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Dominion®

August 19, 2011

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 11-476
NLOS/WEB R0
Docket No. 50-336
License No. DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
RELIEF REQUEST RR-04-12 FOR THE TEMPORARY NON-CODE COMPLIANT CONDITION OF THE CLASS 3 SERVICE WATER SYSTEM 10 INCH EMERGENCY DIESEL GENERATOR SUPPLY PIPING FLANGE

Pursuant to 10CFR50.55a(a)(3)(ii), Dominion Nuclear Connecticut, Inc. (DNC) requests relief from the Section XI requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. This request is based on the hardship of performing required ASME code repair/replacement activities to a piping flange in the 10 inch service water (SW) supply line to the Facility 1 emergency diesel generator (EDG) heat exchangers which has developed a through-wall leak. In accordance with 10CFR50.55a(g)(1), safety-related piping must meet the requirements applicable to components which are classified as ASME Code Class 3.

Options for a code repair include shutting down to replace the piping flange or performing the same repair online. Given the limited risk associated with the present condition, both of these options are considered a hardship without a compensating increase in the level of quality and safety. An alternative of continued operation with compensatory actions is proposed until the flange is replaced at the next refueling outage. Attachment 1 to this letter describes the temporary compensatory actions taken by DNC and the technical basis for the proposed relief request for this 10 inch moderate energy SW flange. A permanent code replacement for the identified 10 inch SW flange will be completed no later than the end of the next refueling outage currently scheduled to start in October 2012.

If you have any questions regarding this submittal, please contact Wanda Craft at (804) 273-4687.

Sincerely,

J. Alan Price
Vice President – Nuclear Engineering

Designate as original
Carleen Sanders
8/19/2011

A047
NRR

Attachments:

1. Relief Request RR-04-12 for the Temporary Non-Code Compliant Condition of the Class 3 Service Water System 10 Inch Emergency Diesel Generator Supply Piping Flange
2. Excerpts From Pipe Stress Analysis Calculation Number MP58B-00138EM, Revision 4, Addendum B, Service Water Supply to Diesel Engine Coolers – Problem 118
3. ETE–CME–2011–1005, Structural Integrity and System Performance Evaluation of Degraded Flange in "A" Service Water Pipe to EDG Spool SK-2952

Commitments made in this letter:

1. Replace the downstream flange on Spool Piece 2952 (Facility 1 SW supply piping to the Facility 1 EDG HXs) no later than the end of the next refueling outage scheduled for October 2012.
2. Leakage monitoring will be performed. UT monitoring will be performed on an approximate 30-day interval. UT examination of the pipe flange, as was done to identify the degraded area, will be done on a monthly basis to track the progression of the corrosion damage.

cc: U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

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Project Manager - Millstone Power Station
U.S. Nuclear Regulatory Commission
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11555 Rockville Pike
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NRC Senior Resident Inspector
Millstone Power Station

ATTACHMENT 1

RELIEF REQUEST RR-04-12 FOR THE TEMPORARY NON-CODE COMPLIANT CONDITION OF THE CLASS 3 SERVICE WATER SYSTEM 10 INCH EMERGENCY DIESEL GENERATOR SUPPLY PIPING FLANGE

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

RELIEF REQUEST RR-04-12

Relief Request
In Accordance with 10 CFR50.55a(a)(3)(ii)

-- Code Repair Hardship/No Compensating Increase in Safety --

1.0 ASME Code Component(s) Affected

ASME Code Class:	Code Class 3
Reference:	ASME Section XI, IWA-4000
Description:	Repair/Replacement Activities
Component:	Service Water (SW) System 10 inch Light Weight Slip-on Flange
Material	Coated Carbon Steel

2.0 Applicable Code Edition and Addenda

Millstone Power Station Unit 2 (MPS2) is currently in the fourth 10-year inservice inspection (ISI) interval, which began on April 1, 2010. American Society of Mechanical Engineers (ASME) Section XI, 2004 Edition, No Addenda (Reference 8.1) applies to the ISI program and is used as the primary ASME code edition for Section XI repair/replacement activities. The SW system piping design code (code of construction) is ANSI B31.1, 1967 Edition through the summer of 1973 Addendum (Reference 8.4).

3.0 Applicable Code Requirement

ASME Code Section XI, 2004 Edition, No Addenda, Article IWA-4000, Repair/Replacement Activities.

4.0 Reason For The Request

On August 17, 2011, an operator on rounds observed a yellow salty stain on the floor near the spent fuel pool purification pumps in the auxiliary building (Reference 8.5). There was water and a salt build-up on the I-beam above the stain on the floor. The operator found water dripping at a rate of 10 drops per minute coming from the "A" SW header to the "A" emergency diesel generator (EDG). Water was observed dripping from the outlet side flange on spool SK2952. The leak was confirmed to be on the flange body.

Ultrasonic test (UT) examinations determined the area of degradation on the flange is localized and is currently contained in a radial alignment between two of the twelve flange bolts.

Enclosure 1 to this attachment contains UT inspection results for the observed flaw area of the flange.

Options for a code repair include shutting down to replace the piping flange or performing the same repair online. Given the limited risk associated with the present condition, both of these options are considered a hardship without a compensating increase in the level of quality and safety. In the case of an online repair, it would require entry into abnormal operating procedures (i.e., OP 2326C, Off-Normal Service Water System Operations) including the following actions and/or conditions to effect a Code repair.

1. Ensure that SW temperature is less than 58°F (currently SW temperature is approximately 71°F and normally remains above 58°F well into October).

2. Align vital switchgear room coolers and chillers to the B train (or establish compensatory cooling).

3. Disable the A EDG.

4. Align the swing reactor building closed cooling water (RBCCW) heat exchanger (HX) to the B train on the SW side and the A train on the RBCCW side and ensure swing RBCCW HX can provide adequate A train cooling with SW flow less than 1500 gpm.

5. Align the swing SW pump mechanically to the B train and electrically to the A train and start the pump.

6. Align two turbine building component cooling water (TBCCW) HXs to the B train on the SW side (this may require a reactor down power to provide sufficient cooling).

Once in this configuration, completion of the work activities for the spool replacement within the remaining time of the limiting condition for operation of 72 hours will not be possible. Therefore a transition to Mode 5 (a hardship) would be required to perform this repair. Further, there is no compensating increase in plant safety by performing the repair during the operating cycle.

This temporary condition of the leaking 10 inch light weight slip on flange is not in compliance with ASME Section XI, 2004 Edition, IWA-4000, nor does it meet the accepted analysis methods contained in NRC Generic Letter (GL) 90-05 (Reference 8.2). Additionally, Code Case N-513-3 (Reference 8.3) is not applicable for use in structural evaluations because the degradation is in a component (10 inch light weight slip-on flange) which is specifically excluded from the scope of the code case. However, the current pipe stress analysis of record has been reviewed and the pipe stress levels adjacent to the flange (for the non-degraded condition) have been determined to be less than 10% of applicable Code allowables. The current corrosion damage to the flange is characterized through UT evaluations as limited (contained radially between two of twelve bolt holes). Because the observed damage is limited, it is considered that adequate margin is available to accommodate the corrosion that is anticipated to occur during the remaining 14 months of operation until the next refueling outage.

5.0 Proposed Alternative and Basis for Use

5.1 **Flaw Characterization** – Based on the UT results of the current condition and experience from other similar lining failures discovered during normal inspection on carbon steel piping components in SW, the flaw is characterized to be a localized area corrosion rather than a crack-like flaw. Dominion procedure ER-AA-NDE-UT-701 (included as Enclosure 2 to Attachment 1) contains additional details on the nondestructive examination process used.

The examination process used identified symptoms of localized area corrosion which is consistent with prior experience from other lining failures on this system. The flange in question was not designed to permit a complete volumetric examination once installed. However, the UT examination process used is capable of identifying localized area corrosion in the flange. There is no history of crack-like flaws in this system and it is not considered credible that such a flaw exists in the small area that did not receive a volumetric examination.

The coating on SW spool SK2952, where the leakage is occurring on the outlet flange, is inspected every other refueling cycle to ensure that the pressure boundary of the SW pipe remains intact and that the tube sheets of safety-related heat exchangers (HXs) do not become clogged by coating material. This every other refueling outage inspection is based upon the inspection of one train of SW every outage. This inspection scheme has been used for over ten years. Numerous defects have been detected by these inspections and repaired before a through-wall leak occurred.

Galvanic Corrosion Mechanism
The typical corrosion encountered in this carbon steel lined pipe, used for MPS2 SW, comes from a break or perforation (holiday) in the coating or lining. This most often is a result of mechanical assembly, disassembly or handling of the spool pieces.

The flaws in the coating most often occur in or around the inner diameter (ID) corners of the flanged joints. Once the coating is damaged, seawater gets into the coating and eventually through to the carbon steel. Once the seawater electrolyte makes contact with the carbon steel, galvanic corrosion occurs. The carbon steel is anodic to the surrounding coated carbon steel and any uncoated alloy surfaces. This creates an electrical current and metal ions are released into solution creating a cavity. The cavity grows from the initial point outwards in a radial shape in all directions and takes on the concave appearance, resembling what could be pictured if the carbon steel was scooped out with an ice cream scoop.

As the cavity grows, this electrical current creates a charged electrical field that actually cathodically protects the surrounding area at the sacrifice of the growing anodically charged cavity.

When the fit-up line between the slip-on flange ID and pipe outer diameter (OD) is exposed, this narrow space is flooded and exposed to seawater which then becomes subject to corrosion. However, the geometry of this gap is not favorable for the mass exchange (movement of negatively charged chloride and free oxygen atoms in and positively charged metal ions out) required for rapid corrosion. The free oxygen within the gap is quickly depleted and the rate of corrosion diminishes to a substantially lower amount compared to that in the active cavity. Thus, significant corrosion of the flange hub or attachment weld beyond the active cavity is not expected.

Starting in 2005, sections of the piping have been replaced with super austenitic stainless steel, AL6XN, designed for seawater service. Dominion has planned a programmatic replacement of the safety-related portion of the SW piping. Spool SK2952 is scheduled for replacement in the next refueling outage (fall 2012).

The coating on the outlet flange was visually inspected by a qualified linings engineer during 2R19 (October 2009). Lining engineers receive specific training in the inspection of linings to recognize coating defects. The epoxy lining on the flange face and ID of the pipe had no evidence of damage at that time. A typical refueling outage inspection has found 10 to 15 areas where the coating has failed and some corrosion has occurred. These

areas are repaired during the outage. Based upon past experience, more areas of coating damage and corrosion will be found in the next refueling outage, but the chances of another leak are small.

It is probable that the lining on the leaking flange was damaged when re-installing the upstream spool. However, a conservative corrosion rate was chosen by assuming the lining defect initiated 11 months ago (one-half the duration since the last inspection occurred) and that the observed damage has occurred in the past 11 months. Based upon UT measurements, the damaged area is about 3 inches long on the ID of the flange (which is approximately 34 inches in circumference and ¾ inch thick). Past experience has shown that the corrosion from this type of lining defect grows radially from a point on the ID of the flange face. Hence, the 3 inches represents twice the actual growth. Therefore the corrosion rate can be conservatively estimated as 1.5 inches/11 months = 0.136 inches/month. The extent of the damage to this outlet flange is limited to the one area noted. UT measurements around the circumference of the flange did not identify any similar areas.

5.2 **Structural Integrity** - Per MPS2 Technical Requirements Manual (TRM) 3.4.10, the structural integrity of an ASME component is determined in accordance with either the original construction code or the ASME Section XI Code, approved code cases or regulatory-approved methods of evaluation. No NRC approved methodology could be identified (i.e., GL 90-05 and Code Case N-513-3) applicable to flanges. Engineering Technical Evaluation ETE-CME-2011-1005, Revision 0 (Reference 8.5) is a structural integrity assessment of the degraded flange. Pipe stress levels for the Code equations for the adjoining pipe are less than 10% of their associated allowables. The area of degradation is currently confined to an area radially aligned between two bolt holes on one carbon steel flange. The area of degradation is assumed to be as large as 33% of the flange circumference (or the area between four bolt holes of a twelve bolt hole pattern) for the purpose of the structural integrity assessment. Based on experience with other similar situations (seawater/exposed carbon steel), this magnitude of corrosion is larger than the magnitude currently predicted by Materials Engineering personnel. Materials Engineering predicts a radial flaw size of approximately 7 inches at the end of the current operating cycle (i.e., 6.8 inches = 3 inches + 2 x 0.136 inches/month x 14 months, this is approximately 22% of the inside circumference = 7/(10 x π)). Since the limiting case assumes that a 33% maximum wall loss is experienced (to be confirmed periodically by UT) and the adjoining pipe element has 90% margin in the stress equations, structural integrity of the flange joint will be maintained for the loading conditions (i.e., dead load, thermal and seismic). The flaw is not crack-like and thus will remain stable under the postulated

design loading conditions since a large structural capability margin exists in the worst case degraded flange.

5.3 **Flow Margin** - SW flow loss from this leak location will not adversely affect the capability of the SW system to provide adequate cooling to the EDG HXs and to the other essential safety-related HXs. A leakage limit of 1 gallon per minute (gpm) is applied as the maximum acceptable leakage rate (currently the leakage rate is approximately 10 drops/min). A detailed system hydraulic analysis has been performed (Reference 8.6). This analysis demonstrates that a margin of at least 50 times is available (i.e., > 50 gpm can be tolerated and all essential safety-related HXs receive adequate SW flow for the limiting accident condition).

5.4 **Spray Concerns** – A walkdown has been performed by System Engineering. The walkdown included components within an approximate 30 foot envelope of the current leak. Primary water system components are located within this area including the non-safety related refueling water purification pumps P14A & B , safety related spent fuel pool cooling pumps P13A &B and heat exchangers X20A & B, and associated piping. Additionally, the non-safety related 480V Motor Control Center Bus (MCC-B31A) is located approximately 25 feet from the leak. Due to the existing leak location on the flange, the most likely spray direction is toward the concrete building wall at the -5 elevation of the auxiliary building located east of the leak. This wall is approximately 1 foot from the leak location. There are no components between the east wall and the leak location (the most probable spray direction) and no active component within a 15 foot envelope. The entire inspected area is further protected by a concrete block house on the south side (4 feet from the leak location). All active components are further protected from spray due to physical obstructions (walls, piping, hangers, etc.). Based on this review, there are no spray concerns affecting any area components for the worst projected leak.

5.5 **Flooding** – The flooding from an assumed 2 gpm leak (this is two times the action level of 1 gpm and allows for a leakage rate increase over the 30-day mission time) would result in a total leak volume of approximately 86,400 gallons. This volume is based on a 30-day mission time. The 30-day mission time is based on the GSI-191 containment emergency sump strainer design that has a 30-day mission time. Cooling over the 30-day mission time is provided by SW.

As a compensatory measure, leakage will be collected and directed to appropriate drains during normal plant operation, facilitating the ability to

monitor for degradation. These drains may not be available/functional or credited following a design basis accident.

If the compensatory drain collection system is unavailable/nonfunctional, then operators will be alerted to any pooling of water in the auxiliary building basement by existing auxiliary building sump system indication. A water volume of approximately 120,000 gallons can be accommodated by the auxiliary building basement (Reference 8.7) without impacting safety-related equipment. Therefore, the flooding for 30 days can be accommodated without operator action.

5.6 **Extent of Condition** – An on-going capital project has replaced much of the carbon steel lined/coated carbon steel piping. However, many similar coated carbon steel flange joints (to the current leaking joint) remain in service. Recent experience (within the last ten years) with the SW system inspections reveals that through-wall coated component failures are rare. Since the initiator for the current condition is presumed to be damage to the coating system upon reinstallation into the system, no other coated carbon steel component through-wall leaks are expected in the current operating cycle. No other SW system flange leaks are present in the MPS2 SW system. Because the degradation of similar coated carbon steel components has been previously evaluated and is the impetus for the ongoing piping replacement project, no scope expansion to examine additional components is warranted based on the identified degradation of the subject flange. Operators on rounds and system engineering walkdowns will continue to identify future instances of this type in a timely manner, just as this one was discovered.

5.7 **Compensatory Monitoring Plan** - Leakage monitoring will be performed. UT monitoring will be performed on an approximate 30-day interval. UT examination of the pipe flange, as was done to identify the degraded area, will be done on a monthly basis to track the progression of the corrosion damage. The estimated ~0.150" increase in the damaged area between examinations should be detected. Monitoring on a more frequent basis would not lend itself to revealing the very small changes which would be expected to occur between frequent examinations and any variability in the measurements may under represent or over represent the actual increase in the damaged area over time. An approximate 30 day interval is adequate and sufficient to detect increases in the damaged area in a timely manner based on the nature of degradation mechanism. Changes in the area of corrosion will be assessed by Engineering on the presumed corrosion rate and for impact to the structural integrity of the affected flange / flange joint. Leakage rate will be trended by System Engineering on an approximate weekly basis. Operations will qualitatively monitor leakage once per shift. If

any of the limits outlined within the relief request are challenged (e.g., the leakage rate of 1 gpm or the flaw size (33% of the flange inside circumference)), the A Train SW system will be declared inoperable.

5.8 **Conclusion** - Although the structural integrity of the leaking flange cannot be demonstrated in accordance with a regulatory-approved methodology, it is concluded the integrity and functional requirements of the flange will be maintained. Thus, SW will continue to be capable of providing required cooling water flow to meet the required cooling loads including the EDG HXs. There will be no adverse impact on neighboring equipment due to either spray or flooding. DNC will implement the compensatory monitoring plan above to ensure any growth of the flaw is identified and assessed for its impact on structural integrity.

6.0 Duration of Proposed Alternative

The affected spool piece was already scheduled to be replaced in October 2012 during 2R21. Therefore, the duration of the proposed alternative is requested until October 2012 or until the limits described above are challenged.

7.0 Precedents

None

8.0 References

8.1 ASME Code Section XI, Division 1, 2004 Edition (No Addenda)

8.2 NRC Generic Letter GL 90-05, "Guidelines for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," June 15, 1990

8.3 Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping," Section XI, Division 1, January 26, 2009

8.4 American National Standards Institute (ANSI) B31.1, Power Piping Code, 1967 Edition through the Summer 1973 Addendum (Note: The MPS2 Pipe Stress Analysis Criteria Document allows the use of ASME III, 1974 Edition to demonstrate pipe stress acceptability)

8.5 Condition Report CR 438193, Possible Through Hole Leak in the "A" Service Water Header To The "A" EDG

8.6 Engineering Technical Evaluation ETE-CME-2011-1005, Revision 0, Structural Integrity and System Performance Evaluation of Degraded Flange in "A" Service Water Line to EDG Spool SK-2952

8.7 Millstone Power Station Unit 2, Probabilistic Risk Assessment Model Notebook, Part III PRA Model Development, Volume IF.1, Internal Flooding Analysis, Partitioning and Source Identification *& Characterization, Revision 0

Enclosure 1
(of Attachment 1)

Ultrasonic Test Results

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

Exam Data Sheet

Millstone Power Station	**ULTRASONIC EXAMINATION STRAIGHT BEAM MEASUREMENTS**
Plant Millstone Unit 3	Page 1 of 11
System & Zone No.	Exam Data Sheet No N/A
Component ID Line 10" JGD-4	AWO Number 53102457364
Component Description 10" Flange	Drawing No. 25203-20150 SH. 471
Examination Purpose Engineering Information / CR438193	Line No. N/A

Instrument & Settings	
Manufacturer	Panametrics
Model No.	36 DL Plus
~~Serial No.~~	~~002181809~~
Range	5.00"
Velocity	.2326
Delay	N/A
Zero Value	4923
Cal Tolerance	±.002"

Calibration Block(s)		
Type	Serial No.	Material
Step Block	061291	C/S
~~Step Block~~	~~99-6791~~	~~C/S~~

Component Data	
Component T_{nom}	N/A
Component Dia.	N/A
~~Attachments~~	~~yes~~

Calibration Checks		Block Thickness		Instrument Reading	
Type	Time	Min.	Max.	Min.	Max.
Initial	08:25	.100"	4.000"	.100"	4.000"
Intermediate	N/A	N/A	N/A	N/A	N/A
Intermediate	N/A	N/A	N/A	N/A	N/A
Final	09:46	.100"	4.000"	.100"	4.000"

Search Unit Data	
Manufacturer	Panametrics
Type No.	D791-RM
Serial No.	19519
Frequency	5.0 MHz
Size	.312"

Couplant Data	
Brand	Ultragel II
Batch No.	09225 I
SAP Batch Mgmt. No.	N/A

Temperature Data	
Cal. Block Temp.	N/A
Component Temp.	N/A
Thermometer No.	N/A

Sketch/Comments Area - Attach Photo(s) of Relevant Conditions Separately

Examined UT Points at 1:00 Through 9:00 Positions Around Flange

See Attached Generic Sketch Sheets for UT Test Results

Examiner (print & sign) ~~Todd Bohnenkamper~~ / [signature] ~~Level II~~ ~~Date~~ 08/18/2011

Reviewer (sign) [signature] for M. Brehler per telecon Level II Date 8/18/11

ANI/ANII If Required (Sign) N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

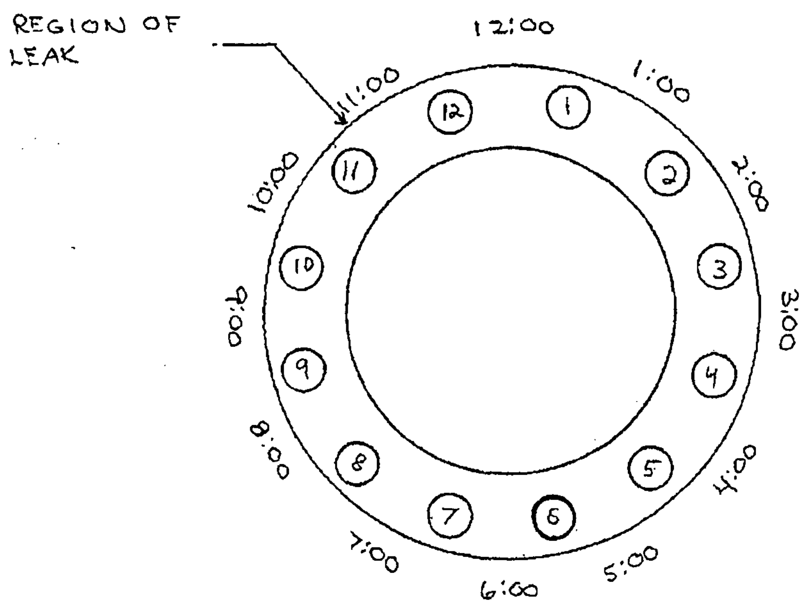
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 2 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4 (Leaking Flange)

EAST WALL (12:00)



VIEWED LOOKING DOWN

Examiner Comments:

Examiner Todd Bohnenkamper [signature] Level II Date 8/18/2011

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use **Reference**

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GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 3 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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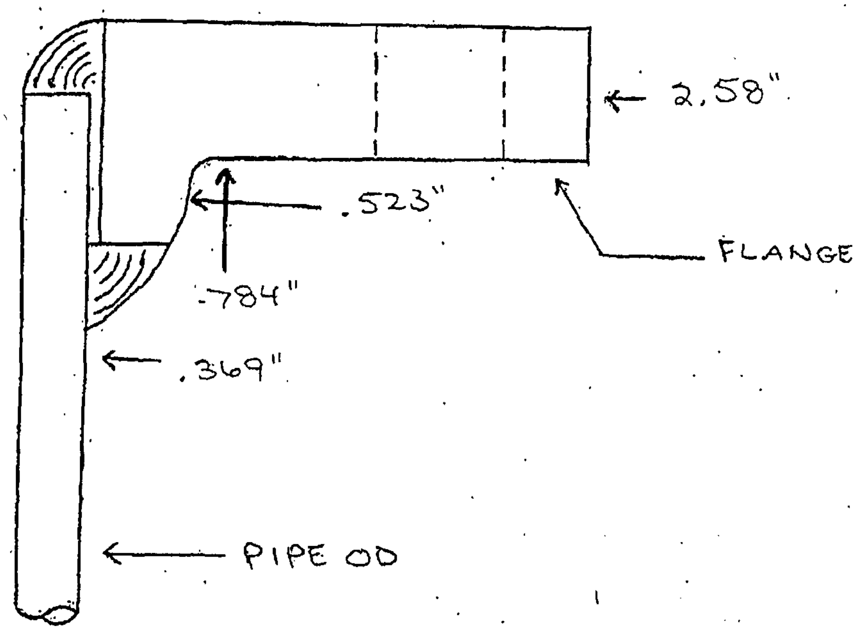

Examiner Comments: SCANNED BETWEEN BOLT HOLES AT EACH UT POINT AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER/[signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use **Reference**

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GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 4 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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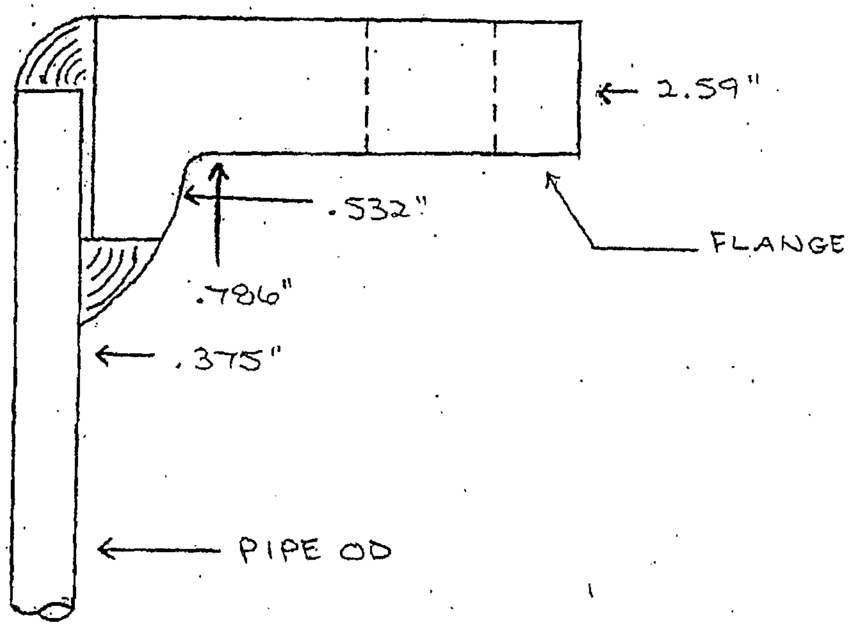

Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner ~~N/A~~ Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 5 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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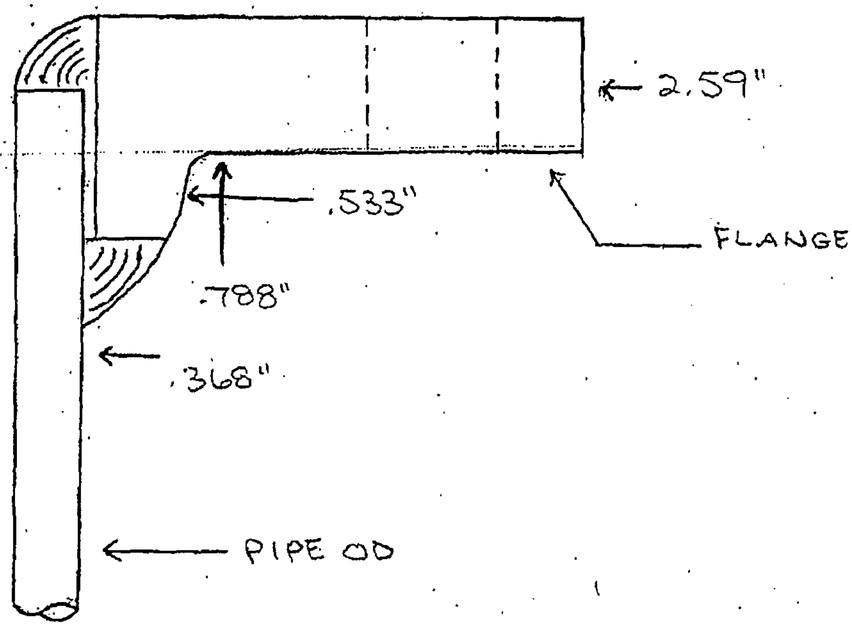

Examiner Comments: SCANNED BETWEEN BOLT HOLES AT EACH UT POINT AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use **Reference**

STOP THINK ACT REVIEW

GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 6 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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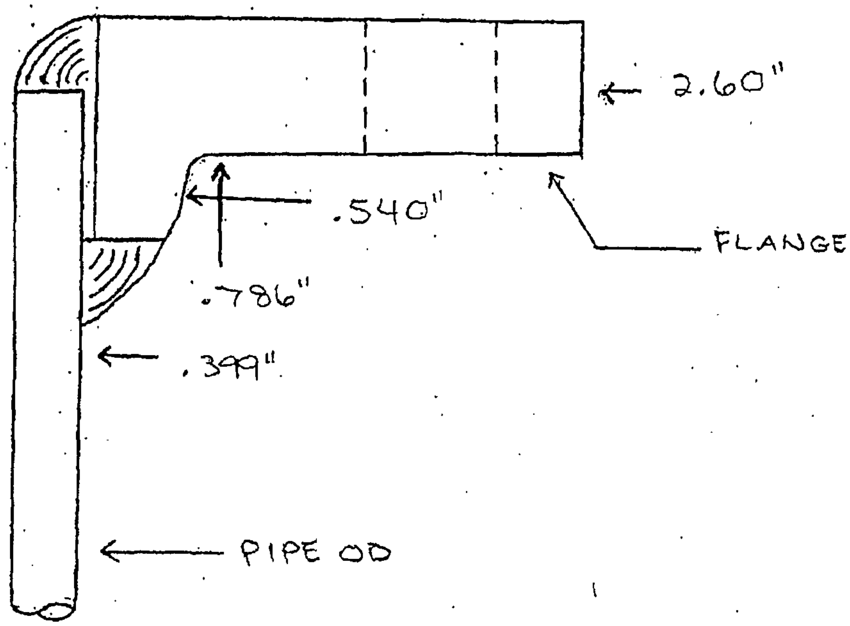

Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use
Reference

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ER-AA-NDE-UT-701

GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 7 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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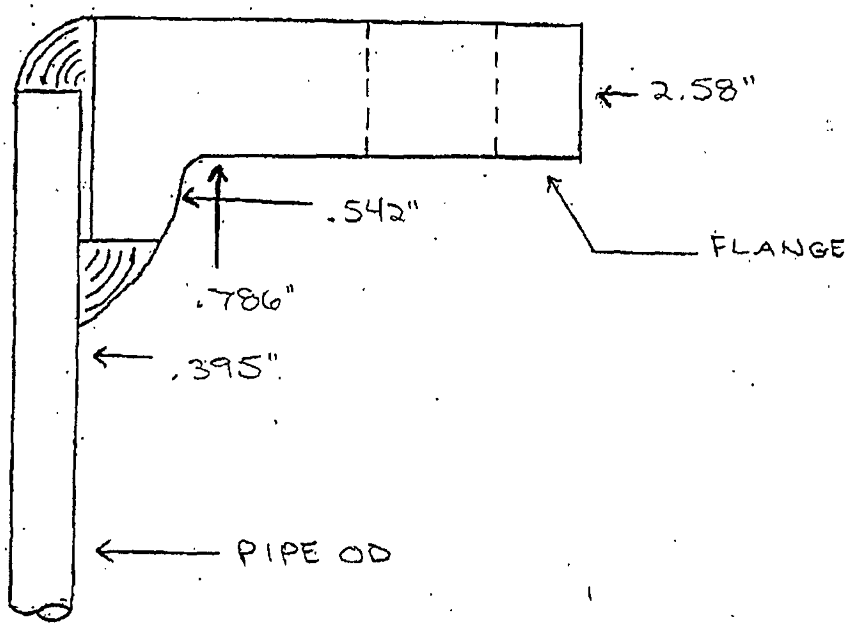

Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner ~~N/A~~ Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use **Reference**

STOP THINK ACT REVIEW

GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 8 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

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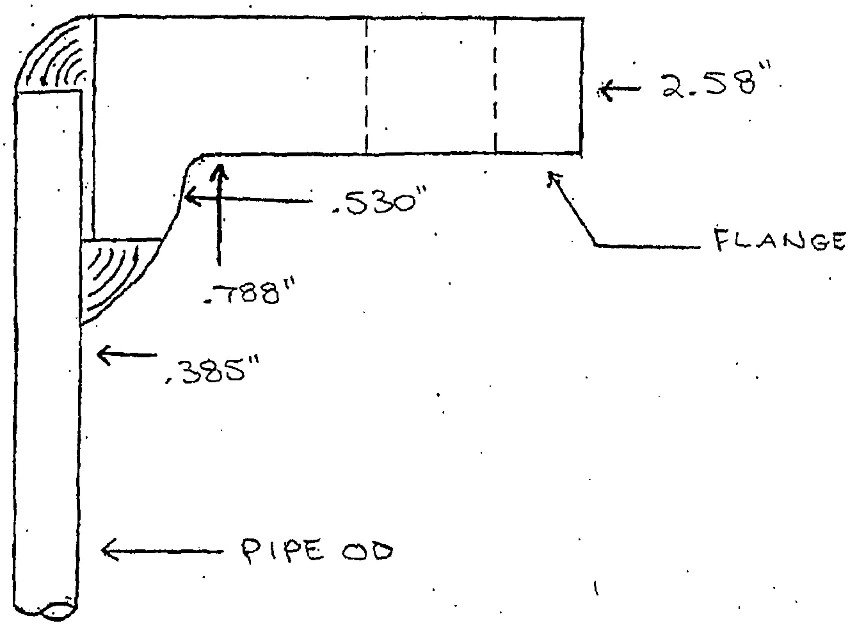

Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use
Reference

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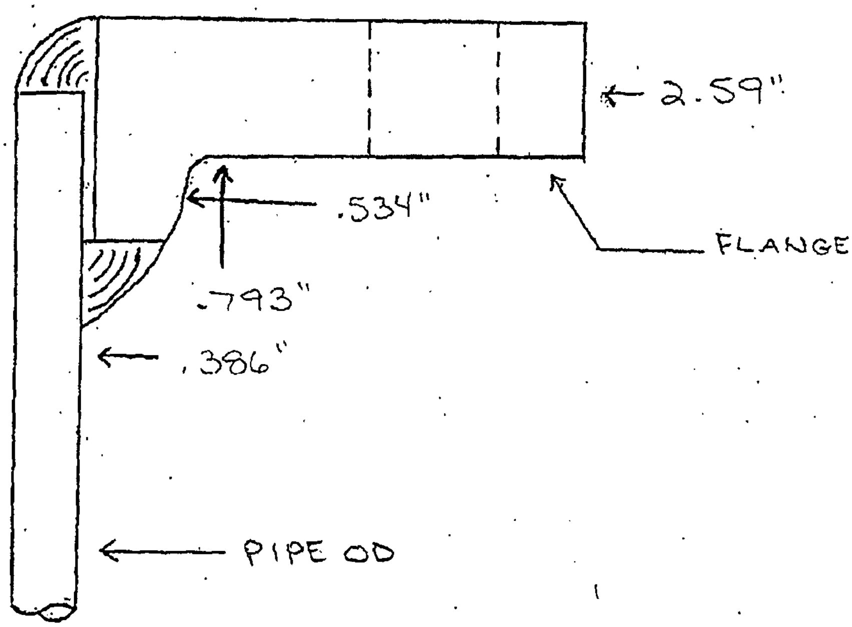
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 9 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

~~UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 7:00 POSITION~~



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner ~~TODD BOHNENKAMPER~~ / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use Reference

STOP THINK ACT REVIEW

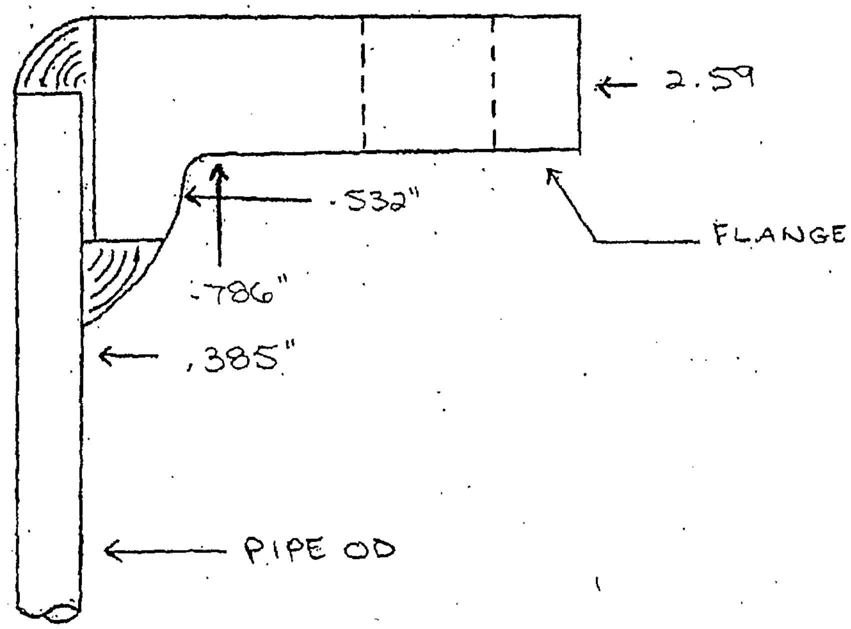
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 10 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 8:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER/ [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

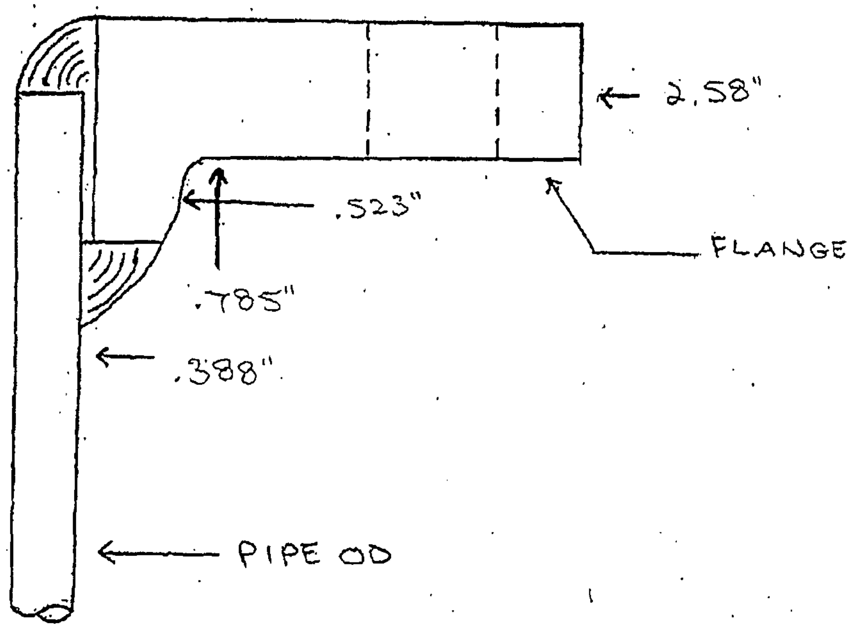
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 11 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

~~UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 9:00 POSITION~~



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner ~~TODD~~ BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

Exam Data Sheet

Millstone Power Station	ULTRASONIC EXAMINATION STRAIGHT BEAM MEASUREMENTS
Plant Millstone Unit 3	Page 1 of 4
System & Zone No.	Exam Data Sheet No N/A
Component ID Line 10" JGD-4	AWO Number 53102457364
Component Description 10" Flange	Drawing No. 25203-20150 SH. 471
Examination Purpose Engineering Information / CR438193	Line No. N/A

Instrument & Settings	
Manufacturer	Panametrics
Model No.	36 DL Plus
~~Serial No.~~	~~002181809~~
Range	5.00"
Velocity	.2326
Delay	N/A
Zero Value	.4923
Cal Tolerance	±.002"

Calibration Block(s)		
Type	Serial No.	Material
Step Block	061291	C/S
~~Step Block~~	~~99-6791~~	~~C/S~~

Component Data	
Component T_{nom}	N/A
Component Dia.	N/A
Attachments	yes

Calibration Checks		Block Thickness		Instrument Reading	
Type	Time	Min.	Max.	Min.	Max.
Initial	15:30	.100"	4.000"	.100"	4.000"
Intermediate	N/A	N/A	N/A	N/A	N/A
Intermediate	N/A	N/A	N/A	N/A	N/A
Final	16:16	.100"	4.000"	.100"	4.000"

Search Unit Data	
Manufacturer	Panametrics
Type No.	D791-RM
Serial No.	19519
Frequency	5.0 MHz
Size	.312"

Couplant Data	
Brand	Ultragel II
Batch No.	09225 I
SAP Batch Mgmt. No.	N/A

Temperature Data	
Cal. Block Temp.	N/A
Component Temp.	N/A
Thermometer No.	N/A

Sketch/Comments Area - Attach Photo(s) of Relevant Conditions Separately

See Attached Generic Sketch Sheets for UT Test Results

Examiner (print & sign) Todd Bohnenkamper [signature] Level II Date 08/17/2011

Reviewer (sign) [signature] for M. Brehler per telecon Level II Date 8/17/11

ANI/ANII If Required (Sign) N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

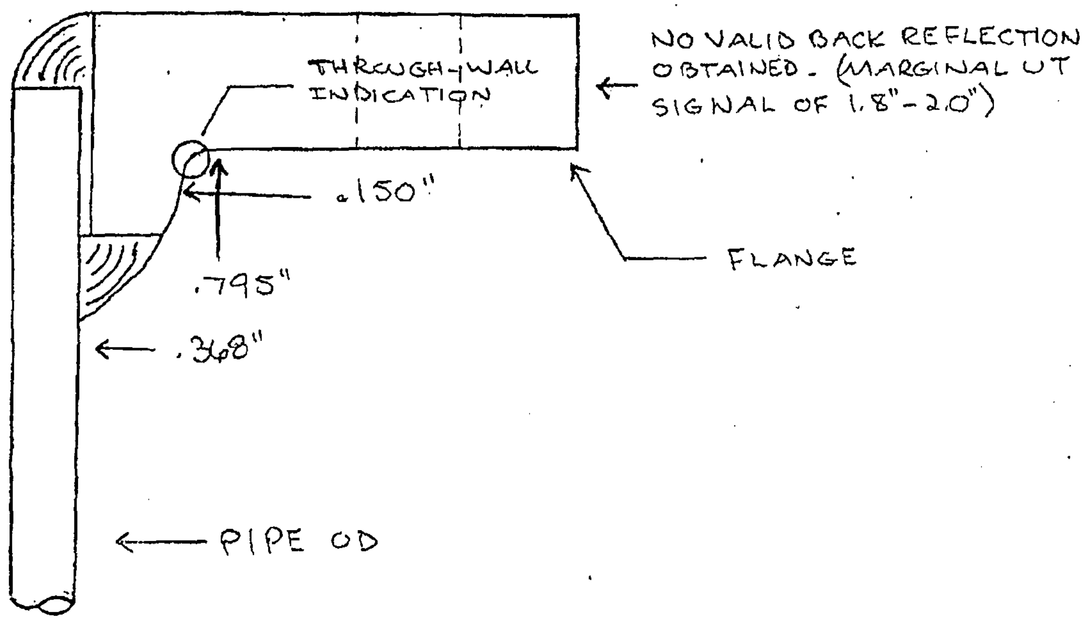
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 2 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

READINGS OBTAINED AT FLAW ZONE (11:00 position)



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Buehler Level II Date 8/17/11

ANII N/A Date N/A

Level of Use **Reference**

STOP THINK ACT REVIEW

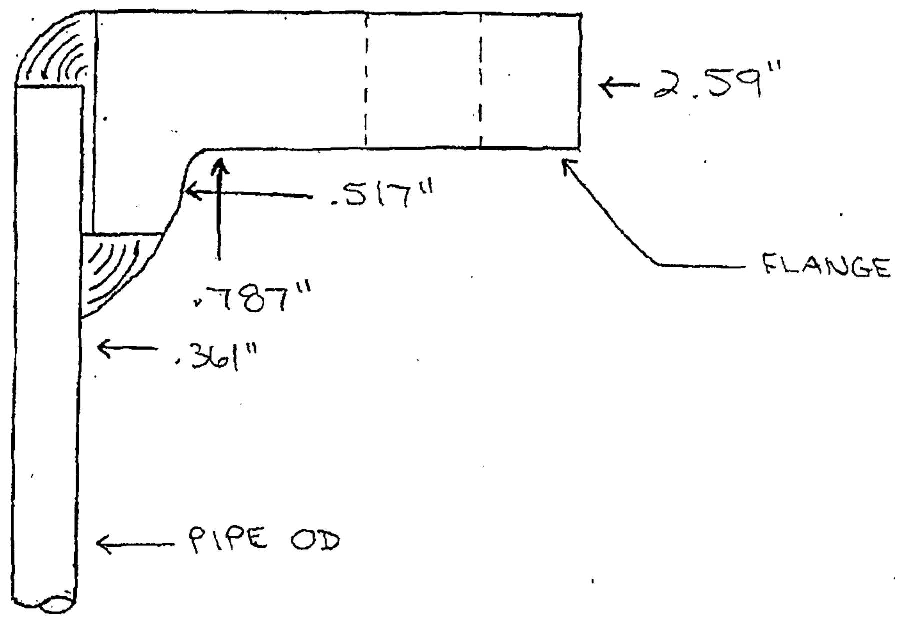
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 3 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES ADJACENT TO FLAW ZONE (CW SIDE) AT 1200 POSITION



Examiner Comments: SCANNED EACH POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/17/11

ANII N/A Date N/A

Level of Use
Reference

STOP THINK ACT REVIEW

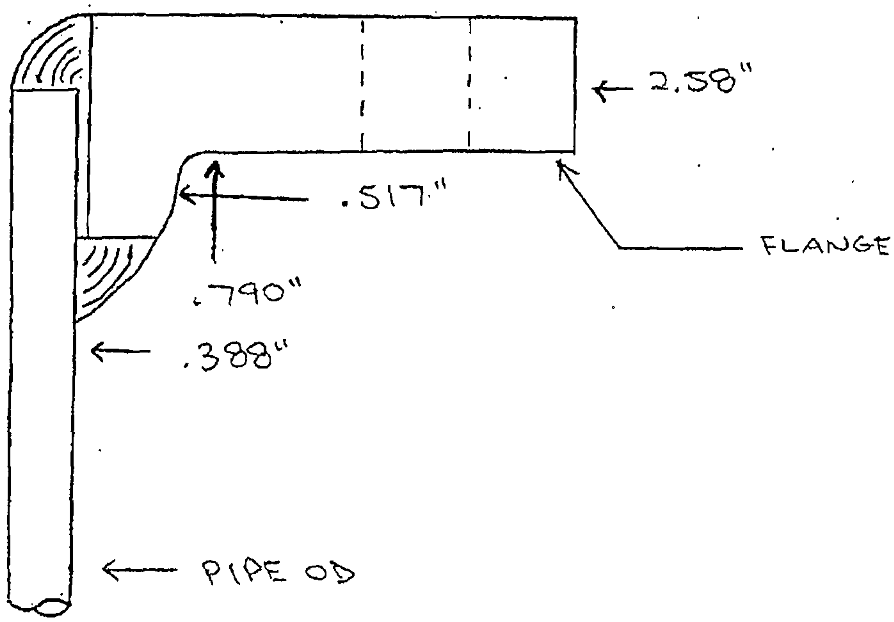
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 4 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

READINGS OBTAINED BETWEEN BOLT HOLES ADJACENT TO FLAW ZONE (CCW SIDE) AT 10:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED

Examiner TODD BOHNENKAMPER/ [signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Bretter Level II Date 8/17/11

ANII N/A Date N/A

Level of Use **Reference**

STOP THINK ACT REVIEW

Enclosure 2
(of Attachment 1)

Dominion Procedure MP-PROC-000-ER-AA-NDE-UT-701, "Nondestructive Examination Procedure"

Nuclear Fleet

Nondestructive Examination Procedure

Dominion

Title: Ultrasonic Thickness Measurement Procedure

Procedure Number	Revision Number	NPQR Number
ER-AA-NDE-UT-701	5	ER-AA-NDE-UT-701-NPQR, Revision 0

Approval signatures on file with approval documentation for this procedure revision.

R. T. Stack	02/26/2011
Independent Level III Review	Date
K. J. Hacker	02/26/2011
Corporate Level III Approval	Date
J.W. Niemerg	02/26/2011
ANII	Date

Level of Use: Reference

Record of Revision

Rev.	Page #	Paragraph #	Summary of Revision
0	All	All	New issue as Dominion Nuclear Fleet Procedure.
1	4	2.3	Added "couplant"
	4	5.1.1	Added the option for using other gauges/scopes with Level III approval.
	5	5.2.4	Deleted requirements for using dual element transducers for measuring through coatings.
	6	6.2.2	Deleted requirements for using the multi-echo technique.
	6	7.1	Deleted reference to multi-echo technique.
	6	7.2	Deleted limitation of single-echo technique for non-coated surfaces.
	6	7.3	Deleted (multi-echo requirements)
	6	7.3.1	Deleted (multi-echo requirements)
	7	8.5	Deleted (multi-echo requirements)
	8	9.8	Added new paragraph for guidance for evaluating thickness results for coated surfaces.
2	4	5.1	Added new paragraph for equipment to comply with ER-AA-NDE-130 requirements.
	5	5.6.1	Provide allowance for using the component being examined as the reference standard for calibration.
	6	8.4	Clarified the guidance for selecting the calibration points for calibration.
	10	10.2	Added new paragraph for data records to be processed in accordance with ER-AA-NDE-140 requirements.
3	4	3.1	Updated reference to the 2004 Edition.
4	4	1.1	Updated the type of UT equipment displays to include A-scan and direct thickness readout.
	4	2.1	Reduced the minimum thickness range from 0.050" to 0.025". Allowed the examination of components outside the specified range provided demonstrated through the calibration process and Level III approval.
	4	4.1	Clarified the Level II-L qualifications by adding straight beam qualification.
	5	5.2.1	Identified the ultrasonic instrument requirements based on display.
	5	5.3.1	Increased the upper range of search unit frequency from 10 MHz to 20 MHz to address thinner limits of the procedure.
	5	5.3.4	Included the use of delay lines for high temperature or improved near surface resolution is required.
	6	5.7.1	Changed to require the use of temperature measurements only for high temperature components.
	8	8.7	Changed to require the use of temperature measurements only for high temperature components.
	9	9.7	Included additional guidance for addressing areas of laminations with lower frequency search units.

Rev.	Page #	Paragraph #	Summary of Revision
5	6	5.3.2	Modified the search unit size to "should" and added criteria for resolution capabilities when using smaller search units.

Table of Contents

1.0 Purpose

1.1 The purpose of this procedure is to provide a process for the calibration and application of straight beam ultrasonic techniques for performing thickness measurements utilizing equipment with A-scan display or direct thickness readout with A-scan displays.

2.0 Scope

2.1 This procedure is applicable to the manual, pulse echo, straight-beam, longitudinal wave, contact ultrasonic technique for performing thickness measurements of ferritic or austenitic tubing, piping, vessels, and components in the nominal thickness range of 0.025 to 20.00 inches. Thickness measurements may be taken outside of the specified nominal thickness ranges provided the equipment capabilities is demonstrated through the calibration process and Level III approval is documented on the examination record.

2.2 Examinations may be conducted from the inside (ID) or outside (OD) surfaces.

2.3 The temperature of the component being examined should not exceed the manufacturer's maximum temperature for the search unit or couplant being used.

3.0 Reference Documents

3.1 ASME Boiler & Pressure Vessel Code, Section V, 1989 Edition through the 2004 Edition, Article 23, SE-797, Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-echo Contact Method.

4.0 Personnel Qualifications

4.1 The examiner shall be certified to Level II-L (limited to straight beam or thickness measurements), Level II, or Level III in the ultrasonic method in accordance with Dominion's written certification practice. The examiner shall be responsible for and shall accept the results of the examination.

4.2 An assistant qualified to at least a Level I in the ultrasonic method in accordance with Dominion's written certification practice may assist the examiner. The Level I shall work under the direct supervision of the examiner and shall not evaluate or accept the examination results.

5.0 Equipment and Material Requirements

5.1 All equipment and materials used to implement this procedure shall comply with the requirements of ER-AA-NDE-130, "Storage and Control of Calibrated NDE Equipment, Calibration Standards, and Consumable NDE Materials".

5.2 Ultrasonic Instruments

5.2.1 Approved pulse echo ultrasonic instruments shall provide either a direct A-scan display or a combination of an A-scan display with direct thickness readout. An acceptable calibration in accordance with this procedure demonstrates acceptable ultrasonic instrument selection for use.

5.3 Search Units

5.3.1 Search units with a nominal central frequency in the range of 5.0 to 20.0 MHz should be selected for performing thickness measurements. For thicknesses 0.050" and less the search unit frequency shall be 10.0 MHz or higher. Other frequencies between 1.0 and 5.0 MHz may be used when their properties (i.e., sensitivity, penetration, resolution, etc.) provide superior results.

5.3.2 The search unit active element size should be between 0.10" and 1.00" square inches, however smaller search units may be used provided the resolution capabilities of 5.3.5 are maintained.

5.3.3 The search unit elements shall be round.

5.3.4 Either single or dual element search units may be used. Delay lines may be used for high temperature components or when improved near surface resolution is required.

5.3.5 Proper search unit selection (size, shape, configuration, frequency) will be indicated by the systems ability to properly display and resolve the calibration standard's reflections throughout the range of the expected thickness measurements for the component to be examined.

5.4 Cabling

5.4.1 The interconnecting cable between the search unit and the ultrasonic instrument shall be RG-58 or RG-174 type coaxial cable (or equivalent) with lengths not to exceed 20 feet.

5.5 Couplant

5.5.1 A suitable liquid couplant medium shall be applied to the examination surface for the examination. The couplant shall be approved for use at the site prior to use. The same couplant used for calibration shall be used to perform the examination.

5.6 Reference Blocks

5.6.1 Reference blocks used for screen distance calibration and verification shall be of the same material as the component material being examined (e.g. carbon steel or stainless steel). As an alternative, the component being examined may be used for calibration. The reference block or component used for calibration must be of known thickness to allow for accurate calibration.

5.7 Thermometer

5.7.1 When required (high temperature components ≥ 125° F), a calibrated surface thermometer shall be used to document the surface temperature of the reference block and component prior to the examination.

6.0 Examination Requirements

6.1 Examination Area

6.1.1 The extent of the area to be examined and the criteria, by which the ultrasonic measurements and part acceptability will be evaluated, shall be determined by the parties requesting that the examination be performed.

6.2 Surface Condition Requirements

6.2.1 The examination surface shall be free of irregularities, loose material, or loose coatings which interfere with the ultrasonic wave transmission. Areas where ultrasonic contact is inadequate shall be documented as limitations.

7.0 Thickness Measurement Technique

7.1 Thickness measurements shall be taken using the single echo measurement technique.

7.2 The single echo technique measures the total thickness of the part using a single backwall reflection. This measurement includes any coating which may be present on the surface, leading to an error in the actual base material thickness.

8.0 Calibration

8.1 Calibration shall include the complete UT system. Any change in search units, couplant, cables, instruments, or any other part of the system shall be cause for calibration verification.

8.2 The calibration shall be performed with a reference block meeting the requirements of section 5.6.

8.3 System setup and calibration (zero, velocity, gain, time base, etc.) shall be performed in accordance with the operating manual for the ultrasonic instrument being used for the examination based upon the selected parameters of the examination (i.e., measurement technique, material, thickness ranges, search units, etc.).

8.4 The calibration shall utilize two points of known thickness. The calibration points may be single backwall reflections or backwall multiples of known thicknesses. When available, the calibration points should be equal to or greater than the nominal thickness being examined and a thickness less than the nominal thickness being examined.

8.5 Upon completion of the system setup and calibration, couple the search unit to each of the thickness steps of the reference block used for calibration and verify that the readings are within ±0.002 inches of the as-built thickness dimension.

8.6 Calibration Verification

8.6.1 System calibration shall be checked using the appropriate reference block. Thickness reading of the calibration points shall be recorded during the initial calibration and shall be verified at the following intervals:

8.6.1.1 At the start and finish of each examination;

8.6.1.2 With any change in examination personnel;

8.6.1.3 Whenever the instrument has been turned off and then turned on;

8.6.1.4 When there is a change in search unit, cable, or couplant;

8.6.1.5 At intervals not to exceed four hours;

8.6.1.6 Whenever the validity of the calibration is in doubt.

8.6.2 If any calibration thickness point changes by more than 0.005 inches, the following shall be performed:

8.6.2.1 Void all examinations referring to the calibration in question and performed after the last valid calibration check;

8.6.2.2 Conduct a new calibration;

8.6.2.3 Reexamine all areas for which the examinations have been voided.

8.7 For thickness measurements on high temperature components (≥ 125° F) the examination surface shall be within 25° F of the reference block used for calibration. The thermometer identification and surface temperatures shall be documented on the data sheets.

9.0 Examination

9.1 The examination shall be performed using a 100 percent scan, partial scan, or spot check scanning technique. The type of scan required for each component shall be defined by the parties requesting that the examination be performed. The types of scans are defined as follows:

9.1.1 100 Percent Scan - This examination will encompass the complete component. It is a detection, as well as a measuring technique, and should be utilized to detect the thickest and thinnest areas or when encountering inclusions, laminations, or rapidly changing thickness (i.e., erosion/corrosion).

9.1.2 Partial Scan - This examination covers only a percentage of the component being examined. The percentage should be based on the requirements of the examination. This technique should not be utilized if finding the thickest or thinnest area of the component is required.

9.1.3 Spot Check - This examination is a point-to-point technique which measures the thickness of the component at predetermined grid locations. It should not be utilized to detect the thickest or thinnest area of the component being examined.

9.2 Thickness readings should be taken using similar couplant thickness and search unit pressure as used for the calibration.

9.3 For dual element search units ensure that the acoustic barrier between the search unit elements is aligned perpendicular to the axis of the pipe to eliminate the effects of the curvature on the UT measurements.

9.4 Thickness readings shall be recorded as required (manually or data logger/recorder).

9.5 The thickness readings taken during an examination should be reviewed at the conclusion of the examination to ensure that no unusual readings exist and that the examination is complete. If there are any erroneous or missing readings, those areas should be reexamined to ensure accurate examination results.

9.6 Where available, the digital readout should be utilized as the primary source for thickness readings. The A-Scan display should be monitored to ensure that thickness readings taken are "true" readings and not the result of couplant readings, inclusions, laminations, etc.

9.7 If inclusions or laminations are encountered, the area should be scanned and marked to properly bound the region. The depth(s) of the inclusion(s) or lamination(s) should also be recorded and documented, as necessary. When areas of laminations are identified, the area of lamination should be examined with a lower frequency search unit to reduce the limited area examined. Lower frequency search units will often penetrate thin/tight laminations due to the increased penetrating power of the longer wave length.

9.8 For components examined through coatings, the coating thickness will cause a slight increase in the recorded thickness from the actual thickness of the component. Although this increase is small, coating with reported thicknesses near the minimum wall thickness (minimum wall +0.015") should be evaluated to determine if the coating should be removed and the actual thickness verified.

9.9 Upon completion of the examination the excess couplant shall be removed. Supplies and equipment shall also be removed from the examination area.

10.0 Data Recording

10.1 Calibration and examination data shall be recorded on data sheets and as a minimum shall include the following:

10.1.1 Calibration sheet identification.

10.1.2 Names and certification levels of examination personnel.

10.1.3 Examination procedure number and revision.

10.1.4 Reference block identification.

10.1.5 Ultrasonic instrument serial number, manufacturer, and model identification.

10.1.6 Ultrasonic instrument settings.

10.1.7 Search unit manufacturer, model, and manufacturer's serial number.

10.1.8 Search unit nominal frequency, size, shape, and number of elements.

10.1.9 Special search units, wedges, shoe type, or saddle's identification, delay line, if used.

10.1.10 Search unit cable type, length, and number of intermediate connectors.

10.1.11 Times and dates of initial calibration and subsequent calibration checks including the thickness measurements of the calibration points.

10.1.12 Signal response amplitudes and sweep positions obtained from the calibration reflectors.

10.1.13 Couplant type and batch number.

10.1.14 Identification and location of the component scanned.

10.1.15 Surface from which the examination is conducted.

10.1.16 When applicable, the temperature of the reference block and component along with the thermometer manufacturer, model, and serial number.

10.1.17 The type of scan completed, i.e. 100 percent scan, partial scan, or spot check. For partial scans, record the approximate percentage of each section examined.

10.1.18 Examination results (thickness readings) including limitations of the area scanned. When using data loggers/recorders the data printout may be attached to document the thickness measurements.

10.1.19 A drawing or photograph of the component should be included with the examination records when possible.

10.2 All data records shall be reviewed and processed in accordance with ER-AA-NDE-140, "Processing of Dominion NDE Data".

ATTACHMENT 2

Excerpts From Pipe Stress Analysis Calculation Number MP58B-00138EM, Revision 4, Addendum B, Service Water Supply to Diesel Engine Coolers – Problem 118

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

Dominion

Calculation Cover Sheet

Calculation Number: MP58B-00138EM	Revision: 4	Addendum: B

Calculation Quality Class: ☒ Safety Related ☐ NSQ ☐ Non-Safety Related

Installation Verification Required? ☒ Yes ☐ No ☐ N/A Note: Not applicable for Virginia Plants
Name: R. E. DeConto, Signature: R. E. DeConto 6/23/11

Subject (Calculation Title):
Service Water Supply to Diesel Engine Coolers – Stress Problem 118

Addendum Title (if applicable):
N/A

Station(s) and Unit(s):	Affected System(s), Structure(s), or Component(s):
Millstone Unit 2	SWS; AB, DG

Purpose:

The purpose of this addendum (Addendum B to Revision 4) is to incorporate the changes documented in DCN DM2-02-0198-09 in support of emergent 2R20 service water system improvements. These improvements include:

1. Replacement of valve 2-SW-8A~~B~~ (handwritten correction: RED 3/28/11) with material fabricated from stainless steel (AL-6XN) material.
2. Replacement of carbon steel piping spools SK-894 and SK-895 with material fabricated from stainless steel (AL-6XN).

This addendum was prepared in accordance with CM-AA-CLC-301, Revision 3. Screening (50.59, programs, etc...) is not required for this addendum as this addendum supports a parent process (i.e., DCN DM2-02-0198-09). Screening will be performed under the aforementioned DCN.

	Date:
Originator: Provide printed name and signature (Qual. Required): R. E. DeConto [signature]	3/12/11
Independent Reviewer: Provide printed name and signature (Qual. Required): Z. A. Withrow [signature]	3/28/11
Approval: Provide printed name and signature: M. F. Marino [signature]	3/28/11

REC'D 5/31/11
ON 3/28/11
PROCESSED 6/23/11
RM ✓

Form No. 731189 (Apr 2009)

Dominion

MPS Transitional Site-Specific Guidance

PassPort DATABASE INPUTS CHANGE

Calculation Number: MP58B-00138EM Revision: 4

Vendor Calculation Number/Other N/A Revision: N/A

ADD/CCN#: B Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes: N/A

CHANGES (Change Codes [CC]: "A" = Add; "D" = Delete)

Discipline (Up to 10) CC [ ]:

CC	Unit M1, M2, M3	Project Reference (EWA)	Component Id	Computer Code	Rev. No./ Level No.
A		DCN DM2-02-0198-09			

CC	MEL CODES*			Reference Calculation	Rev No.	ADD/CCN
	Structure	System	Component			

*The codes required must be alpha codes designed for structure, system and component.

NOTE: Avoid multiple item references on a line, e.g., LT 1210 A-D requires four separate lines.

CC	Reference Drawing	Sheet	Rev. No.

Comments:

Pipe support calculations with loads that exhibit a load increase of 5% or more will be formally revised (via a revision, an addendum or a CCN). See Attachment E for the summary of load changes based on this addendum. In addition, seismic / nonseismic supports will be revised to document the change related to the seismic / nonseismic supports

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
327160-00149EM		X	
PROBLEM 121		X	
PROBLEM 122		X	

MPS Transitional Site-Specific Guidance

Dominion

PassPort DATABASE INPUTs CHANGE

Page 3

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # B Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
327012-00144EM		X	
327013-00145EM		X	
327122-00146EM		X	
327123-00147EM		X	
327124-00148EM		X	
327125-00150EM		X	
327138-00154EM		X	
327141-00153EM		X	
327145-00155EM		X	
327147-00156EM		X	
327148-00157EM		X	
327149-00158EM		X	
327150-00159EM		X	
327157-00151EM		X	
327165-00160EM		X	
380352-00161EM		X	
427026-00162EM		X	
427031-00163EM		X	
427030-00164EM		X	
427055-00165EM		X	
427067-00168EM		X	
427069-00170EM		X	
427080-00173EM		X	
427083-00175EM		X	
427085-00177EM		X	
427089-00178EM		X	
427090-00179EM		X	
427092-00181EM		X	

Dominion

PassPort DATABASE INPUTs CHANGE

Page 4

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # B Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
427093-00182EM		X	
427094-00183EM		X	
427104-00184EM		X	
527009-00185EM		X	
60469-00193EM		X	
60492-00192EM		X	
60493-00191EM		X	
527010-00199EM		X	
527012-00189EM		X	
527017-00190EM		X	
527019-00198EM		X	
327002-01005M2		X	
427113-01006M2	X		Rev. 3, Addendum B
427063-01007M2		X	
327098-01008M2		X	
427114-01011M2	X		Rev. 2, Addendum B
427079-01012M2		X	
427076-01013M2		X	
527027-01014M2		X	
60214-01017M2		X	
60216-01018M2		X	
60221-01022M2		X	
60223-01023M2	X		Rev. 2, Addendum B
60228-01024M2		X	
97-118C-02027C2		X	
97-118C-02061C2		X	
97-118C-02062C2	X		Rev. 2, Addendum A
427074-01004M2		X	
427075-01009M2		X	
427115-01010M2		X	

Dominion

PassPort DATABASE INPUTs CHANGE

Page 5

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # B Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
427064-00167EM		X	
427082-00174EM		X	
427068-00169EM		X	
327135-00152EM		X	
427073-00171EM		X	
427087-00172EM		X	
60492-00192EM		X	
427084-00176EM		X	
427091-01016M2		X	
427056-00166M		X	
527014-00186EM		X	
527013-00188EM		X	
527011-00187EM		X	
60219-01020M2		X	
60220-01021M2		X	
60218-01019M2		X	
527028-01015M2		X	
60229-01025M2		X	
95-ENG-01186M2		X	
MP2-SEIS.RPT		X	
02-CP-03111M2		X	
98-209		X	

Table of Contents

TABLE OF CONTENTS (continued)

1.0 Purpose

The overall objective of this addendum is to qualify the Service Water piping (as shown in the Pipe Stress Worksketches in Section 6.11) in accordance with the requirements of the Millstone Unit 2 FSAR (Reference 2), ANSI code (Reference 1 of the calculation body) and Millstone Pipe Stress and Pipe Support Specification SP-M2-ME-030 (Reference 4).

In accordance with Reference 4, section 3.13.8, identify the seismic / nonseismic interface boundary support(s) for the fire water cross connect line (see worksketch sheet 6).

Additional objectives of this calculation are as follows:

- ☒ Pipe support design loads will be generated and will be compared to the existing pipe support design loads in order to determine acceptability. Seismic / nonseismic boundary support seismic loads will be developed in accordance with Reference 4, section 3.13.8.
- ☒ Valve accelerations will be determined and evaluated for acceptability.
- ☒ Equipment nozzle loadings/stresses will be determined and evaluated for acceptability.
- ☒ Flange loads will be determined and evaluated for acceptability.
- ☒ Evaluation of pipe local stresses due to Integral Welded Attachments (IWA) will be performed to document acceptability.

2.0 Assumptions

None.

3.0 General Notes

1. The coordinate system for all data expressed in the global system is as follows:

   (-X) is plant "called North" per piping drawing.
   (+Y) is vertical "up".
   (+Z) is according to the right hand rule.

   The local system is defined as follows:

   For straight piping members

   (X) is along the axis of the pipe, positive in the direction of coding.
   (Y) in the plane of the local X-Axis and the global +Y-Axis unless the local X-Axis is aligned with the global Y-Axis, then the local Y-Axis will be parallel to the global X-Axis.
   (Z) according to the right hand rule.

   For curved piping members a radial-normal-tangential system is used where X and Y are in the plane of the curve and Z is normal to the plane as follows:

   (X) is the tangential component, positive in the direction of coding.
   (Y) is the positive (outward) radial component.
   (Z) is normal to the X and Y plane according to the right hand rule.

