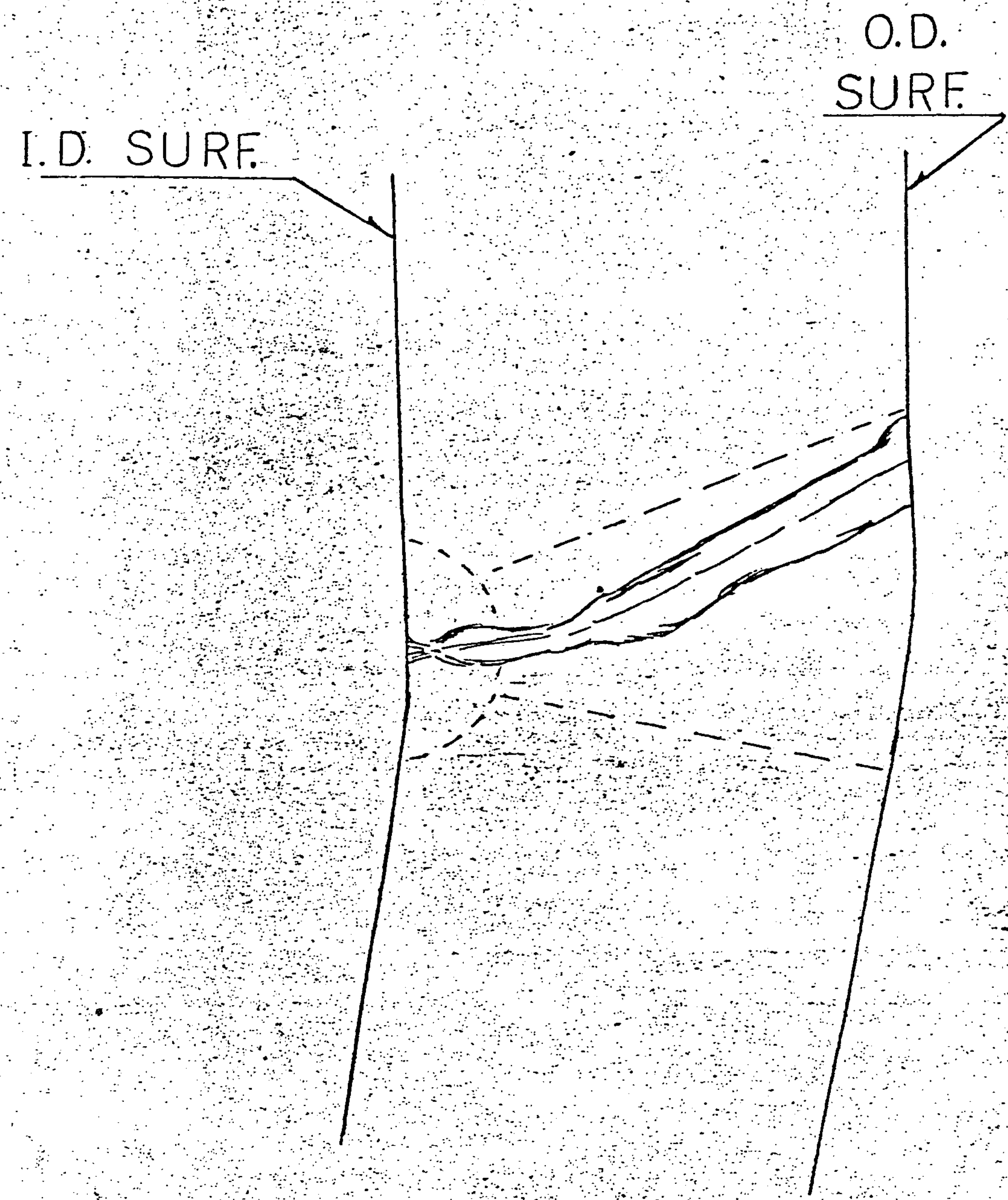
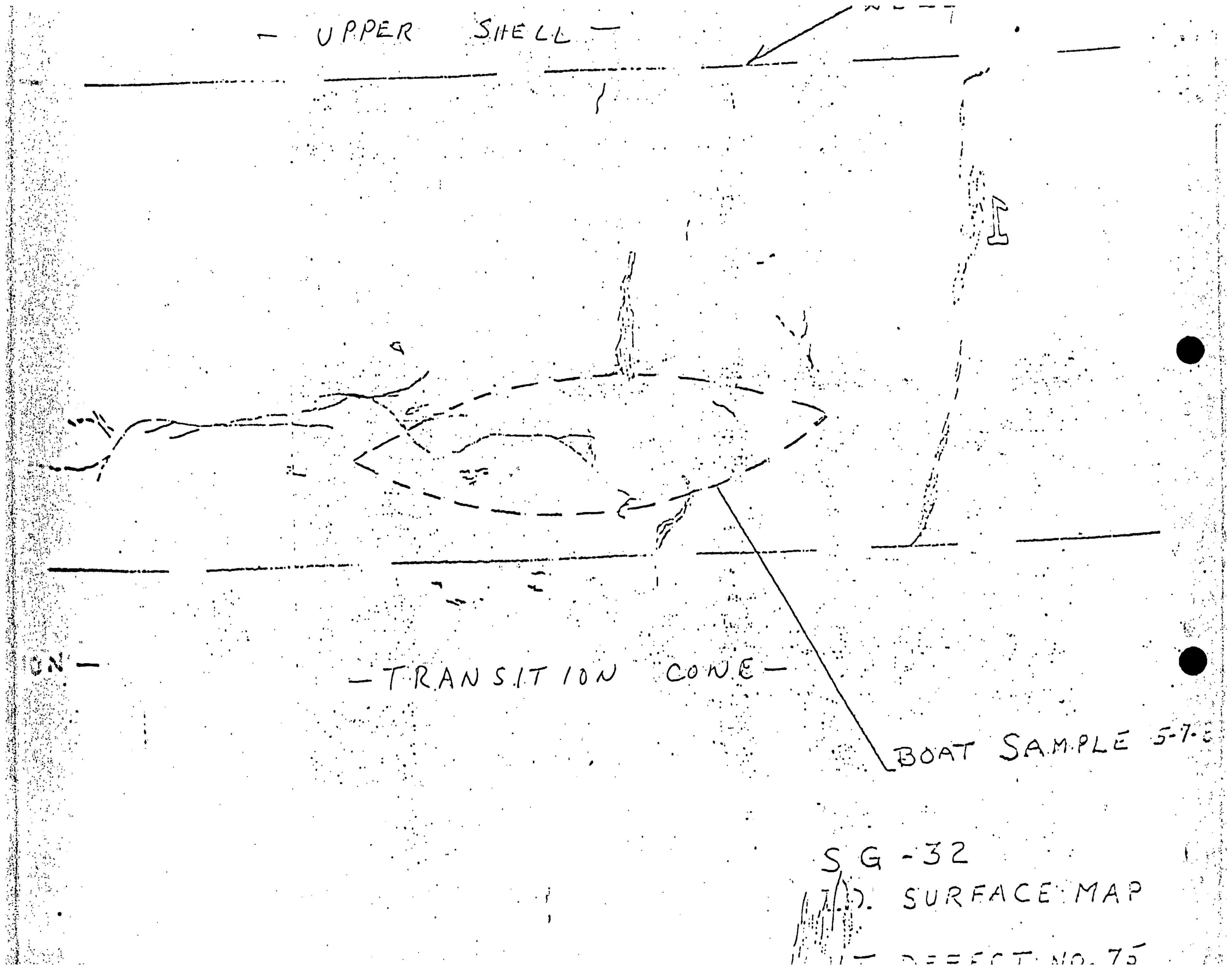
