MILLSTONE NUCLEAR POWER STATION, UNIT NO. 3
CONTAINMENT RECIRCULATION SPRAY (RSS)
SYSTEM

TUBECO RADIOGRAPHY ISSUE

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PREPARED BY:

James J. Cirilli
James J. Cirilli
Component Engineering

REVIEWED BY:

K. Lakshmipathiah
K. Lakshmipathiah
Civil Structures

William C. Faye
William C. Faye
Reactor Plant Systems

APPROVED BY:

J. F. Ely
J. F. Ely
Supervisor, Component Engineering

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MILLSTONE UNIT NO. 3 CONTAINMENT RECIRCULATION
SPRAY SYSTEM (RSS)
REPORT

PURPOSE

The purpose of this report is to resolve the issues relative to the TUBECO supplied piping and radiographs comprising the Millstone Unit No. 3 (MP3) RSS system. The issues concerned are those resulting from an NRC review of TUBECO pipe weld radiographs, and a subsequent review by Stone and Webster, wherein Nonconformance and Disposition Reports (N&Ds) were generated.

It is the intent of this report, via the recommendations and conclusions established herein, to resolve the TUBECO radiograph issues, and maintain that the RSS system can function as originally designed.

SYSTEM DESCRIPTION

The Containment Recirculation System (RSS) at MP3 contains four lines (3RSS-1, 3RSS-2, 3RSS-3, and 3RSS-4) which are embedded in the containment floor. The RSS System was fabricated and supplied by TUBECO, Inc., of Brooklyn, New York.

System Design Requirements: In accordance with the MP3 FSAR, the RSS System must comply with Regulatory Guide 1.26, Sections C1a and C1b, and Standard Review Plan 6.2.2. Per this Regulatory Guide, the RSS System must be designed, constructed, and qualified per ASME III, Class 2 requirements.

The current system design complies with: 10CFR50, Appendix A, General Design Criteria 38, 39, and 40; SRP 6.2.2; and ASME III, Class 2. Additionally, the RSS System fabrication, installation, and inspection was in conformance with ASME III, Class 2.

Containment Isolation Requirements: The containment isolation requirements are delineated in SRP 6.2.4 and Regulatory Guide 1.141. These requirements must be followed per the FSAR commitments. Included in SRP 6.2.4 is the requirement to provide a leak-tight barrier in the event of valve packing leaks. The RSS System design complies with all of the above standards.

Stress Analysis: The original piping analysis was based on the initial design temperature of 230°F, and the assumption that the embedded pipe was wrapped in two-inch thick insulation. The system design temperature was subsequently changed to 235°F, and much later to the post accident peak temperature of 256°F. It was also determined that the insulation had never been applied. This is supported by the installation specification wherein piping insulation is only required for piping subject to a service temperature exceeding 250°F. At the time of installation, the RSS piping service temperature was the 230°F mentioned above.

The piping system has been reanalyzed using the peak temperature of 256°F, and accounting for total embeddment without insulation.

Materials: The RSS System is constructed of ASME materials, with the exception of the encapsulation assembly, which is fabricated from ASTM and ASME materials. Both the ASME and ASTM materials were supplied with the necessary documentation, i.e., mill certs and test reports. The welding filler material was purchased per ASME requirements, and was also supplied with the mill certs and test reports. The materials of construction used are summarized as follows:

(1) Welding filler material per ASME Section II, Part C;

(2) 12" diameter process pipe material per ASME Section II, Part A, SA-312, Type 304;

(3) TUBECO fabricated elbows - plate per ASME Section II, Part A, SA-240, Type 304;

(4) Encapsulation materials - per ASTM A358, Class 1, Type 304 (16" diameter pipe); SA403, WP304 (16" x 24" flued head); and ASTM A240, Type 304 L plate (flanges).

Welding: All of the welding was performed using TUBECO welding procedure specifications (WPS) and welders qualified to ASME Sections IX and III requirements. Two WPSs were used for all of the subject welding: GT8-1, gas-tungsten-arc welding, and SM8-1, shielded-metal-arc welding. The gas-tungsten-arc process was used for the root passes in all of the groove welds (circumferential butt and elbow longitudinal butt-welds). The shielded-metal-arc process was used for the fill passes in the above groove welds and for all fillet welds.

Due to the inability of qualified manufacturers to furnish material in accordance with the urgent field requirements, the following operations were performed by TUBECO:

(1) TUBECO removed and rewelded the longitudinal seam weld in the ASTM A-358 pipe used in the encapsulation assembly;

(2) Eight (8) long-radius elbows were fabricated by TUBECO using ASME SA-240 plate material.

The seam welds in both (1) and (2) above were made using the two (2) TUBECO welding procedures referenced above. The encapsulation welds were both liquid penetrant examined and radiographed wherein the elbow welds were radiographed.

INSPECTION AND TESTING

Nondestructive Examination: The RSS System welds were nondestructively examined by TUBECO prior to shipment to the Millstone site. The NDE procedures and personnel were qualified in accordance with ASME Section III and ASNT, respectively. The following is a summary of the NDE performed on the RSS system welds:

(1) Fillet welds - liquid penetrant examination;

(2) Groove welds in encapsulation assembly - liquid penetrant of root passes and completed weld, and radiography of completed weld;

(3) 12" diameter process piping circumferential butt welds - liquid penetrant of root pass and completed weld, and radiography of completed weld;

(4) TUBECO fabricated elbows - radiography of completed weld.

Nondestructive examination reports and records were provided for each weld. If defects were found, the necessary repairs were made (and documented) in accordance with the approved procedures mentioned above. The repair was then examined using the same NDE technique used to find the defect. Such NDE was documented, and those documents also provided with the material.

Hydrostatic Testing: The four (4) RSS lines were hydrostatically tested subsequent to their installation at MP3, but prior to pouring of the concrete containment floor. The tests were performed in accordance with both ASME and ACI standards. All tests were successfully performed with no leaks detected.

Tables 1, 2, and 3 outline the welding and examinations performed on the process pipe, encapsulations, and elbows, respectively. Table 4 summarizes the hydrostatic test conditions and results.

PROBLEM DESCRIPTION

TUBECO Radiograph Review: A review of TUBECO pipe weld radiographs was conducted at MP3 by the NRC Region I Inspection Team from August 1 to August 23, 1983. The NRC reported two violations (radiographic density and penetrameter located in the area of interest) on NRC Inspection Report No. 50-423/83-14, issued November 22, 1983. NNECO responded to this notice of violation and concluded that these were not technical problems or safety concerns. A subsequent NRC review of TUBECO radiographs revealed three additional items: undocumented linear indications; excessive geometric unsharpness; and penetrameter identification numbers in the weld. A later review was performed by Stone and Webster wherein N&D 13,218 was generated. The N&D identified the same type of items listed above, and as summarized below.

Summary of Compliant and Noncompliant Welds: As a result of the reviews mentioned above, a number of questions arose relative to the radiographic film quality and possible indications in some welds. The following is a summary of the welds contained in the RSS System, and the findings of the subject reviews:

(1) Total of 30 circumferential butt welds in the process piping system:

- 3 circumferential butt welds with poor quality radiographs;

- 2 welds have unacceptable indications on the radiographs. NOTE: One indication, although shown on the circumferential butt weld radiograph, is actually contained in the elbow longitudinal seam weld.