2. Forces and moments on restraints, supports and equipment are those imposed by the piping system (i.e., actions not reactions).

3. Unless otherwise indicated, intersections are considered as unreinforced branch connections.

4. N/A or NA indicated throughout this calculation represents "not applicable."

5. Abbreviations used for pipe support functions as applicable:

CS	-	Constant Support	AC	-	Axial Constraint
SH	-	Spring Hanger	VSS	-	Vertical Shock Suppressor
VS	-	Vertical Support	NSS	-	North-South Shock Suppressor
VC	-	Vertical Constraint	ESS	-	East-West shock suppressor
NS	-	North South Constraint	LSS	-	Lateral Shock Suppressor
EW	-	East West constraint	ASS	-	Axial shock suppressor
LC	-	Lateral Constraint	ANC	-	Anchor

4.0 Methods

A. NUPIPE-II Model

The NUPIPE-II computer program (Reference 5) is utilized in this Addendum. The NUPIPE-II model is based on the NUPIPE-II model generated in Revision 4, Addendum A. The following adjustments to the Addendum A NUPIPE-II model were made to evaluate the requested changes (i.e., the replacement of valve 2-SW-8A and pipe spools SK-894 and SK-895:

1. Points 5 to 35 are now modeled with NOP 2 (stainless steel properties)
2. Points 5 to 15 and 20 to 35 are modeled with XSEction 13 (ss pipe)
3. Valve 2-SW-8A is modeled as stainless steel (points 15, 18, 20 & 22) with XSEctions 14 (valve body) and 31 valve operator. The weight of the replacement valve is 1765 lbs.
4. Valve inlet and out flange weight is 170 lbs each.

5.0 REFERENCES

References 1 through 23 are from the body of the calculation Revsion 4, pages 18 amd 19.

24. Design Change Notice: DM2-02-0198-09

25. Drawing 25203-29053, Sheet 130, Revision 1, 24 inch Class 150 Tricentric Valve with Limitorque H4BC

26. Crane Catalog Number 61, Welding Fittings Forged Flanges, Crane Company, St Louis Fitting Division, 1450 So. Second Street, St Louis, Missouri 063104. (Calculation Body Reference 9)

27. Grinnell Catalog Pipe Hanger Design and Engineering, Revised 1979, Grinnell Corporation, Cranston, Rhode Island. (Calculation Body Reference 10)

28. AISC Manual of Steel Construction, Eighth Edition, American Institute of Steel Construction, Inc. 400 North Michigan Avenue, Chicago, Illinois 60611, Page 6-9

29. Specification SP-M2-ME-1093, Revision 1, Procurement Specification for MP2 RBCCW Heat Exchanser Channel Heads

30. NUPIPE-II Computer Program, Version 3.0.0, Serial No. NUP300 Intel, Copyright 1985 – 1995, Quadrex Energy Services

6.0 DESIGN INPUT

The following design input pages consist of data obtained from various sources which is required to perform the stress analysis of this piping system. This data is assembled in a manner which is suitable for input into the NUPIPE-II analysis.

Density of Rolled Steel: 490 lbs / ft^3 (Reference 28)

Density of Stainless Steel: 500 lbs / ft^3 or 0.290 lbs / in^3 (Reference 28 times 1.02 per Reference 27)

6.0 Design Input

6.1 Basic Analytical Data:

Unchanged in Addendum B.

6.2 Piping Data:

XSEction Card 31 added to model 24 inch stainless steel valve operator)

Ref.	X SECTION CARD No. 31	
No.		
13a,b	LINE NUMBER: 24"-JGD-1, 24"-JGD-3	CODE CLASS: 3
13a,b	LINE CLASS: JGD	DESIGN PRESSURE: 150 PSI
13a,b	SCHEDULE: 20	CONTENTS: Water
13a,b	PIPING MATERIAL: B-675, UNS NO8367	
10	OUTSIDE DIAMETER: 24.0 In	WALL THICKNESS: 0.375 In
13a,b	INSULATION THICKNESS: 1.5 In.	INSULATION TYPE: I
	INSULATION DENSITY ***: 12 LB/ CUBIC FT	INSULATION MATERIAL: Calcium Silicate
1	'P' NUMBER (WELDING REF. No.): 8	E COLD: 28.3 x E 06 PSI
10	PIPE WEIGHT:* N/A LB/FT	CONTENTS WEIGHT: N/A LB/FT
10	INSULATION WEIGHT:** N/A LB/FT	
	TOTAL PIPE WEIGHT .0001 LB/FT	
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.	
	Xsection 2 includes only Contents and Insulation weights.	
	Xsection 9 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.	

Ref.	X SECTION CARD No	
No.		
	LINE NUMBER:	CODE CLASS:
	LINE CLASS:	DESIGN PRESSURE: PSI
	SCHEDULE:	CONTENTS:
	PIPING MATERIAL:	
	OUTSIDE DIAMETER:	WALL THICKNESS: In
	INSULATION THICKNESS:	INSULATION TYPE:
	INSULATION DENSITY ***: LB/ CUBIC FT	INSULATION MATERIAL: Calcium Silicate
	'P' NUMBER (WELDING REF. No.):	E COLD: PSI
	PIPE WEIGHT:* LB/FT	CONTENTS WEIGHT: LB/FT
	INSULATION WEIGHT:** LB/FT	
	TOTAL PIPE WEIGHT: LB/FT	
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.	
	Xsection 4 includes only Contents and Insulation weights.	
	Xsection 10 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.	

Ref. 10

* $10.68t\,(D-t)$ For Carbon Steel

$10.89t\,(D-t)$ For Austenitic Stainless Steel B-675 UNS NO8367

$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = $0.0218\,d\,K\,(D+K)$ LB / FT

- d = Insulation Density (LBS /Cubic Foot)
- D = Outside Diameter of Pipe (IN)
- K = Insulation Thickness (IN)
- t = Pipe Wall Thickness (IN)
- Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.3 Valve Data

TABLE 6.3.1 (Valve Data)

Size (in.)	Type	Node No.	C.G. Location (ft.)			Total Weight (Lbs.)	Ref:
			X	Y	Z		
24	2-SW-8A[1]	22	-1.10			1765	24, 25

Notes:

1. C.G. location ignores the orthogonal offset of approximately 1 inch in the two remaining orthogonal directions relative to the main axis of the operator.

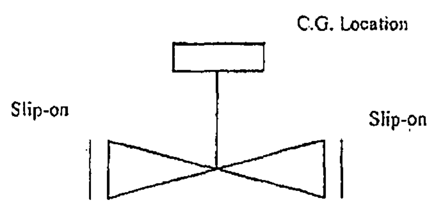
The 24 inch replacement valve is 7 inches (0.58 ft) long (Reference 25).

The 24 inch replacement valve (Reference 25), is captured between two flanges. Valve 2-SW-8A is captured between two slip-on flanges

The weight of a 125# slip-on (SO) flange is 117 lbs [115 lbs (Reference 26) x 1.02]

The weight of the 20 studs and 40 nuts per valve / flange connection must be considered: The studs are 1 ¼ inch diameter (Reference 26). The length will be set equal to 14.5 inches to account for the studs and the nuts. Thus the total weight of the studs are nuts is: $20 \times (\pi/4) \times 1.25^2 \times 14.5 \times 0.290$ lbs / in^3 = 103 lbs.

SO flange locations: The weight applied to valve end (pipe / valve centerline) with SO flanges is 117 lbs + ½ x 103 lbs ≈ <u>170 lbs</u>
Nodes: <u>15, and 20</u>.



6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data

TABLE 6.4.1 (Flange Weight Data) Flange data is based on the information provided above in the valve section but the length of 1 ¼ inch rod considered to represent the studs and nuts is set equal to 9 inches (studs are 6 ¾ inches long per Addendum Reference 3, therefore 2 ¼ inches of 1 ¼ inch rod are considered to account for the nuts on each rod). The weight of two stainless steel 125# SO flanges is 234 lbs (2 x 117 lbs) plus 20 – 1 ¼ inch diameter rods 9 inches long weight approximately 64 lbs. Therefore, the total weight for two SS 125# SO flanges plus the weight of the studs and nuts is approximately 298 lbs. Note: 317 lbs was conservatively input into the NUPIPE II model.

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.) incl. studs / nuts	Ref.
24	35	2 x 117			298	3, 4, 5

6.0 **Design Input (Continued)**

6.5 Thermal Operating Conditions

(Unchanged by Addendum B)

PIPE SECTIONS FOR NOP No's:

~~NOP 2 = From 5 to 35~~

NOTE:

1. For Node No's, refer to the work sketch (Section 6.11).

6.0 Design Input (Continued)

6.6 Thermal Anchor Displacements
(Unchanged in Addendum B)

<u>RBCCW Heat Exchanger X-18A,B,C Movements:</u>

6.7 Response Spectra
(Reference 14)

The Response Spectra of Auxiliary Building at Elev. 14'-6", 0.5% Damping (OBE) which is used for X and Z directions and Vertical Accelerations are 2/3 of the ground acceleration (i.e. 2/3 of 0.09gs) or 0.06gs for OBE and 0.113gs for DBE.

TABLE 6.7-1 Horizontal Unchanged by Addendum B

HORIZONTAL ACCELEARTIONS (X AND Z DIRECTIONS)					
T (Seconds)	A (g)	T(Seconds)	A (g)	T (Seconds)	A (g)
0.02	0.23	0.038	0.23	0.054	0.46
0.089	0.497	0.109	0.914	0.111	0.96
0.116	5.507	0.119	7.86	0.147	7.86
0.156	4.883	0.161	3.562	0.172	1.857
0.179	1.445	0.238	0.757	0.250	0.686
0.333	0.64	0.714	0.368	0.833	0.326
1.00	0.28	2.000	0.17		

TABLE 6.7-2 Vertical Accelerations Unchanged in this Addendum (Reference 14)

VERTICAL ACCELEARTIONS (Y DIRECTION)					
T (Seconds)	A (g)	T(Seconds)	A (g)	T (Seconds)	A (g)
0.010	0.06	10.00	0.06		

Note:

1. T is for Period (Seconds) and g is for Spectral Acceleration (g's).

6.0 Design Input (Continued)

6.8 Seismic Anchor Movements

(Reference 14) Unchanged per Addendum B

6.9 Pipe Support Data

Pipe support hanger 60542 (an anchor) was previously identified as the seismic ./ nonseismic interface support. This addendum redefines the seismic / nonseismic interface zone to be the two vertical / lateral hangers (60541 and 60542 - see worksketch sheet 6) upstream of hanger 60452. This is consistent with the pipe stress / pipe support criteria (Reference 4), section 3.13.8. The seismic loads for these two hangers will be increased by a factor of three to account for the seismic loads from the unanalyzed side.

6.0 Design Input (continued)

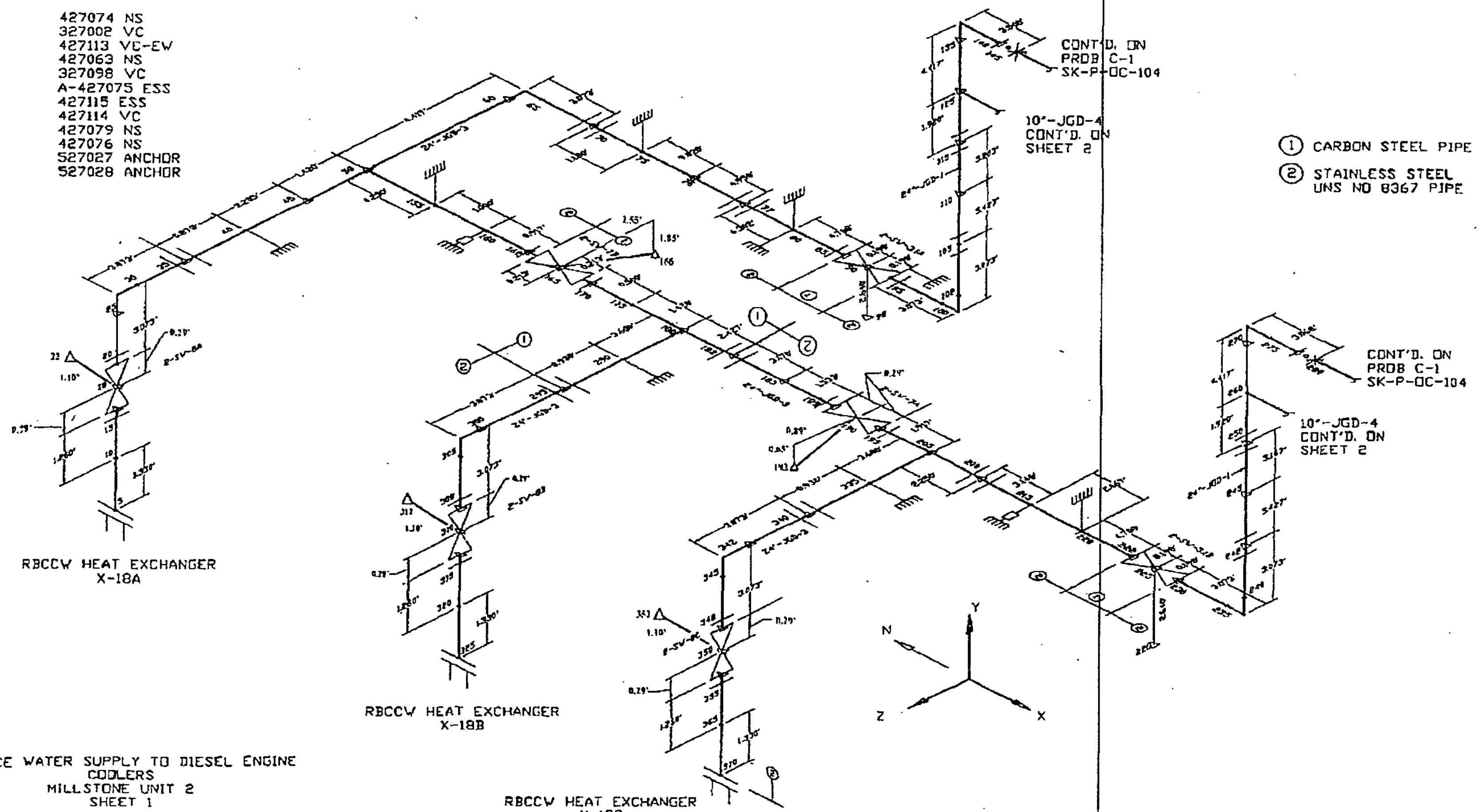
6.10 Special Stress Intensification Factors (SIF's)

Unchanged per Addendum B

6.0 **Design Input (continued)**

6.11 **Worksketch**

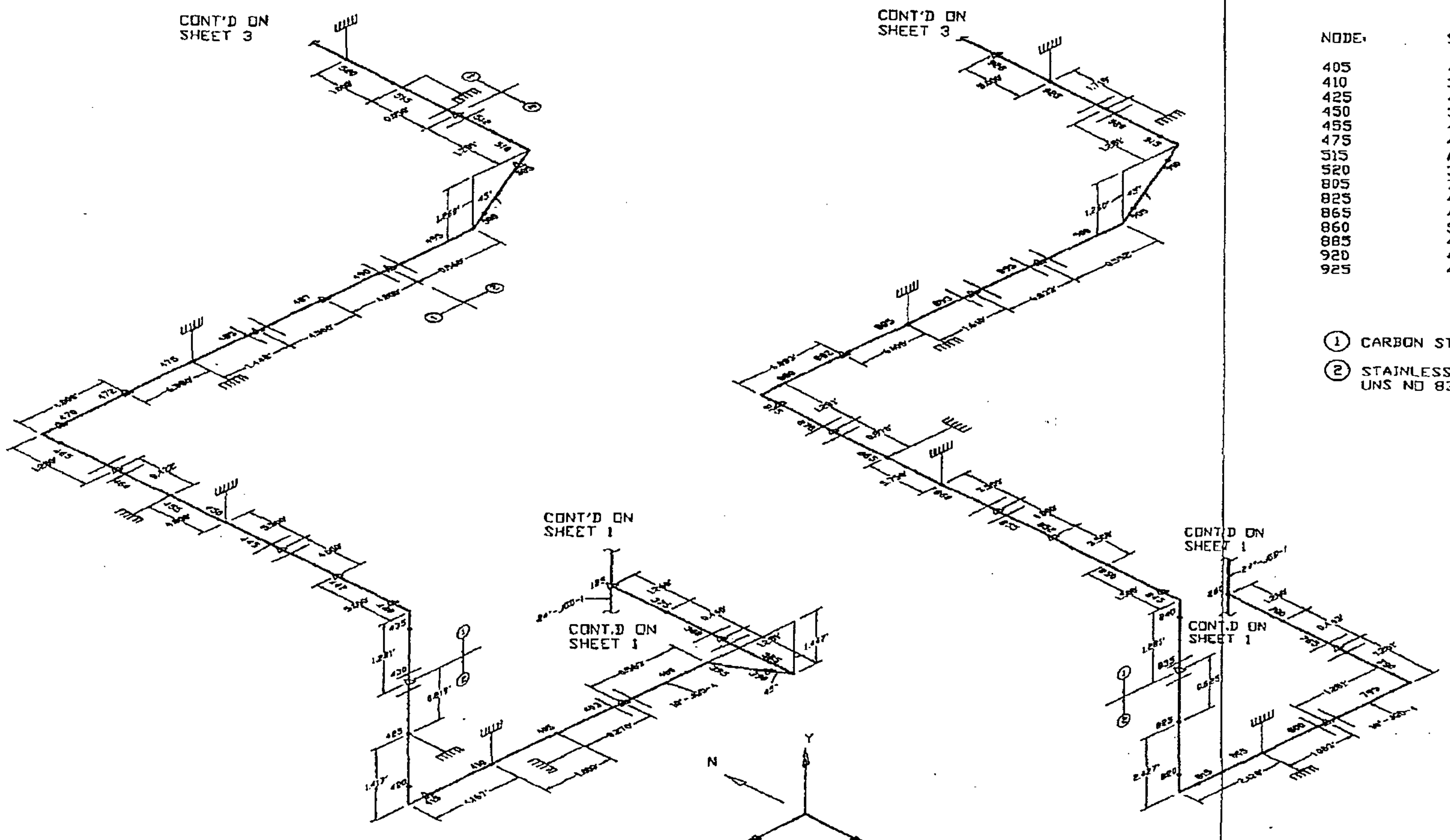
NODE:	SUPPORT MARK NO.:
40	427074 NS
75	327002 VC
80	427113 VC-EW
95	427063 NS
155	327098 VC
160	A-427075 ESS
215	427115 ESS
220	427114 VC
290	427079 NS
335	427076 NS
145	527027 ANCHOR
280	527028 ANCHOR



SERVICE WATER SUPPLY TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 1

6.0 Design Input (continued)

6.11 Worksketch



NODE	SUPPORT MARK NO
405	427064 EW
410	327012 V.C.
425	427080 NS
450	327013 V.C.
455	427082 EW
475	427085 NS, VC
515	A427068 NS
520	380352 VC
805	79-14-22 NC, VC
825	427080 NS, EW
865	427083 EW
860	SK-ALW-102579 VC
885	427084 NS, VC
920	427069 NS
925	427030 VC

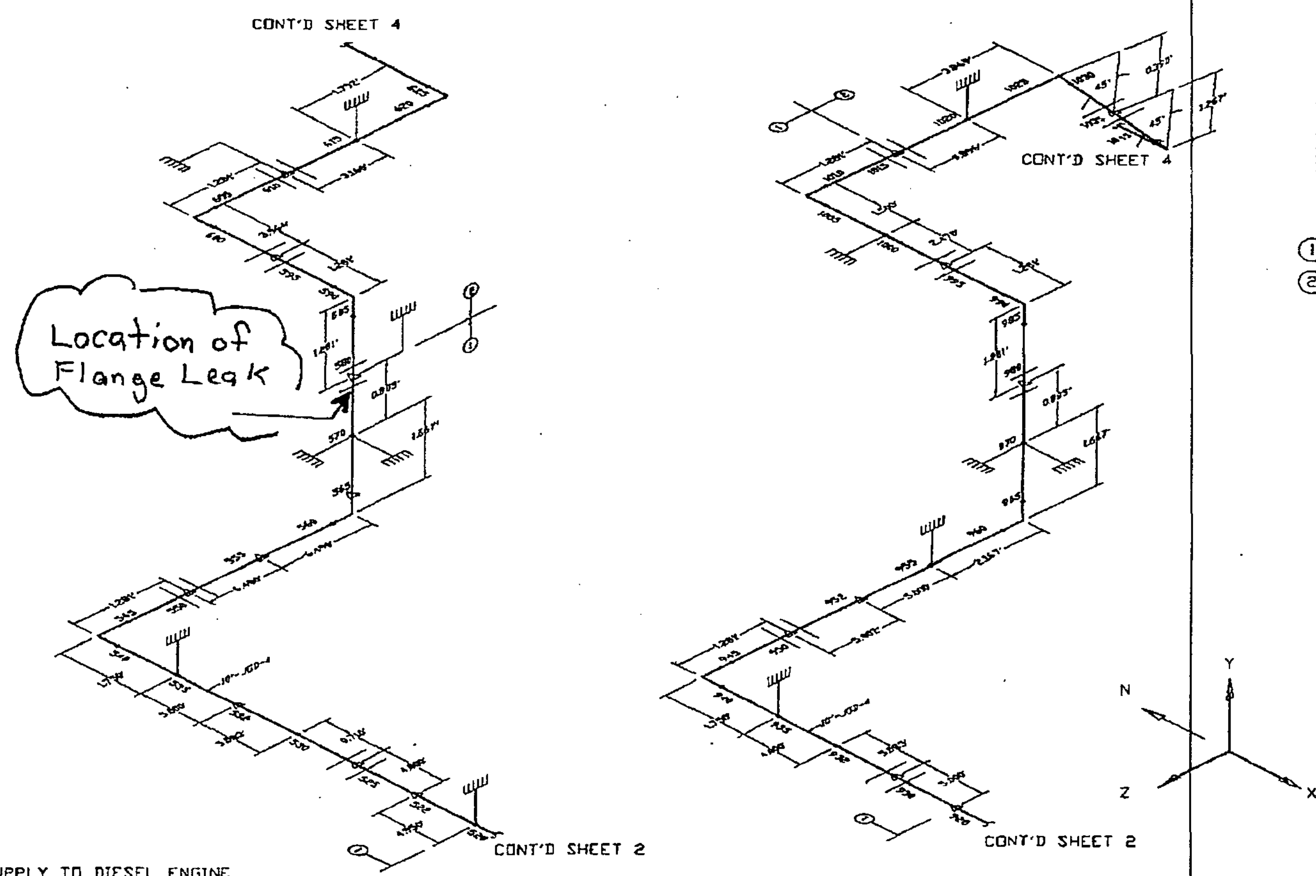
(1) CARBON STEEL PIPE

(2) STAINLESS STEEL UNS NO 8367 PIPE

SERVICE WATER TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 2

6.0 **Design Input (continued)**

6.11 **Worksketch**



NODE	SUPPORT MARK NO
535	427026 VC
570	327135 NS, EW
580	427089 VC
610	427073 EW
615	427087 VC
935	427031 VC
955	427091 VC
970	327141 NS, EW
1000	427090 EW
1020	427104 VC

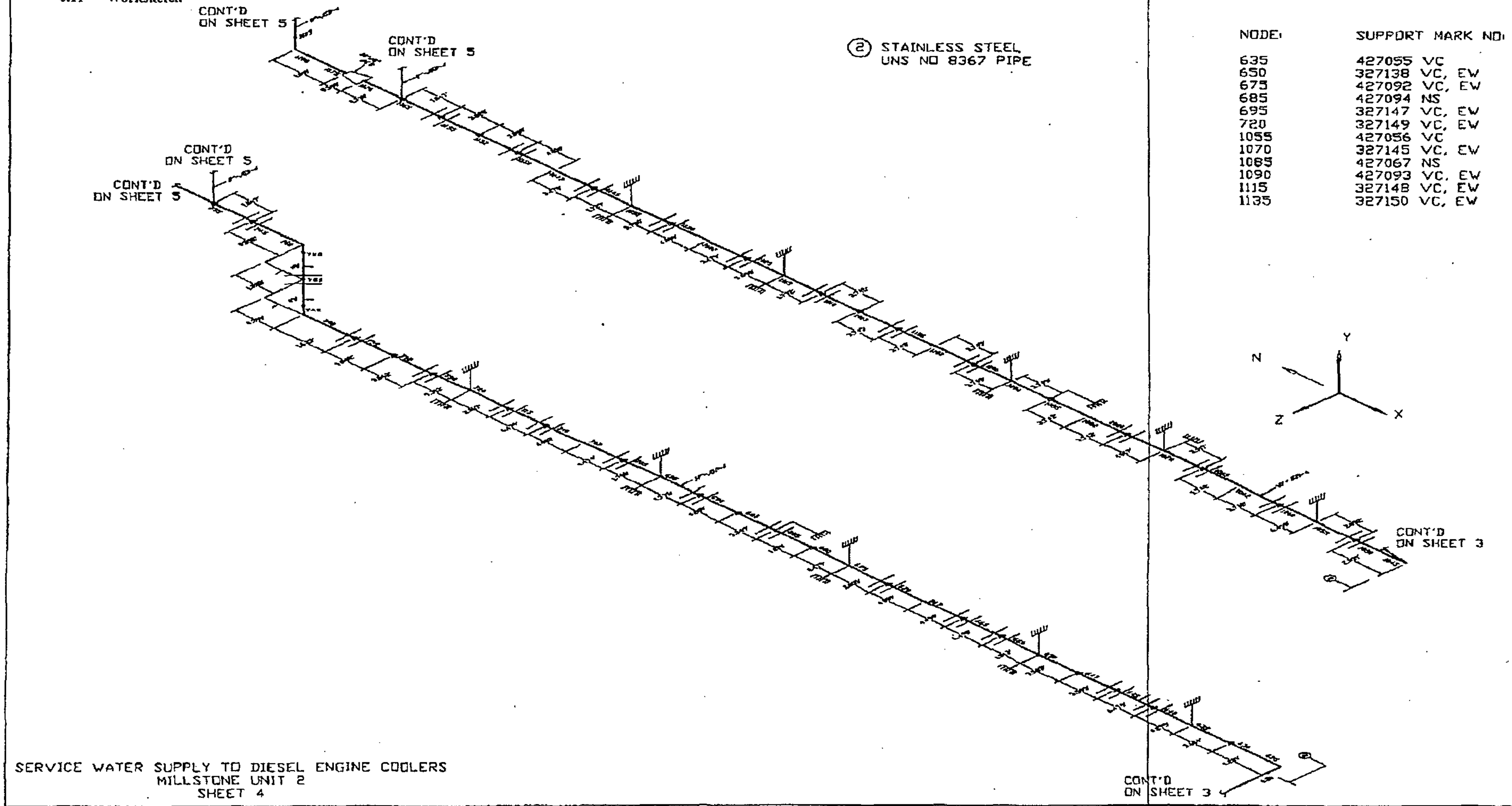
(1) CARBON STEEL PIPE

(2) STAINLESS STEEL UNS NO 8367 PIPE

SERVICE WATER SUPPLY TO DIESEL ENGINE
COOLERS
MILLSTONE UNIT 2
SHEET 3

6.0 **Design Input (continued)**

6.11 **Worksketch**



NODE	SUPPORT MARK NO
635	427055 VC
650	327138 VC, EW
675	427092 VC, EW
685	427094 NS
695	327147 VC, EW
720	327149 VC, EW
1055	427056 VC
1070	327145 VC, EW
1085	427067 NS
1090	427093 VC, EW
1115	327148 VC, EW
1135	327150 VC, EW

CALCULATION IDENTIFICATION NUMBER			PAGE 24
CALCULATION NO. MP58B-00138EM	REV NO 04	ADD B	

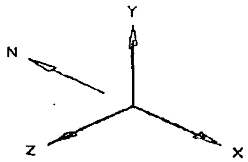
6.0 **Design Input (continued)**

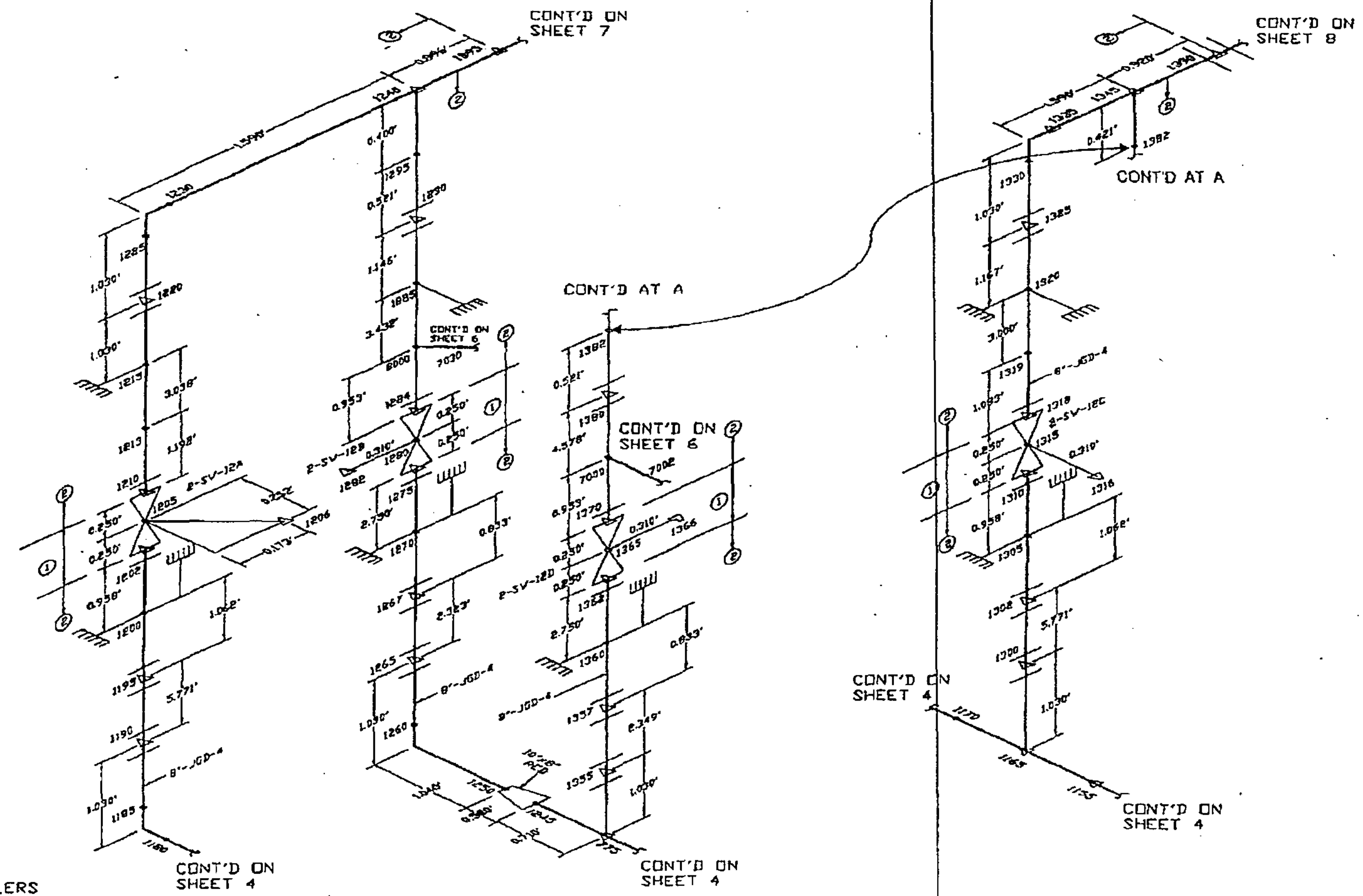
6.11 **Worksketch**

NODE:	SUPPORT MARK NO:	
1200	60469	VC, EW
1215	527019 EW	
1270	60469A	VC, EW
1285	527019 NS	
1305	60469	VC, EW
1320	527010 NS, EW	
1360	60469A	VC, EW