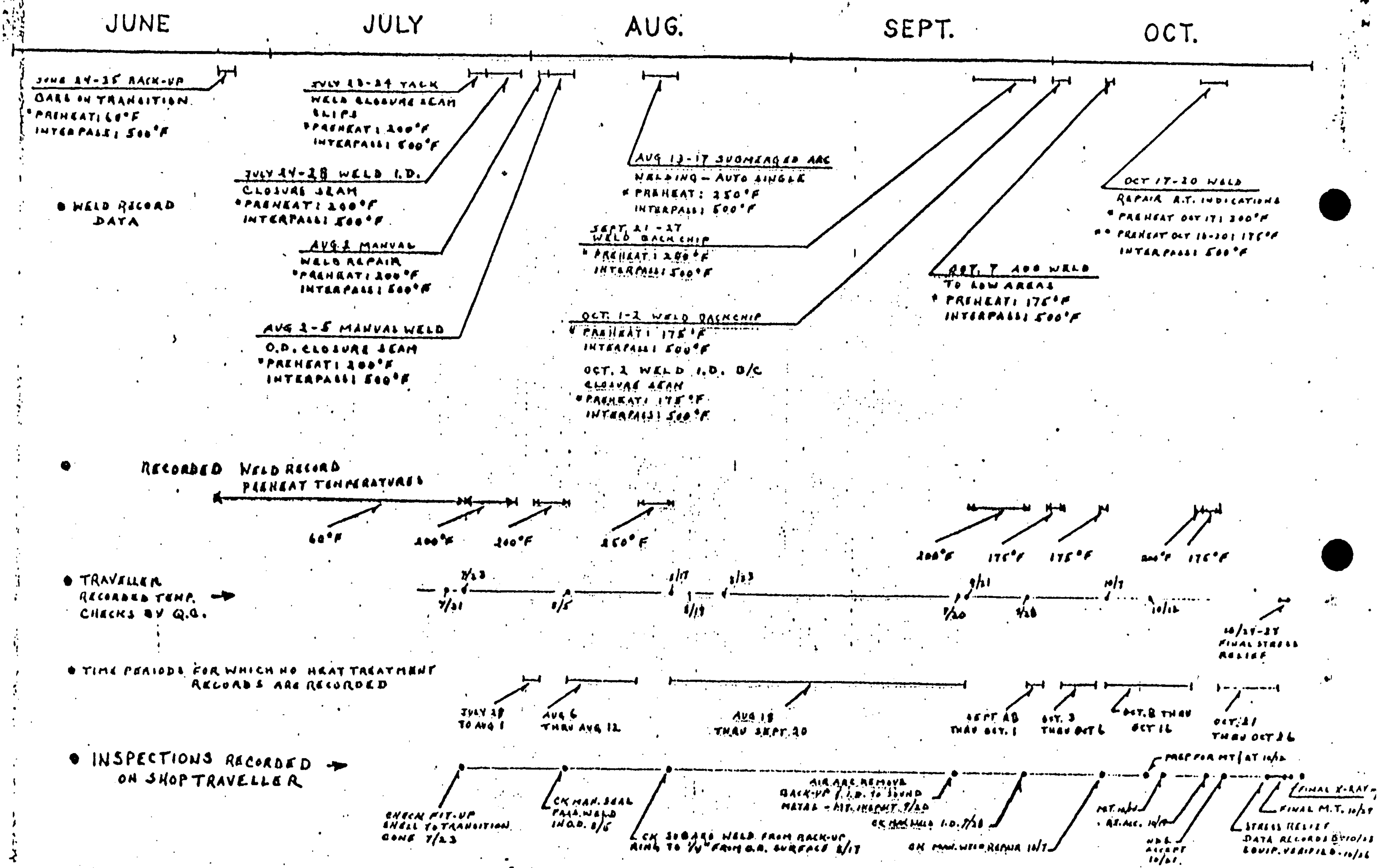
S/G 32
I.D. MARKER
WELD
AREA
HOLE
O.D. MARKER