(2) Total of 8 TUBECO fabricated elbows comprising 16 longitudinal seam welds (2 seams/elbow):

- 4 elbows (8 longitudinal seam welds) with poor quality radiographs and indications;

- 4 elbows (8 longitudinal seam welds) for which radiographs do not exist.

(3) Total of 28 welds contained in 4 encapsulation sleeves:

- 1 circumferential butt weld with poor quality radiographs;

- 4 longitudinal seam welds (in 16" Ø pipe) with poor quality radiographs:

- 4 combination groove/fillet welds with poor quality radiographs;

- 1 of the 4 groove/fillet welds also has an unacceptable indication.

With the exception of the encapsulation welds, all noncompliant welds are embedded in the concrete containment floor.

A detailed illustration of the above items is contained on the four weld maps (one for each line) included in Figures 1, 2, 3, and 4, and also in Tables 1, 2, and 3. Each weld map shows all of the welds contained in the applicable RSS line, and illustrates the items outlined above for each weld.

SUPPLEMENTARY CORRECTIVE MEASURES

In an attempt to resolve the TUBECO radiography problems, alternate NDE techniques were explored. Due to the encasement of the RSS pipe in concrete reradiography of the welds with indications, film quality problems, and missing films cannot be performed. Therefore, alternate NDE methods were sought which could be executed from the pipe I.D. surface.

Ultrasonic Testing Feasibility: Radiography of longitudinal and circumferential butt welds is required per ASME III, NC-5212 and NC-5222. However, ASME III, IX-3100 permits modified methods and techniques for special configurations and materials. The IX-3100 section requires that such modified inspection methods be proven, via demonstration, to be capable of detecting discontinuities to the same extent that applicable normal techniques would detect under normal conditions. Additionally, the special procedure shall be submitted to the Installer's Authorized

Inspection Agency for acceptance, and adopted as part of the Installer's Quality Assurance Program.

It is believed that the 12-inch diameter piping, which is embedded in the containment floor, can be considered as a special configuration. The assessment of ultrasonics as an alternate inspection technique to radiography is dependent upon: providing meaningful results; ANI acceptance; obtaining the necessary specialized equipment; and development and demonstration of the inspection technique.

The possibility for I.D. ultrasonics was researched. Only one company (Brown Boveri) performs, and has performed, such inspections with satisfactory results. Brown Boveri's application, however, is for ultrasonics of steam generator tubing, and the equipment would require modification to adapt for 12" diamater piping. Thus, the feasibility for I.D. ultrasonics is only in concept and has to be developed.

This technology, therefore, is not currently available due to: Brown Boveri's schedule constraints; the time necessary to design/adapt the UT equipment for the MP3 RSS piping; and the extensive amount of time needed to develop and qualify procedures to obtain meaningful data.

I.D. Surface Examinations: In light of the above, the only viable NDE that can be performed is I.D. visual and liquid penetrant examinations. CTS Services has been requisitioned to perform these examinations. The areas of particular concern are those which show suspect indications on the radiographs. These indications may actually be I.D. surface irregularities; the potential of which exists due to their location on the radiographic film. The results of these examinations are discussed in the Fitness-For-Purpose section of this report.

Image enhancement of the TUBECO films will be pursued only if resolution of the subject indications cannot be accomplished via visual/liquid penetrant examinations. Image enhancement would allow for a more accurate determination of the flaw size.

Encapsulation Welds: The encapsulation longitudinal seam weld was re-radiographed, and the "T" weld was ultrasonically tested. Both examinations were performed at the Millstone site. No apparent defects were found in either weld.

FITNESS-FOR-PURPOSE

An engineering assessment of the RSS piping was performed to substantiate the system operability without the need for repair or replacement. The fitness-for-purpose assessment is discussed below, and considers the following topics:

(1) Piping Stress Analysis

(2) Piping Integrity/Leak Tightness

(3) Material Properties/Weld Quality

(4) NDE Characterization

(5) Corrosion Considerations

(6) Fracture Mechanics Assessment

Piping Stress Analysis: The RSS Piping System has been evaluated to ensure that the design conditions of the FSAR have been met. The evaluation entailed an assessment of the thermal effects on the embedded pipe in accordance with ASME III, Subsections NC and NE (Class MC), 1971 Edition to Summer 1973 Addenda. A summary of the analysis is as follows:

The most critical loading condition for the RSS piping will occur following the Design Basis Accident (DBA). The accident scenario causes the piping system within containment to be heated with coolant water to 256°F (and a pressure of 40 psig). This loading produces thermal expansion within the piping system.

The layout of the embedded pipe includes three 90° long-radius elbows before it penetrates out of the mat. The minimum straight length of pipe between the elbows is approximately 5 feet. The embedded pipe under the 186°F differential temperature would produce an axial force of approximately 375 kips. Under the same condition, a normal force of approximately 1.5 ksi is produced between the interface of the pipe wall and the concrete.

In order to eliminate the thermal growth of the pipe, a frictional force between the concrete and pipe surface must be developed, which exceeds the 375 kip axial force produced by the pipe. The minimum length of straight pipe required to develop this frictional force is about 10 inches which is far less than the straight length available. Therefore, the layout of the embedded piping system is such that there will be no thermal growth.

The other area of concern is the effect of the embedded piping on the strength of the structural concrete. ACI 349-80, Section 6.3, addresses pipes embedded in concrete. The code has two areas of concern, which are:

a. Structural strength of the concrete section.

b. Degradation of concrete under high temperature for long-term duration.

The dimensional quantities of the piping layout do meet the requirements of Section 6.3.5 relative to:

a. The diamater of the embedded pipe with respect to the thickness of the slab.

b. The minimum spacings between two layouts has been maintained more than the three times the diameter of the pipe.

c. The pipe is allowed to pass through the slab without significantly impairing the strength of the construction.

The 256°F temperature under the faulted condition is less than the 350°F allowed by the ACI 349-80 code, Section 6.3.8. The long-term temperature is less than the 150°F which is allowed by the code. Therefore, the embedded piping system meets the requirements of ACI 349-80 and does not adversely affect the strength of the concrete. Based upon this evaluation, it can be concluded that the embedded pipe will remain functional after the DBA, and that the concrete will be unaffected by the piping system.

Piping Integrity/Leak Tightness: In addition to the NDE performed during the piping fabrication (Tables 1, 2, 3, and 4), the four RSS sump lines were hydrostatically tested at 155 psig after installation, but before pouring of the containment floor. All lines proved to be leak-tight. A minimum required wall thickness calculation (per ASME III, NC-3641.1) shows that only 0.052" is required to sustain a design pressure of 155 psig (Attachment 1). Thus, a single root pass of approximately 1/8 inch in thickness would be sufficient to sustain the 60 psig pressure in the RSS piping. Similar minimum thickness (tm) calculations concluded that minimum wall thicknesses of 0.020 inches and 0.018 inches are required to sustain the system design pressure (60 psig) and maximum hydrostatic test pressure to be experienced during the plant life (52 psig), respectively. In light of the hydrostatic testing and NDE referenced above, the RSS piping weld root passes are considered both sound and sufficient to sustain the necessary system pressure.