① CARBON STEEL PIPE

② STAINLESS STEEL UNS NO 8367 PIPE

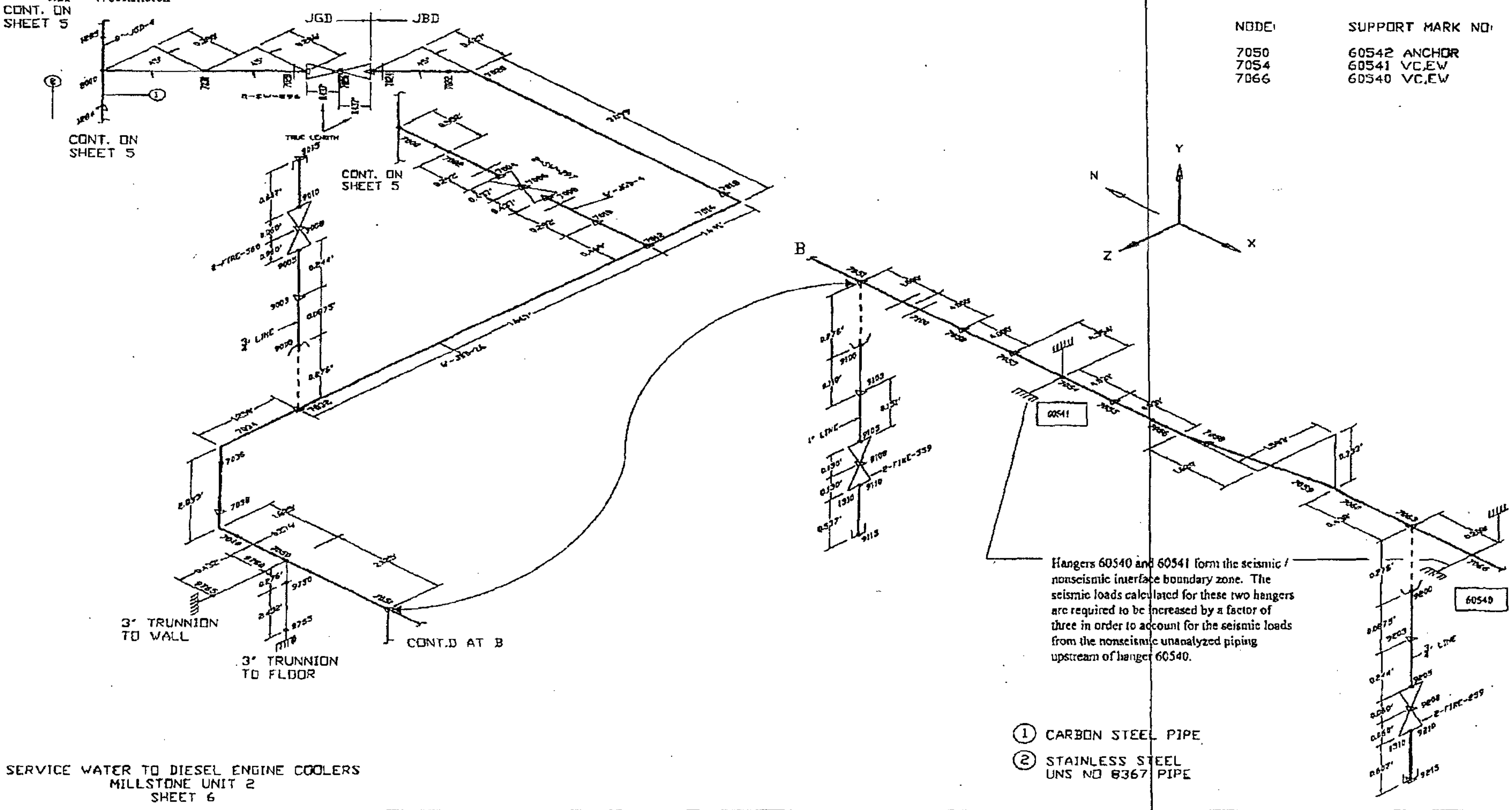




SERVICE WATER TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 5

6.0 Design Input (continued)

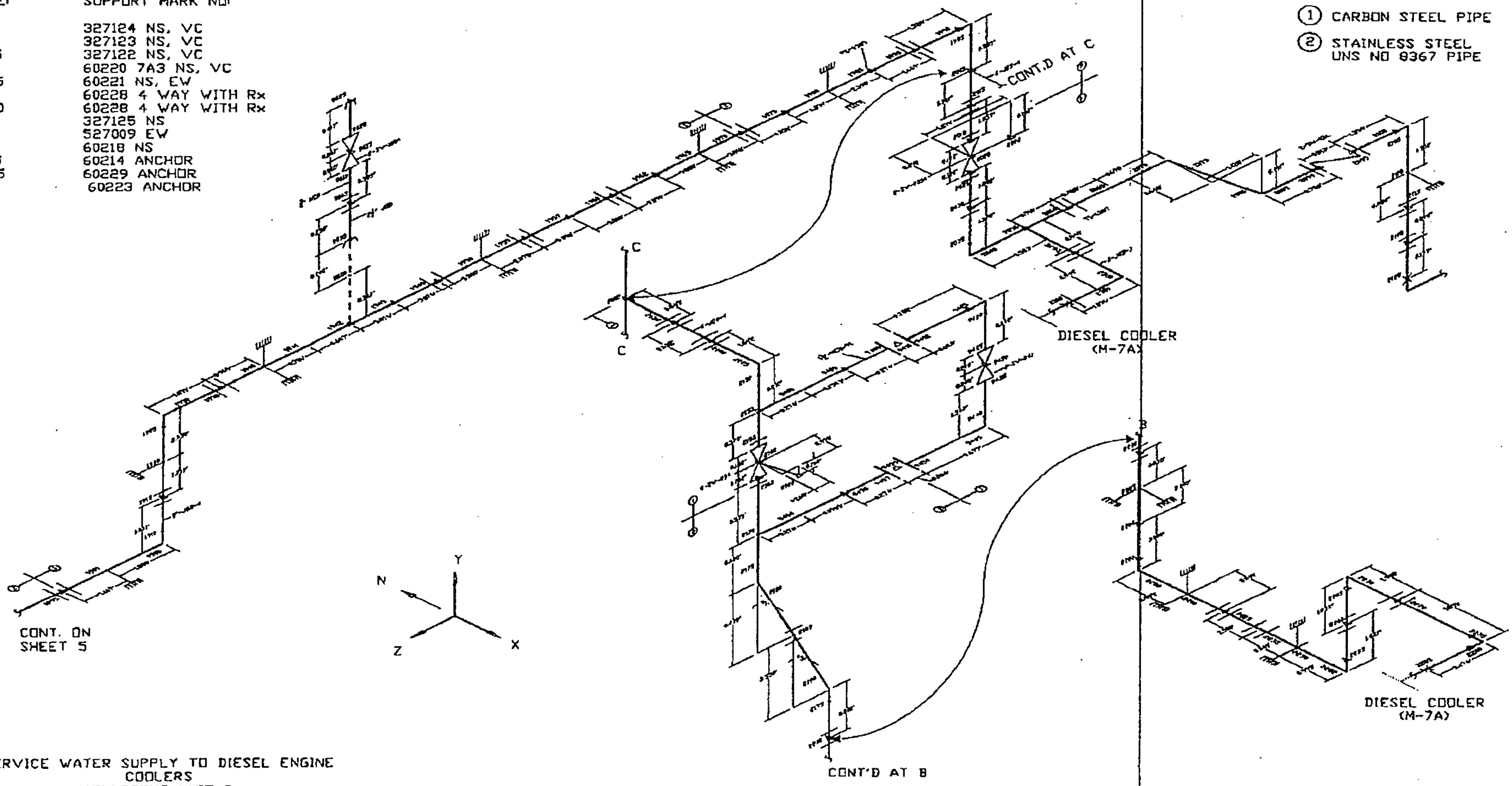
6.11 Worksketch



6.0 **Design Input (continued)**

6.11 **Worksketch**

NODE	SUPPORT MARK NO
1940	327124 NS, VC
1950	327123 NS, VC
1965	327122 NS, VC
1980	60220 7A3 NS, VC
2205	60221 NS, EW
2210	60228 4 WAY WITH Rx
2250	60228 4 WAY WITH Rx
1900	327125 NS
1920	527009 EW
2110	60218 NS
2125	60214 ANCHOR
2285	60229 ANCHOR
2310	60223 ANCHOR



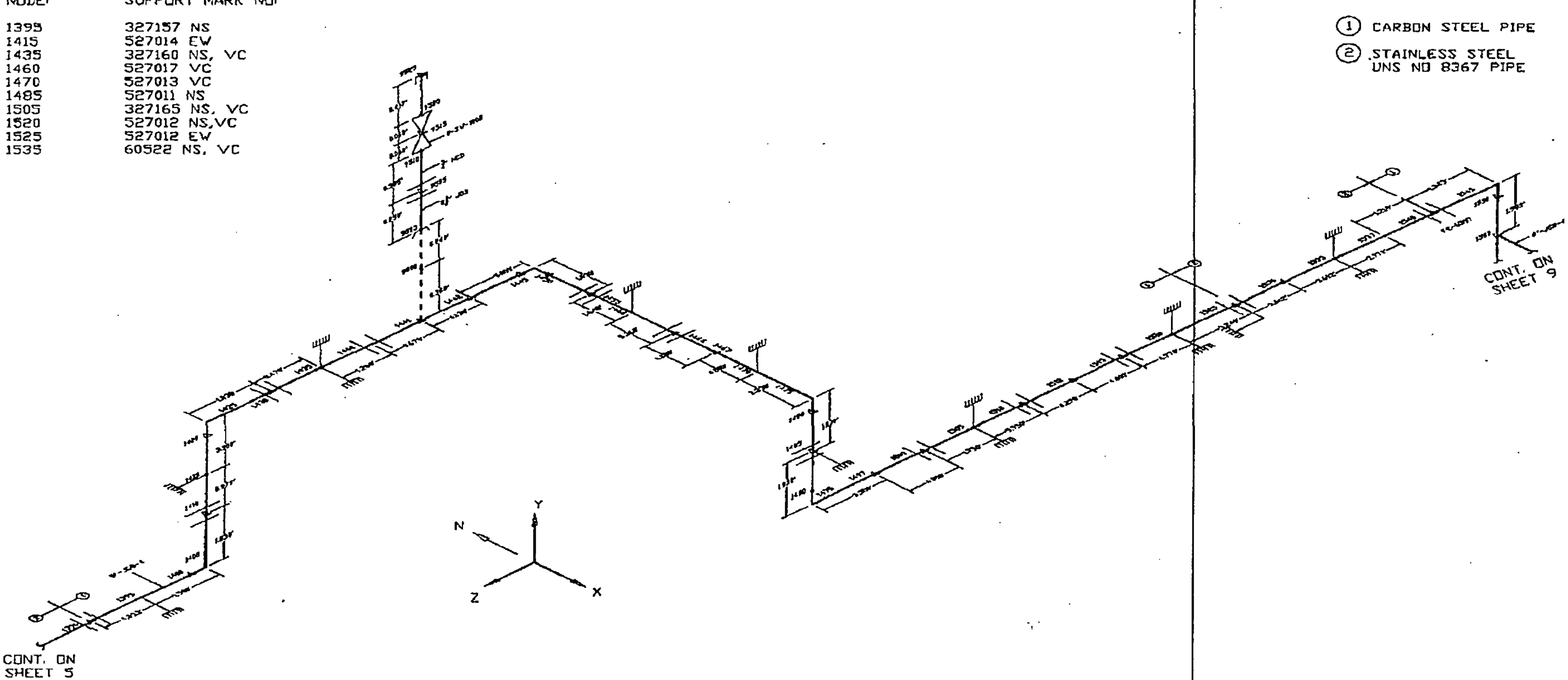
SERVICE WATER SUPPLY TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 7

CALCULATION IDENTIFICATION NUMBER			PAGE 27
CALCULATION NO. MP58B-00138EM	REV NO 04	ADD B	

6.0 **Design Input (continued)**

6.11 Worksketch

NODE	SUPPORT MARK NO
1395	327157 NS
1415	527014 EW
1435	327160 NS, VC
1460	527017 VC
1470	527013 VC
1485	527011 NS
1505	327165 NS, VC
1520	527012 NS,VC
1525	527012 EW
1535	60522 NS, VC

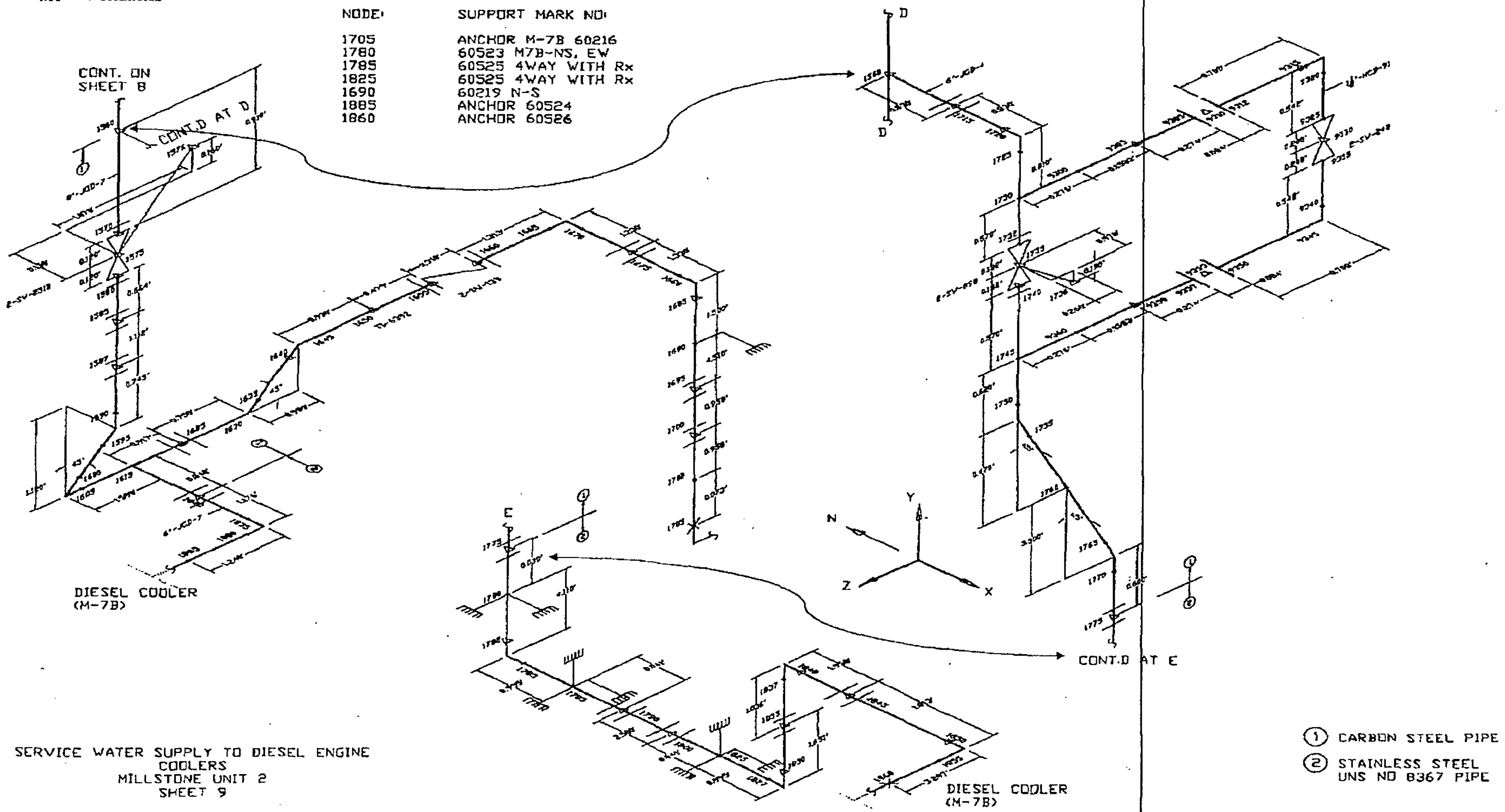


SERVICE WATER SUPPLY TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 8

6.0 Design Input (continued)

6.11 Worksketch

NODE:	SUPPORT MARK NO:
1705	ANCHOR M-7B 60216
1780	60523 M7B-NS, EW
1785	60525 4WAY WITH Rx
1825	60525 4WAY WITH Rx
1690	60219 N-S
1885	ANCHOR 60524
1860	ANCHOR 60526



7.0 Summary of Results

The analytical results were based on the following NUPIPE-SWPC computer runs.

Description	Run Date	Run ID	Attachment No.	Comments
NUPIPE II				
NUPIPE II Normal/Upset/Faulted	03-06-11	12220117	A, B, C & D	Run of Record for all commodities.

7.0 Summary of Results (cont.)
(Reference Numbers in this section of the Addendum are from the main calculation body, unless otherwise noted.)

7.1 MAXIMUM STRESS LEVELS AND ALLOWABLES

MAXIMUM STRESS LEVELS AND ALLOWABLE - ASME CLASS 3 PIPING

Material: A53 Gr. B or A106 Gr. B (Existing Piping)

Design Temperature: 115°F (Max. Operating Temp. is used)
Max Operating Temperature N/U: 115°F

S_c=15,000 psi @ 33°F (Ref. 1)
S_h=15,000 psi @ 115°F Normal/Upset (Ref. 1)
S_A=f (1.25 S_c + 0.25 S_h) = 22,500 psi @ 115°F (Ref. 1)
f = 1.0 as total number of significant cycles is less than 7,000. (Ref. 1)

S_Y= 35,000 psi @ 115°F (Ref. 1)

Table 7.1.1 Normal/ Upset Conditions

Condition	Allowable Stress (psi)	Maximum Stress (psi)	Node Number	Component Type	Reference Page No. for Max. Stress
Equation 8	1.0 S_h = 15,000	4,407	1745	Branch	B27
Equation 9	1.2 S_h = 18,000	6,532	1745	Branch	B27
Equation 10 (Note 1)	S_A = 22,500	17,948	7032	Branch	B36
Equation 11 (Note 1)	S_h + S_A = 37,500	19,026	7032	Branch	B36

Note:
1. Either the requirements of Eq 10 or Eq 11 must be satisfied.

Equation 8 $P_d + D \leq 1.0\ S_h$ (Ref. 4)

Equation 9 (Upset) $P_p + D + E + H \leq 1.2\ S_h$ (Ref. 4)

Equation 10 $T + R + A \leq S_A$ (Ref. 4)

Equation 11 $P_d + D + T + R + A \leq (S_h + S_A)$ (Ref. 4)

For definition of terms, see page 34.

7.0 Summary of Results (cont.)

7.1 MAXIMUM STRESS LEVELS AND ALLOWABLE (continued)

MAXIMUM STRESS LEVELS AND ALLOWABLE - ASME CLASS 3 PIPING

Material: AL-6XN (UNS NO8367) (Replaced Piping)

Design Temperature: 115°F (Max. Operating Temp. is used)
Max Operating Temperature N/U: 115°F

S_c=20,200 psi @ 33°F (Ref. 5,18)
S_h=20,200 psi @ 115°F Normal/Upset (Ref. 5,18)
S_A=f (1.25 S_c + 0.25 S_h) = 30,300 psi @ 115°F (Ref. 1)
f = 1.0 as total number of significant cycles is less than 7,000. (Ref. 1)

S_Y= 47,000 psi @ 200°F considered (Ref. 18)

Table 7.1.2 Normal/ Upset Conditions

Condition	Allowable Stress (psi)	Maximum Stress (psi)	Node Number	Component Type	Reference Page No. for Max. Stress
Equation 8	1.0 S_h = 20,200	4,742	140	Elbow	B4
Equation 9	1.2 S_h = 24,240	6,563	205	Tee	B5
Equation 10 (Note 1)	S_A = 30,300	22,864	2170	Branch	B33
Equation 11 (Note 1)	S_h + S_A = 50,500	27,086	2170	Branch	B33

Note:
1. Either the requirements of Eq 10 or Eq 11 must be satisfied.

Equation 8 $P_d + D \leq 1.0\ S_h$ (Ref. 4)

Equation 9 (Upset) $P_p + D + E + H \leq 1.2\ S_h$ (Ref. 4)

Equation 10 $T + R + A \leq S_A$ (Ref. 4)

Equation 11 $P_d + D + T + R + A \leq (S_h + S_A)$ (Ref. 4)

For definition of terms, see page 34.

7.0 **Summary of Results** (cont.)

7.1 **MAXIMUM STRESS LEVELS AND ALLOWABLE (continued)**

MAXIMUM STRESS LEVELS AND ALLOWABLE - ASME CLASS 3 PIPING

Material: A53 Gr. B or A106 Gr. B (Existing Piping)

Design Temperature: 115°F (Max. Operating Temp. is used)
Max Operating Temperature (Faulted): 115°F

S_Y= 35,000 psi @ 115°F (Ref. 1)

Table 7.1.3: Faulted Condition

Condition	Allowable Stress (psi)	Maximum Stress (psi)	Node Number	Component Type	Reference Page No. for Max. Stress
Equation 9	S_y = 35,000	8,423	1745	Branch	B70

Equation 9 (Faulted) $P_p + D + E' + H \leq Sy$ (Ref. 4)

For definition of terms, see page 34.

7.0 Summary of Results (cont.)

7.1 MAXIMUM STRESS LEVELS AND ALLOWABLE (continued)

MAXIMUM STRESS LEVELS AND ALLOWABLE - ASME CLASS 3 PIPING

Material: AL-6XN (UNS NO8367) (Replaced Piping)

~~Design Temperature: 115°F (Max. Operating Temp. is used)~~
Max Operating Temperature Faulted: 115°F

S_Y= 47,000 psi @ 200°F considered (Ref. 18)

Table 7.1.4: Faulted Condition

Condition	Allowable Stress (psi)	Maximum Stress (psi)	Node Number	Component Type	Reference Page No. for Max. Stress
Equation 9	S_y = 47,000	8,269	205	Tee	B48

Equation 9 (Faulted) $P_p + D + E' + H \leq Sy$ (Ref. 4)

For definition of terms, see page 34.

7.0 Summary of Results (cont.)

7.1 MAXIMUM STRESS LEVELS AND ALLOWABLE (continued)

DEFINITION OF TERMS

~~S_c = Allowable stress at lower temperature between ambient at 70° F or minimum operating temperature.~~

S_h = Allowable stress for Class 2, 3, and Class 4 piping is based on the higher of maximum operating temperature or ambient temperature.

S_A = Allowable stress range for expansion stress $f(1.25\ S_c + 0.25\ S_h)$.

D = Stress due to sustained mechanical loads including deadweight of piping, components, contents and insulation.

E = Stresses due to inertia effects of the OBE.

H = Stresses due to occasional loads other than seismic. Examples of these loads would be: water hammer, steam hammer, opening of safety relief valves, etc.

T = Stress due to thermal expansion of the system in response to average fluid temperature.

R = Stresses induced in the piping due to thermal growth of equipment and/or structures to which the piping is connected as a result of plant normal or upset conditions.

A = Stresses induced in the piping due to response of the connected equipment and/or structures to the OBE (commonly referred to as OBE anchor movements).

E' = Stresses due to inertia effects of the SSE.

P_d = Internal pressure loads due to design pressure.

P_p = Internal pressure loads due to peak pressure.

f = Stress range reduction factor for cyclic conditions (See Reference 1, SubSection NC-3611, for Class 2, ND-3611 for Class 3 piping).

CALCULATION MP58B-00138EM REV.4, ADDENDUM B *SW TO DIESEL ENGINE COOLERS

ASME SECTION III CLASS 2, 3 OR ANSI B31.1.B STRESS SUMMARY

			EQUATION 8 SUSTAINED PSI		EQUATION 9 OCCASIONAL PSI		EQUATION 10 EXPANSION PSI		EQUATION 11 SUSTAIN+EXPANS PSI			EQ. 9+10 PSI
MEMBER	NODE	SIF	ACTUAL	ALLOW	ACTUAL	ALLOW	ACTUAL	ALLOW	ACTUAL	ALLOW	STATUS	
RUN	532	1.000	1635.	15000.	2256.	18000.	526.	22500.	2160.	37500.	.	2782.
	535	1.000	1906.	15000.	2134.	18000.	742.	22500.	2647.	37500.	.	2876.
RUN	535	1.000	1906.	15000.	2134.	18000.	742.	22500.	2647.	37500.	.	2876.
	540	1.000	1762.	15000.	2001.	18000.	771.	22500.	2533.	37500.	.	2772.
ELBOW	540	1.997	2089.	15000.	2448.	18000.	1539.	22500.	3629.	37500.	.	3987.
	545	1.200	1459.	15000.	1790.	18000.	912.	22500.	2371.	37500.	.	2702.
RUN	545	1.200	1459.	15000.	1790.	18000.	912.	22500.	2371.	37500.	.	2702.
	550	1.200	1462.	15000.	1793.	18000.	910.	22500.	2372.	37500.	.	2703.
RUN	550	1.200	1462.	15000.	1793.	18000.	910.	22500.	2372.	37500.	.	2703.
	555	1.200	1980.	15000.	2371.	18000.	784.	22500.	2764.	37500.	.	3155.
RUN	555	1.200	1980.	15000.	2371.	18000.	784.	22500.	2764.	37500.	.	3155.
	560	1.000	1611.	15000.	1934.	18000.	986.	22500.	2597.	37500.	.	2920.
ELBOW	560	2.605	2094.	15000.	2725.	18000.	2568.	22500.	4662.	37500.	.	5293.
	565	2.605	1836.	15000.	2256.	18000.	2625.	22500.	4461.	37500.	.	4881.
RUN	565	1.000	1479.	15000.	1694.	18000.	1008.	22500.	2486.	37500.	.	2702.
	570	1.200	1474.	15000.	1691.	18000.	1178.	22500.	2652.	37500.	.	2870.
RUN	570	1.200	1474.	15000.	1691.	18000.	1178.	22500.	2652.	37500.	.	2870.
	580	1.200	1502.	15000.	1709.	18000.	1138.	22500.	2640.	37500.	.	2847. Location of Flange Leak
RUN	580	1.200	1502.	20200.	1709.	24240.	1138.	30300.	2640.	50500.	.	2847.
	585	1.200	1503.	20200.	1710.	24240.	1170.	30300.	2673.	50500.	.	2880.
ELBOW	585	1.200	1503.	20200.	1710.	24240.	1170.	30300.	2673.	50500.	.	2880.
	590	1.200	1371.	20200.	1591.	24240.	2406.	30300.	3777.	50500.	.	3997.
RUN	590	1.200	1371.	20200.	1591.	24240.	2406.	30300.	3777.	50500.	.	3997.
	595	1.200	1369.	20200.	1588.	24240.	2402.	30300.	3771.	50500.	.	3990.
RUN	595	1.200	1369.	20200.	1588.	24240.	2402.	30300.	3771.	50500.	.	3990.
	600	1.200	1394.	20200.	1626.	24240.	3718.	30300.	5111.	50500.	.	5344.
ELBOW	600	1.200	1394.	20200.	1626.	24240.	3718.	30300.	5111.	50500.	.	5344.
	605	1.200	1444.	20200.	1662.	24240.	3207.	30300.	4651.	50500.	.	4870.

10/85

Calculation MP58B-00138EM, Revision 4, Addendum B
Attachment B

FAULTED STRESS CHECK SY=35000 PSI OR SY=47000 PSI ALLOWABLE

ASME SECTION III CLASS 2, 3 OR ANSI B31.1.B STRESS SUMMARY

			EQUATION 8 SUSTAINED PSI		EQUATION 9 OCCASIONAL PSI		EQUATION 10 EXPANSION PSI		EQUATION 11 SUSTAIN+EXPANS PSI			EQ. 9+10 PSI
MEMBER	NODE	SIF	ACTUAL	ALLOW	ACTUAL	ALLOW	ACTUAL	ALLOW	ACTUAL	ALLOW	STATUS	
RUN	532	1.000	1635.	15000.	2809.	36000.	526.	22500.	2160.	37500.	.	3335.
	535	1.000	1906.	15000.	2337.	36000.	742.	22500.	2647.	37500.	.	3079.
RUN	535	1.000	1906.	15000.	2337.	36000.	742.	22500.	2647.	37500.	.	3079.
	540	1.000	1762.	15000.	2214.	36000.	771.	22500.	2533.	37500.	.	2985.
ELBOW	540	1.997	2089.	15000.	2767.	36000.	1539.	22500.	3629.	37500.	.	4306.
	545	1.200	1459.	15000.	2084.	36000.	912.	22500.	2371.	37500.	.	2996.
RUN	545	1.200	1459.	15000.	2084.	36000.	912.	22500.	2371.	37500.	.	2996.
	550	1.200	1462.	15000.	2087.	36000.	910.	22500.	2372.	37500.	.	2997.
RUN	550	1.200	1462.	15000.	2087.	36000.	910.	22500.	2372.	37500.	.	2997.
	555	1.200	1980.	15000.	2719.	36000.	784.	22500.	2764.	37500.	.	3503.
RUN	555	1.200	1980.	15000.	2719.	36000.	784.	22500.	2764.	37500.	.	3503.
	560	1.000	1611.	15000.	2222.	36000.	986.	22500.	2597.	37500.	.	3207.
ELBOW	560	2.605	2094.	15000.	3287.	36000.	2568.	22500.	4662.	37500.	.	5855.
	565	2.605	1836.	15000.	2631.	36000.	2625.	22500.	4461.	37500.	.	5255.
RUN	565	1.000	1479.	15000.	1886.	36000.	1008.	22500.	2486.	37500.	.	2893.
	570	1.200	1474.	15000.	1885.	36000.	1178.	22500.	2652.	37500.	.	3063.
RUN	570	1.200	1474.	15000.	1885.	36000.	1178.	22500.	2652.	37500.	.	3063.
	580	1.200	1502.	15000.	1893.	36000.	1138.	22500.	2640.	37500.	.	3031.
RUN	580	1.200	1502.	20200.	1893.	48480.	1138.	30300.	2640.	50500.	.	3031.
	585	1.200	1503.	20200.	1895.	48480.	1170.	30300.	2673.	50500.	.	3065.
ELBOW	585	1.200	1503.	20200.	1895.	48480.	1170.	30300.	2673.	50500.	.	3065.
	590	1.200	1371.	20200.	1786.	48480.	2406.	30300.	3777.	50500.	.	4192.
RUN	590	1.200	1371.	20200.	1786.	48480.	2406.	30300.	3777.	50500.	.	4192.
	595	1.200	1369.	20200.	1783.	48480.	2402.	30300.	3771.	50500.	.	4185.
RUN	595	1.200	1369.	20200.	1783.	48480.	2402.	30300.	3771.	50500.	.	4185.
	600	1.200	1394.	20200.	1833.	48480.	3718.	30300.	5111.	50500.	.	5550.
ELBOW	600	1.200	1394.	20200.	1833.	48480.	3718.	30300.	5111.	50500.	.	5550.
	605	1.200	1444.	20200.	1857.	48480.	3207.	30300.	4651.	50500.	.	5064.

Calculation Cover Sheet

Dominion

Calculation Number: MP58B-00138EM	Revision: 4	Addendum: N/A

Calculation Quality Class: ☒ Safety Related ☐ NSQ ☐ Non-Safety Related

Installation Verification Required? ☒ Yes ☐ No ☐ N/A Note: Not applicable for Virginia Plants R.E. DeLoato R.E. DeLoato 2/17/10

Subject (Calculation Title):
Service Water Supply to Diesel Engine Coolers – Stress Problem 118

Addendum Title (if applicable):
N/A

Station(s) and Unit(s):	Affected System(s), Structure(s), or Component(s):
Millstone Unit 2	SWS; AB, DG

Purpose:
The purpose of Revision 4 is to incorporate the changes documented in Revision 3 CCN 01 through CCN 24 of this calculation as well as the service water piping replacements being implemented by DCN DM2-00-0345-08.

REC'D 2-17-10
ON HOLD —
PROCESSED 2-18-10
RM

Signatures	Date
Originator: Provide printed name and signature (Qual. Required): R. Sainath R Sainath	2-10-10
Reviewer: Provide printed name and signature (Qual. Required): P. V. Patel P. V. Patel	2-10-10
Approval: Provide printed name and signature: R. A. Bain A. Taft for R Bain; Owner's Review R.E. DeLoato 2/17/10 R. E. DeLoato	2-10-10

Dominion

MPS Transitional Site-Specific Guidance

PassPort DATABASE INPUTs

Page 2

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # N/A Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Discipline (Up to 10) L, N, P,V

Unit (M1, M2, M3)	Project Reference (EWA, DCR or MMOD)	Component Id	Computer Code	Rev. No./ Level No.
M2	DM2-00-0345-080	RBCCW-X18A	NUPIPE-SWPC	01/00
		RBCCW-X18B	NUDL-PC	01/00
		RBCCW-X18C		

MEL CODES*

Structure	System	Component	Reference Calculation	Rev No.	ADD CCN
AB	SWS	PIP	98-209	0	N/A
DG					

*The codes required must be alpha codes designed for structure, system and component.

NOTE: Avoid multiple item references on a line, e.g., LT 1210 A-D requires four separate lines.