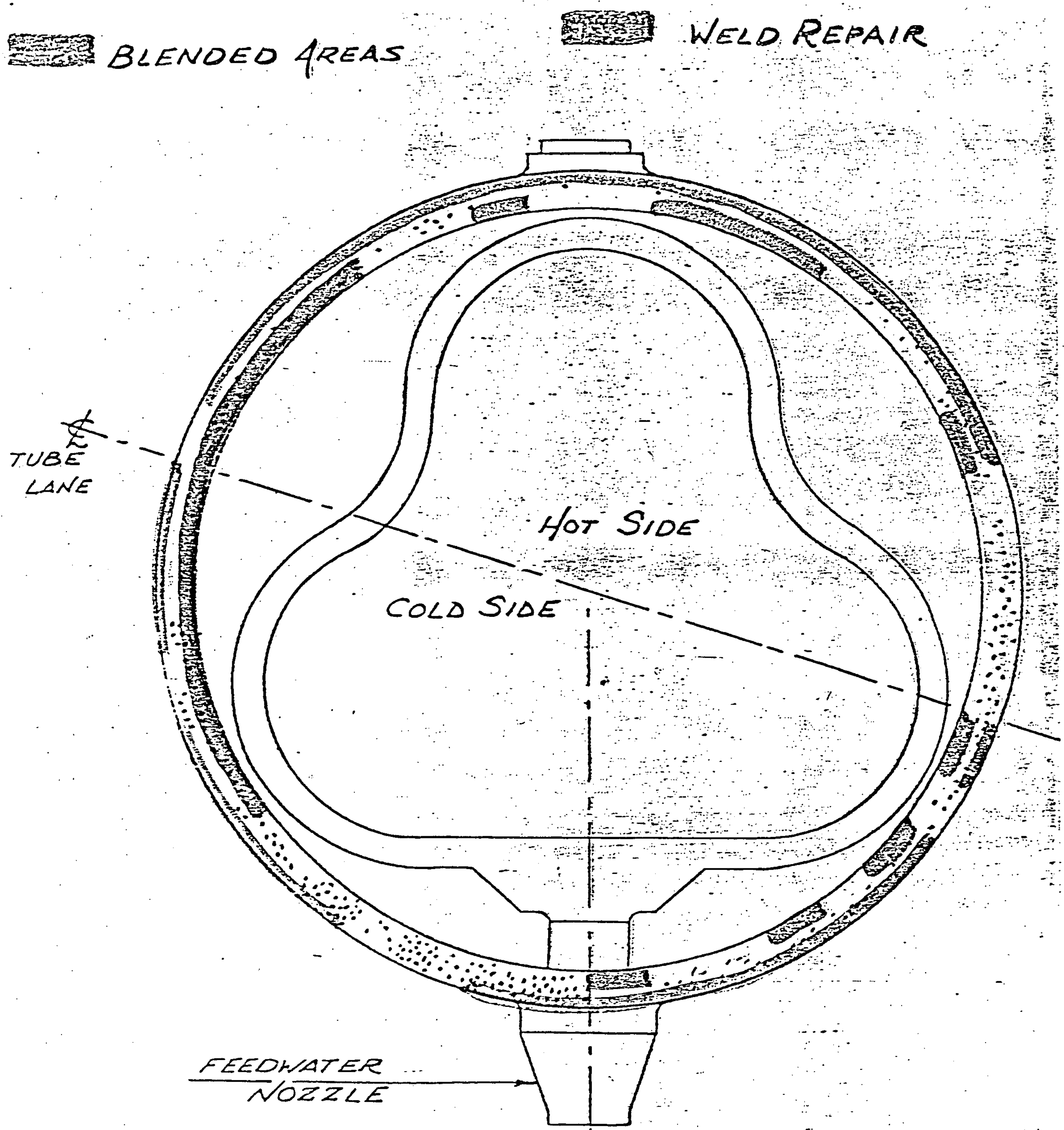

O.D.
SURF.
I.D. SURF.