Material Properties/Weld Quality Assessment: The RSS system is constructed of ASME materials, as described in the System Description portion of this report. All materials were manufactured and tested to ASME Section III requirements including: ultrasonic inspection of plate; hydrostatic testing of pipe and fittings; liquid penetrant examination of welds; ferrite measurements of welds and weld filler material; and additional chemical analysis per ASME III requirements. All test results were in compliance with ASME Sections II and III for the nuclear applications.

As indicated earlier in this report, all welding was performed using ASME qualified procedures and welders. In addition to the NDE outlined in Table 3, the longitudinal seam welds in the TUBECO elbows were measured for ferrite content using a severn gauge. All measurements were within the ASME range of 5-15 percent ferrite.

In light of the above, the RSS System base and welding materials are of ASME quality, as were the procedures used in their fabrication.

NDE Characterization: To address the inspection concerns with the RSS sump piping radiography, the NUSCO NDE Level III pursued the following:

1. Review of the film for the quality, technique, and acceptability to Codes and/or procedures;

2. Visual examination of pipe I.D. surface; and

3. Meeting with the Stone and Webster NDE Level III to further characterize and disposition the suspect indications.

The films reviewed on the RSS System show improper density, no penetrameter sensitivity, excessive film artifacts, and poor quality performance. Based on the above, the radiographs do not (and cannot) meet ASME Code compliance. Six welds contain suspect indications that require dispositioning. There are 11 indications, 2 of which are on an encapsulation weld (3RSS-2-2-1-2, Weld T1), that has accessibility for resolution of the indication. The remaining nine will require additional NDE (I.D. visual) and discussion with the author of the Stone and Webster radiograph review report. Visual examination using a remote camera placed in the I.D. of the pipe was used for the dispositioning process.

To address the encapsulation radiography concerns, reexamination of the long seam welds and flange-to-reducer welds (T-weld) was performed. The longitudinal seam welds were reradiographed, wherein the "T" welds were ultrasonically inspected. No indications of flaws were found.

The results of the above work are provided in Table 5 and Attachment 2: NDE Level III Position.

Corrosion: Corrosion of the RSS type 304 stainless steel piping and subject welds is not of concern during the 40-year MP3 operating life. Stress corrosion cracking (SCC) of stainless steel in simulated pressure-suppression and fission product absorption sprays were investigated by Griess in 1971. It was found that higher pH borate solutions (pH of 6.5 and 7.5) caused little or no SCC of this material.

The environmental (chemistry) conditions subjected to the RSS piping will be maintained in accordance with the Technical Specifications. These requirements have been established such that piping/welding material degradation should not occur. The design and operating conditions of the RSS System are delineated in the System Description part of this report.

Fracture Mechanics Evaluation: A fracture mechanics analysis was performed to assess the extent/effect of the suspect flaws on the system operability. The primary objective of the analysis is to demonstrate that the RSS sump lines will successfully function without the need for further inspection. In doing so, the analysis establishes the largest possible crack that could have survived the hydrostatic test conditions (155 psig). Further evaluation illustrates that this maximum-size crack will not progress through-wall during the life of the plant.

The following conclusions are established from the analysis:

1. The maximum edge flaw which could survive the hydrostatic test has a depth of 0.356 inches, which is 95% of the pipe nominal wall thickness;

2. This maximum flaw would grow by less than the 0.0001 inch during the design life of the plant;

3. The minimum end-of-design-life safety factors against leakage are 3.0 for normal, upset and test conditions and 2.6 for emergency and faulted conditions;

4. Since these safety factors compare well with those implied by the ASME Code and are consistent with good engineering judgment, the lines are acceptable without further examination.

Furthermore, the minimum wall thickness required to survive the 155 psig hydrostatic test (established herein as 0.019 inches) compares well with those necessary to sustain the system design pressure and maximum hydrostatic test pressure during the plant operating life (0.020 inches and 0.018 inches, respectively). Therefore, the minimum wall thickness present (0.019 inches; that which sustained the 155 psig hydro) is sufficient to sustain both the system operating pressure (40 psig) and maximum hydrostatic test pressure (52 psig).

SUMMARY/CONCLUSION

As a result of a rereview of TUBECO radiographs, some questions have risen relative to the radiographic film quality and possible suspect indications. The following tasks were performed as part of the problem resolution:

1. Exhaustive document search relative to the materials used, fabrication methods employed; and inspections and tests performed:

2. Investigation of supplemental NDE methods possible. Visual examination of pipe I.D. surface performed to assess condition of suspect welds;

3. Piping stress analysis (embedded portion) using faulted conditions, concluding that the pipe remains functional after the DBA;

4. Characterization of all suspect indications and radiographic films via radiograph reviews, I.D. visual inspection, and meeting between NUSCO and Stone & Webster Level III personnel;

5. Fracture mechanics evaluation of embedded portion of pipe to assess the extent/effect of flaws relative to the operability of the system.

6. Additional radiography and ultrasonic testing of encapsulation welds.

In light of the above work, the following conclusions are made:

1. The RSSS system was designed, constructed and inspected in accordance with ASME III, Class 2 requirements;

2. The materials of construction and procedures and personnel used in the fabrication conformed to the applicable ASME Code(s) for manufacturing and qualification, respectively;

3. The requirements of ACI 349-80 are met, relative to the effects of the pipe on the concrete;

4. The NDE characterization (NUSCO NDE Level III) addresses all suspect flaws and radiograph film items;

5. The piping was successfully hydrostatically tested at 155 psig in compliance with both ASME and ACI requirements;

6. The fracture mechanics evaluation demonstrated that the maximum size flaw possible will not progress through-wall during the life of the plant and that the system will function without the need for repair or rework.

7. Reradiography of longitudinal seam weld in encapsulation and ultrasonic examination of encapuslation "T" weld were performed. Both tests were acceptable with no apparent defects observed.

Based upon the engineering assessment provided in this report (Fitness-for-Purpose) and the results obtained from the supplementary NDE, NUSCO/NNECO concludes that the RSS piping meets the intent of ASME Section III, Class 2. However, due to the presence of noncompliant information (i.e., poor quality and missing radiographs, and suspect indications) the embedded piping cannot be N-stamped. It is, therefore, concluded that the embedded RSS piping and encapsulation:

1. Can function as originally intended (designed);

2. Be exempt from the radiography requirements for ASME III, Class 2 piping for those welds listed in Table 5; and

3. Be accepted as ASME III, Class 2 piping in light of the additional NDE and engineering assessment provided herein.

The necessary FSAR changes are included in Attachment 3.