Reference Drawing	Sheet	Rev. No.
25203-20224	00058	4
25203-20224	00057	3
25203-20224	00056	4
25203-20224	00061	2
25203-20224	00059	7
25203-20224	00060	2
25203-20146	01028	7
25203-20146	01029	8
25203-20150	01014	3
25203-22200	60542	1
25203-22200	60469	2
25203-22200	427094	6

Comments :

Dominion

PassPort DATABASE INPUTs

Page 3

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # N/A Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Discipline (Up to 10) L, N, P, V

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
327160-00149EM	X		Revision 04
PROBLEM 121		X	
PROBLEM 122		X	
327012-00144EM		X	
327013-00145EM		X	
327122-00146EM		X	
327123-00147EM		X	
327124-00148EM	X		Revision 02
327125-00150EM	X		Revision 04
327138-00154EM		X	
327141-00153EM		X	
327145-00155EM		X	
327147-00156EM		X	
327148-00157EM		X	
327149-00158EM		X	
327150-00159EM	X		Revision 03
327157-00151EM		X	
327165-00160EM		X	
380352-00161EM		X	
427026-00162EM		X	
427031-00163EM		X	
427030-00164EM		X	
427055-00165EM		X	
427067-00168EM		X	
427069-00170EM		X	
427080-00173EM	X		Revision 02
427083-00175EM		X	
427085-00177EM		X	
427089-00178EM		X	
427090-00179EM		X	
427092-00181EM	X		Revision 03

Dominion

PassPort DATABASE INPUTs

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

~~ADD/CCN # N/A~~ ~~Calc Voided:~~ ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Discipline (Up to 10) L, N, P, V

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
427093-00182EM		X	
427094-00183EM	X		Revision 04
427104-00184EM		X	
527009-00185EM		X	
60469-00193EM	X		Revision 03
60492-00192EM		X	
60493-00191EM		X	
527010-00199EM	X		Revision 05
527012-00189EM		X	
527017-00190EM		X	
527019-00198EM	X		Revision 04
327002-01005M2		X	
427113-01006M2	X		Revision 03
427063-01007M2		X	
327098-01008M2		X	
427114-01011M2	X		Revision 02
427079-01012M2	X		Revision 01
427076-01013M2		X	
527027-01014M2	X		Revision 02
60214-01017M2		X	
60216-01018M2		X	
60221-01022M2		X	
60223-01023M2	X		Revision 02
60228-01024M2	X		Revision 02
97-118C-02027C2		X	
97-118C-02061C2		X	
97-118C-02062C2	X		Revision 01
427074-01004M2		X	
427075-01009M2		X	
427115-01010M2		X	

Dominion

MPS Transitional Site-Specific Guidance

PassPort DATABASE INPUTs

Calculation Number: MP58B-00138EM Revision: 04

Vendor Calculation Number/Other: N/A Revision: N/A

ADD/CCN # N/A Calc Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Discipline (Up to 10) L, N, P, V

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
427064-00167EM		X	
427082-00174EM		X	
427068-00169EM		X	
327135-00152EM	X		Revision 02
427073-00171EM	X		Revision 02
427087-00172EM	X		Revision 02
60492-00192EM	X		Revision 01
427084-00176EM		X	
427091-01016M2		X	
427056-00166M		X	
527014-00186EM		X	
527013-00188EM		X	
527011-00187EM		X	
60219-01020M2		X	
60220-01021M2		X	
60218-01019M2		X	
527028-01015M2	X		Revision 01
60229-01025M2		X	
95-ENG-01186M2		X	
MP2-SEIS.RPT		X	
02-CP-03111M2		X	
98-209		X	

Review Statement for Calculation

Review of this calculation was based on the methods below:

			Initial Upon Completion
1)	Review of:		
a)	Inputs to ensure that they have been properly selected and correctly used in the calculation. (Check One) i) Limited review (provide justification) ii) Line by line review	☐ ☒	PV
b)	Assumptions to assure their validity and need for later confirmation.	☒	PV
c)	Methodology to assure the appropriateness of the overall approach, its implementation, and the correctness of the specific equations utilized. i) Limited review (provide justification) ii) Line by line review	☐ ☒	PV
d)	Results to ensure reasonableness and accuracy	☒	PV
e)	If alternate calculation is performed to verify c) and d) check here and attach calculation as an appendix	☐	
2)	Check of Calculation (Check One)		
a)	Complete numerical check	☒	PV
b)	Numerical check of critical items (state items and justification below)	☐	
3)	Administrative check of format and content	☒	PV
4)	Comments/Justification		

Review Methods Selected as Indicated Above

P. V. Patel	P. V. Patel	2-10-10
Reviewer		Date
P. V. Patel	P. V. Patel	2-10-10
Independent Reviewer		Date
R. A. Bain	A. Tatt telecon R Bain	2-10-10
Lead concurrence		Date

TABLE OF CONTENTS

Pages

TABLE OF CONTENTS (continued)

CALCULATION IDENTIFICATION NUMBER			PAGE 9
CALCULATION NO. MP58B-00138EM	REV NO 04	CCN NO N/A	

REVISION STATUS

REV. NO.	DESCRIPTION/REASON FOR CHANGE	AFFECTED PAGES
0	ORIGINAL ISSUE / TO INCORPORATE PA# 86-007 SERVICE WATER PIPE REPLACEMENT.	ALL
	THIS CALC. SUPERSEDES MP2 BECHTEL PIPE STRESS CALC. FOR PROBLEMS 118 & 120 SERVICE WATER SUPPLY TO DIESEL ENGINE COOLERS. (SEE INPUT DATA PAGE 13).	
1	1.) INCORPORATED CCN #1 (INC. NEW PIPE SPOOL PIECES AND FLANGES PER AS BUILT) 2.) INCORPORATED CCN #2 (DCN DM2-S-909-92: ADDS INSTRUMENTATION TAP FLANGES) 3.) INCORPORATED CCN #3 (SUPERSEDED CALC. 78-883-140-GM REV.1) 4.) INCREASED MAXIMUM TEMPERATURE PER MEMO SE-93-180. 5.) ADDED 1" SPACER PLATES NEAR VALVES 2-SW-12A, 2-SW-12C AND 2-SW-12D PER DCN DM2-P-217-92. 6.) INCLUDED REV.0 TITLE PAGE AS PAGE 1A.	ALL
2	1.) INCORPORATED DCN DM-S-541-93, ADDS VENT AND INSTRUMENTATION TUBING. 2.) TO UPDATE CALCULATION: ADDED NEW PAGES ADDED PAGE 1 OF REVISION 1 AS PAGE 1B DESCRIBED REVISIONS REVISED INDIVIDUAL PAGES AS INDICATED ADDED NEW LOAD TABULATION SHEETS ADDED ATTACHMENT NO. 7 (APPLICABLE DCN) ADDED NEW APPENDIX A FOR THIS ANALYSIS	 1, 2, 3 1B 7 4,5,6,9,21 23,53,54 30 to 52 ATT. NO 7 APPEN. A
3	1.) NEW ANALYSIS USING ADLPIPE PIPE STRESS COMPUTER PROGRAM. 2.) ADDED ANALYSES FOR TEMPORARY CONFIG. PER DCN DM2-S-541-93.	ALL

REV. NO.	DESCRIPTION/REASON FOR CHANGE	AFFECTED PAGES
3 CONTD	3.) ADDED ANALYSES FOR TEMPORARY CONFIG. PER DCN DM2-S-0116-94. 4.) ADDED ANALYSES FOR TEMPORARY CONFIG. PER DCN DM2-S-0449-94	

REVISION STATUS (cont.)

Rev. No.	Description/ Reason for Revision	Affected Pages
4	This revision has incorporated applicable changes described in Calculation Change Notices (CCN01 through CCN 24) to Revision 3 of this calculation in order to address the potential impact of the cumulative effects of these changes. Revision 4 also incorporates the piping replacements implemented by DCN DM2-00-0345-08.	All

1.0 Purpose

The overall objective of this calculation is to qualify the Service Water piping (as shown in the Pipe Stress Worksketches in Section 6.11) in accordance with the requirements of the Millstone Unit 2 FSAR (Reference 2), ANSI code (Reference 1) and Millstone Pipe Stress and Pipe Support Specification SP-M2-ME-030 (Reference 4).

~~Additional objectives of this calculation are as follows:~~

- ☒ Pipe support design loads will be generated and will be compared to the existing pipe support design loads in order to determine acceptability.
- ☒ Valve accelerations will be determined and evaluated for acceptability.
- ☒ Equipment nozzle loadings/stresses will be determined and evaluated for acceptability.
- ☒ Flange loads will be determined and evaluated for acceptability.
- ☒ Evaluation of pipe local stresses due to Integral Welded Attachments (IWA) will be performed to document acceptability.

2.0 Assumptions

None.

3.0 General Notes

1. The coordinate system for all data expressed in the global system is as follows:

   (-X) is plant "called North" per piping drawing.
   (+Y) is vertical "up".
   (+Z) is according to the right hand rule.

   The local system is defined as follows:

   For straight piping members

   (X) is along the axis of the pipe, positive in the direction of coding.
   (Y) in the plane of the local X-Axis and the global +Y-Axis unless the local X-Axis is aligned with the global Y-Axis, then the local Y-Axis will be parallel to the global X-Axis.
   (Z) according to the right hand rule.

   For curved piping members a radial-normal-tangential system is used where X and Y are in the plane of the curve and Z is normal to the plane as follows:

   (X) is the tangential component, positive in the direction of coding.
   (Y) is the positive (outward) radial component.
   (Z) is normal to the X and Y plane according to the right hand rule.

2. Forces and moments on restraints, supports and equipment are those imposed by the piping system (i.e., actions not reactions).

3. Unless otherwise indicated, intersections are considered as unreinforced branch connections.

4. N/A or NA indicated throughout this calculation represents "not applicable."

5. Abbreviations used for pipe support functions as applicable:

CS	-	Constant Support	AC	-	Axial Constraint
SH	-	Spring Hanger	VSS	-	Vertical Shock Suppressor
VS	-	Vertical Support	NSS	-	North-South Shock Suppressor
VC	-	Vertical Constraint	ESS	-	East-West shock suppressor
NS	-	North South Constraint	LSS	-	Lateral Shock Suppressor
EW	-	East West constraint	ASS	-	Axial shock suppressor
LC	-	Lateral Constraint	ANC	-	Anchor

3.0 **General Notes (continued)**

6. The following minor modeling discrepancies are contained in the NUPIPE-SWPC coding. The effects of these discrepancies were reviewed and concluded to be insignificant with respect to the calculation results/conclusions.

- ~~Valve Operator at node 192 is coded in vertical direction instead of +Z direction.~~
- Pipe Runs between nodes 7060-7063, 7063-7066 should be in the +X direction to agree with the piping Iso. (Ref. 13.i) instead of –Z direction coded.
- Flange weight of 17 lbs at node 2310 was inadvertently input at node 2285. It should be noted that there is already a CWEIGHT card at node 2285.
- Flange weights of 26 lbs (Node 1740) and 36 Lbs (Node 1941) were inadvertently omitted in the Nupipe input.

7. The Minimum Wall Thickness (t_m) calculation shown in Section 5.4 of Revision 3 of this calculation was qualified for a Design Pressure of 100 psig and is included in Attachment D of this calculation. The calculation sheets included in Attachment D were "marked-up" to show acceptability for a Design Pressure of 150 psig.

8. The Design Input (Piping, Pipe Supports, Valves and Heat Exchanger Drawings) from Section 3.1 of Revision 3 of this calculation are included in Attachment D for information only.

4.0 Methods

A. NUPIPE-SWPC Model/ NUDL-PC Computer Program

The NUPIPE-SWPC model generated in Revision 4 was developed using the two existing computer models as described below.

- ADLPIPE Runs (Thermal, Deadweight and Seismic analysis) 138EM3.001, 138EM3.006, 138EM3.002, 138EM3.003 as noted in Section 5.2 of Revision 3 of this calculation.

- Pipestress run based on CCN 08 to the Revision 3 of this calculation. This run include Cross-Tie between Service Water lines (8"-JGD-004) above the existing valves 2SW-12B and 2SW-12D, and the Fire Protection line 6"-JBD-026 downstream of valve 2-FIRE-258.

The NUPIPE-SWPC model also incorporated the piping changes based on "CCNs/DCNs" summarized in Revision 3 CCN 01 through CCN 24. The following provides a summary of these modeling updates

- DCN DM2-00-0345-08 (Ref. 5a) addresses pipe replacement spool pieces.

- DCN's DM2-00-0225-08, DM2-00-0055-08, DM2-01-0054-08 and DM2-00-0054-08 (Ref. 5) which covers replacement of Service Water pipe spool P-14 with AL-6XN material and the removal of Service Water Inlet Strainers L350B, L350A and replacing these components with spool pieces of AL-6XN material.

- Design Pressure of 150 psi was conservatively considered for the entire stress problem. CCN 10 to Revision 3 of this calculation is qualified for the uprated design pressure of 150 psi to the portions of Service Water to Diesel Engine Coolers. CCN 10 also adds a pair of flanges, a vent and a drain line to Fire Protection line 6"-JBD-26 (analyzed in CCN 08).

- Based on CCN 13 to the Revision 3 of this calculation, the overall valve weight for 2-SW-89A/B is changed from 119 lbs to 135 lbs.

- Based on CCN 15 to the Revision 3 of this calculation, the overall valve weight for 2-SW-12A/B/C/D is changed from 80 lbs to 292 lbs.

- Based on CCN 17 to the Revision 3 of this calculation, the overall valve weight for 2-SW-231A/B is changed from 156 lbs (noted in CCN 13) to 347 lbs.

- Service Water line 6"-JGD-7 (between nodes 1870 and 1875) pipe material including fittings and flanges is replaced with material AL-6XN (UNS NO8367) per CCN 19 to the Revision 3 of this calculation.

4.0 **Methods (continued)**

The NUPIPE-SWPC model also addressed the piping replacements being implemented by DCN DM2-00-0345-08 (Ref. 5). Additionally, as described in the correspondence contained on page D9 and D10, Pipe Support 60525 (Nodes 1785, 1825) and 60228 (Nodes 2210, 2250) were modeled as 4-way restraints, and Pipe Support 60221 (Node 2205) and 60523 (Node 1780) were modeled as NS/EW restraints. The trunnions related to Anchor 60542 (Node 9755 at Floor and Node 9765 at Wall) were also included in the NUIPE-SWPC model.

The NUDL-PC computer program was used to determine the new "Pipe Support Design Loads."

B. **Operating Conditions**

The operating conditions considered in the NUPIPE-SWPC analysis were based on Section 5.1.1 of Revision 3 of this calculation, except a lower 33° F temperature for SW supply piping to the RB CCW heat exchangers was considered instead of 40° F used in the existing analysis, and 115° F temperature at the outlet of the Diesel Generator Coolers M-7A AND M-7B was also considered.

The specific thermal operating conditions considered in the NUPIPE-SWPC run are summarized in Section 6.5.

C. **Seismic Response Spectra**

The applicable Amplified Response Spectra Curves are:

Building(s) Location	Elevation	Damping
Auxiliary Building (Horizontal Accelerations X and Z Directions)	14'-6"	0.5% Damping (OBE)

Vertical Accelerations are 2/3 of the ground acceleration (i.e. 2/3 of 0.09gs) or 0.06gs for OBE and 0.113gs for DBE.

SSE Inertia results are obtained by multiplying OBE Inertia results by **1.89** as noted in Section 5.1 of Revision 3 of this calculation and also in Section 3.6 of Pipe Stress Spec SP-M2-ME-030 (Ref. 4).

D. **Seismic Anchor Movements (SAM's)**

The Maximum Relative displacements between Auxiliary Building and Warehouse are less than 0.125"and is considered negligible as noted in Section 3.3 of Revision 3 of this calculation. Therefore SAM's analysis was not performed.

The details extracted from Section 3.3 are documented in Section 6.8 of this calculation.

4.0 **Methods (continued)**

E. Computer Programs

The NUPIPE-SWPC program (Ref. 6a) is designed to perform analysis in accordance with the ASME Boiler and Pressure Vessel Code, Section III Nuclear Power Plant Components, and also the USAS ANSI B31.1.0 Power Piping Code. This program performs a linear elastic analysis of three-dimensional piping systems subjected to various thermal, static and dynamic loading conditions.

The NUDL-PC program (Ref. 6b) is a load combination generator that serves as an aid in the design of pipe support and equipment nozzles. The program reads the pipe support or equipment nozzle loads and global deflections from a file (called CADEPS) created by NUPIPE-SWPC, combine them according to a set of specified combination equations, and outputs to a disk file in a tabular format.

The NUPIPE-SWPC and NUDL-PC analyses were performed on a computer system named "1MV7491" which has been designated as a QS 2.7 machine in accordance with Section 11.5.2 of the Shaw Stone & Webster Nuclear Quality Standard Number QS 2.7, Rev. F (Ref. 7).

This system is an IBM compatible Personal Computer "DELL" with Pentium 4 CPU, 3.2 GHz with 2.0 GB of RAM, using the Microsoft Windows XP Professional Version 2002, Service Pack 1 Operating System.

F. Support 60542 Design Loads

Pipe support anchor 60542 is considered to be the "seismic/non-seismic" boundary anchor isolating the non-seismic portion of the piping system from the safety related seismic portion of the piping system. To meet the intent of section 3.2 (item c, seismic/non-seismic boundaries) of Specification SP-M2-ME-030 (Reference 4), the design loads for this support will be determined by "doubling" the existing NUDL-PC based design loads in order to account for the effects of the non seismic piping located beyond the NUPIPE-SWPC analytical model. It should also be noted that two additional supports beyond the seismic/non-seismic anchor 60542 (that are part of the computer model) will be designed considering the seismic loads that were determined by the NUPIPE-SWPC analysis.

5.0 REFERENCES

1. American National Standard Institute Code for Pressure Piping, ANSI B31.1, 1967 Edition; All applicable addenda up to and including Summer 1973 Addendum.

2. Millstone Unit 2 FSAR Criteria.

3. ~~Not Used.~~

4. SP-M2-ME-030 Rev. 01 dated 12/13/00 "Specification for Rigorous Piping Stress Analysis and Pipe Support Design."

5. Design Change Notice (DCN) No.;

   a. DM2-00-0345-08 "Replace "A" Train Service Water 10" Supply Line to EDG Coolers with AL-6XN Material."

   b. DM2-00-0225-08 "Replacement of Service Water Spool P-14 with AL-6XN Material and Annubar Flow Measuring Connection Replacement to FE-6397."

   c. DM2-00-0055-08 "Removal of "B" Diesel Generator Service Water Inlet Strainer (L350B)."

   d. DM2-01-0054-08 "Removal of "A" Diesel Generator Service Water Inlet Strainer (L350A)."

   e. DM2-00-0054-08 "Removal of "A" Diesel Generator Service Water Inlet Strainer (L350A)."

6. Computer Codes:

   a. NUPIPE-SWPC, ME-110.01, "Stress Analysis of Nuclear Piping," Version 01, Level 00.
   b. NUDL-PC, ME-268.01, "Nupipe Support Structural Design Loads," Version 01, Level 00.

7. Shaw Stone & Webster Nuclear Quality Standard, "Computer Software," QS 2.7, Rev. F.

8 Tube Turn Catalog 311, pages 101-103.

9. Crane Catalog No. 61 – "Welding Fittings Forged Flanges."

10. ITT Grinnell Industrial Piping, Inc. "Pipe Design and Engineering," Fifth Edition, 1976.

11. Specification No. SP-ME-668 "Millstone Unit 2 Class Sheets," Revision 4.

12. Not Used.

5. **REFERENCES** (continued)

13. Dominion Piping Drawing Number — Revision Number

	Dominion Piping Drawing Number	Revision Number
a.	25203-20224 SH 58	4
b.	25203-20224 SH 57	3
c.	25203-20224 SH 56	4
d.	25203-20224 SH 61	2
~~e.~~	~~25203-20224 SH 59~~	~~7~~
f.	25203-20224 SH 60	2
g.	25203-20146 SH 1029	8
h.	25203-20146 SH 1028	7
i.	25203-20150 SH 1014	3

14. Seismic Analysis Input Data Sources:
Millstone Point Building Floor Response Spectra developed by Bechtel Corporation.
Amplified Response Spectra Curves
The curves are as noted on Millstone Unit 2, Revision 3 sheet no. 12 of this calculation.
(See Attachment D)
The ARS curves are hand input in NUPIPE-SWPC run.

Building(s) Location	Elevation	Damping
Auxiliary Building	14'-6"	0.5% (OBE)

(Horizontal Accelerations X and Z Directions)
Vertical Accelerations are 2/3 of the ground acceleration (i.e. 2/3 of 0.09gs) or 0.06gs for OBE and 0.113gs for DBE.
A review of ARS indicates that the input ARS is conservative in the area of the peak through the ZPA relative to the vertical accelerations input.

15. WALWORTH Valve Catalog 130.

16. LADISH Fittings- Catalog No 55.

17. Pipe Support Drawing: Dominion Dwg. No. 25203-22200 SH. 60542 Revision 1.

18. Allegheny Ludlum, "Stainless Steel AL-6XN Alloy (UNS Designation NO8367)," Technical Data Bluesheet B155, 1998.

19. ASME, Procedure for the Evaluation and Design of Rectangular Cross Section Attachments on Class 2 or 3 Piping," B&PV Code, Section III, Division 1, Code Case N-318-3, 1985.

20. Pipe Support Drawing Nos. 25203-22200, SH. 60469A through 60469H, Revision 2.

21. Pipe Support Drawing Nos. 25203-22200, SH. 427094 and 427094A, Revision 6.

22. Pipe Support Calculations (Refer to table provided in Attachment E for list of pipe support calculations).

23. Calc. 98-209, Revision 0, "Determination of Maximum Allowable Moment on a 8" 125# Light Weight Slip-On Flange."

6.0 DESIGN INPUT

The following design input pages consist of data obtained from various sources which is required to perform the stress analysis of this piping system. This data is assembled in a manner which is suitable for input into the NUPIPE-SWPC analysis.

6.0 Design Input

6.1 Basic Analytical Data

TABLE 6.1.1
(Existing Pipe)

Line Designation	Pipe class	Material Existing Pipe	E_{cold} (psi) x 10^6	Design Pressure (psi)	Design Temp. (°F)	Max. Operating Pressure (psi)	Max. Operating Temp. (°F)	Co-Eff. of Expansion in/ft	Outside Diameter (in)	Wall Thickness (in)
24"-JGD-1	JGD	A53 GR.B	27.9	150	100	150	Note 1	Note 1	24	0.687
24"-JGD-3	JGD	A53 GR.B	27.9	150	100	150	Note 1	Note 1	24	0.687
10"-JGD-4	JGD	A53 GR.B	27.9	150	100	150	Note 1	Note 1	10.75	0.365
8"-JGD-4	JGD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	8.625	0.322
8"-JGD-7	JGD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	8.625	0.322
6"-JGD-4	JGD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	6.625	0.280
6"-JGD-7	JGD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	6.625	0.280
6"-JBD-26	JBD	A106 GR.B	27.9	150	115	150	Note 1	Note 1	6.625	0.280
3/4" Vent, Drain	JBD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	1.05	0.154
1" Drain	JBD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	1.315	0.179
1.5"-HCD-91	HCD	A53 GR.B	27.9	150	115	150	Note 1	Note 1	1.9	0.200
2.5"-JGD	JGD	A53 GR.B	27.9	150	100	150	Note 1	Note 1	2.875	0.203
3/4-HCD Vent	HCD	A53 GR.B	27.9	150	100	150	Note 1	Note 1	1.05	0.113
Reference	13	11, 13	1	See Note 3	See Note 5	See Note 4			10,9	10,9

Line Designation	Contents	Wt. Total lbs/ft	Insulation Thick (in)	Insulation Type	Sc (psi)	Sh (psi)	Sy (psi)
24"-JGD-1	Water	355.47	1.5	I	15000	16000	35000
24"-JGD-3	Water	355.47	1.5	I	15000	15000	35000
10"-JGD-4	Water	79.02	1.5	I	15000	15000	35000
8"-JGD-4	Water	53.85	1.5	I	15000	15000	35000
8"-JGD-7	Water	50.24	1.5	I	15000	15000	35000
6"-JGD-4	Water	31.48	0	N/A	15000	15000	35000
6"-JGD-7	Water	31.48	0	N/A	15000	15000	35000
6"-JBD-26	Water	31.48	0	N/A	15000	15000	35000
3/4" Vent, Drain	Water	1.662	0	N/A	15000	15000	35000
1" Drain	Water	2.483	0	N/A	15000	15000	35000
1.5"-HCD-91	Water	4.396	0	N/A	15000	15000	35000
2.5"-JGD	Water	9.58	0	N/A	15000	15000	35000
3/4-HCD Vent	Water	1.36	0	N/A	15000	15000	35000
Reference		10,9	13	13	1	1	1

Notes:

1. For details see system operational modes Section 6.5.
2. S_h and S_y is based on maximum operating temperature of 115° F.
3. Design Pressure of 150 psi is considered for the entire problem and is conservative.
4. Design Pressure is considered as Maximum Operating Pressure and is conservative.
5. Design Temperature is based on the Maximum of Design or Operating Temperature as noted in Section 3.6 of Revision 3 of this calculation.

6.0 **Design Input (Continued)**

6.1 **Basic Analytical Data (continued)**

TABLE 6.1.2
(Replaced Pipe)

Line Designation	Pipe class	Material Replaced Pipe	E_{cold} (psi) x 10^6	Design Pressure (psi)	Design Temp. (°F)	Max. Operating Pressure (psi)	Max. Operating Temp. (°F)	Co-Eff. of Expansion in/ft	Outside Diameter (in)	Wall Thickness (in)
24"-JGD-1	JGD	B675UNSN08367	28.3	150	100	150	Note 1	Note 1	24	0.375
24"-JGD-3	JGD	B675UNSN08367	28.3	150	100	150	Note 1	Note 1	24	0.375
10"-JGD-4	JGD	B675UNSN08367	28.3	150	100	150	Note 1	Note 1	10.75	0.365
8"-JGD-4	JGD	B675UNSN08367	28.3	150	115	150	Note 1	Note 1	8.625	0.322
8"-JGD-7	JGD	B675UNSN08367	28.3	150	115	150	Note 1	Note 1	8.625	0.322
6"-JGD-4	JGD	B675UNSN08367	28.3	150	115	150	Note 1	Note 1	6.625	0.28
6"-JGD-7	JGD	B675UNSN08367	28.3	150	115	150	Note 1	Note 1	6.625	0.28
1.5"-HCD-91(Branch)	HCD	B675UNSN08367	28.3	150	115	150	Note 1	Note 1	1.9	0.145
Reference	13	11, 13	18	See Note 3	See Note 5	See Note 4			10,9	10,9

Line Designation	Contents	Wt. Total lbs/ft	Insulation Thick (in)	Insulation Type	Sc (psi)	Sh (psi)	Sy (psi)
24"-JGD-1	Water	290.81	1.5	I	20200	20200	47000
24"-JGD-3	Water	290.81	1.5	I	20200	20200	47000
10"-JGD-4	Water	80.20	1.5	I	20200	20200	47000
8"-JGD-4	Water	54.69	1.5	I	20200	20200	47000
8"-JGD-7	Water	54.69	1.5	I	20200	20200	47000
6"-JGD-4	Water	31.86	0	N/A	20200	20200	47000
6"-JGD-7	Water	31.86	0	N/A	20200	20200	47000
1.5"-HCD-91(Branch)	Water	3.653	0	N/A	20200	20200	47000
Reference		10,9	13	13	18	18	18

Notes:

1. For details see system operational modes Section 6.5.

2. S_h is based on maximum operating temperature of 115° F.
   S_y is based on temperature of 200° F to be conservative.

3. Design Pressure of 150 psi is considered for the entire problem and is conservative.

4. Design Pressure is considered as Maximum Operating Pressure and is conservative.

5. Design Temperature is based on the Maximum of Design or Operating Temperature as noted in Section 3.6 of Revision 3 of this calculation.

6.0 Design Input (Continued)

6.2 Piping Data

Ref. No.	X SECTION CARD No. 1, 2, 9			
13a,b	LINE NUMBER:	24"-JGD-1, 24"-JGD-3	CODE CLASS:	3
13a,b	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13a,b	SCHEDULE:	40	CONTENTS:	Water
13a,b	PIPING MATERIAL:	A53 Gr. B		
10	OUTSIDE DIAMETER:	24.0 In	WALL THICKNESS:	0.687 In
13a,b	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	I
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
I	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	171.16 LB/FT	CONTENTS WEIGHT:	174.10 LB/FT
10	INSULATION WEIGHT:**	10.21 LB/FT		
	TOTAL PIPE WEIGHT:	355.47 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			
	Xsection 2 includes only Contents and Insulation weights.			
	Xsection 9 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.			

Ref. No.	X SECTION CARD No. 3, 4, 10			
13b-f	LINE NUMBER:	10"-JGD-4	CODE CLASS:	3
13b-f	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13b-f	SCHEDULE:	40	CONTENTS:	Water
13b-f	PIPING MATERIAL:	A53 Gr. B		
10	OUTSIDE DIAMETER:	10.75 In	WALL THICKNESS:	0.365 In
13b-f	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	I
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
I	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	40.11 LB/FT	CONTENTS WEIGHT:	34.10 LB/FT
10	INSULATION WEIGHT:**	4.81 LB/FT		
	TOTAL PIPE WEIGHT:	79.02 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			
	Xsection 4 includes only Contents and Insulation weights.			
	Xsection 10 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.			

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT
- d = Insulation Density (LBS /Cubic Foot)
- D = Outside Diameter of Pipe (IN)
- K = Insulation Thickness (IN)
- t = Pipe Wall Thickness (IN)
- Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref.	X SECTION CARD No. 5, 6, 11 and 20	
No.	(Xsection 20 is used for 8"-JGD-7 on Iso.s 1028, 1029 and is not insulated)	
13e,g,h	LINE NUMBER: 8"-JGD-4; 8"-JGD-7	CODE CLASS: 3
13e,g,h	LINE CLASS: JGD	DESIGN PRESSURE: 150 PSI
13e,g,h	SCHEDULE: 40	CONTENTS: Water
13e,g,h	PIPING MATERIAL: A53 Gr. B	
10	OUTSIDE DIAMETER: 8.625 In	WALL THICKNESS: 0.322 In
13e,g,h	INSULATION THICKNESS: 1.5 In.	INSULATION TYPE: I
	INSULATION DENSITY ***: 12 LB/ CUBIC FT	INSULATION MATERIAL: Calcium Silicate
1	'P' NUMBER (WELDING REF. No.): 1	E COLD: 27.9 x E 06 PSI
10	PIPE WEIGHT:* 28.19 LB/FT	CONTENTS WEIGHT: 21.69 LB/FT
10	INSULATION WEIGHT:** 3.97 LB/FT	
	TOTAL PIPE WEIGHT: 53.85 LB/FT	
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.	
	Xsection 6 includes only Contents and Insulation weights.	
	Xsection 11 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.	
	Xsection 20 includes Pipe weight and Contents weight of 50.24 Lbs/ft instead of 49.88 Lbs/ft and is conservative.	
Ref.	X SECTION CARD No. 7, 8, 12	
No.		
13g,h,i	LINE NUMBER: 6"-JGD-4, 6"-JGD-7; 6"-JBD-26	CODE CLASS: 3
13g,h,i	LINE CLASS: JGD ; JBD	DESIGN PRESSURE: 150 PSI
13g,h,i	SCHEDULE: 40	CONTENTS: Water
13g,h,i	PIPING MATERIAL: A53 Gr. B; A106 Gr. B	
10	OUTSIDE DIAMETER: 6.625 In	WALL THICKNESS: 0.280 In
13g,h,i	INSULATION THICKNESS: N/A In.	INSULATION TYPE: N/A
	INSULATION DENSITY ***: N/A	INSULATION MATERIAL: N/A
1	'P' NUMBER (WELDING REF. No.): 1	E COLD: 27.9 x E 06 PSI
10	PIPE WEIGHT:* 18.97 LB/FT	CONTENTS WEIGHT: 12.51 LB/FT
	INSULATION WEIGHT:** N/A	
	TOTAL PIPE WEIGHT: 31.48 LB/FT	
	.	
Note:	Xsection 8 includes only Contents weight.	
	Xsection 12 for Valve Operator considers Design Pressure and Total Pipe Weight as Zero.	

Ref. 10

* 10.68t (D-t) For Carbon Steel

10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367

$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT

d = Insulation Density (LBS /Cubic Foot)

D = Outside Diameter of Pipe (IN)

K = Insulation Thickness (IN)

t = Pipe Wall Thickness (IN)

Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 13, 14 (For Replaced Spool Piece Piping)			
13a,b	LINE NUMBER:	24"-JGD-1, 24"-JGD-3	CODE CLASS:	3
13a,b	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13a,b	SCHEDULE:	20	CONTENTS:	Water
13a,b	PIPING MATERIAL:	B-675, UNS NO8367		
10	OUTSIDE DIAMETER:	24.0 In	WALL THICKNESS:	0.375 In
13a,b	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	I
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
1	'P' NUMBER (WELDING REF. No.):	8	E COLD:	28.3 x E 06 PSI
10	PIPE WEIGHT:*	97.00 LB/FT	CONTENTS WEIGHT:	183.80 LB/FT
10	INSULATION WEIGHT:**	10.01 LB/FT		
	TOTAL PIPE WEIGHT:	290.81 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			
	Xsection 14 includes only Contents and Insulation weights.			

Ref. No.	X SECTION CARD No. 15, 16 (For Replaced Spool Piece Piping)			
13b-f	LINE NUMBER:	10"-JGD-4	CODE CLASS:	3
13b-f	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13b-f	SCHEDULE:	40	CONTENTS:	Water
13b-f	PIPING MATERIAL:	B-675, UNS NO8367		
10	OUTSIDE DIAMETER:	10.75 In	WALL THICKNESS:	0.365 In
13b-f	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	I
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
1	'P' NUMBER (WELDING REF. No.):	8	E COLD:	28.3 x E 06 PSI
10	PIPE WEIGHT:*	41.30 LB/FT	CONTENTS WEIGHT:	34.10 LB/FT
10	INSULATION WEIGHT:**	4.80 LB/FT		
	TOTAL PIPE WEIGHT:	80.20 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			
	Xsection 16 includes only Contents and Insulation weights and is not used in the calculation.			

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT
- d = Insulation Density (LBS /Cubic Foot)
- D = Outside Diameter of Pipe (IN)
- K = Insulation Thickness (IN)
- t = Pipe Wall Thickness (IN)
- Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 17, 18 (For Replaced Spool Piece Piping)			
13e,g,h	LINE NUMBER:	8"-JGD-4, 8"-JGD-7	CODE CLASS:	3
13e,g,h	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13e,g,h	SCHEDULE:	40	CONTENTS:	Water
13e,g,h	PIPING MATERIAL:	B-675, UNS NO8367		
10	OUTSIDE DIAMETER:	8.625 In	WALL THICKNESS:	0.322 In
13e,g,h	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	1
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
1	'P' NUMBER (WELDING REF. No.):	8	E COLD:	28.3 x E 06 PSI
10	PIPE WEIGHT:*	29.03 LB/FT	CONTENTS WEIGHT:	21.69 LB/FT
10	INSULATION WEIGHT:**	3.97 LB/FT		
	TOTAL PIPE WEIGHT:	54.69 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			
	Xsection 18 includes only Contents and Insulation weights and is not used in the calculation.			

Ref. No.	X SECTION CARD No. 19 (For Replaced Spool Piece Piping)			
13g,h	LINE NUMBER:	6"-JGD-4, 6"-JGD-7	CODE CLASS:	3
13g,h	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13g,h	SCHEDULE:	40	CONTENTS:	Water
13g,h	PIPING MATERIAL:	B-675, UNS NO8367		
10	OUTSIDE DIAMETER:	6.625 In	WALL THICKNESS:	0.280 In
13g,h	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	8	E COLD:	28.3 x E 06 PSI
	PIPE WEIGHT:*	19.35 LB/FT	CONTENTS WEIGHT:	12.51 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	31.86 LB/FT		

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT

d = Insulation Density (LBS /Cubic Foot)
D = Outside Diameter of Pipe (IN)
K = Insulation Thickness (IN)
t = Pipe Wall Thickness (IN)
Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 21, 22			
13i	LINE NUMBER:	3/4 Inch Vent and Drain Lines	CODE CLASS:	3
13i	LINE CLASS:	JBD	DESIGN PRESSURE:	150 PSI
13i	SCHEDULE:	80	CONTENTS:	Water
13i	PIPING MATERIAL:	A106 Gr. B		
9	OUTSIDE DIAMETER:	1.050 In	WALL THICKNESS:	0.154 In
13i	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY :	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
9	PIPE WEIGHT:*	1.474 LB/FT	CONTENTS WEIGHT:	0.188 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	1.662 LB/FT		
Note:	Xsection 22 includes only Contents weight.			

Ref. No.	X SECTION CARD No. 23,24			
13i	LINE NUMBER:	1 Inch Drain Line	CODE CLASS:	3
13i	LINE CLASS:	JBD	DESIGN PRESSURE:	150 PSI
13i	SCHEDULE:	80	CONTENTS:	Water
13i	PIPING MATERIAL:	A106 Gr. B		
10	OUTSIDE DIAMETER:	1.315 In	WALL THICKNESS:	0.179 In
13i	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	2.172 LB/FT	CONTENTS WEIGHT:	0.311 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	2.483 LB/FT		
Note:				
	Xsection 24 includes only Contents weight.			