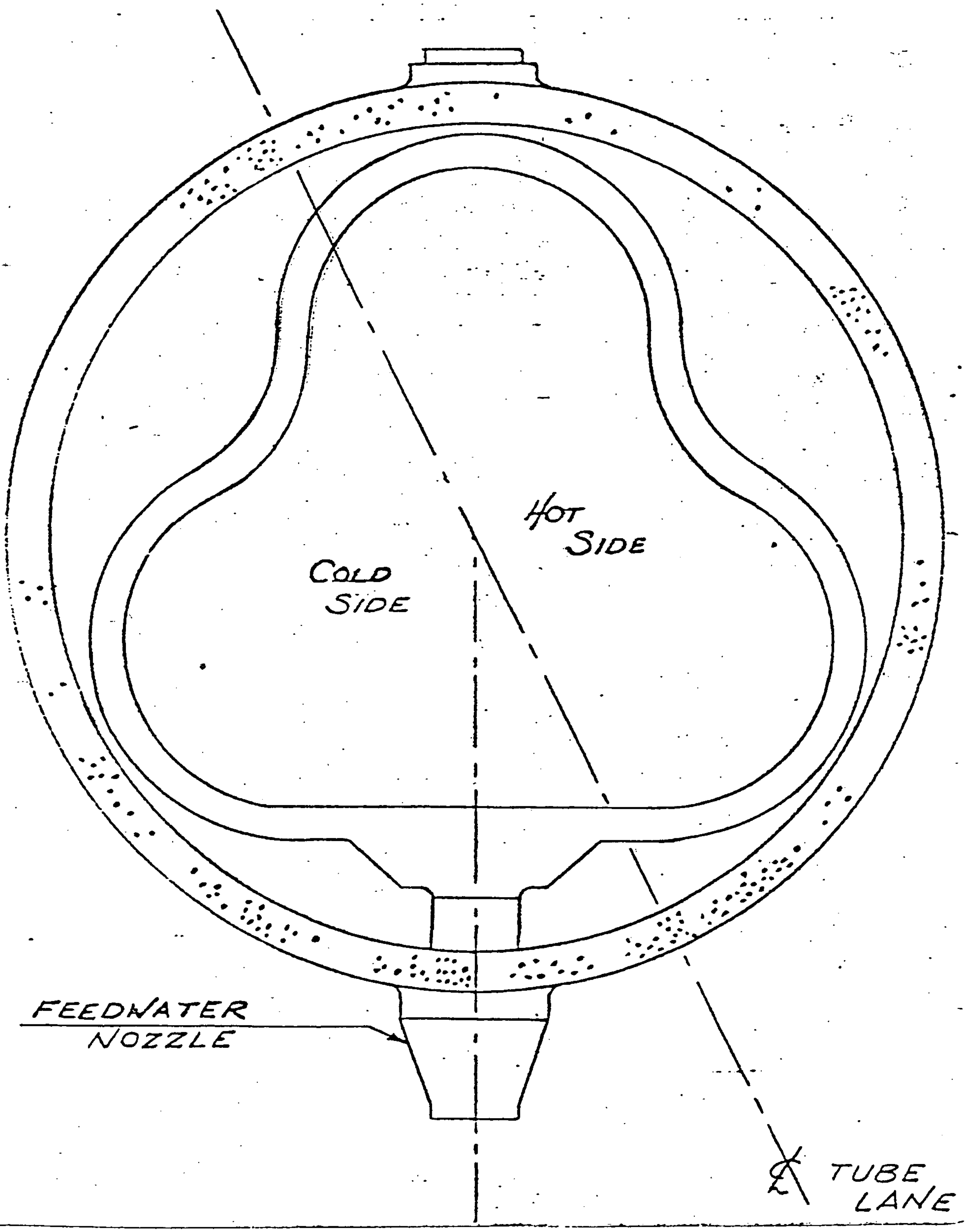

UPPER SHELL
TRANSITION CONE
BOAT SAMPLE 5-7-
SG-32
I.D. SURFACE MAP
DEFECT NO. 75

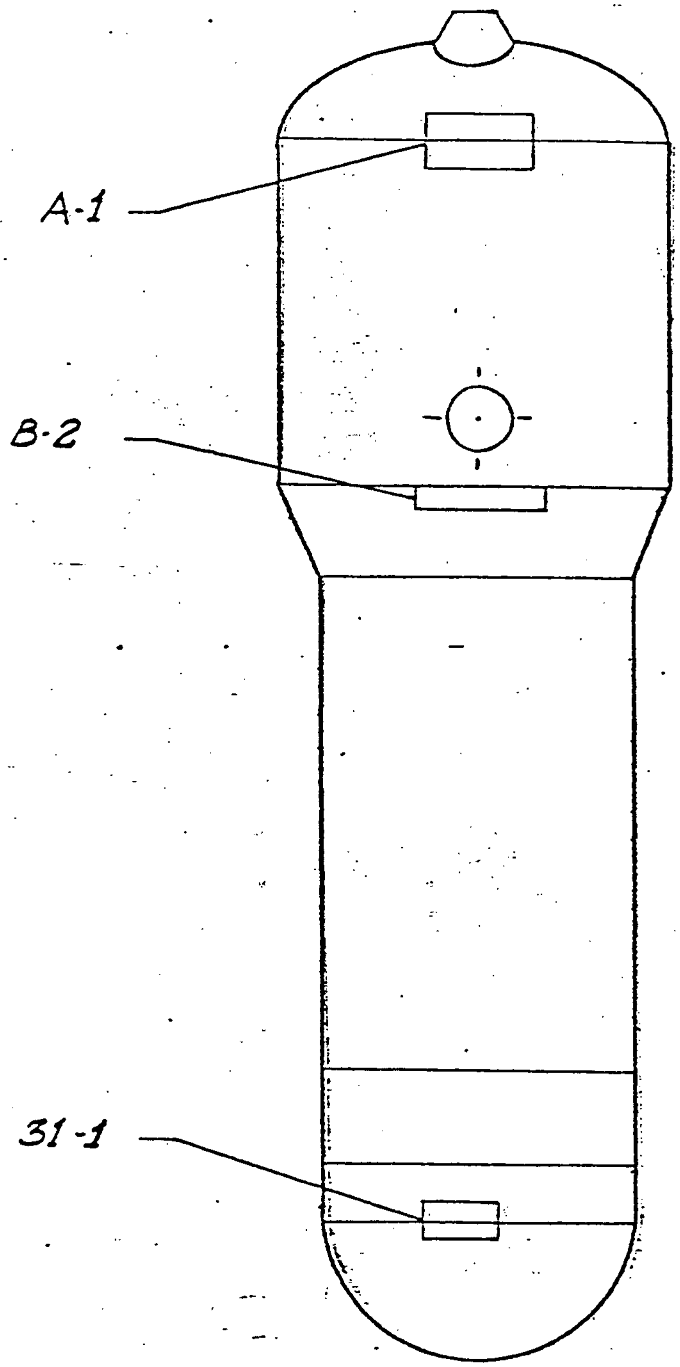
S.G. 32 SHELL TO TRANSITION WELD, HEAT-TREAT. & INSP. HISTORY -1970-



S.G. -31

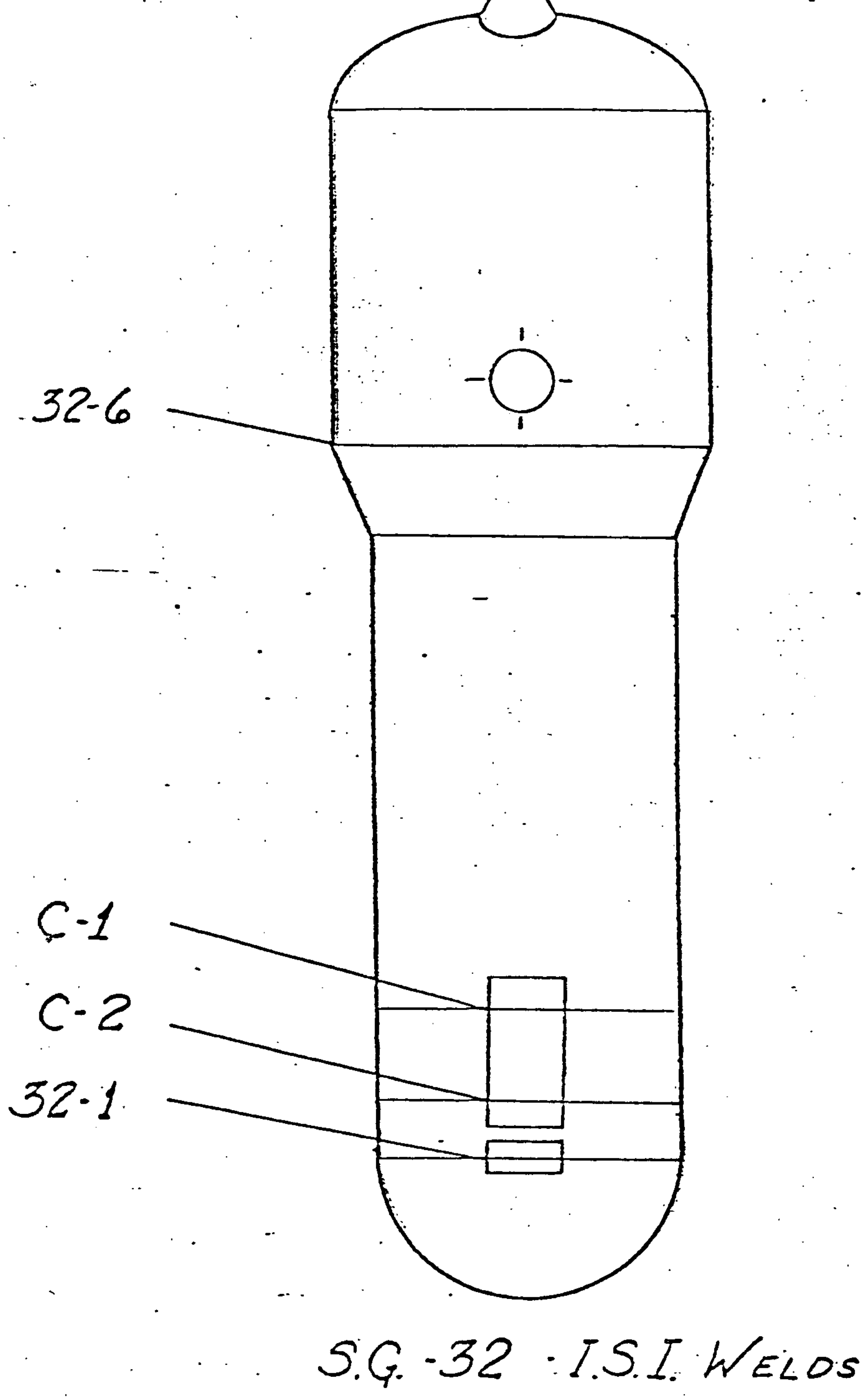

BLENDED AREAS
WELD REPAIR
TUBE
LANE
HOT SIDE
COLD SIDE
FEEDWATER
NOZZLE


HOT SIDE
COLD SIDE
FEEDWATER NOZZLE
℄ TUBE LANE



S.G.-31 - I.S.I. WELDS

S.G.-31- ISI WELDS



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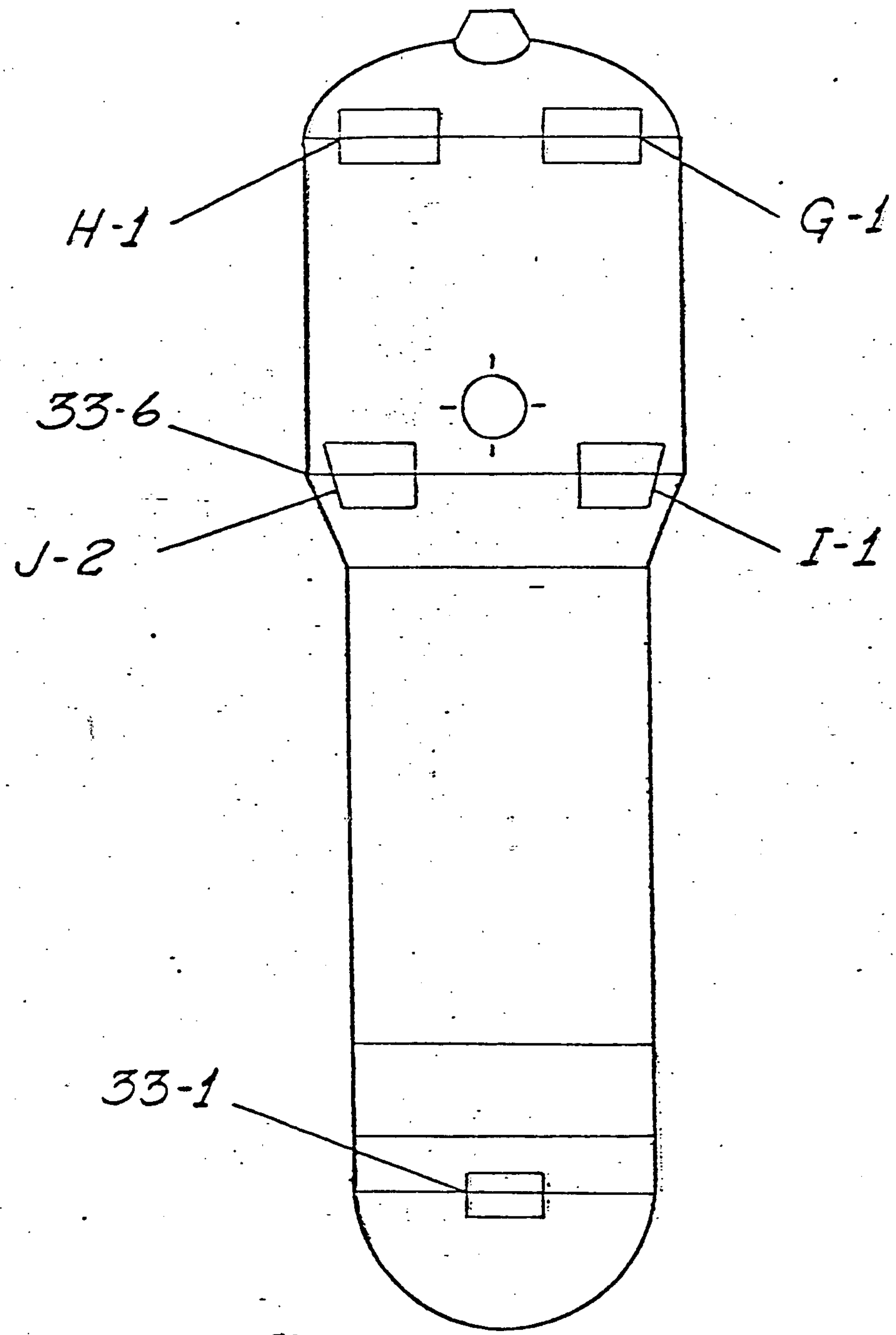
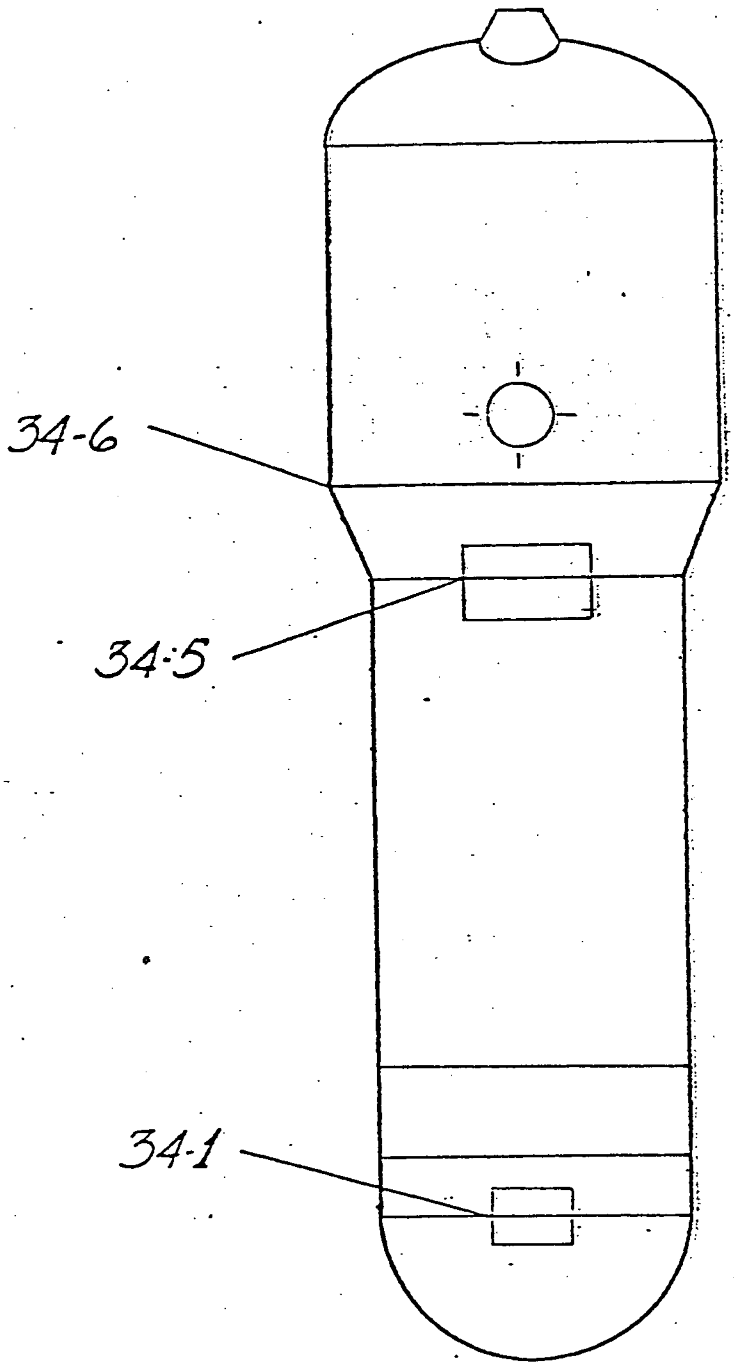


SG-33 - I.S.I. WELDS



S.G.-34 - I.S.I. WELDS

Lucius Pitkin