MILLSTONE UNIT NO. 3 RSS PIPING SYSTEM
WELD HISTORY/METALLURGY
PROCESS PIPING
TABLE 1

LINE NO./ SPOOL NO.	WELD JOINT NO.	WELD JOINT DESCRIPTION	NDE PERFORMED ROOT	NDE PERFORMED COMPLETED WELD	NOTES
3RSS-1/ 3RSS-1-1-1-2	B	Pipe to Elbow	LP	LP & RT	o Indication on Film
	C	Elbow to Pipe	LP	LP & RT	o None
	D	Pipe to Elbow	LP	LP & RT	o None
	E	Elbow to Pipe	LP	LP & RT	o None
	F	Pipe to Elbow	LP	LP & RT	o None
3RSS-2/ 3RSS-2-1-1-2	B	Pipe to Elbow	LP	LP & RT	o None
	C	Elbow to Pipe	LP	LP & RT	o None
	H	Pipe to Pipe	LP	LP & RT	o None
	D	Pipe to Elbow	LP	LP & RT	o None
	E	Elbow to Pipe	LP	LP & RT	o None
	F	Pipe to Elbow	LP	LP & RT	o None
3RSS-3/ 3RSS-3-1-1-2	B	Pipe to Elbow	LP	LP & RT	o None
	C	Elbow to Pipe	LP	LP & RT	o None
	H	Pipe to Pipe	LP	LP & RT	o Film Quality Item
	D	Pipe to Elbow	LP	LP & RT	o None
	E	Elbow to Pipe	LP	LP & RT	o None
	F	Pipe to Elbow	LP	LP & RT	o None
3RSS-4/ 3RSS-4-1-1-2	B	Pipe to Elbow	LP	LP & RT	o None
	C	Elbow to Pipe	LP	LP & RT	o Film Quality & Ind.
	D	Pipe to Elbow	LP	LP & RT	o Film Quality
	E	Elbow to Pipe	LP	LP & RT	o None
	F	Pipe to Elbow	LP	LP & RT	o None

MILLSTONE UNIT NO. 3 RSS PIPING SYSTEM
WELD HISTORY/METALLURGY
ENCAPSULATIONS
TABLE 2

LINE NO./ SPOOL NO.	WELD JOINT DESIGNATION	WELD JOINT DESCRIPTION	WELD PROCEDURE USED	NDE PERFORMED	NOTES
3RSS-1/ 3RSS-1-2-1-2	*B, D, E, S, F	Fillet	SM8-1	LP	o None
	*T	Groove/Fillet	GT8-1 & SM8-1	LP & RT	o Film Quality Item
	L, S	Groove-Butt	GT8-1 & SM8-1	LP & RT	o Film Quality for "S"
	R	HLF. CPLG.	SM8-1	LP	o None
	*Long-Seam	Groove-Butt	GT8-1 & SM8-1	LP & RT	o Film Quality
3RSS-2/ 3RSS-2-2-1-2	*B, D, E, S, F	Fillet	SM8-1	LP	o None
	*T	Groove/Fillet	GT8-1 & SM8-1	LP & RT	o Film Quality & Ind's
	L, S	Groove-Butt	GT8-1 & SM8-1	LP & RT	o None
	R	HLF. CPLG.	SM8-1	LP	o None
	*Long-Seam	Groove-Butt	GT8-1 & SM8-1	LP & RT	o Film Quality
3RSS-3/ 3RSS-3-2-1-2	*B, D, E, S, F	Fillet	SM8-1	LP	o None
	*T	Groove/Fillet	GT8-1 & SM8-1	LP & RT	o Film Quality Item
	L, S	Groove-Butt	GT8-1 & SM8-1	LP & RT	o None
	R	HLF. CPLG.	SM8-1	LP	o None
	*Long-Seam	Groove-Butt	GT8-1 & SM8-1	LP & RT	o Film Quality Items
3RSS-4/ 3RSS-4-2-1-2	*B, D, E, S, F	Fillet	SM8-1	LP	o None
	*T	Groove/Fillet	GT8-1 & SM8-1	LP & RT	o Film Quality Item
	L, S	Groove-Butt	GT8-1 & SM8-1	LP & RT	o None
	R	HLF. CPLG.	SM8-1	LP	o None
	*Long-Seam	Groove-Butt	GT8-1 & SM8-1	LP & RT	o Film Quality Items

*Welds, B, T, and Long-Seam were LP'd on root pass and completed weld. All other LP on completed weld only.

Notes:

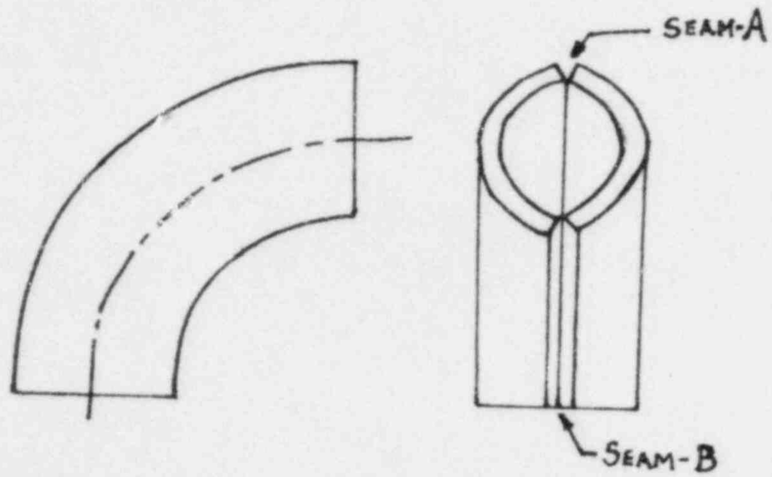
1. TUBECO Weld Procedures: GT8-1; GTAW
   SM8-1; SMAW

2. Base Metals: 16"Ø pipe; ASTM A358, Class 1, Type 304
   12"Ø pipe, ASME SA312, Type 304
   Plate; ASTM A240, Type 304-L

3. Weld Filler Metals: Type 308

MILLSTONE UNIT NO. 3 RSS SYSTEM
WELD HISTORY/METALLURGY
TUBECO FABRICATED ELBOWS
LONG-SEAM WELDS
TABLE 3

LINE NO.	ELBOW S.N.	WELDER(S) I.D. ROOT	WELDER(S) I.D. REM.	RT. PERFORMED FINAL	RT. PERFORMED REPAIR	SEVERN GAUGE FERRITE PERCENT SEAM-A	SEVERN GAUGE FERRITE PERCENT SEAM-B	NOTES
3RSS-1	12913	21	114	Yes	No	5.5	6.0	o No Film
	12914	21	142	Yes	Yes (Seam A)	5.5	6.0	o No Film
3RSS-2	12922	21	141	Yes	Yes (Seam A)	6.0	6.5	o Indication On Film; Film Quality
	12923	21	142	Yes	No	7.5	7.5	o No Film
3RSS-3	12919	21	141	Yes	Yes (Seam A)	7.5	7.5	o Film Quality; Indications
	12920	21	142	Yes	No	7.5	7.5	o Film Quality; Indications
3RSS-4	12916	21	4	Yes	No	6.5	7.5	o No Film
	12917	21	4	Yes	No	5.5	6.5	o Film Quality: Indication



NOTES:

1. TUBECO Weld Procedures: GT8-1; GTAW Root Passes
   SM8-1; SMAW Fill Passes
2. Base Material: SA-240, Type 304
3. Filler Metal: Type 308

MILLSTONE UNIT NO. 3 RSS SYSTEM
HYDROSTATIC TEST RESULTS
SUMMARY
TABLE 4

LINE NO.	TEST DATE	TEST PRESSURE (PSIG)	GAUGE PRESSURE (PSIG) INITIAL	FINAL	TEST DURATION (HRS)
3RSS-1	10/13/75	150^{+5}_{-0}	152	155	4
3RSS-2	10/13/75	150^{+5}_{-0}	152	155	4
3RSS-3	10/13/75	150^{+5}_{-0}	152	155	4
3RSS-4	10/13/75	150^{+5}_{-0}	152	155	4