Ref. 10

* 10.68t (D-t) — For Carbon Steel
10.89t (D-t) — For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ — Weight of Water per foot (LB)
** Insulation weight = 0.0218 d K (D+K) LB / FT
d = Insulation Density (LBS /Cubic Foot)
D = Outside Diameter of Pipe (IN)
K = Insulation Thickness (IN)
t = Pipe Wall Thickness (IN)
Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 25,26			
13g,h	LINE NUMBER:	1.5"-HCD-91	CODE CLASS:	3
13g,h	LINE CLASS:	HCD	DESIGN PRESSURE:	150 PSI
13g,h	SCHEDULE:	80	CONTENTS:	Water
13g,h	PIPING MATERIAL:	A53 Gr. B		
10	OUTSIDE DIAMETER:	1.900 In	WALL THICKNESS:	0.200 In
13g,h	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	3.631 LB/FT	CONTENTS WEIGHT:	0.765 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	4.396 LB/FT		
Note:	Xsection 26 includes only Contents weight.			

Ref. No.	X SECTION CARD No. 27			
13g,h	LINE NUMBER:	1.5"-HCD-91 (Between nodes 9455 - 9460)	CODE CLASS:	3
13g,h	LINE CLASS:	HCD	DESIGN PRESSURE:	150 PSI
13g,h	SCHEDULE:	40	CONTENTS:	Water
13g,h	PIPING MATERIAL:	B-675, UNS NO8367		
10	OUTSIDE DIAMETER:	1.900 In	WALL THICKNESS:	0.145 In
13g,h	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	8	E COLD:	28.3 x E 06 PSI
10	PIPE WEIGHT:*	2.771 LB/FT	CONTENTS WEIGHT:	0.882 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	3.653 LB/FT		

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT

- d = Insulation Density (LBS /Cubic Foot)
- D = Outside Diameter of Pipe (IN)
- K = Insulation Thickness (IN)
- t = Pipe Wall Thickness (IN)
- Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 28 (Connects to 3/4 HCD Vent Line to the Valves 2-SW-100A, B)			
13e	LINE NUMBER:	2.5 Inch-JGD Line	CODE CLASS:	3
13e	LINE CLASS:	JGD	DESIGN PRESSURE:	150 PSI
13e	SCHEDULE:	40	CONTENTS:	Water
13e	PIPING MATERIAL:	A53 Gr. B		
10	OUTSIDE DIAMETER:	2.875 In	WALL THICKNESS:	0.203 In
13e	INSULATION THICKNESS:	1.5 In.	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	12 LB/ CUBIC FT	INSULATION MATERIAL:	Calcium Silicate
1	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	5.79 LB/FT	CONTENTS WEIGHT:	2.07 LB/FT
10	INSULATION WEIGHT:**	1.72 LB/FT		
	TOTAL PIPE WEIGHT:	9.58 LB/FT		
Note:	***Insulation Density is taken from Section 3.6 of Revision 3 of this calculation.			

Ref. No.	X SECTION CARD No. 29 (3/4 HCD Vent Line to the Valves 2-SW-100A, B)			
13e	LINE NUMBER:	3/4 Inch	CODE CLASS:	3
13e	LINE CLASS:	HCD	DESIGN PRESSURE:	150 PSI
13e	SCHEDULE:	40	CONTENTS:	Water
13e	PIPING MATERIAL:	A53 Gr. B		
10	OUTSIDE DIAMETER:	1.050 In	WALL THICKNESS:	0.113 In
13e	INSULATION THICKNESS:	N/A	INSULATION TYPE:	N/A
	INSULATION DENSITY ***:	N/A	INSULATION MATERIAL:	N/A
1	'P' NUMBER (WELDING REF. No.):	1	E COLD:	27.9 x E 06 PSI
10	PIPE WEIGHT:*	1.13 LB/FT	CONTENTS WEIGHT:	0.230 LB/FT
	INSULATION WEIGHT:**	N/A		
	TOTAL PIPE WEIGHT:	1.360 LB/FT		

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT
d = Insulation Density (LBS /Cubic Foot)
D = Outside Diameter of Pipe (IN)
K = Insulation Thickness (IN)
t = Pipe Wall Thickness (IN)
Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.2 Piping Data (cont.)

Ref. No.	X SECTION CARD No. 30 (Trunnions are used for Anchor Model (Mark No. 60542) at Node 7050)	
13i	LINE NUMBER: 3 inch Trunnion	CODE CLASS: 3
	LINE CLASS:	DESIGN PRESSURE: 0 PSI
10	SCHEDULE: 40	CONTENTS: Water
10	PIPING MATERIAL: A53 Gr. B	
10	OUTSIDE DIAMETER: 3.500 In	WALL THICKNESS: 0.216 In
	INSULATION THICKNESS: N/A	INSULATION TYPE: N/A
	INSULATION DENSITY ***: N/A	INSULATION MATERIAL: N/A
1	'P' NUMBER (WELDING REF. No.): 1	E COLD: 27.9 x E 06 PSI
10	PIPE WEIGHT:* 7.58 LB/FT	CONTENTS WEIGHT: N/A
	INSULATION WEIGHT:** N/A	
	TOTAL PIPE WEIGHT: 7.58 LB/FT	

Ref. No.	X SECTION CARD No. N/A	
	LINE NUMBER:	CODE CLASS:
	LINE CLASS:	DESIGN PRESSURE: PSI
	SCHEDULE:	CONTENTS:
	PIPING MATERIAL:	
	OUTSIDE DIAMETER: In	WALL THICKNESS: In
	INSULATION THICKNESS: In.	INSULATION TYPE:
	INSULATION DENSITY ***: LB/ CUBIC FT	INSULATION MATERIAL:
	'P' NUMBER (WELDING REF. No.):	E COLD: PSI
	PIPE WEIGHT:* LB/FT	CONTENTS WEIGHT: LB/FT
	INSULATION WEIGHT:** LB/FT	
	TOTAL PIPE WEIGHT: LB/FT	

Ref. 10

* 10.68t (D-t) For Carbon Steel
10.89t (D-t) For Austenitic Stainless Steel B-675 UNS NO8367
$0.3405(Di)^2$ Weight of Water per foot (LB)

** Insulation weight = 0.0218 d K (D+K) LB / FT

- d = Insulation Density (LBS /Cubic Foot)
- D = Outside Diameter of Pipe (IN)
- K = Insulation Thickness (IN)
- t = Pipe Wall Thickness (IN)
- Di = Inside Diameter of Pipe (IN)

6.0 Design Input (Continued)

6.3 Valve Data

TABLE 6.3.1 (Valve Data)

Size (in.)	Type	Node No.	C.G. Location (ft.)			Total Weight (Lbs.)	Ref.
			X	Y	Z		
24	2-SW-8A	22	3.15			925	13.a
	2-SW-3.1A	92		-2.64		975	13.a
	2-SW-7B	166			3.15	925	13.a
	2-SW-7A	192			3.15 (2)	925	13.a
	2-SW-3.1B	226		-2.64		975	13.a
	2-SW-8B	312	3.15			925	13.a
	2-SW-8C	352	3.15			925	13.a
8	2-SW-12A	1206	0.252		-0.173	292(3)	13.e
	2-SW-12B	1282			0.31	292(3)	13.e
	2-SW-12C	1316	0.31			292(3)	13.e
	2-SW-12D	1366			-0.31	292(3)	13.e
8	2-SW-231B	1576	-0.15	0.16	-1.07	347(4)	13.g
8	2-SW-231A	2022	-0.15	0.16	-1.07	347(4)	13.h
6	2-SW-89B	1736	0.97	-0.19	-0.26	135(5)	13.g
6	2-SW-89A	2162	0.97	-0.19	-0.26	135(5)	13.h
6	2-SW-297	7006				124(6)	13.i
6	2-SW-296	7026				124(6)	13.i
3/4	2-FIRE-560	9008				2(7)	13.i
1	2-FIRE-559	9108				3(7)	13.i
3/4	2-FIRE-259	9208				2(7)	13.i
1-1/2	2-SW-241	9430				12(8)	13.h
1-1/2	2-SW-242	9330				12(8)	13.g
3/4	2-SW-100B	9515				2(9)	13.e
3/4	2-SW-100A	9615				2(9)	13.e

Notes:

1. C.G. locations are taken from Section 3.4 (sheet 14) of Revision 3 of this calculation and weights from the piping iso's or from the applicable Revision 3 Calculation Change Notices (CCN).
2. C.G. direction coded in NUPIPE-SWPC as +Y direction. Seismic results (Eq. 9) being low, the results of this analysis should be still acceptable.
3. Valve weight is revised from 80 lbs to 292 lbs per CCN 15 to Rev. 3 of this calculation.
4. C.G. location and valve weight revised per CCN 17 to Rev. 3 of this calculation.
5. Actuator wt. of 16 lbs is added to the existing valve wt. of 119 lbs per CCN 13 to Rev. 3 of this calculation.
6. Valve Wt. is from Attachment B of CCN 8 to Rev. 3 of this calculation.
7. Valve Wt's are taken from sheet 10 of CCN 10 to Rev. 3 of this calculation.
8. Valve Wt. is considered as 12 lbs (9.5 Lbs from page 76 of Walworth Catalog (Ref. 15)).
9. Valve Wt. is considered same as sheet 10 of CCN 10 to Rev. 3 of this calculation.

6.0 **DESIGN INPUT: (continued)**

6.4 **Flange Weight Data**

TABLE 6.4.1 (Flange Weight Data)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
24	15			268	268	16
	25	113			113	8
	35	113	204		317	8,16
	70		2(204)		408	16
8	76				96 (1)	16
24	77		2 (204)		408	16
	85		204		204	16
	95		204		204	16
	105	2(113)			226	8
	115		204	268	472	16
	145			268	268	16
	162		204		204	16
	170			268	268	16
	182	113	204		317	8,16
8	183				96 (1)	16
24	185		204		204	16
	195			268	268	16
	210		204	268	472	16
	222		204		204	16
	230		204		204	16
	242		2(204)		408	16
	250		204	268	472	16
	280		204		204	16
	295	2(113)			226	8
	308	113			113	8
	315			268	268	16
	325	113			113	8
	340		2(204)		408	16
	348		204		204	16
	355			268	268	16
	370		204		204	16

Note:

1. Wt. of 2 Blind Flanges from Ladish Catalog (Ref.16).

6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data (continued)

TABLE 6.4.1 (Flange Weight Data) (continued)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
10	380		2(40)		80	16
	403		2(40)		80	16
	430	26	40		66	8,16
	445	2(26)			52	8
	460	2(26)			52	8
	485	2(26)			52	8
	490	26	40		66	8,16
	512	26	40		66	8,16
	525	2(26)			52	8
	550	2(26)			52	8
	580	26	40		66	8,16
	595		2(40)		80	16
	610		2(40)		80	16
	630		2(40)		80	16
	640		2(40)		80	16
	645		2(40)		80	16
	660		2(40)		80	16
	665		2(40)		80	16
	670		2(40)		80	16
	685		2(40)		80	16
	690		2(40)		80	16
	705		2(40)		80	16
	710		2(40)		80	16
	715		2(40)		80	16
	730		2(40)		80	16
	735		2(40)		80	16
	750		2(40)		80	16
	765		2(40)		80	16
	785	26	40		66	8,16
	800	26	40		66	8,16
	835	26	40		66	8,16
	855	2(26)			52	8
	870	2(26)			52	8
	893	2(26)			52	8
	895	2(26)			52	8
	920	2(26)			52	8

6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data (continued)

TABLE 6.4.1 (Flange Weight Data) (continued)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
10	930	2(26)			52	8
	950	2(26)			52	8
	980	2(26)			52	8
	995	2(26)			52	8
	1015	26	40		66	8,16
	1035		2(40)		80	16
	1050		2(40)		80	16
	1060		2(40)		80	16
	1065		2(40)		80	16
	1080		2(40)		80	16
	1085		2(40)		80	16
	1100		2(40)		80	16
	1105		2(40)		80	16
	1110		2(40)		80	16
	1125		2(40)		80	16
	1130		2(40)		80	16
	1145		2(40)		80	16
	1150		2(40)		80	16
	1155		40	54	94	16
8	1190		2(28))		56	16
	1195		2(28)		56	16
	1202		28		28	16
	1210		28		28	16
	1220		2(28)		56	16
	1265		2(28)		56	16
	1267		2(28)		56	16
	1275		28		28	16
	1284		28		28	16
	1290		28	42	70	16
	1300		28	42	70	16
	1302		2(28)		56	16
	1310		28		28	16
	1318		28		28	16
	1325		2(28)		56	16

6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data (continued)

TABLE 6.4.1 (Flange Weight Data) (continued)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
8	1355		28	42	70	16
	1357		2(28)		56	16
	1362		28		28	16
	1370		28		28	16
	1380		28	42	70	16
	1390	18		42	60	8,16
	1410	2(18)			36	8
	1430	2(18)			36	8
	1440	2(18)			36	8
	1455	2(18)			36	8
	1465	2(18)			36	8
	1485	2(18)			36	8
	1500	2(18)			36	8
	1510	2(18)			36	8
	1515	2(18)			36	8
	1525	18	28		46	8,16
	1540		28	42	70	16
	1570			42	42	16
	1580		28		28	16
	1585		2(28))		56	16
	1587		28	42	70	16
	1625			2(42)	84	16
	1655		28		28	16
	1660		28	42	70	16
	1675			2(42)	84	16
	1695		2(28)		56	16
	1700		2(28)		56	16
6	1715		17	26	43	16
	1732			26	26	16
	1760		17	26	43	16
	1775		17	26	43	16
	1790		17	26	43	16
	1800		17	26	43	16
	1835		17	26	43	16
	1845		2(17)		34	16
	1860		17		17	16

Notes:

1. Wt. of FE-6397 (8 inch pipe size) is considered 20 Lbs at node 1537.
2. Wt. of TI-6392 (8 inch pipe size) is considered 20 Lbs at node 1650.

6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data (continued)

TABLE 6.4.1 (Flange Weight Data) (continued)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
6	1870		17	26	43	16
	1885		17		17	16
8	1895	18	28		46	8,16
	1915	2(18)			36	8
	1935	2(18)			36	8
	1945	2(18)			36	8
	1955	2(18)			36	8
	1960	2(18)			36	8
	1970	18	28		46	8,16
	1985		28	42	70	16
	2015	18		42	60	8,16
	2018	18			18	8
	2025	18			18	8
	2030		28	42	70	16
	2060		28	42	70	16
	2090		28		28	16
	2095	2(18)			63(1)	8
	2115		2(28)		56	16
	2120		2(28)		56	16
6	2135		17	26	43	16
	2140		17	26	43	16
	2155		17		17	16
	2165		17		17	16
	2185		17	26	43	16
	2200		17	26	43	16
	2215		17	26	43	16
	2235		17	26	43	16
	2260		17	26	43	16
	2272		2(17)		34	16
	2285		17		17	16
	2295		17	26	43	16
	2310		17		17(2)	16
	7004			26	26	16
	7010			26	26	16
	7024			26	26	16
	7028			26	26	16

Notes:

1. Wt. of 1" inserted plate of 27 lbs is included for a total wt. of 63 lbs. (See Attachment B of CCN 8 to Rev. 3 of this calculation).
2. Wt. of 17 Lbs. is coded at node 2285. Effect is insignificant and therefore acceptable.

6.0 DESIGN INPUT: (continued)

6.4 Flange Weight Data (continued)

TABLE 6.4.1 (Flange Weight Data) (continued)

Pipe size (in.)	Node No.	125 Lb. Slip on Flange (Lbs.)	150 Lb Slip on Flange (Lbs.)	150 Lb. WeldNeck Flange (Lbs.)	Total Flange Wt. (Lbs.)	Ref.
6	7100			2(26)	52	16
1.5	9310				12 (1)	9
	9330				12 (1)	9
	9355				12 (1)	9
	9410				12 (1)	9
	9430				12 (1)	9
	9455				12 (1)	9
2.5	9505			2(7.5)	15	9
	9605			2(7.5)	15	9
3/4	9003				0.31 (4)	9

Notes:

1. Wt. of 300# Socket weld flanges (6 Lbs each) from Crane Catalog (Ref. 9) is used.
2. Wt. of FE-6389 (8 inch pipe size) is considered 20 Lbs at node 1983.
3. Wt. of TI-6387 (8 inch pipe size) is considered 20 Lbs at node 2065.
4. Wt. of 3000# Socketweld coupling is considered.

6.0 **Design Input (Continued)**

6.5 **Thermal Operating Conditions**

Table 6.5.1 Thermal Operating Conditions (Mode, NOP & Temp.)

Condition	Mode No.	NOP No. (1)	Temp. (°F)	Coefft. of Expansion (Inch/Ft)	Operating Pressure (psi)
Thermal Mode 1 – All piping at 33°F (Normal, Upset, Faulted)					
CarbonSteel Pipe	1	1	33	-0.00259	150
Aust.Steel Pipe		2	33	-0.00382	150
Aust.Steel Pipe		3	33	-0.00382	150
Fire Protection Pipe		4	70	0.0	150
Ambient-SS Pipe		5	70	0.0	150
Ambient-CS Pipe		6	70	0.0	150
CarbonSteel Pipe		7	33	-0.00259	150
Trunnion		8	70	0.0	0.0
Thermal Mode 2 – All piping at 80°F/ 115°F (Normal, Upset, Faulted)					
CarbonSteel Pipe	2	1	80	0.00077	150
Aust.Steel Pipe		2	80	0.00113	150
Aust.Steel Pipe		3	80	0.00113	150
FireProtection Pipe		4	70	0.0	150
Aust.Steel Pipe		5	115 (3)	0.00508	150
CarbonSteel Pipe		6	115 (3)	0.00344	150
CarbonSteel Pipe		7	115 (3)	0.00344	150
Trunnion		8	70	0.0	0.0

NOTES:

1. NOP = Number representing operating parameters of pipe section as noted in the next page.
2. αT = Thermal Coefficient of expansion (in/ft) based on operating temperature and pipe material Carbon Steel (A53 Gr. B), Aust. Steel (AL-6XN).
3. 115°F is considered based on sheets 18 and 19 of Revision 3 of this calculation.

6.0 **Design Input (Continued)**

6.5 **Thermal Operating Conditions (continued)**

PIPE SECTIONS FOR NOP No's:

NOP 1 = From 5 to 35, From 85 to 95, From 162 to 195, From 222 to 230, From 180 to 325, From 348 to 355, From 430 to 490, From 512 to 580, From 835 to 1010, From 1202 to 1210, From 1275 to 1284, From 1310 to 1318, From 1362 to 1370, From 1390 to 1525, From 1545 to 1615, From 1560 to 1775, From 1895 to 1970, From 2018 to 2050, From 2005 to 2165, From 7000 to 7008, From 7024 to 8000, From 1730 – 9300 to 1745, From 2153-9400 to 9455, From 1441 to 9525 and From 1942 to 9625.

NOP 2 = From 35 to 85, From 95 to 145, From 50 to 162, From 195 to 222, From 230 to 280, From 205 to 348, From 355 to 370, From 125 to 430, From 490 to 512, From 580 to 775, From 260 to 835, From 1010 to 1202, From 1210 to 1275, From 1284 to 1310, From 1318 to 1345, From 775 to 1362, From 1370 to 1390, From 1525 to 1545, From 1775 to 1785, From 1825 to 1870, From 1240 to 1895, From 1970 to 2018, From 2165 to 2210, From 2250 to 2285 and From 9455 to 2170.

NOP 3 = From 1785 to 1825, From 2210 to 2250.

NOP 4 = From 7008 to 7024, From 7012 to 7050, From 7050 to 7066, From 7032 to 9015, From 7051 to 9115 and From 7063 to 9215.

NOP 5 = From 1870 to 1885.

NOP 6 = From 2295 to 2310.

NOP 7 = From 1615 to 1705, From 1615 to 1870, From 2050 to 2125 and From 2050 to 2295.

NOP 8 = From 7050 to 9765.

NOTE:

1. For Node No's, refer to the work sketch (Section 6.11).

6.0 Design Input (Continued)

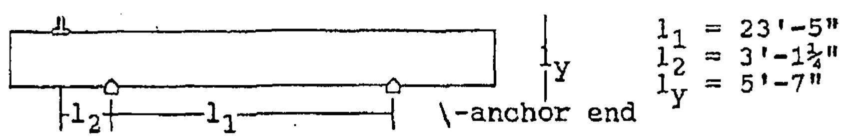
6.6 Thermal Anchor Displacements

RBCCW Heat Exchanger X-18A,B,C Movements:

The Heat Exchanger X-18A,B,C movements at nodes 5, 325, 370 are recalculated using the same procedure as shown on page 15 of Revision 3 of this calculation.

The Design Temperature is considered as 110°F and the direction of d_z movement is changed based on Section 4 of CCN 02 of Revision 3 of this calculation.

B = Thermal Expansion = 1.46" per 100 ft.at 200°F.
T = Temperature Range = (200°F - 70°F) = 130°F
dTemp = Design Temperature Range = (110°F - 70°F) = 40°F



$d_X = 0.0"$

$d_Y = (1.46"/130°F)*(40°F)*(5.583'/100') = 0.025"$

$d_Z = (1.46"/130°F)*(40°F)*((-)26.5208'/100') = (-)0.119"$

Stiffness Used at the Heat Exchanger X-18A, B, C (Nodes 5, 325, 370)

Translational Stiffness = 1.0E07 Lbs/Inch.
Rotational Stiffness = 1.0E09 In-Lb/Radian.

6.0 Design Input (Continued)

6.7 Response Spectra (Reference 14)

The Response Spectra of Auxiliary Building at Elev. 14'-6", 0.5% Damping (OBE) which is used for X and Z directions and Vertical Accelerations are 2/3 of the ground acceleration (i.e. 2/3 of 0.09gs) or 0.06gs for OBE and 0.113gs for DBE. Acceleration used in Revision 3 of this calculation (See Attachment D) is input as Period (T) and Acceleration (g) and is shown below.

TABLE 6.7-1 (Horizontal Accelerations)

HORIZONTAL ACCELEARTIONS (X AND Z DIRECTIONS)					
T (Seconds)	A (g)	T(Seconds)	A (g)	T (Seconds)	A (g)
0.02	0.23	0.038	0.23	0.054	0.46
0.089	0.497	0.109	0.914	0.111	0.96
0.116	5.507	0.119	7.86	0.147	7.86
0.156	4.883	0.161	3.562	0.172	1.857
0.179	1.445	0.238	0.757	0.250	0.686
0.333	0.64	0.714	0.368	0.833	0.326
1.00	0.28	2.000	0.17		

TABLE 6.7-2 (Vertical Accelerations)

VERTICAL ACCELEARTIONS (Y DIRECTION)					
T (Seconds)	A (g)	T(Seconds)	A (g)	T (Seconds)	A (g)
0.010	0.067	0.050	0.167	0.067	0.187
0.100	0.214	0.125	0.226	0.167	0.24
0.333	0.233	0.500	0.2	0.667	0.166
1.000	0.132	1.250	0.08	1.667	0.06
2.000	0.047	2.500	0.05		

Note:

1. T is for Period (Seconds) and g is for Spectral Acceleration (g's).

6.0 Design Input (Continued)

6.8 Seismic Anchor Movements (Reference 14)

The information extracted from Section 3.3 of Revision No. 3 of this calculation is shown below.

WAREHOUSE	X		Z	
EL. 14'6"	0.002' (0.024")		0.002' (0.024")	
EL. 38'6"	0.003' (0.036")		0.004' (0.048")	
AUXILIARY BLDG	**X**		**Z**	
EL. -25'6"	0.0		0.0	
EL. -5'0"	0.0014' OBE	(0.0168")	0.0021' OBE	(0.0252")
	0.0019' DBE	(0.0228")	0.0028' DBE	(0.0336")
EL. 14'6"	0.0026' OBE	(0.0312")	0.0030' OBE	(0.036")
	0.0035' DBE	(0.042")	0.0042' DBE	(0.0504")
EL. 25'6"	0.0031' OBE	(0.0372")	0.0036' OBE	(0.0432")
	0.0042' DBE	(0.0504")	0.0050' DBE	(0.060")
EL. 38'6"	0.0036' OBE	(0.0432")	0.0041' OBE	(0.0492")
	0.0049' DBE	(0.0588")	0.0056' DBE	(0.0672")

THE MAXIMUM RELATIVE DISPLACEMENT BETWEEN BUILDINGS IS IN THE Z DIRECTION AT ELEVATION 38'-6" AND IS CALCULATED AS:

DELTA Z = (DELTA Z OF WAREHOUSE) + (DELTA Z OF AUX BUILDING)

= 0.048"+ 0.0672"

= 0.1152"

THIS VALUE IS LESS THAN 0.125" AND IS CONSIDERED NEGLIGIBLE. IT IS ALSO CONSERVATIVE AS THE PIPING IS ROUTED FROM THE AUX BUILDING TO THE WAREHOUSE BELOW THE 14'-6" ELEVATION. THEREFORE A SAM ANALYSIS WAS NOT PERFORMED.

6.0 Design Input (Continued)

6.9 Pipe Support Data

Table 6.9-1 (Pipe Support Data)

Support Mark No.	Node No.	Support Type	Support Stiffness (Reference 4) Translational (Lbs/inch)	Rotational (In-Lbs/Rad)
H1-427074	40	NS	1.0E06	
H2-327002	75	VC	1.0E06	
H3-427113	80	VC,EW	1.0E06	
H4-427063	95	NS	1.0E06	
Anchor 527027	145	ANCHOR	1.0E09	1.0E11
H5-327098	155	VC	1.0E06	
H5A-427075	160	EW SNUBBER	1.0E06	
H6-427115	215	EW SNUBBER	1.0E06	
H7-427114	220	VC	1.0E06	
Anchor 527028	280	ANCHOR	1.0E09	1.0E11
427079	290	NS	1.0E06	
427076	335	NS	1.0E06	
H10-427064	405	EW	1.0E06	
H11-327012	410	VC	1.0E06	
H12-427080	425	NS	1.0E06	
H13-327013	450	VC	1.0E06	
H14-427082	455	EW	1.0E06	
H15-427085	475	NS,VC	1.0E06	
H15A-427068	515	NS	1.0E06	
H23-380352	520	VC	1.0E06	
H24-427026	535	VC	1.0E06	
H25-327135	570	NS,EW	1.0E06	
427089	580	VC	1.0E06	
427073	610	EW	1.0E06	
427087	615	VC	1.0E06	
427055	635	VC	1.0E06	
327138	650	VC, EW	1.0E06	
427092	675	VC, EW	1.0E06	
427094	685	NS	1.0E06	
327147	695	VC,EW	1.0E06	
327149	720	VC,EW	1.0E06	
79-14-022	805	NS,VC	1.0E06	
H17-427080	825	NS,EW	1.0E06	
SK-ALW-102579	860	VC	1.0E06	
H20-427083	865	EW	1.0E06	
H21-427084	885	NS,VC	1.0E06	
427069	920	NS	1.0E06	
H32A-427030	925	VC	1.0E06	
H33-427031	935	VC	1.0E06	
H34-427091	955	VC	1.0E06	

6.0 Design Input (Continued)

6.9 Pipe Support Data (continued)

Table 6.9-1 (Pipe Support Data) (continued)

Support Mark No.	Node No.	Support Type	Support Stiffness (Reference 4)	
			Translational (Lbs/inch)	Rotational (In-Lbs/Rad)
H35-327141	970	NS,EW	1.0E06	
H36-427090	1000	EW	1.0E06	
427104	1020	VC	1.0E06	
427056	1055	VC	1.0E06	
327145	1070	VC,EW	1.0E06	
427067	1085	NS	1.0E06	
427093	1090	VC,EW	1.0E06	
327148	1115	VC,EW	1.0E06	
327150	1135	VC,EW	1.0E06	
60469	1200	NS,VC,EW	1.0E06	
527019	1215	EW	1.0E06	
60469A	1270	NS,VC,EW	1.0E06	
527019	1285	NS	1.0E06	
60469	1305	NS,VC,EW	1.0E06	
527010	1320	NS,EW	1.0E06	
60469A	1360	NS,VC,EW	1.0E06	
327157	1395	NS	1.0E06	
527014	1415	EW	1.0E06	
327160	1435	NS,VC	1.0E06	
527017	1460	VC	1.0E06	
527013	1470	VC	1.0E06	
527011	1485	NS	1.0E06	
327165	1505	NS,VC	1.0E06	
527012	1520	NS,VC	1.0E06	
527012	1525	EW	1.0E06	
60522	1535	NS,VC	1.0E06	
60219	1690	NS	1.0E06	
Anchor 60216	1705	ANCHOR	1.0E06	1.0E08
60523	1780	NS,EW	1.0E06	
60525	1785	4-WAY	1.0E06	1.0E08 Rx
60525	1825	4-WAY	1.0E06	1.0E08 Rx
Anchor 60526	1860	ANCHOR	1.0E06	1.0E08
Anchor 60524	1885	ANCHOR	1.0E06	1.0E08

6.0 **Design Input (Continued)**

6.9 **Pipe Support Data (continued)**

Table 6.9-1 (Pipe Support Data) (continued)

Support Mark No.	Node No.	Support Type	Support Stiffness (Reference 4)	
			Translational (Lbs/inch)	Rotational (In-Lbs/Rad)
327125	1900	NS	1.0E06	
527009	1920	EW	1.0E06	
327124	1940	NS,VC	1.0E06	
327123	1950	NS,VC	1.0E06	
327122	1965	NS,VC	1.0E06	
60220	1980	NS,VC	1.0E06	
60218	2110	NS	1.0E06	
60214	2125	ANCHOR	1.0E06	1.0E08
60221	2205	NS,EW	1.0E06	
60228	2210	4-WAY	1.0E06	1.0E08 Rx
60228	2250	4-WAY	1.0E06	1.0E08 Rx
60229	2285	ANCHOR	1.0E06	1.0E08
60223	2310	ANCHOR	1.0E06	1.0E08
60542FLR	9755	ANCHOR (1)	1.0E06	1.0E08
60542WALL	9765	ANCHOR (1	1.0E06	1.0E08
60541	7054	VC,EW	1.0E06	
60540	7066	VC,EW	1.0E06	

Notes:

1. Existing Anchor is modeled with two Trunnions, one attached to the Floor and the other attached to the Wall (See Attachment D).

6.0 Design Input (continued)

6.10 Special Stress Intensification Factors (SIF's) (Reference 1)

Special SIFs are considered at the following weld locations.

~~Stress Intensification Factor (SIF) of 1.2 is considered at the following nodes of Slipon Flange~~ connections.

The nodes are 5, 25, 35, 70, 77, 85, 95, 105, 162, 182, 185, 210, 222, 230, 242, 250, 280, 295, 308, 325, 340, 348, 370, 380, 403, 405, 430, 445, 460, 485, 490, 512, 525, 550, 580, 595, 610, 630, 640, 645, 660, 665, 670, 685, 690, 705, 710, 715, 730, 735, 750, 765, 785, 800, 835, 855, 870, 893, 895, 920, 930, 950, 980, 995, 1015, 1035, 1050, 1060, 1065, 1080, 1085, 1100, 1105,1110, 1125, 1130, 1145, 1150, 1155, 1190, 1195, 1202, 1210, 1220, 1265, 1267, 1275, 1284, 1290, 1300, 1310, 1318, 1325, 1355, 1357, 1362, 1370, 1380, 1390, 1410, 1430, 1440, 1455, 1465, 1485, 1500, 1510, 1515, 1525, 1540, 1585, 1587, 1655, 1660, 1695, 1700, 1715, 1732, 1740, 1760, 1775, 1785, 1790, 1800, 1835, 1845, 1860, 1870, 1885, 1895, 1915, 1935, 1945, 1955, 1960, 1970, 1985, 2015, 2018, 2030, 2035, 2060, 2090, 2095, 2115, 2120, 2140, 2155, 2165, 2185, 2200, 2210, 2215, 2235, 2250, 2260, 2272, 2285, 2295 and 2310.

Stress Intensification Factor (SIF) of 2.3 is considered at the nodes 9005, 9010, 9105, 9110, 9205, 9210 of Threaded connections.

Stress Intensification Factor (SIF) of 2.1 is considered at the nodes 9315, 9320, 9340, 9345, 9415, 9420, 9440,9445 of Socket Weld connections.

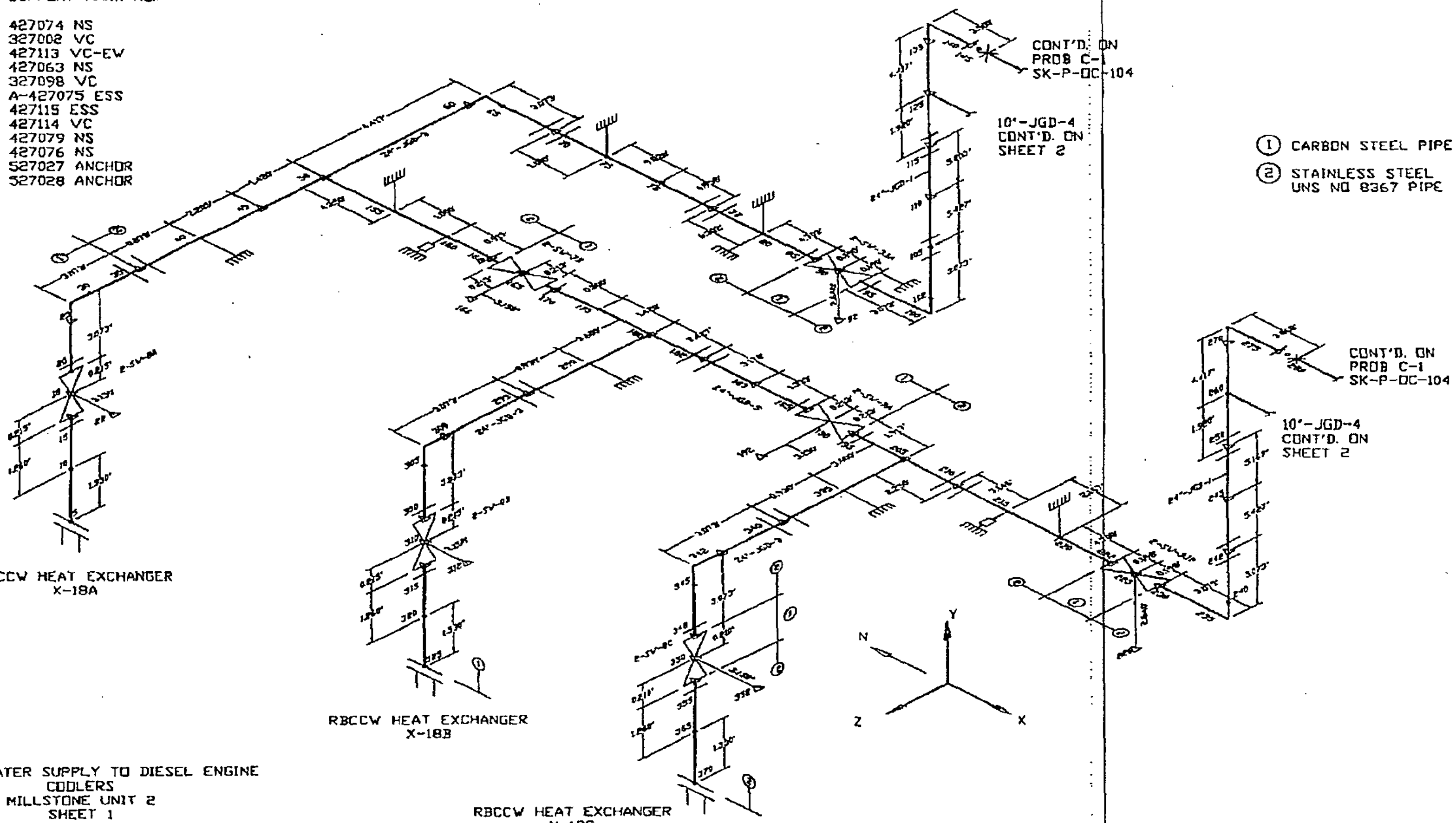
All the Junction nodes are considered as ANSI Tee except at nodes 7000, 7050, 8000 which are considered as Unreinforced Tees and 7032, 7051, 7063, 1730, 1745, 2153, 2170, 1441 and 1942 which are considered as Branch connections.