INCORPORATED

Metallurgical and Chemical Consultants

Testing Laboratories–Nondestructive Examination Services

EST. 1885

50 HUDSON STREET, NEW YORK, N.Y. 10013 · (212) 233-273
TELEX 12-6615 · CABLE NIKTIP (212) 233-255

DESIGNATED ORIGINAL

Certified By [signature]

SPECTROGRAPHIC ESTIMATES

Date May 18, 1982

Report No. M-6785

The following is our analysis of 14 sample(s) of filings from Steam Generator No. 32 Indian Point No. 3

BY QUANTITATIVE CHEMICAL AND QUALITATIVE SPECTROGRAPHIC ANALYSES

	1	2	3	4	5
Carbon, %	0.13	0.11	0.15	0.14	0.10
Manganese	1.40	1.42	1.35	1.43	1.43
Phosphorous	0.014	0.013	0.014	0.012	0.012
Sulfur	0.015	0.015	0.014	0.011	0.013
Silicon	0.24	0.24	0.26	0.23	0.31
Molybdenum	0.48	0.47	0.47	0.50	0.50
Nickel	0.50	0.48	0.12	0.094	0.093
Chromium	0.092	0.098	0.094	0.090	0.079
Iron	Major	Major	Major	Major	Major
Copper	0.0X	0.0X	0.0X	0.0X	0.0X
Aluminum	0.0X	0.0X	0.0X	0.0X	0.0X
Vanadium	0.00X	0.00X	0.00X	0.00X	0.00X
Magnesium	0.00X low	0.00X low	0.00X low	0.00X low	0.00X low

Other elements looked for, but not found:

titanium, zirconium, zinc, bismuth, lead, tin, antimony, gallium, germanium, boron, beryllium, cobalt, columbium, tungsten.

Power Authority of the State of New York
10 Columbus Circle
New York, N.Y. 10019
Attn.: Mr. W. Spataro

Continued ....

Respectfully submitted,
LUCIUS PITKIN, INC.