NOTES:

o One test performed for each line conforming to the following acceptance criteria:

1. ASME - No leakage from welded joints.

2. ACI STD. 318-71 - No drop in pressure is allowed except that which may be caused by air temperature.

MILLSTONE UNIT NO. 3 RSS SYSTEM
NDE CHARACTERIZATION RESULTS
TABLE 5

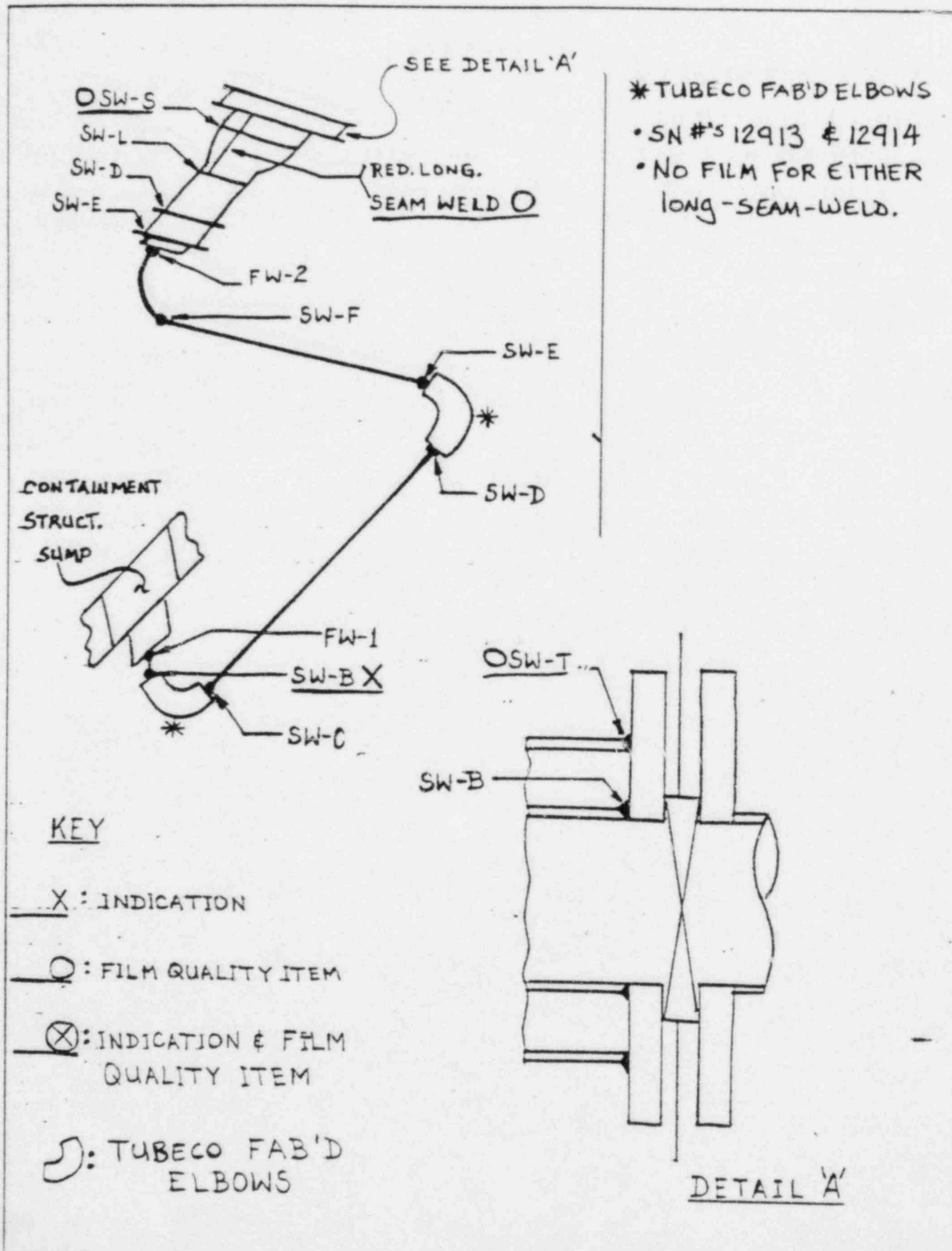
LINE NO./ SPOOL NO.	WELD NO.	RT FILM REVIEW RESULTS	NUSCO ID VISUAL RESULTS	NOTES
3RSS-1/	B	Indication	NAD	
3RSS-1-1-1-2	Elbow 12913	No Film	NAD	
	Elbow 12914	No Film	NAD	
3RSS-2/	Elbow 12922	Film Quality; Indication	NAD	Crimp Marks*
3RSS-2-1-1-2	Elbow 12923	No Film	NAD	
3RSS-3/	H	Film Quality	NAD	
3RSS-3-1-1-2	Elbow 12919	Film Quality; Indication	NAD	
	Elbow 12920	Film Quality; Indication	ID Surface Mismatch	
3RSS-4/	C	Film Quality; Indication	NAD	
3RSS-4-1-1-2	D	Film Quality	NAD	
	Elbow 12916	No Film	NAD	
	Elbow 19217	Film Quality; Indication	NAD	

NAD = No Apparent Defects
*Indication identified as lead crimp marks from film cassette.