CALCULATION IDENTIFICATION NUMBER			PAGE 47
CALCULATION NO. MP58B-00138EM	REV NO 04	CCN NO N/A	

6.0 Design Input (continued)

6.11 Worksketch

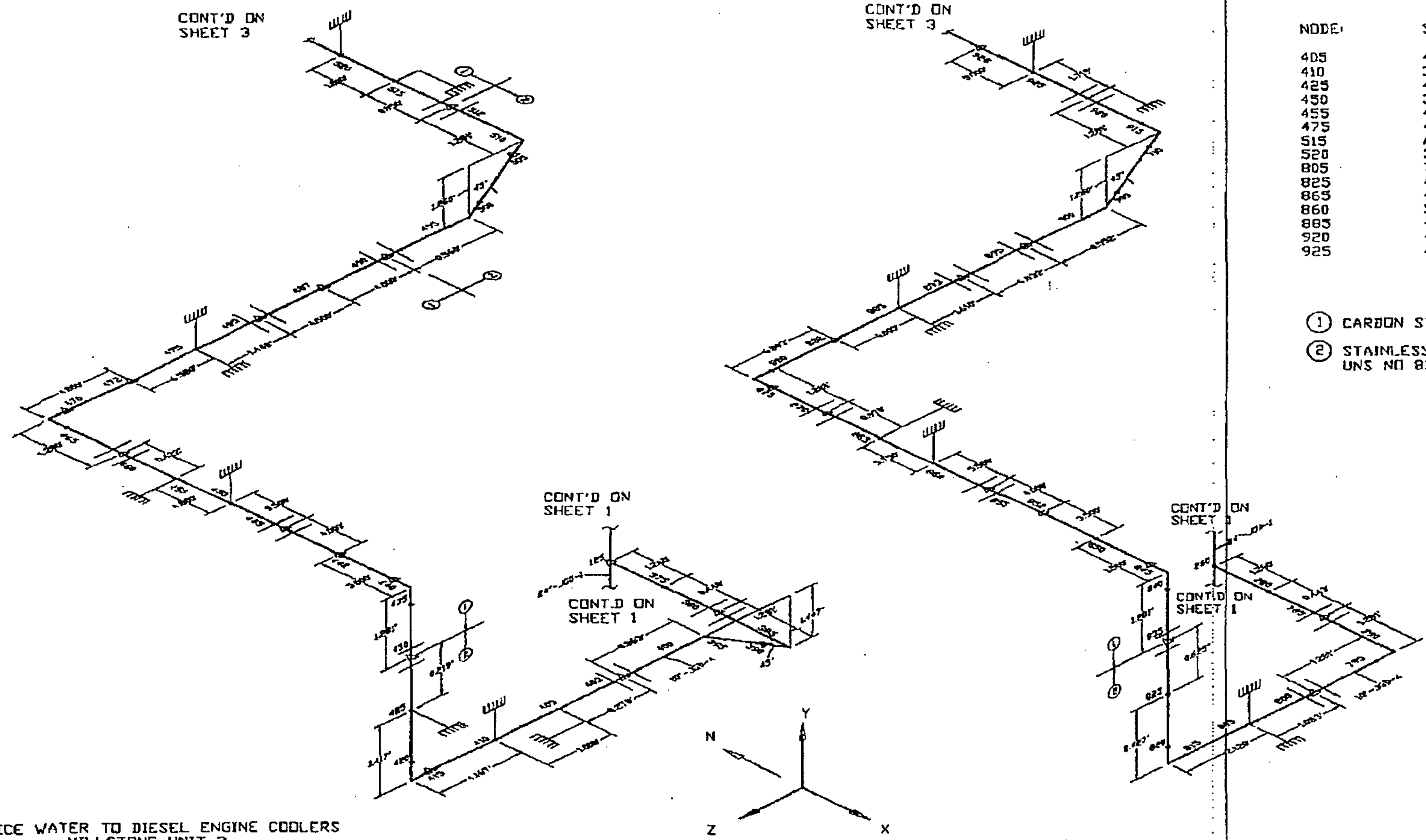
NODE	SUPPORT MARK NO.
40	427074 NS
75	327002 VC
80	427113 VC-EW
95	427063 NS
155	327098 VC
160	A-427075 ESS
215	427115 ESS
220	427114 VC
290	427079 NS
335	427076 NS
145	527027 ANCHOR
280	527028 ANCHOR



SERVICE WATER SUPPLY TO DIESEL ENGINE
COOLERS
MILLSTONE UNIT 2
SHEET 1

6.0 Design Input (continued)

6.11 Worksketch



NODE	SUPPORT MARK NO
405	427064 EW
410	327012 V.C.
425	427080 NS
450	327013 V.C.
455	427082 EW
475	427085 NS, VC
515	A427068 NS
520	380352 VC
805	79-14-22 NC, VC
825	427080 NS, EW
865	427083 EW
860	SK-ALW-102579 VC
885	427084 NS, VC
920	427069 NS
925	427030 VC

(1) CARBON STEEL PIPE

(2) STAINLESS STEEL UNS NO 8367 PIPE

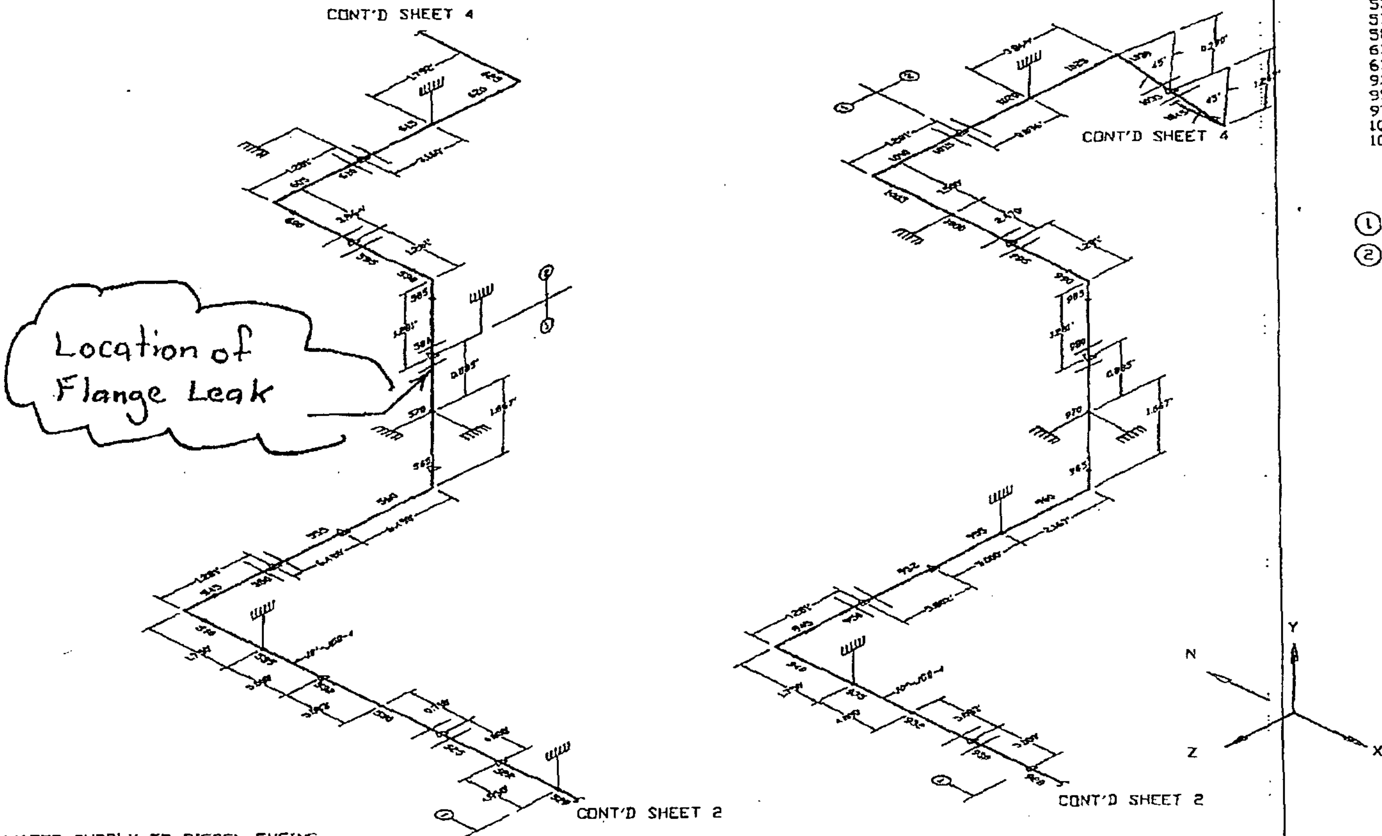
SERVICE WATER TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 2

Shaw Stone & Webster Nuclear
CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER			
CALCULATION NO. MP58B-00138EM	REV NO 04	CCN NO N/A	

6.0 **Design Input (continued)**

6.11 **Worksketch**



NODE	SUPPORT MARK NO
535	427026 VC
570	327135 NS, EW
580	427089 VC
610	427073 EW
615	427087 VC
935	427031 VC
955	427091 VC
970	327141 NS, EW
1000	427090 EW
1020	427104 VC

(1) CARBON STEEL PIPE

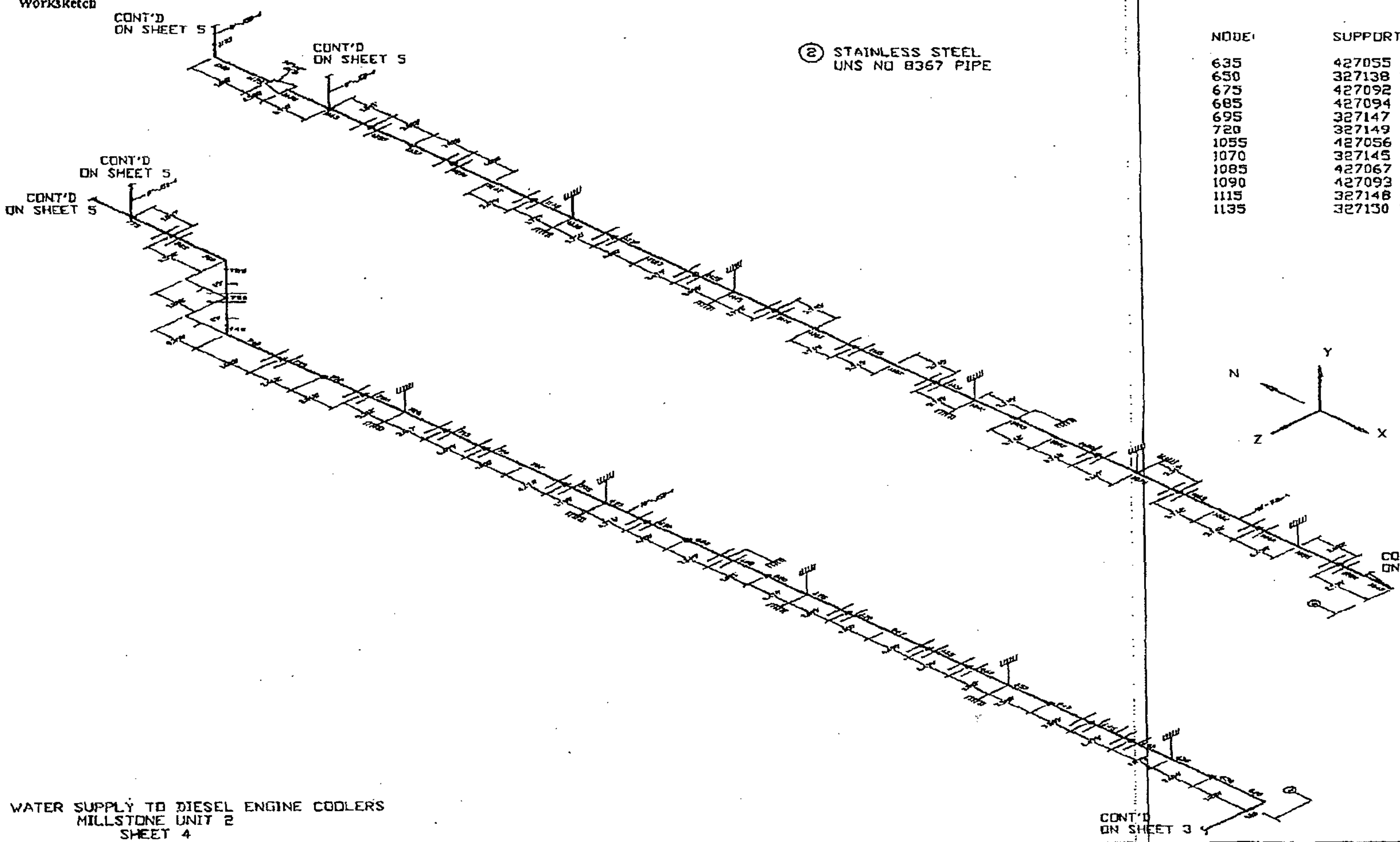
(2) STAINLESS STEEL UNS NO 8367 PIPE

SERVICE WATER SUPPLY TO DIESEL ENGINE
COOLERS
MILLSTONE UNIT 2
SHEET 3

CALCULATION IDENTIFICATION NUMBER			PAGE 50
CALCULATION NO. MP58B-00138EM	REV NO 04	CCN NO N/A	

6.0 Design Input (continued)

6.11 Worksketch



NODE	SUPPORT MARK NO:
635	427055 VC
650	327138 VC, EW
675	427092 VC, EW
685	427094 NS
695	327147 VC, EW
720	327149 VC, EW
1055	427056 VC
1070	327145 VC, EW
1085	427067 NS
1090	427093 VC, EW
1115	327148 VC, EW
1135	327150 VC, EW

SERVICE WATER SUPPLY TO DIESEL ENGINE COOLERS
MILLSTONE UNIT 2
SHEET 4

ATTACHMENT 3

ETE-CME-2011-1005, Revision 1, Structural Integrity and System Performance Evaluation of Degraded Flange in "A" Service Water Line to EDG Spool SK-2952

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

Dominion

Engineering Technical Evaluation Cover Sheet

1. Stations	Doc Type:	Sub Type:	2. Document Number	3. Rev #	4. Decomissioning?
☑ MP ☐ SU ☐ NA ☐ KW ☐ CO (Note: If both SU and NA, then check CO)	ETE	000	ETE-CME-2011-1005	1	☐ Yes ☑ No

5. Title:
Structural Integrity and System Performance Evaluation of Degraded Flange in "A" Service Water Pipe to EDG Spool SK-2952

6. ETE Level	7. Unit(s)	8. Quality Classification	9. FSRC Approval Req.?
☐ Level I ☑ Level II	☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ ISFSI	☑ SR ☐ NS ☐ NSQ	☑ Yes ☐ No

10. *Preparation, Review, and Approval Signatures (add or delete rows as needed)*

	Signature:	Date:
Preparer : (Print) Digitally signed by: Steahr, Thomas	Signature: Thomas A. Steahr	08/19/2011 11:09:00 am
Reviewer : (Print) Digitally signed by: Deconto, Raymond	Signature: Raymond E. Deconto	08/19/2011 11:16:05 am
Engineering Supervisor / Designee : (Print) Digitally signed by: Marino, Michael	Signature: Michael J. Marino	08/19/2011 11:19:42 am

Standard Attachments	Attachment	# of pages	*Reviewed / No Impact*	Not Req.
11. Design Effects and Considerations (DNES-AA-GN-1003)	Att#1	1	☐	☐
12. Document Impact Summary (DRUL) (DNES-AA-GN-1002)	Att#2	1		☐

13. Considerations and Conditions for Document Updates (check N/A ☑ if no document updates are noted on the DRUL) *

☐ All Document updates noted on the DRUL can be initiated immediately

☐ Document updates noted on the DRUL are delayed until the following documents/actions are completed:

____________________ (e.g., WO, CR etc.) (See DRUL Remarks section)

10CFR50.59 Attachments	Attachment	# of pages	Not Req.
14. 10CFR50.59/72.48 applicability review forms (DNAP-3004 or CM-AA-400)	Att#3		☐
15. 10CFR50.59/72.48 screen form (DNAP-3004 or CM-AA-400)			☑
16. 10CFR50.59/72.48 evaluation form (DNAP-3004 or CM-AA-400)			☑

17. Additional Attachments

Attachment	# of pages	Description
Attachment_A_MP2_SW_Leak_at_Spo	39	
Attachment_B_MP2_SW_Leak_at_Spo	18	

Dominion

Engineering Technical Evaluation Cover Sheet

18. Distribution			
Primary Recipient(s):	(Enter the Name / Dept or Location for EACH Primary Recipient in this block.)		
Copy To?	Other Recipient / Department or Location	Copy To?	Other Recipient/Department or Location
☐	Preparer		
☐	Reviewer		
☐	Supervisor		
☐	Site DCE		
☐	Affected organization		
☐	Program Owners		

1.0 Table of Contents

N/A

2.0 Source Document

CR438193 - "Possible Through Hole Leak In the "A" Service Water Header To The "A" EDG"

3.0 Record of Revision

N/A

4.0 Purpose

This ETE evaluates the structural integrity and leakage acceptability of a degraded slip-on flange located on 10" service water supply line to "A" Emergency Diesel Generator (10"JGD-4 spool SK-2952) to support demonstration of continued operability of the MP2 A service water supply header.

5.0 Design Inputs and Assumptions

N/A

6.0 Methodology

N/A

7.0 Discussion

Reference 1 CR and Reference 2 UT examination document a degraded slip-on flange exibiting through wall leakage with a current leak rate of 10 drops per minute. The subject flange is located on the Millstone Unit 2 "A" service water supply train to the "A" emergency diesel generator. This line is designated as 10"JGD-4. The subject flange is the downstream end of spool piece SK-2952 as shown on Reference 3 isometric drawing.

This class 125 light weight flange is lined carbon steel. The degradation is suspected to be the result of a failed lining which can occur if the coating is compromised during spool installation.

Structural Integrity Assessment:

Currently there is no NRC approved methodology for ASME Code temporary acceptance of flaws in moderate energy Class 3 flanges. ASME Code Case N-513-2 (Reference 4) provides NRC approved flaw acceptance methodology for Class 2 or 3 piping but specifically excludes application to a flange joint.

Since no ASME Code or NRC approved methodology is available to evaluate flanges, a non Code methodology is developed here. The objective is to assess the applied piping design loads at the flange (as documented in the stress calculation of record Reference 5) compared to a conservative assessment of the extent of remaining flange material (based on bounding the degradation documented in UT examination report Reference 2). In addition, the piping support local to the flange will be assessed for possible reduction in load carrying capability.

The current piping stress analysis run of record is documented in Addendum B of Reference 5. In the piping analysis computer model the subject flange is located at node point 580 (shown in model worksketch sheet 3). The ASME Code equation pipe stresses for eq 8, eq 9 normal/upset, eq 9 faulted, eq 10 and eq 11 were extracted (stress calculation Attachment B pages 10 and 53) and are shown in Table 1. Also included in Table 1 are the corresponding allowable stresses and percent ratio of allowable. As shown in the table the maximum stress at the flange location is 10.0 percent of ASME Code allowable in the undegraded condition. This low stress condition (1/10 of allowable) provides considerable margin for material degradation while maintaining structural integrity. The reduced load carrying capability of the flange is proportional to the reduction in area. This results in an increase of 50 percent to the calculated stresses. This increase in stress will increase the percent ratio of applied to allowable stress from 10 percent to 15 percent leaving 85 percent margin.

Table 1

Node 580	Stress (psi)	Allowable (psi)	Percent Ratio of Allowable
Eq 8	1502	15000	10.0
Eq 9N/U	1709	18000	9.49
Eq 9F	1893	35000	5.41
Eq 10	1138	22500	5.06
Eq 11	2640	37500	7.04

The UT examination report is included in Attachment B.. Also included in Attachment B are photographs of the flange

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Engineering Technical Evaluation Cover Sheet

showing the through wall leak, located between two bolt holes at the crotch region. The sketch on page B2 identifies the location of the leak relative to the flange orientation. The bolts/holes have been numbered sequentially 1 through 12 for the purpose of discussion. As shown in the UT exam report a number of measurements were taken on the flange between each of the twelve bolt holes. Radial and axial thickness measurements were taken on the flange edge, flange face, crotch region and of the pipe at the point of insertion into the flange. Review of this data indicates the degradation is localized to a single location between two adjacent bolt holes (holes 11 and 12) . The adjacent areas and all other areas of the flange do not exhibit any degradation. This would indicate the current degradation is bounded by an area approximately 1/6 of the total circumference. To allow for potential additional flaw growth it can be assumed that 1/3 of the circumference of the flange has been lost to wastage and only 2/3 of the circumference of the flange remains.

Based on the extremely low loads (10 percent of allowable) a 33 percent loss of the flange load bearing area / structural load path will not challenge the structural integrity of the flange as the remaining 66 percent flange area is more than sufficient to support the low applied loading.

Pipe support mark number 427089 (shown on pipe support isometric drawing Reference 6) is attached to the mating flange. Details of this rigid tandem pipe support are shown on the support detail drawings References 7, 8 and 9. Each leg (attachment point) of this support is rated for a 2500lb load per Reference 7. This pipe support utilizes the bolts located in holes 11, 12, 1, 2 on the east side of the support and holes 5 through 8 for the west side of the support. A review of the support load calculation (Attachment E, page 1 of the pipe stress calculation Reference 5, node 580) indicated the maximum load for this support is 1793lbs. This load is shared equally between both struts. Therefore each strut is subject to approximately 897lbs (1793lbs/2). Strut attachment to the flange is accomplished by 4 bolts, through the holes described above. The 2500lb capacity of each strut is shared evenly over the 4 attachment bolts. In order to support the required 897lb applied load at least two of the four bolts are required, resulting a reduction of the strut capacity by half to 1250lbs. Therefore a minimum of 2 bolts are required at each strut attachment plate. Currently the degraded area is located between bolt numbers 11 and 12 (see sketch Attachment B page B2). Because the flange is degraded in this area it is conservatively assumed bolts 11 and 12 are insufficiently supported to be capable of carrying any load. Bolts 1 and 2 are still capable of carrying load. Since 2 bolts provide adaquate capability for carrying the required load, this support remains fully capably of performing its design function.

For the purpose of pipe support qualification, additional flange degradation counter-clockwise in the direction of hole 10 will have no impact on support qualification. Additional flange degradation in the clockwise direction toward hole 1 is only acceptable provided full flange thickness immediately surrounding hole 1 can continue to be demonstrated (under the nut).

Loss of Service Water Flow Assessment:

Service water flow loss from this leak location will not adversely affect the capability of the SW system to provide adequate cooling to the EDG heat exchangers and to all other essential safety related heat exchangers. A leakage limit of 5 gpm is applied as the maximum acceptable leakage rate (currently the leakage rate is approximately 10 drops / min). A detailed system hydraulic analysis has been performed (Attachment A). This analysis demonstrates that a margin of at least 10 to this leak rate is available (i.e., > 50 gpm can be tolerated and all essential safety related heat exchangers receive adequate service water flow for the limiting accident condition.)

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8.0 Conclusions

Based on the above discussion the subject degraded flange maintains structural integrity and remains capable of supporting all required design loads. Since the flange is degraded and exhibiting through wall leakage, it is non compliant with ASME Code requirements. A conservatively large degradation (1/3 of the circumference of the flange) is considered to allow for potential additional flange degradation.

The associated pipe support (mark number 427089) also remains capable of supporting the required design load. Additional flange degradation is acceptable providing continued demonstration of full flange thickness can be shown under at least 2 of the four nuts supporting each strut attachment plate.

9.0 Precautions or Limitations

This evaluation places limitations on the maximum acceptable flange degradation and maximum allowable leak rate. Flange degradation must not exceed 1/3 (120 degrees) of flange circumference and full flange thickness must be maintained under at least 2 of the four nuts supporting each strut attachment plate. Maximum leakage must not exceed 5 gpm. If desired, it is acceptable to impose a more restrictive limitation on maximum leakage to address additional concerns not considered here (such as flooding).

10.0 Required Actions

Consistent with the guidance for piping flaw evaluation provided in Reference 4, periodic inspection of approximate 30 day intervals shall be preformed to assure the degraded area remains bounded and the limitations listed in section 9 remain satisfied.

11.0 Recommendations

N/A

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Engineering Technical Evaluation Cover Sheet

12.0 References

1. CR438193 - "Possible Through Hole Leak In the "A" Service Water Header To The "A" EDG."

2. AWO 53102457364 UT Examination Report - See Attachment B.

3. Drawing 25203-20150 SH. 471, Rev 7 "Millstone Nuclear Power Station - Unit 2 "A" Train Service Water Supply to Diesel Engine Coolers".

4. ASME Code Case N-513-2 "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1.

5. Calculation MP58B-00138EM Revision 4, Addendum B "Service Water Supply to Diesel Engine Coolers - Stress Problem 118".

6. Drawing 25203-20224 SH. 61, Rev 3 "Millstone Nuclear Power Station - Unit 2 "A" Train Service Water Supply to Diesel Engine Coolers".

7. Drawing 25203-22200 SH 427089 Rev 4 "Service Water Supply to Diesel Engine Coolers Mark No 427089".

8. Drawing 25203-22200 SH 427089A Rev 5 "Service Water Supply to Diesel Engine Coolers Mark No 427089".

9. Drawing 25203-22200 SH 427089B Rev 4 "Service Water Supply to Diesel Engine Coolers Mark No 427089".

13.0 Attachments

Attachment A - MP2 SW Leak at Spool SK-2952 Flow Evaluation

Attachment B - UT Examination Report and Flange Photographs

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Design Effects Table

DNES-AA-GN-1003 Page 1 of 1

Instructions:
This table will identify impacted programs. If a question is answered yes, the responsible engineer shall address and document in the discussion section of the Design Change. The responsible engineer shall check "No Impact" or "Impact" as appropriate. If necessary, consult the program owner to assist with the determination. If it is determined that there is an impact, identify program owner, check "Impact" in the applicable section, obtain the consulted individual(s) signature on the engineering product cover sheet and document the discussion in the change package. If an impact is determined for any program, then relevant portions of this attachment should be attached to the appropriate document. If it is determined that there is "No Impact" in a section where a question is answered "Yes", document the basis for this determination in the change package. When all questions are answered "No" in a particular section, do not check "Impact" or "No Impact."

Station: ☐ KPS ☑ MPS ☐ CO ☐ NAPS ☐ SPS	**Unit:** ☐ 1 ☑ 2 ☐ 3 ☐ ISFSI	**ETE Document Number:** ETE-CME-2011-1005
Change Document Title: Structural Integrity and System Performance Evaluation of Degraded Flange in "A" Service Water Pipe to EDG Spool SK-2952		

1.1 Fire Protection Equipment or Features	☐ Yes ☑ No	
1.2 Combustible Loading	☐ Yes ☑ No	
1.3 Hazards and Ignition Sources	☐ Yes ☑ No	
1.4 Fire Safe-Shutdown Analysis	☐ Yes ☑ No	
2.0 Environmental Qualification (EQ)	☐ Yes ☑ No	
3.0 ASME Codes / ISI / IST	☐ Yes ☑ No	
3.1 Inservice Inspection	☐ Yes ☑ No	
3.2 Inservice Testing	☐ Yes ☑ No	
4.0 Regulatory Guide 1.97 - Post Accident Monitoring	☐ Yes ☑ No	
5.0 Maintenance Rule	☐ Yes ☑ No	
6.0 Radiological Protection Program (ALARA)	☐ Yes ☑ No	
7.0 Environmental Impact (Non-Radiological)	☐ Yes ☑ No	
8.0 Nuclear Material Control	☐ Yes ☑ No	
9.0 License Renewal Rule Program and Aging Management Activities	☐ Yes ☑ No	
10.0 Generic Letter (GL) 89-13 Program	☐ Yes ☑ No	
11.0 Station Blackout (SBO)	☐ Yes ☑ No	
12.0 Appendix J Program	☐ Yes ☑ No	
13.0 NERC - North American Electric Reliability Council	☐ Yes ☑ No	
14.0 GSI-191 (Containment Recirculation Sump) Considerations	☐ Yes ☑ No	

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Documents Required To Be Updated List (DRUL)

STATION	UNIT	ETE Document Number
☐ KPS ☑ MPS ☐ NAPS ☐ SPS ☐ CO	☐ 1 ☑ 2 ☐ 3 ☐ ISFSI	ETE-CME-2011-1005

Operations Critical Documents Needed	☑ N/A
Department / Contact	**Impacted Document Number and/or Title**

Closeout Documents Needed	☑ N/A
Department / Contact	**Impacted Document Number and/or Title**

Remarks (Attach additional pages if needed):

ETE-CME-2011-1005 Attachment A: MP2 SW Leak at Spool SK-2952 Flow Evaluation

Preparer: Deborah L Godinez

Independent Reviewer: James J Craffey

References:

A. CR438193

B. Calculation 92-120 Rev 4 Addendum B, "MP2 SWS Design Basis Alignment- Summer and Winter" dated 3/29/11.

C. Calculation 03-ENG-04035M2 "MP2 Service Water Design Basis Summary Calculation" Rev 0 CCN 03 dated 5/24/10

Reference A identified a leak in spool SK-2952 (10-JGD-4). As requested, a 10 gpm leak and the maximum allowable break as been evaluated using the PROTO-FLO MP2 Service Water flow model documented in Reference B.

To verify that the correct model was used, a benchmark case was run. Since Ref B did not run case 2b3 it has been run for the limiting EDG case.

	Case 2a2		Case 2b3
	From Ref B Attach A 3/28/11 09:08	Benchmark 8/18/11 08:39	Benchmark 8/18/11 08:41 (Ref B did not rerun this case)
SW Pump Flow(gpm)	9948.08	9948.08	10946.12
RBCCW Hx Flow (gpm)	8430.25	8430.25	9519.89
DGA Flow(gpm)	774.28	774.28	721.59

The spool where the break is located is modeled in pipe 83. To model the break it can be located at either node encompassing this pipe; either ARBCCW or ADG. Node ARBCCW is located at 3.5 ft elevation and node ADG is located at 11.5 ft elevation. The break elevation is approximately 9 ft. Cases were run for a 10 gpm break in both locations. To model the break, the nodal flow in the boundary conditions menu is changed to flow out of the system and a value in gallons per minute is added. For the cases listed in Tables 1 and 2, 10 gpm was used. To determined the maximum flow, this break size was increased until unacceptable results were obtained.

There is less than two-tenths difference between modeling the break at ARBCCW vs ADG. ARCCW is the limiting case for RBCCW and ADG is limiting for the EDG. For the limiting RBCCW case (2a2), the majority of the 10 gpm leak is compensated by increased SW pump flowrate (~6 gpm) to facility 1. RBCCW flow is reduced approximately 3.5 gpm and EDG flow drops approximately 0.3 gpm. For the limiting EDG case (2b3), the leak results in approximately 0.4 gpm reduction in flow. The normal

operation cases were run to verify acceptable results. As shown below in the table, all flows exceed their minimum flow requirements. These runs conservatively assume the EDG bypass is open.

The limiting case for RBCCW (Case 2a2 with the leak at node ARBCCW) and the EDG (Case 2b3 with leak at node ADG) were run to determine the maximum break size that still provides the minimum flow requirements. This maximum break size was determined to be 54 gpm.

Table 1: LOCA w/o LNP Summer Operation - Facility 1 with 10 gpm break

Component	Predicted Flow gpm				Required flow rates (Ref 1)	Required flow corrected for uncertainties
	Minimum RB TCV Position		Max RB TCV Position			
	Case 2a2 P5B to X18A		Case 2b3 P5B to X18B			
	ARCCW	ADG	ARCCW	ADG		
X18A	8426.70	8426.76	9516.19	9516.25	7570	8411
EDG A Hx	773.95	773.80	721.30	721.15	507	563
X-181A	120.24	120.25	112.78	112.78	40.4	44.9
X-181B	69.02	69.02	64.74	64.74	20.2	22.4
X-182	46.58	46.58	43.69	43.70	22.9	25.4
X-169A	58.50	58.50	54.88	54.88	26.9	29.9
Total flow	9953.96	9953.87	10951.94	10951.85	-	-

Table 2: Normal Summer Operation w/o LNP - Facility 1 with 10 gpm break

Component	Predicted Flow (gpm)				Required flow rates (Ref 1)	Required flow corrected for uncertainties
	Min RB TCV Position		Max RB TCV Position			
	Case 4a1 F1 P5B-X18B		Case 4b F1 P5A-X18A			
	ARCCW	ADG	ARCCW	ADG		
X18A			6806.18	6806.55	4421	4912
X18B	6138.98	6139.31			4421	4912
X17A	5677.44	5677.43	5328.99	5328.97	4706	5229
EDG A Bypass	1465.86	1464.86	1411.20	1410.20	-	-
X-181A	84.53	84.54	81.71	81.71	40.4	44.9
X-181B	48.52	48.53	46.91	46.91	20.2	22.4
X-182	32.77	32.77	31.67	31.67	22.9	25.4
X-169A	34.98	34.98	33.83	33.83	-	-
Pump P5A			14106.64	14106.29		
Pump P5B	13703.90	13703.53				

Table 3: LOCA w/o LNP Summer Operation - Facility 1 with 54 gpm break

Component	Predicted Flow gpm		Required flow rates (Ref 1)	Required flow corrected for uncertainties
	Case 2a2 P5B to X18A	Case 2b3 P5B to X18B		
	ARCCW	ADG		
X18A	8411.10	9500.22	7570	8411
EDG A Hx	772.51	719.22	507	563
X-181A	120.04	112.61	40.4	44.9

X-181B	68.90	64.64	20.2	22.4
X-182	46.50	43.63	22.9	25.4
X-169A	58.40	54.79	26.9	29.9
Total flow	9979.82	10977.02	-	-

Conclusion

A 10-gpm leak in Spool SK-2952 has no adverse impact upon the service water header's safety related support design functions. It has been shown that the safety related equipment will continue to meet its minimum flow requirements with a 54-gpm leak at this spool location.