[signature]
A. J. Vecchio
Vice President &
Asst. Chief Metallurgist

AJV/rm/4

NOTE: Major = above 5% estimated. Minor = 1-5% estimated. X, OX, OOX, etc. = concentration of the elements estimated [illegible]

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DESIGNATED ORIGINAL

Certified By [signature]

SPECTROGRAPHIC ESTIMATES

Date May 18, 1982

Report No. M-6785

The following is our analysis of 14 sample(s) of filings from Steam Generator No. 32
Indian Point No. 3

BY QUANTITATIVE CHEMICAL AND QUALITATIVE SPECTROGRAPHIC ANALYSES

	6	7	8	9	10
Carbon, %	0.18	0.11	0.16	0.18	0.13
Manganese	1.33	1.43	1.42	1.41	1.40
Phosphorous	0.017	0.011	0.012	0.014	0.010
Sulfur	0.009	0.010	0.015	0.016	0.010
Silicon	0.26	0.23	0.24	0.24	0.22
Molybdenum	0.44	0.51	0.49	0.50	0.50
Nickel	0.50	0.11	0.50	0.50	0.10
Chromium	0.073	0.098	0.14	0.13	0.098
Iron	Major	Major	Major	Major	Major
Copper	0.0X	0.0X	0.0X	0.0X	0.0X
Aluminum	0.0X	0.0X	0.0X	0.0X	0.0X
Vanadium	0.00X	0.00X	0.00X	0.00X	0.00X
Magnesium	0.00X low	0.00X low	0.00X low	0.00X low	0.00X low

Other elements looked for, but not found:

titanium, zirconium, zinc, bismuth, lead, tin, antimony, gallium, germanium, boron, beryllium, cobalt, columbium, tungsten.

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LUCIUS PITKIN, INC.

By [signature] A. J. Vecchio
Vice President &
Asst. Chief Metallurgist

AJV/mn/4

NOTE: Major = above 5% estimated. Minor = 1-5% estimated. .X, .0X, .00X, etc. = concentration of the elements estimated to the nearest decimal place — e.g. .0X = .01-.09% estimated. ** less than. NF = not found. The numbers in parenthesis indicate the estimated relative concentration of the element among the various samples. [illegible] varies considerably among the elements and also depends upon the amount and nature of the sample, [illegible] "Not Found" or NF means not detected in the particular sample by the technique employed.

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SPECTROGRAPHIC ESTIMATES

Date May 18, 1982

Report No. M-6785
The following is our analysis of 14 sample(s) of filings from Steam Generator No. 32
Indian Point No. 3

BY QUANTITATIVE CHEMICAL AND QUALITATIVE SPECTROGRAPHIC ANALYSES

	I1	I2	I3	I8
Carbon, %	0.13	0.16	0.16	0.15
Manganese	1.27	1.45	1.35	1.45
Phosphorous	0.014	0.014	0.011	0.014
Sulfur	0.016	0.015	0.014	0.015
Silicon	0.29	0.25	0.25	0.26
Molybdenum	0.39	0.49	0.48	0.48
Nickel	0.67	0.49	0.11	0.49
Chromium	0.079	0.11	0.098	0.098
Iron	Major	Major	Major	Major
Copper	0.0X	0.0X	0.0X	0.0X
Aluminum	0.0X	0.0X	0.0X	0.0X
Vanadium	0.00X	0.00X	0.00X	0.00X
Magnesium	0.00X low	0.00X low	0.00X low	0.00X low

Other elements looked for, but not found:

titanium, zirconium, zinc, bismuth, lead, tin, antimony, gallium, germanium, boron, beryllium, cobalt, columbium, tungsten.

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Continued ......
Respectfully submitted,
LUCIUS PITKIN, INC.
By A.J. Vecchio
Vice President &
Asst. Chief Metallurgist

AJV/mm/4

NOTE: Major = above 5% estimated. Minor = 1.5% estimated. .X, .OX, .OOX, etc. = concentration of the elements estimated to the nearest decimal place – e.g. .OX = .01-.09% estimated. *= less than. NF = not found. The numbers in parenthesis indicate the estimated relative concentration of the element among the various samples. Detectability varies considerably among the elements and also depends upon the amount and nature of the sample, therefore, "Not Found" or NF means not detected in the particular sample by the technique employed.

CRACKING - CAUSES AND CONSEQUENCES

The cracking is stress related. The stresses causing the crack initiation and crack progression are associated with the following primary conditions, which tend to cause or contribute to cracking:

(1) Design

(2) Original welding with some cracking along the inside of shell (weld metal and heat-affected zone)

(3) Residual welding stresses

(4) Heavy submerged-arc welds

(5) Inadequate preheat and interpass temperature

(6) Wide and heavy major repair weld areas

(7) Inadequate postheat treatment

(8) Thermal cycling (i.e., thermal fatigue)

General Considerations

(1) All cracking in weld areas (weld metal and heat-affected zone)

(2) Cracking is NOT safety related

(3) The worst possible conditions will be a leak

(4) The cracking is likely to have developed at a very slow rate over a period of several years

(5) Consider modification to reduce severity of thermal fatigue cycles at weld location

(6) Without redesign, cracking may occur again, although at a much slower rate

CRACK APPEARANCE

The cracking appears to have the following characteristics:

(1) Initiation of cracking and progression from inside surface

(2) Cracks occur primarily circumferential

(3) Leak crack is transverse (in major repair weld area - probably due to excessively severe local shrinkage, distortion and stresses in repair weld area)

(4) Crack progression perpendicular to insude surface

(5) Cracks widened by corrosion

(6) Presence of aligned surface (corrosion) pitting (at cracks and elsewhere on surface of shell)

REPAIR CRITERIA

The repairs are intended to return the steam generator to a level of integrity better than applicable to the original steam generators, and insure compliance of the steam generators with the requirements of the ASME Boiler and Pressure Vessel Code.

The following basic criteria apply to the repair program:

(1) Remove all progressive cracks from inside surface in weld metal and in adjacent base metal

(2) Maintain wall thickness integrity by grinding narrow grooves at crack locations, and fill in grooves by welding (utilizing low-stress welding procedures and techniques)

(3) Do NOT remove original subsurface weld defects which are non-progressive and inconsequential. (This would result in further distortion and stressing)

(4) Perform uniform postheat treatment at higher temperatures than applicable to the original steam generators to minimize final residual stress level (which would represent an improvement over the original weld quality levels

REPAIR PLANNER - OUTLINE

(A) Complete all inspections (final defect analysis, sketches, wall thickness, UT, crack depth measurements from inside surface, etc.)