MP3 RSS WELD MAP

3RSS-1

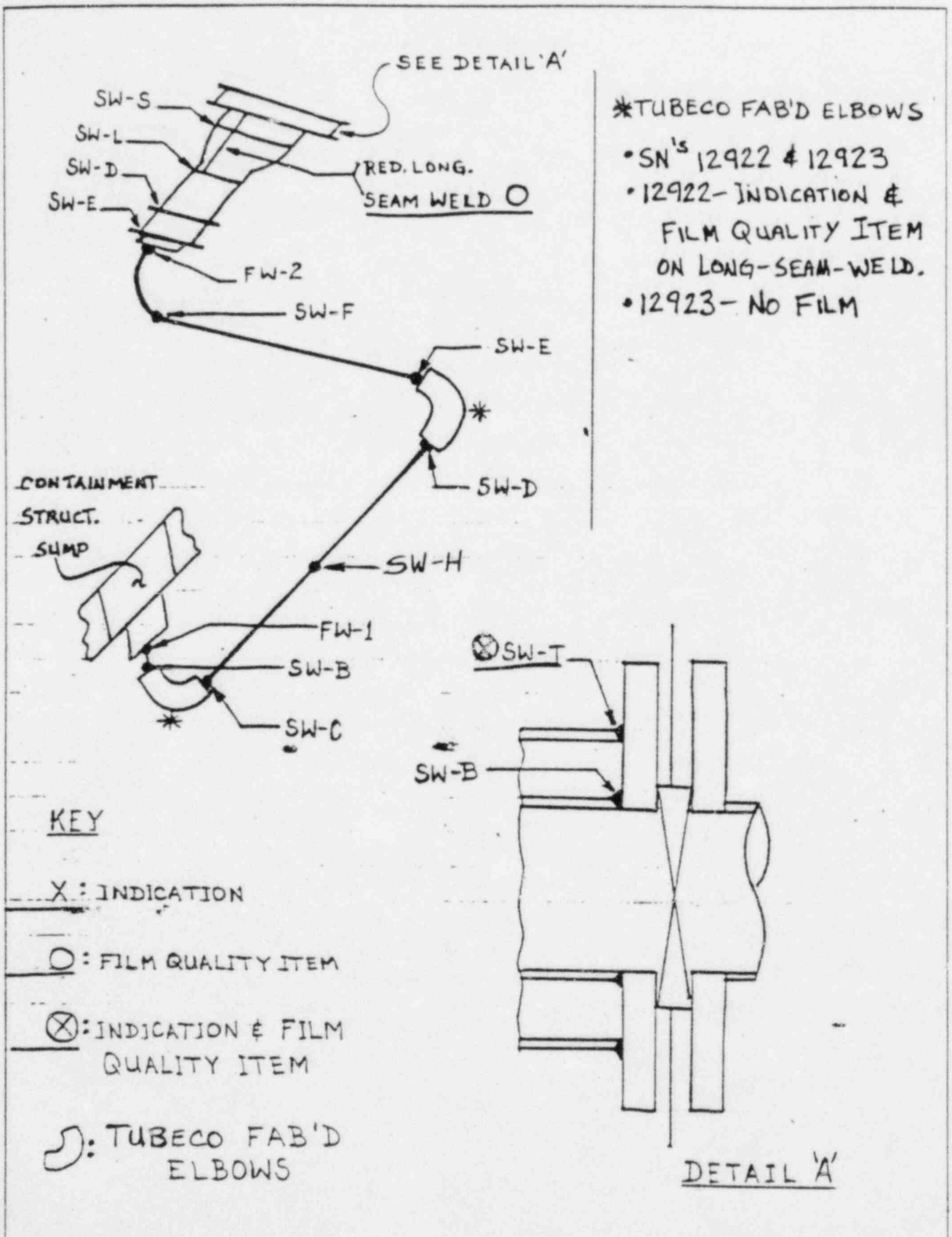
FIGURE 1



MP3 RSS WELD MAP

3RSS-2

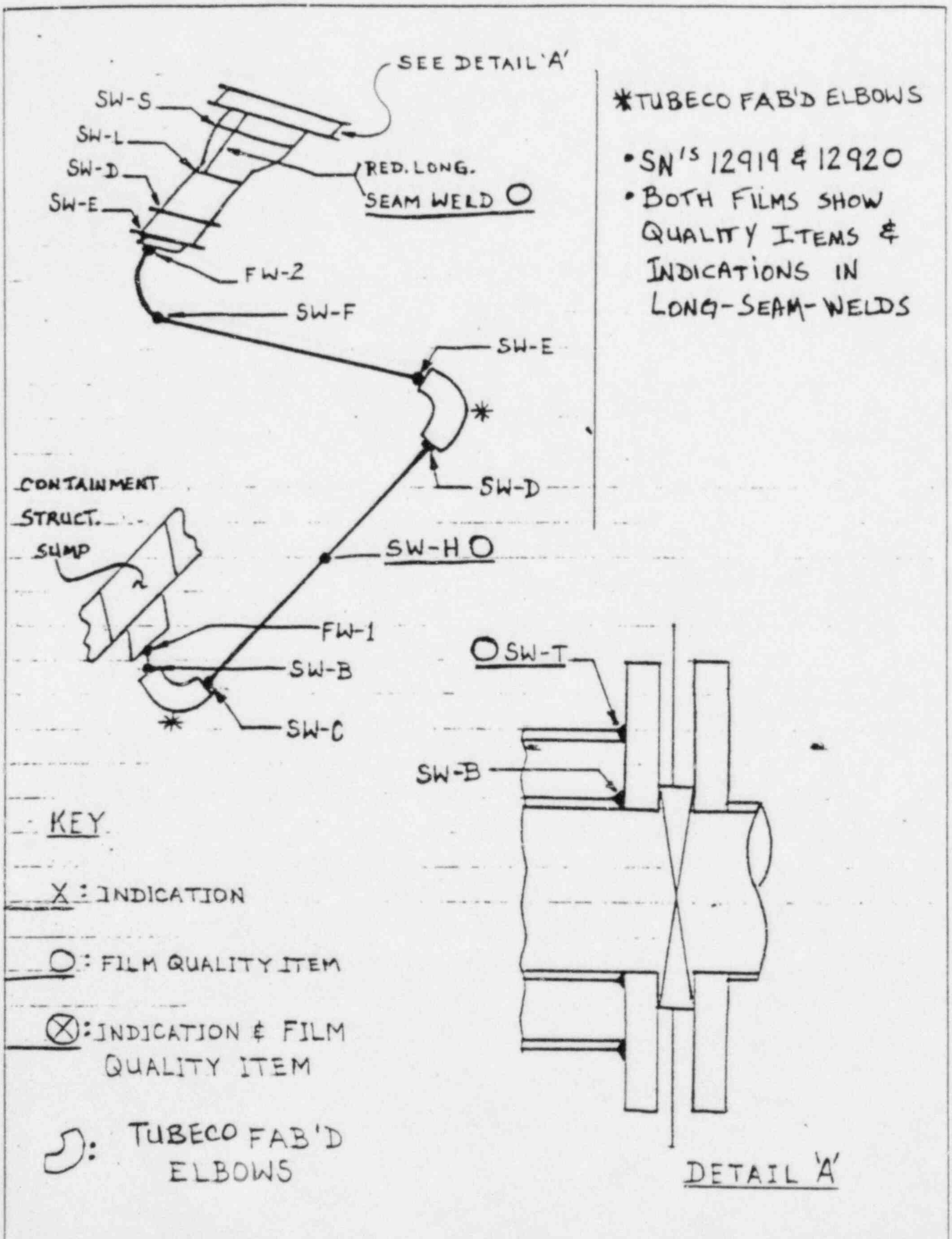
FIGURE 2



MP3 RSS WELD MAP

3RSS-3

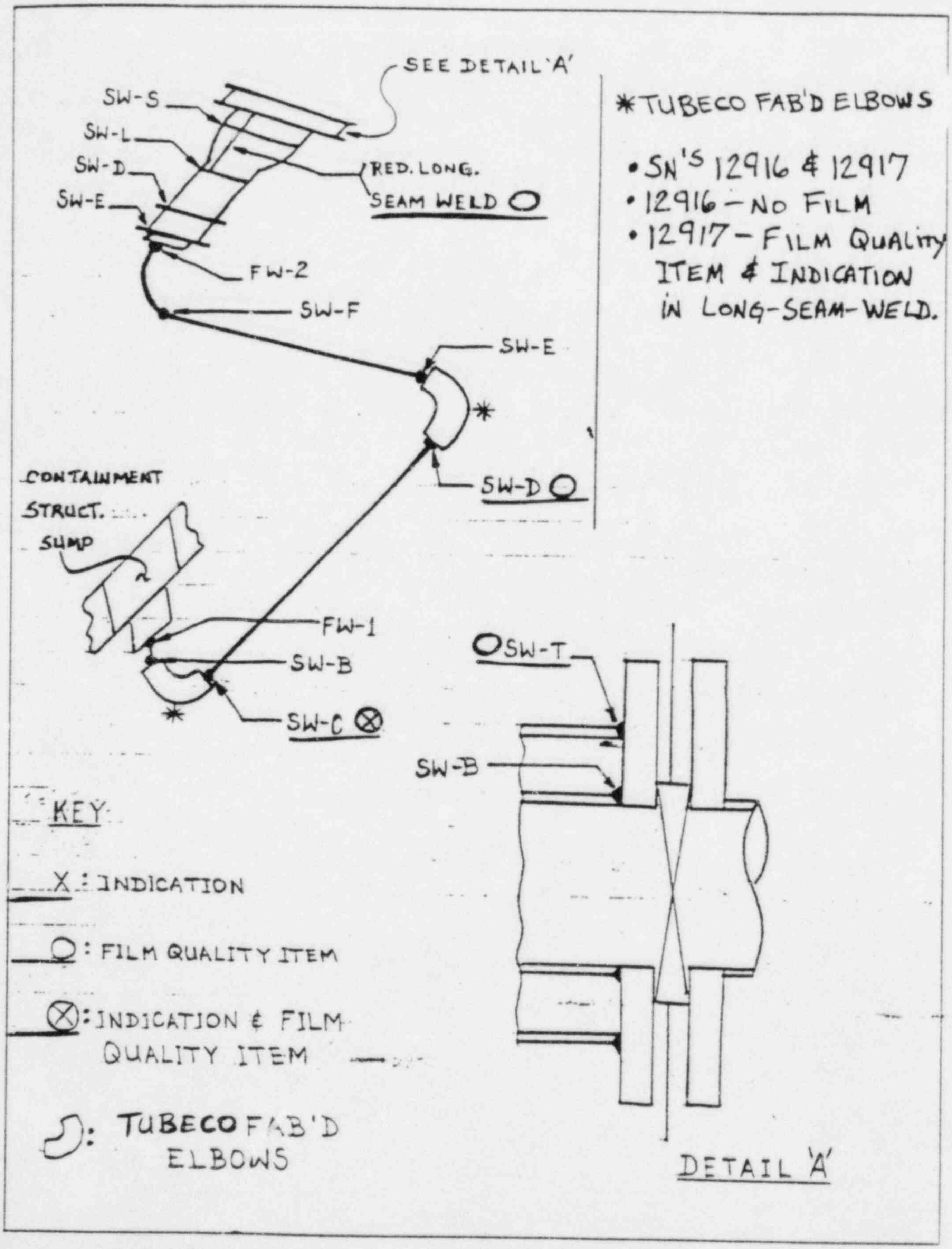
FIGURE 3



MP3 RSS WELD MAP

3RSS-4

FIGURE 4



ATTACHMENT 1

- ASME Section III, NC-3641.1 Equation (3), 1971 Edition
- Material: SA312, TP304
- Piping Size: 12" diameter, standard wall (0.375").
- Hydrostatic Test Pressure: 155 psig, ambient temperature

- Equation (3): $t_m = \frac{PDo}{2(SE+Py)} + A$

where: P = 155 psig, internal design pressure

Do = 12.75, outside diameter

S = 18.8 ksi @ $100^{\circ}F$, Table I-7.2 (ASME III)

E = 1.0, joint efficiency factor

y = 0.4,

A = 0", corrosion allowance

$$t_m = \frac{(155 \text{ psig})(12.75")}{2(18{,}800 \text{ psi} \times 1 + 155 \text{ psig} \times 0.4)} + 0"$$

$$t_m = \underline{\underline{0.052"}}$$

Therefore,

A 12" x 0.375" SA312, TP304 pipe with a minimum thickness of 0.052" would meet ASME III, Class 2 rules for a design internal pressure of 155 psig.

ATTACHMENT 2

NDE LEVEL III POSITION

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
THE HARTFORD ELECTRIC LIGHT COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

On August 5 and 6, 1985, a camera was placed (from the sump) into each of the four RSS sump lines and video tapes taken of the I.D. weld roots. The objective of this exercise is to provide information for the welds with lost radiographs, welds with indications and welds with radiographs which did not meet ASME Code required quality levels.

The tapes were reviewed by NUSCO NDE Level III S. Sikorski on August 7 and 8 during initial taping to determine the feasibility of additional NDE. An assessment of the welds, base metal geometry and surface finish negated the options of I.D. penetrant examination and/or I.D. ultrasonic weld examination. The penetrant examination was deemed impractical due to root reinforcement, counterbore geometry and hand grinding of the root and counterbore. These geometries would hold penetrant, thus making the validity of the examination results questionable. Ultrasonic examination, which was considered but determined improbable, was entirely discounted due to the I.D. geometry and compound angles which would make the results uninterpretable.

The most viable examination that could be provided was an I.D. visual using the video tapes and available radiographs by which the following results were determined:

<u>3-RSS-1 - Visual and Radiograph Results</u>:

Visual examination was performed on SW-E, SW-D, SW-C, SW-B and the elbow long seams (S/N Nos. 12913 and 12914). No visible flaws were found in the areas inspected. The extrados long seam from SW-C to SW-B was partially obscurred (approximately 10% of length) due to residual water and dirt film.

Weld radiograph SW-B had an indication at the intersect area of the circumferential weld to long seam. This was not detected on the pipe I.D. by visual examination. The remaining weld radiographs were acceptable; however, the radiographs of the long seam welds were misplaced and not available for review. Visual examination of these long seams revealed no apparent defects at the I.D. root area.

3-RSS-2 - Visual and Radiograph Examination Results:

Visual examination was performed on SW-E, SW-D, SW-C, SW-B and the elbow long seams (S/N Nos. 12922 and 12923). No visible flaws were detected in the areas inspected. The elbow seams visually examined had a surface film partially obscuring the area of interest.

The radiograph review for this line identified no apparent defects. Film quality for radiographs taken of the elbow seams for elbow S/N 12922 were not acceptable to ASME standards. Radiographs of elbow seams S/N 12923 were misplaced and not reviewed. These radiographs were initially accepted.

3-RSS-3 - Visual and Radiography Examination Results:

Visual examination was performed on SW-E, SW-D, SW-H, SW-C, SW-B and the elbow long seams (S/N Nos. 12929 and 12920). No visible flaws were detected in the areas examined.

The radiograph review of the welds in this line showed all the circumferential butt welds to be acceptable. The radiographs of the long seams showed unacceptable film quality and possible flaws. The potential flaw in elbow #12920 on radiograph V-H-4-039 view 1-2 was visually identified as I.D. surface mismatch adjacent to the root due to undercut. The remaining indications could not be located visually.

3-RSS-4 - Visual and Radiograph Examination Results

Visual examination was performed on SW-E, SW-D, SW-C, SW-B and elbow long seam (S/N Nos. 12916 and 12917). The extrodos long seam weld from SW-B to SW-C was 30% obscured by residual water and surface film at the pipe bottom. Approximately 10% of SW-C was also obscured. No visible flaws were detected in the areas examined.

Radiograph review of SW-B and SW-E found these welds acceptable. Film quality problems were identified for SW-D, SW-C and elbow seam welds S/N 12917. The seam weld radiographs for elbow S/N 12916 were misplaced and not available for review. Weld SW-C and elbow seam weld S/N 12917 radiographs revealed suspect indications which could not be located visually on the I.D. surface.