(B) Nozzle designs at leak location (8" and 6" diameter)

(C) Determine weld cross section of shell (wall thickness) and minimum wall thickness determination and design

(D) Grinding - preparation, training, workmanship samples, and practice grinding

(E) Welding - procedure preparations and procedure and welder qualifications (including material qualifications, heat treatment, etc.)

(F) Welder - preparation, training and practice welding

(G) Welding repair plan and criteria procedure

(H) Preheat parameters (if necessary)

(I) In-process inspection and quality assurance (including documentation)

(J) Postheat treatment (final, intermediate, etc.)

(K) Final inspection (acceptance and baseline inspection)

(L) Final Reports with complete documentation

Other Requirements

(1) Procedures for changes and modifications

(2) Repair personnel organizational charts, detailing reporting and communications

(3) Code Inspector interface

(4) NRC Regulatory interface

(5) Health Physics monitoring

(6) Decontamination of No. 33 Steam Generator.

(A) INSPECTION

(1) Complete final plotting and identification of inside surface and subsurface defects (including identification of locations, measurement of crack depths, defect types, etc.)

(2) Wall thickness UT measurement

(3) Sandpaper polishing and etching of surface (I.D.) areas to delineate crack patterns and weld locations, particularly involving repair welded area

(4) Prepare new sketch of estimated remaining defects along inside surface if 3/4" (or 1") of metal is removed from the inside surface of shell at weld location

(5) Permanent identification of entire circumference by degrees to insure accurate referencing to specific locations

(B) NOZZLE AT THRU-WALL LEAK

(1) Design 8" nozzle (and 6" alternate)

(a) for original 3½" wall thickness
(b) for reduced 2½" wall thickness

Include weld overlay on outside surface

(2) Westinghouse review and concurrence

(3) Decide on machine cutting or plasma arc or flame cutting

(Prefer machine cut)

Retain sample for analysis

Radiography
PT, MT
Metallography
Hardness
Microhardness

Comments:

Other weld probe samples shall not be removed, as they will increase the amount of welding necessary.

(C) SHELL CROSS SECTION AND CONTOUR

(1) Redesign of weld cross section for 2½" (or 2-3/4") shell wall thickness.

(2) Consider retaining original wall thickness at 8" (or 6") nozzle diameter

(3) Westinghouse review and concurrence

(4) Determine method of metal removal

(a) Machine cut - preferred but doubtful

(b) Grinding - most practical

(c) Arc-air gouging (may not be practical)

Consider leaving original wall thickness at areas free of cracking

(5) Prepare and check grinding with contour depth gage

(6) Consider possibility of not reducing wall thickness, and repairing all inside surface cracks

Comments:

Wall thickness considerations should recognize the effects of several postheat treatments at 1200 to 1225°F.

Excessive reductions in wall thickness may require a weld build-up at a future date.

(D) GRINDING

(1) Have available various grinders for overall grinding and fine groove and slot grinding. (Wheels of various types and sizes, and carbide burrs)

Procedure

(2) Grind narrow V-type grooves into cracks for complete removal of cracks

(3) When cracks begin to disappear because of tightness, check with P.T.

(4) Keep applying P.T. developer as grinding is continued

(5) When crack appears removed, perform final P.T. examination

Preparation

(6) Prepare workmanship (ground groove) samples

(7) Train and explain grinding requirements to grinders

(8) Have grinders grind practice grooves

Steam Generator Grinding

(9) On inside of steam generators, delineate and mark grooves to be ground

(10) Explain grinding requirements for each groove to grinders

(11) Grooves should be as small as practical, and only as long and as deep as the crack

(12) Do not grind out an excessive amount of metal. Grooves should only be sufficiently wide for proper electrode manipulation

(13) Perform final grinding very lightly to remove "smeared" metal which might cover up, or seal tight cracks

(14) Intermittently inspect to insure minimum grinding

(15) Final inspection by QA to confirm removal of cracks

(E) WELDING

All welding - shielded metal-arc welding process

(1) Write procedure

(2) Qualify procedure (and material at various variables and postheats) for

no preheat

300°F preheat

(3) Qualify welders

(4) Instruct and train welders on specific welding techniques applicable to this repair project

(5) Weld without preheat

(6) To maximize and improve skills for the most critical (deep and wide) repair welds

(a) weld shallowest grooves first
(b) weld intermediate groove sizes
(c) weld most severe grooves

(7) If cracking problems arise - preheat locally

(8) Apply stringer beads with 3/32" dia. electrodes

(9) In narrow grooves, tie in roots and sidewalls

(10) In wider (and deeper) grooves, weld roots and butter up side walls with final weld bead protruding over inside surface

(11) To prevent slag entrapment, weld beads shall be smooth and blend smoothly into prior weld beads

(12) Use needle guns, chipping hammers (including air chipping hammers), and wire brushes for between-pass cleaning

(13) Avoid grinding except for removal of bad starts and stops, and weld defects

(14) Break arc on prior weld deposit metal

(15) If cracking occurs, grind out crack and preheat weld area to 350°F

(16) Before start of welding on inside of steam generator, each welder should carefully check marking settings and experiment with groove welding on pregrooved plate sections in order to be certain of the proper machine settings.

Comments:

If major cracking problems develop because of high-stress levels remaining from the original fabrication, and/or because of material characteristics, an intermediate stress relief heat treatment may be desirable or necessary.

(F) WELDER TRAINING

(1) Explain to welders the importance of low-stress welding.

(2) Illustrate buttering techniques, where applicable.

(3) Point out importance of side wall fusion (which may necessitate some weaving and adequate groove width).

(4) Emphasize weld bead smoothness and tie in of weld beads to side wall of groove and prior weld beads to avoid slag entrpment, and avoid need for grinding.

(5) Prepare workmanship samples of narrow groove of 3/4" (crack) depth and intermediate grooves of 1½" (crack) depth.

(6) Have welders perform practice welding of different groove cross sections and check for side wall fusion.