JJC/edv
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NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

On August 20th, 1985 valves were removed from the RSS sump piping providing access for additional NDE around the encapsulation area. Radiography of the accessible portion of the encapsulation long seams was performed. No defects were identified. A circumferential butt weld (3-RSS-1 SW-S) was re-radiographed due to film quality violations of the original radiographs.

The encapsulation sleeve to flange weld (SW-T) on all four lines were ultrasonically examined after radiography attempts failed to provide meaningful results. Ultrasonic examination consisted of straight beam from the flange and high angle L-wave examination from the sleeve. No indications of flaws have been identified in any of the additional NDE.

On July 31st, 1985, a review of the radiographs was performed by Burt Jersild and Steve Sikorksi. Radiograph indications on weld seam 10-12922 were identified as crimp marks. No other indications were resolved during that review.

This concludes all practical NDE that could be performed on this system to date.

ATTACHMENT 3

PROPOSED MILLSTONE UNIT 3 FSAR
CHANGES IN CONSIDERATION OF THE
RSS PIPING ISSUE

The ESF actuation signals that initiate closure of the containment isolation valves are discussed in Section 6.2.4.1.1 and described in Section 7.3.1.

GDC Exceptions

The containment isolation system conforms to the specification of General Design Criteria 54 through 57 with the following exceptions:

1. ESF Penetrations (Section 6.0)

   The containment isolation valves for the emergency core cooling system, the quench spray system, and the discharge lines of the containment recirculation system are not closed by an automatic containment isolation signal, because operation of these systems is required following an accident inside the reactor containment. However, each line is fitted with the valving necessary to satisfy the single failure criterion and to remote-manually isolate these lines, when isolation is desired or required.

2. Containment Recirculation Pump Suction Penetrations (Section 6.2.2)

   The suction piping for the containment recirculation pumps is buried in the reinforced concrete reactor containment base mat. Inclusion of inside containment isolation valves in this piping is impractical because the valves would have to be encased in concrete or be capable of submerged operation after an accident. Because the containment recirculation system is operated after a LOCA, suction line isolation is only required in the event of a pipe rupture outside of the reactor containment. Outside the reactor containment, single normally open, remotely controlled, motor-operated isolation valves are provided. Because these lines do not have isolation valves inside the reactor containment, the piping between the reactor containment wall and the valves is individually encapsulated in stainless steel (Figure 6.2-47). This encapsulation is an extension of the containment structure and prevents a rupture in the suction line between the reactor containment wall and the motor-operated isolation valve from causing a release of fluids from inside the reactor containment to the environment.

   INSERT A

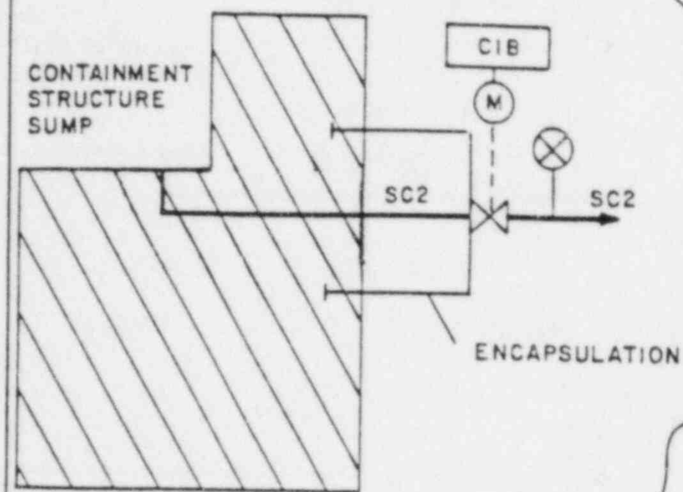
3. Containment Leakage Monitoring Open Tap Penetrations (Section 6.2.6)

   The containment isolation designs for these small instrument lines comply with the requirements of Regulatory Guide 1.11 instead of General Design Criteria 55 and 56 due to their size. All instrument lines are Safety Class 2, up to and including the containment isolation valves. The design, protection and location of these safety class lines minimize

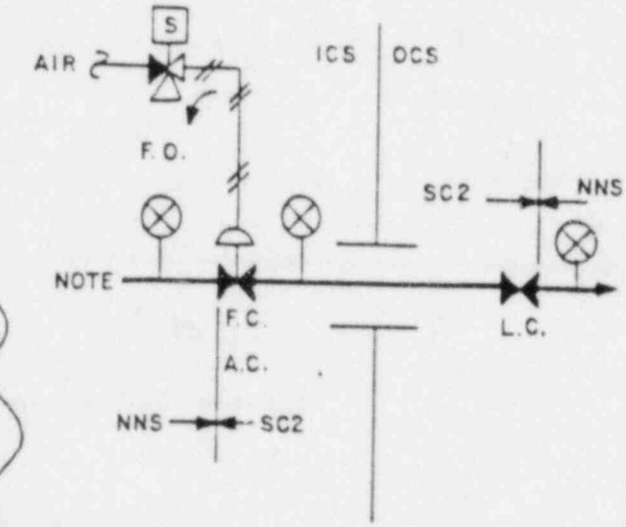
INSERT A

... In addition, the piping is qualified to the requirements of SRP 3.6.2 and Branch Technical Position MEB 3-1 as a break exclusion zone.

AA. CONTAINMENT RECIRCULATION PUMP SECTION (TYPICAL OF FOUR PENETRATIONS)



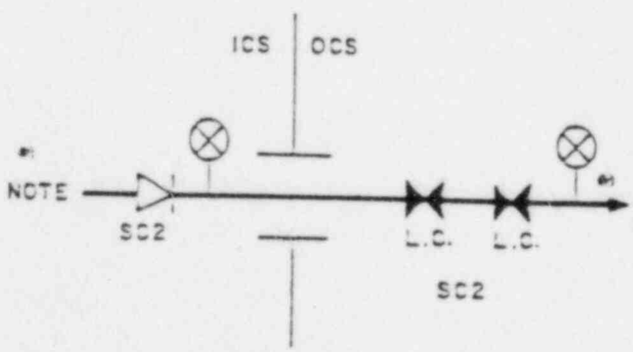
BB. CONTAINMENT VACUUM EJECTOR SUCTION



NOTE: OPEN TO CONTAINMENT ATMOSPHERE

REVISE AA.

CC. DBA H_2 RECOMBINER SUCTION (TYPICAL OF TWO PENETRATIONS)



NOTE: OPEN TO CONTAINMENT ATMOSPHERE

DD. RESIDUAL HEAT REMOVAL PUMP SUCTION FROM HOT LEGS (TYPICAL OF TWO PENETRATIONS)

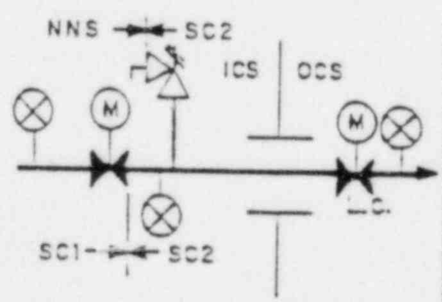


FIGURE 6.2-47 (SHEET 10 OF 13)
CONTAINMENT ISOLATION SYSTEM
MILLSTONE NUCLEAR POWER STATION
UNIT 3
FINAL SAFETY ANALYSIS REPORT