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Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Benchmark Case 2a2

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	9,948.08		37.24	2.34
Facility 1 HEADER	23.125	9,547.00			
HV-6439	16.410	294.47			
TB Discharge	23.125	294.63			
HV-6399	23.250	8,430.25			
X-18A	23.125	8,430.25			
TV-6308	23.250	8,482.87			
RB A Discharge	23.125	8,482.87			
DGA Flow	5.940	774.28			
FV-6389 bypass	1.610	1.97			
DG Discharge	12.210	778.75			
L-1B Strainer Blowdown	3.068	383.08			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	58.52			
PCV-8943	1.380	26.84			
From Chillers	3.068	58.56			
PV-6925	3.068	189.34			
X-181	3.068	189.34			
X-181A	2.067	120.29			
X-181B	2.067	69.05			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Benchmark Case 2a2

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
From SWGR Room	4.026	236.06			
PV-6927	2.469	46.60			
X-182	2.067	46.60			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

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Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Benchmark Case 2b3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	10,946.12		37.24	2.08
Facility 1 HEADER	23.125	10,565.67			
HV-6439	16.410	276.19			
TB Discharge	23.125	276.35			
HV-6399	23.250	9,519.89			
X-18B	23.125	9,519.89			
TV-6307	23.250	8,107.46			
TV-6307A	6.065	1,412.43			
RB A Discharge	23.125	9,519.89			
DGA Flow	5.940	721.59			
FV-6389 bypass	1.610	1.84			
DG Discharge	12.210	726.02			
L-1B Strainer Blowdown	3.068	362.46			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	54.89			
PCV-8943	1.380	25.18			
From Chillers	3.068	54.94			
PV-6925	3.068	177.58			
X-181	3.068	177.58			
X-181A	2.067	112.82			

!! Reverse Flow Through Check Valve && Pump Flow is Past End of Curve

** Flow Below Minimum $$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Benchmark Case 2b3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-181B	2.067	64.76			
From SWGR Room	4.026	221.41			
PV-6927	2.469	43.71			
X-182	2.067	43.71			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

08/18/2011 09:26 PROTO-FLO 4.60 by Proto-Power Corporation - Serial #PFL-1011 Page 1 of 2
LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used.

Case 2a2 Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	9,953.96		37.24	2.34
Facility 1 HEADER	23.125	9,553.01			
HV-6439	16.410	294.35			
TB Discharge	23.125	294.51			
HV-6399	23.250	8,426.70			
X-18A	23.125	8,426.70			
TV-6308	23.250	8,479.32			
RB A Discharge	23.125	8,479.32			
DGA Flow	5.940	773.95			
FV-6389 bypass	1.610	1.97			
DG Discharge	12.210	778.42			
L-1B Strainer Blowdown	3.068	382.95			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	58.50			
PCV-8943	1.380	26.83			
From Chillers	3.068	58.54			
PV-6925	3.068	189.27			
X-181	3.068	189.27			
X-181A	2.067	120.24			
X-181B	2.067	69.02			

$\frac{8430.25 - 8426.70}{8430.25} \times 100 = 0.04\%$

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2a2 Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
From SWGR Room	4.026	235.97			
PV-6927	2.469	46.58			
X-182	2.067	46.58			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

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Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2a2 Leak at ARBCCW

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*Default Mode - 3 ***** Current Mode - 3*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ARBCCW	Flow (gpm)	-10	0

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2a2 Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	9,953.87		37.24	2.34
Facility 1 HEADER	23.125	9,552.92			
HV-6439	16.410	294.35			
TB Discharge	23.125	294.51			
HV-6399	23.250	8,426.76			
X-18A	23.125	8,426.76			
TV-6308	23.250	8,479.38			
RB A Discharge	23.125	8,479.38			
DGA Flow	5.940	773.80			
FV-6389 bypass	1.610	1.97			
DG Discharge	12.210	778.27			
L-1B Strainer Blowdown	3.068	382.95			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	58.50			
PCV-8943	1.380	26.83			
From Chillers	3.068	58.54			
PV-6925	3.068	189.27			
X-181	3.068	189.27			
X-181A	2.067	120.25			
X-181B	2.067	69.02			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2a2 Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
From SWGR Room	4.026	235.97			
PV-6927	2.469	46.58			
X-182	2.067	46.58			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2a2 Leak at ADG

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 3 ***** Current Mode - 3*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ADG	Flow (gpm)	-10	0
Valve Data	2-CL-080	Position (%Open)	.300669657332101	.300647488186602

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3 leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	10,951.94		37.24	2.08
Facility 1 HEADER	23.125	10,571.59			
HV-6439	16.410	276.09			
TB Discharge	23.125	276.25			
HV-6399	23.250	9,516.19			
X-18B	23.125	9,516.19			
TV-6307	23.250	8,104.31			
TV-6307A	6.065	1,411.88			
RB A Discharge	23.125	9,516.19			
DGA Flow	5.940	721.30			
FV-6389 bypass	1.610	1.84			
DG Discharge	12.210	725.74			
L-1B Strainer Blowdown	3.068	362.35			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	54.88			
PCV-8943	1.380	25.17			
From Chillers	3.068	54.92			
PV-6925	3.068	177.52			
X-181	3.068	177.52			
X-181A	2.067	112.78			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3 leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-181B	2.067	64.74			
From SWGR Room	4.026	221.33			
PV-6927	2.469	43.69			
X-182	2.067	43.69			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2b3 leak at ARBCCW

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 8 ***** Current Mode - 8*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ARBCCW	Flow (gpm)	-10	0
Valve Data	2-CL-080	Position (%Open)	.322688007298614	.32256299628028

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	10,951.85		37.24	2.08
Facility 1 HEADER	23.125	10,571.50			
HV-6439	16.410	276.09			
TB Discharge	23.125	276.25			
HV-6399	23.250	9,516.25			
X-18B	23.125	9,516.25			
TV-6307	23.250	8,104.36			
TV-6307A	6.065	1,411.89			
RB A Discharge	23.125	9,516.25			
DGA Flow	5.940	721.15			
FV-6389 bypass	1.610	1.84			
DG Discharge	12.210	725.59			
L-1B Strainer Blowdown	3.068	362.35			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	54.88			
PCV-8943	1.380	25.17			
From Chillers	3.068	54.92			
PV-6925	3.068	177.52			
X-181	3.068	177.52			
X-181A	2.067	112.78			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-181B	2.067	64.74			
From SWGR Room	4.026	221.34			
PV-6927	2.469	43.70			
X-182	2.067	43.70			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2b3

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 8 ***** Current Mode - 8*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ADG	Flow (gpm)	-10	0
Valve Data	2-CL-080	Position (%Open)	.32256725428473	.32256299628028

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4a1 Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	13,703.90		37.24	1.56
Pump 5C	23.125	13,751.06		37.24	1.56
Facility 1 HEADER	23.125	13,401.92			
Facility 2 HEADER	23.125	13,429.21			
HV-6439	16.410	5,760.25			
HV-6438	15.410	5,741.31			
X-17A	14.875	5,677.44			
X-17C	14.875	5,559.45			
TB Discharge	23.125	11,519.89			
HV-6400	23.250	6,187.46			
HV-6399	23.250	6,138.98			
X-18B	23.125	6,138.98			
X-18C	23.250	6,187.46			
TV-6307	23.250	6,145.96			
TV-6306	23.250	6,193.96			
RB A Discharge	23.125	6,145.96			
RB B Discharge	23.125	6,193.96			
DGA bypass	7.856	1,465.86			
DGB bypass	7.856	1,473.54			
DGA Flow	5.940	2.82			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4a1 Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
DGB Flow	5.940	2.90			
FV-6389 bypass	1.610	2.82			
FV-6397 bypass	1.610	2.90			
DG Discharge	12.210	2,945.12			
L-1B Strainer Blowdown	3.068	296.87			
L-1C Strainer Blowdown	3.068	308.96			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	34.98			
X-169B	2.469	35.83			
From Chillers	3.068	70.98			
PV-6925	3.068	133.06			
X-181	3.068	133.06			
X-181A	2.067	84.53			
X-181B	2.067	48.52			
From SWGR Room	4.026	194.18			
PV-6927	2.469	32.77			
X-182	2.067	32.77			
PV-6926	2.469	28.04			
X-183	2.067	28.04			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 4a1 Leak at ARBCCW

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 34 ***** Current Mode - 34*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 228.00	RO-6669 BALANCED	Flow = 24.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 24.00	*****
Node Data	ARBCCW	Flow (gpm)	-10	0

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4a1 Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	13,703.53		37.24	1.56
Pump 5C	23.125	13,751.07		37.24	1.56
Facility 1 HEADER	23.125	13,401.53			
Facility 2 HEADER	23.125	13,429.23			
HV-6439	16.410	5,760.54			
HV-6438	15.410	5,741.30			
X-17A	14.875	5,677.43			
X-17C	14.875	5,559.73			
TB Discharge	23.125	11,520.17			
HV-6400	23.250	6,187.45			
HV-6399	23.250	6,139.31			
X-18B	23.125	6,139.31			
X-18C	23.250	6,187.45			
TV-6307	23.250	6,146.29			
TV-6306	23.250	6,193.95			
RB A Discharge	23.125	6,146.29			
RB B Discharge	23.125	6,193.95			
DGA bypass	7.856	1,464.86			
DGB bypass	7.856	1,473.59			
DGA Flow	5.940	2.82			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4a1 Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
DGB Flow	5.940	2.90			
FV-6389 bypass	1.610	2.82			
FV-6397 bypass	1.610	2.90			
DG Discharge	12.210	2,944.16			
L-1B Strainer Blowdown	3.068	296.88			
L-1C Strainer Blowdown	3.068	308.96			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	34.98			
X-169B	2.469	35.83			
From Chillers	3.068	70.98			
PV-6925	3.068	133.06			
X-181	3.068	133.06			
X-181A	2.067	84.54			
X-181B	2.067	48.53			
From SWGR Room	4.026	194.19			
PV-6927	2.469	32.77			
X-182	2.067	32.77			
PV-6926	2.469	28.04			
X-183	2.067	28.04			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 4a1 Leak at ADG

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 34 ***** Current Mode - 34*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 228.00	RO-6669 BALANCED	Flow = 24.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 24.00	*****
Node Data	ADG	Flow (gpm)	-10	0
Valve Data	2-CL-080	Position (%Open)	.415688644584038	.413148407027606
	2-SW-140A	Position (%Open)	6.3421478966722	6.28955628906281
	2-SW-140B	Position (%Open)	6.34624994029729	6.2940418648455
	2-SW-140C	Position (%Open)	6.41065804469728	6.35688485334702
	2-SW-140D	Position (%Open)	6.38206433364657	6.32900813782273

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5A	23.125	14,106.64		37.24	1.50
Pump 5C	23.125	14,212.67		37.24	1.48
Facility 1 HEADER	23.125	13,820.71			
Facility 2 HEADER	23.125	13,914.50			
HV-6439	16.410	5,566.60			
HV-6438	15.410	5,388.97			
X-17A	14.875	5,328.99			
X-17C	14.875	5,372.48			
TB Discharge	23.125	10,973.72			
HV-6400	23.250	7,125.90			
HV-6399	23.250	6,806.18			
X-18A	23.125	6,806.18			
X-18C	23.250	7,125.90			
TV-6308	23.250	5,683.16			
TV-6306	23.250	6,065.16			
TV-6308A	6.065	1,129.79			
TV-6306A	6.065	1,067.63			
RB A Discharge	23.125	6,812.94			
RB B Discharge	23.125	7,132.78			
DGA bypass	7.856	1,411.20			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
DGB bypass	7.856	1,372.93			
DGA Flow	5.940	2.72			
DGB Flow	5.940	2.70			
FV-6389 bypass	1.610	2.72			
FV-6397 bypass	1.610	2.70			
DG Discharge	12.210	2,789.55			
L-1A Strainer Blowdown	3.068	271.57			
L-1C Strainer Blowdown	3.068	294.52			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	33.83			
X-169B	2.469	33.66			
From Chillers	3.068	67.66			
PV-6925	3.068	128.62			
X-181	3.068	128.62			
X-181A	2.067	81.71			
X-181B	2.067	46.91			
From SWGR Room	4.026	186.94			
PV-6927	2.469	31.67			
X-182	2.067	31.67			
PV-6926	2.469	26.33			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ARBCCW

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-183	2.067	26.33			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 4b Leak at ARBCCW

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 36 ***** Current Mode - 36*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 228.00	RO-6669 BALANCED	Flow = 24.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 24.00	*****
Node Data	ARBCCW	Flow (gpm)	-10	0

08/18/2011 12:21 PROTO-FLO 4.60 by Proto-Power Corporation - Serial #PFL-1011 Page 1 of 3
LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5A	23.125	14,106.29		37.24	1.50
Pump 5C	23.125	14,212.68		37.24	1.48
Facility 1 HEADER	23.125	13,820.34			
Facility 2 HEADER	23.125	13,914.52			
HV-6439	16.410	5,566.88			
HV-6438	15.410	5,388.96			
X-17A	14.875	5,328.97			
X-17C	14.875	5,372.75			
TB Discharge	23.125	10,973.98			
HV-6400	23.250	7,125.89			
HV-6399	23.250	6,806.55			
X-18A	23.125	6,806.55			
X-18C	23.250	7,125.89			
TV-6308	23.250	5,683.46			
TV-6306	23.250	6,065.15			
TV-6308A	6.065	1,129.85			
TV-6306A	6.065	1,067.63			
RB A Discharge	23.125	6,813.31			
RB B Discharge	23.125	7,132.77			
DGA bypass	7.856	1,410.20			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
DGB bypass	7.856	1,372.97			
DGA Flow	5.940	2.71			
DGB Flow	5.940	2.70			
FV-6389 bypass	1.610	2.71			
FV-6397 bypass	1.610	2.70			
DG Discharge	12.210	2,788.59			
L-1A Strainer Blowdown	3.068	271.58			
L-1C Strainer Blowdown	3.068	294.52			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	33.83			
X-169B	2.469	33.66			
From Chillers	3.068	67.66			
PV-6925	3.068	128.62			
X-181	3.068	128.62			
X-181A	2.067	81.71			
X-181B	2.067	46.91			
From SWGR Room	4.026	186.95			
PV-6927	2.469	31.67			
X-182	2.067	31.67			
PV-6926	2.469	26.33			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 4b Leak at ADG

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-183	2.067	26.33			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 4b Leak at ADG

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 36 ***** Current Mode - 36*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 228.00	RO-6669 BALANCED	Flow = 24.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 24.00	*****
Node Data	ADG	Flow (gpm)	-10	0
Valve Data	2-CL-080	Position (%Open)	.438823831973723	.438822898451321
	2-SW-140A	Position (%Open)	7.08929798497615	7.0895218616805
	2-SW-140B	Position (%Open)	7.09558729182421	7.09583564711775
	2-SW-140C	Position (%Open)	7.18595336935983	7.18561510942035
	2-SW-140D	Position (%Open)	7.1457484764626	7.14541666499543

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2a2 ARBCCW 54 gpm leak

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	9,979.82		37.24	2.33
Facility 1 HEADER	23.125	9,579.46			
HV-6439	16.410	293.85			
TB Discharge	23.125	294.00			
HV-6399	23.250	8,411.10			
X-18A	23.125	8,411.10			
TV-6308	23.250	8,463.69			
RB A Discharge	23.125	8,463.69			
DGA Flow	5.940	772.51			
FV-6389 bypass	1.610	1.97			
DG Discharge	12.210	776.98			
L-1B Strainer Blowdown	3.068	382.36			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	58.40			
PCV-8943	1.380	26.79			
From Chillers	3.068	58.44			
PV-6925	3.068	188.94			
X-181	3.068	188.94			
X-181A	2.067	120.04			
X-181B	2.067	68.90			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2a2 ARBCCW 54 gpm leak

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
From SWGR Room	4.026	235.56			
PV-6927	2.469	46.50			
X-182	2.067	46.50			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2a2 ARBCCW 54 gpm leak

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 3 ***** Current Mode - 3*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ARBCCW	Flow (gpm)	-54	0
Valve Data	2-CL-080	Position (%Open)	.301257330966614	.300647488186602

LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3 ADG 53 gpm leak

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pump 5B	23.125	10,977.02		37.24	2.07
Facility 1 HEADER	23.125	10,597.12			
HV-6439	16.410	275.68			
TB Discharge	23.125	275.84			
HV-6399	23.250	9,500.22			
X-18B	23.125	9,500.22			
TV-6307	23.250	8,090.71			
TV-6307A	6.065	1,409.51			
RB A Discharge	23.125	9,500.22			
DGA Flow	5.940	719.22			
FV-6389 bypass	1.610	1.83			
DG Discharge	12.210	723.65			
L-1B Strainer Blowdown	3.068	361.90			
Feed to Hypochloride System	5.940	18.00			
X-169A	2.469	54.79			
PCV-8943	1.380	25.13			
From Chillers	3.068	54.83			
PV-6925	3.068	177.25			
X-181	3.068	177.25			
X-181A	2.067	112.61			

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

08/18/2011 13:15 PROTO-FLO 4.60 by Proto-Power Corporation - Serial #PFL-1011 Page 2 of 2
LSTONE\4\DATA3\NE MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-12

Millstone Power Station Unit 2 - Service Water System

Flow Summary Report

Convergence: Pressure=0.0E+0 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3 - Balancing Parameters Used

Case 2b3 ADG 53 gpm leak

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
X-181B	2.067	64.64			
From SWGR Room	4.026	221.00			
PV-6927	2.469	43.63			
X-182	2.067	43.63			
Feed to Pump Seal Cooling	1.939	48.00			

!! Reverse Flow Through Check Valve
** Flow Below Minimum
&& Pump Flow is Past End of Curve
$$ NPSH Available Below NPSH Required

DNC - S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B SK-2952 leak.PDB - Version 9, 92-120 Rev 4 Add B

Millstone Power Station Unit 2 - Service Water System

Differences Report

Case 2b3 ADG 53 gpm leak

S:\MILLSTONE\4\DATA3\NE_MSS\PROTOFLO CALCS\92-120 Rev 4 Add B\92-120 REV 4-B.DBD Created: 08/18/2011 8:25:36 AM

*Default Mode - 8 ***** Current Mode - 8*

Type	Name	Parameter	Current	Default
System Data	Pipe: 128.10	BALANCED	Flow = 18.00	*****
	Pipe: 239.00	RO-6670 BALANCED	Flow = 48.00	*****
Node Data	ADG	Flow (gpm)	-54	0

Exam Data Sheet

Millstone Power Station — ULTRASONIC EXAMINATION STRAIGHT BEAM MEASUREMENTS

Plant Millstone Unit 3	Page 1 of 11
System & Zone No.	Exam Data Sheet No N/A
Component ID Line 10" JGD-4	AWO Number 53102457364
Component Description 10" Flange	Drawing No. 25203-20150 SH. 471
Examination Purpose Engineering Information / CR438193	Line No. N/A

Instrument & Settings	
Manufacturer	Panametrics
Model No.	36 DL Plus
Serial No.	002181809
Range	5.00"
Velocity	.2326
Delay	N/A
Zero Value	4923
Cal Tolerance	±.002"

Calibration Block(s)		
Type	Serial No.	Material
Step Block	061291	C/S
Step Block	99-6791	C/S

Component Data	
Component T_{nom}	N/A
Component Dia.	N/A
Attachments.	yes

Calibration Checks		Block Thickness		Instrument Reading	
Type	Time	Min.	Max.	Min.	Max.
Initial	08:25	.100"	4.000"	.100"	4.000"
Intermediate	N/A	N/A	N/A	N/A	N/A
Intermediate	N/A	N/A	N/A	N/A	N/A
Final	09:46	.100"	4.000"	.100"	4.000"

Search Unit Data	
Manufacturer	Panametrics
Type No.	D791-RM
Serial No.	19519
Frequency	5.0 MHz
Size	.312"

Couplant Data	
Brand	Ultragel II
Batch No.	09225 I
SAP Batch Mgmt. No.	N/A

Temperature Data	
Cal. Block Temp.	N/A
Component Temp.	N/A
Thermometer No.	N/A

Sketch/Comments Area - Attach Photo(s) of Relevant Conditions Separately

Examined UT Points at 1:00 Through 9:00 Positions Around Flange

See Attached Generic Sketch Sheets for UT Test Results

Examiner (print & sign) ~~Todd Bohnenkamper / [signature]~~ ~~Level II~~ ~~Date~~ 08/18/2011

Reviewer (sign) [signature] for M. Brehler per telecon Level II Date 8/18/11

ANI/ANII If Required (Sign) N/A Date N/A

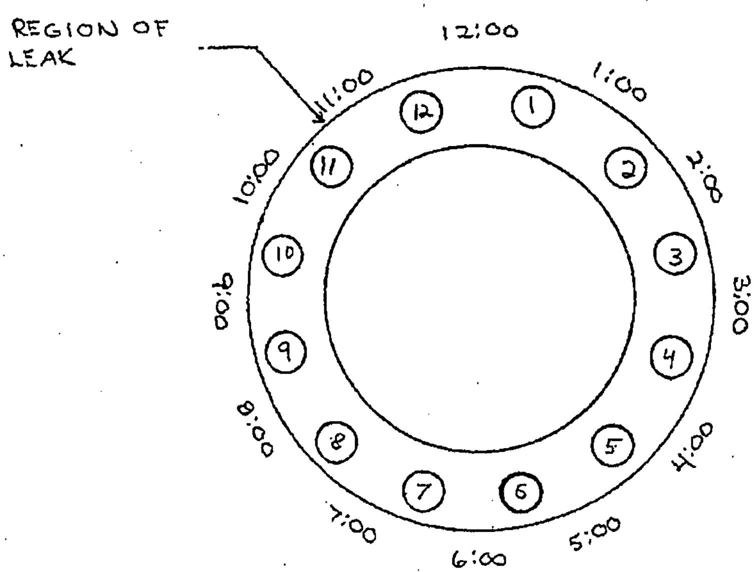
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 2 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4 (Leaking Flange)

EAST WALL (12:00)



VIEWED LOOKING DOWN

Examiner Comments:

Examiner Todd Bohnenkamper [signature] Level II Date 8/18/2011

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

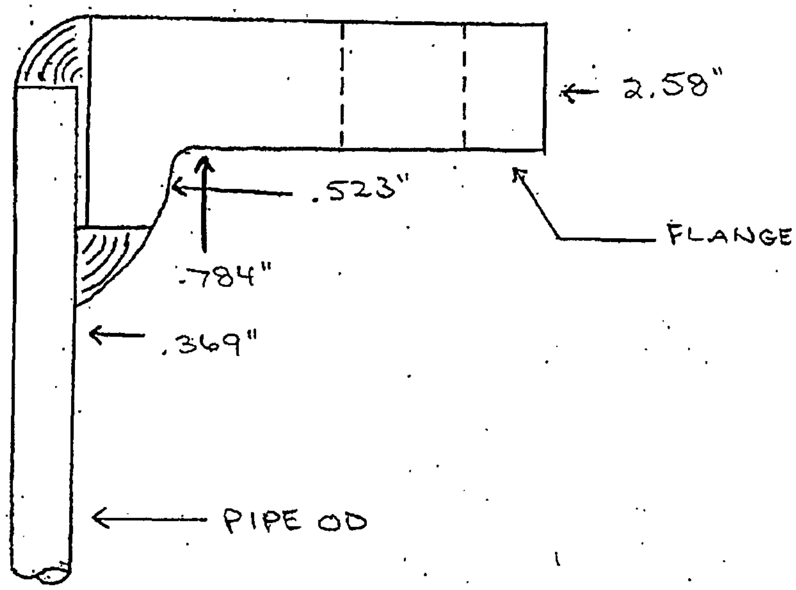
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 3 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

READINGS OBTAINED ~~AT~~ BETWEEN BOLT HOLES AT THE 1:00 POSITION



Examiner Comments: SCANNED BETWEEN BOLT HOLES AT EACH UT POINT AND RECORDED MIN. THICKNESS DETECTED.

Examiner ~~TODD~~ BOHNENKAMPER/[signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

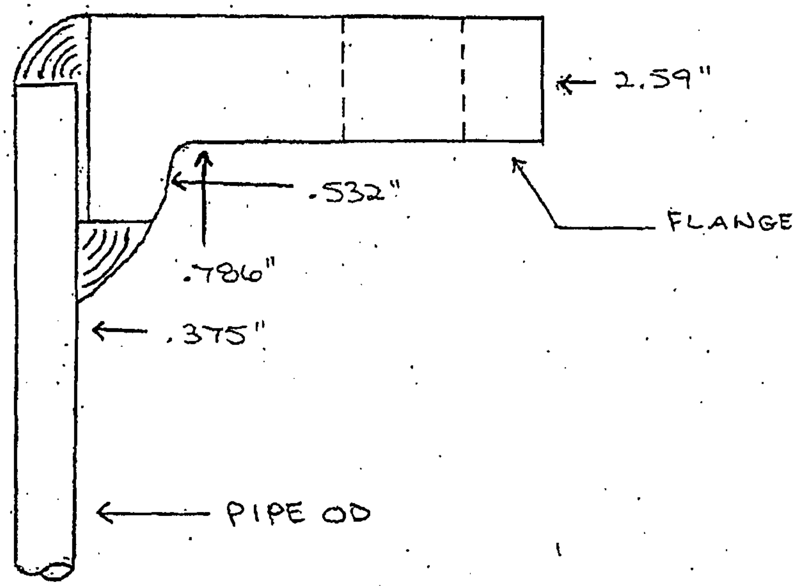
GENERIC SKETCH SHEET

Plant Millistone Unit 2 Page 4 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 2:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

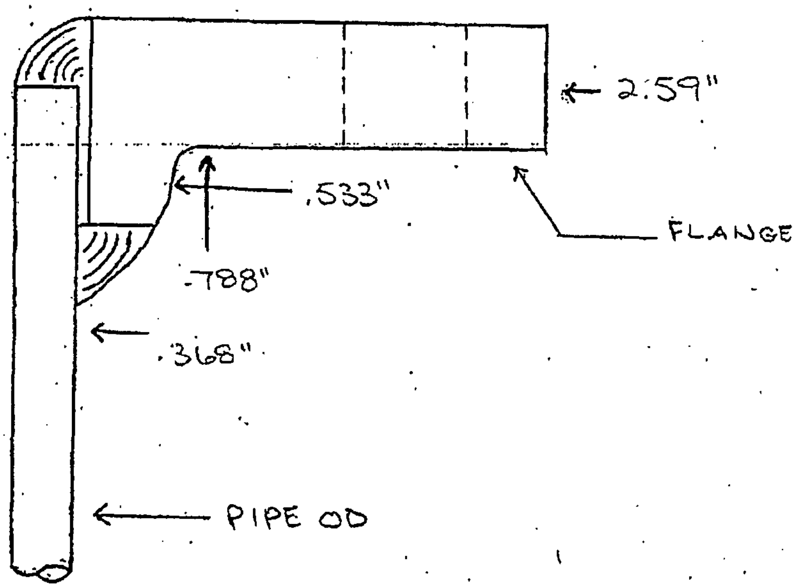
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 5 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED ~~AT~~ BETWEEN BOLT HOLES AT THE 3:00 POSITION



Examiner Comments: SCANNED BETWEEN BOLT HOLES AT EACH UT POINT AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

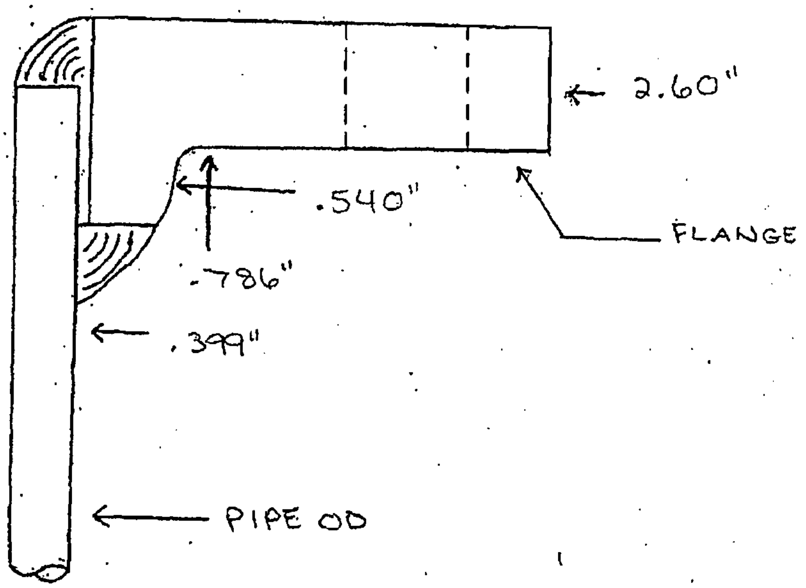
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 6 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE ~~2:00~~ 4:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level III Date 8/18/11

ANII N/A Date N/A

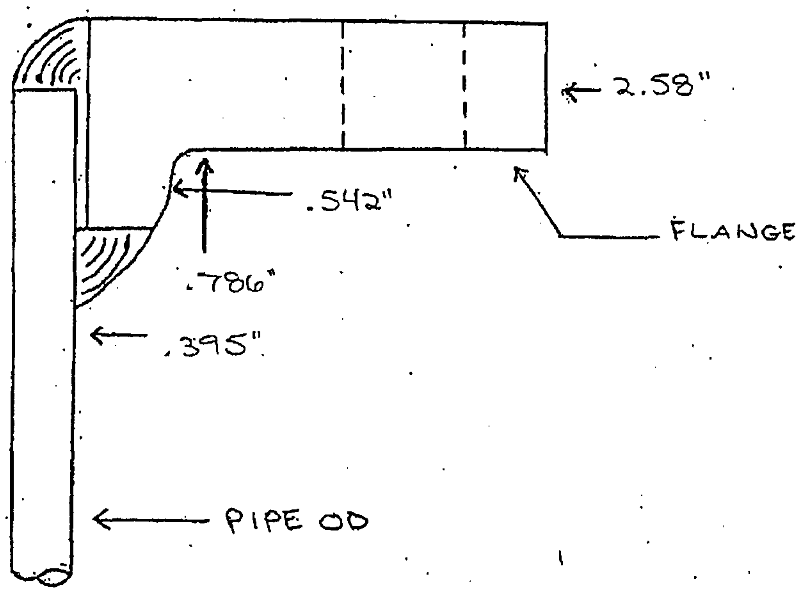
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 7 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 5:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

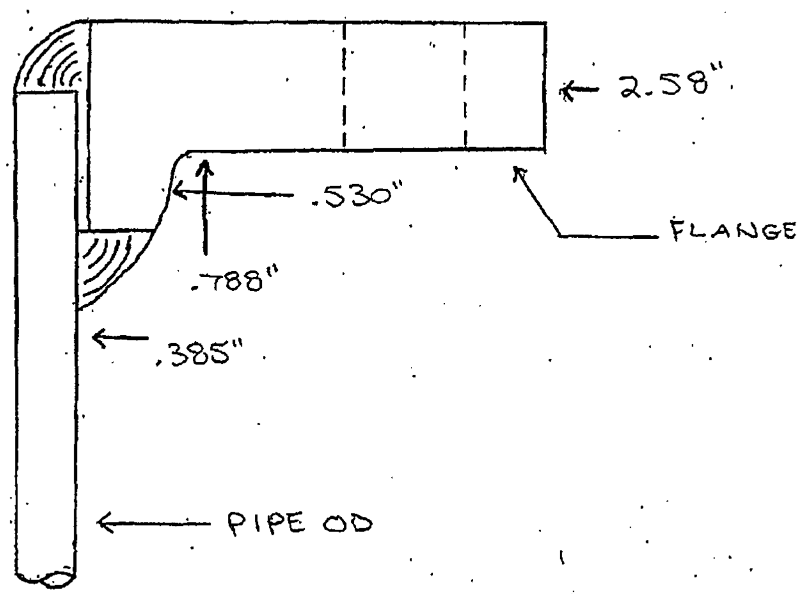
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 8 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 6:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

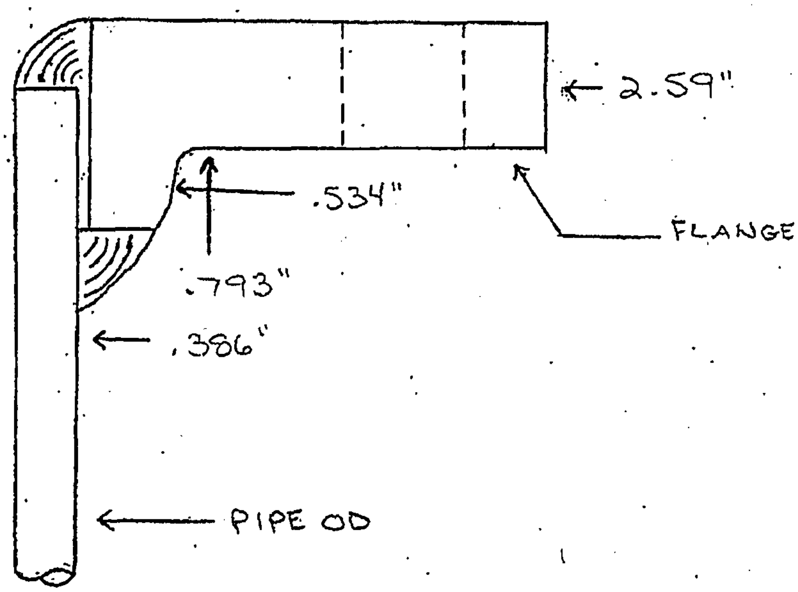
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 9 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 7:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

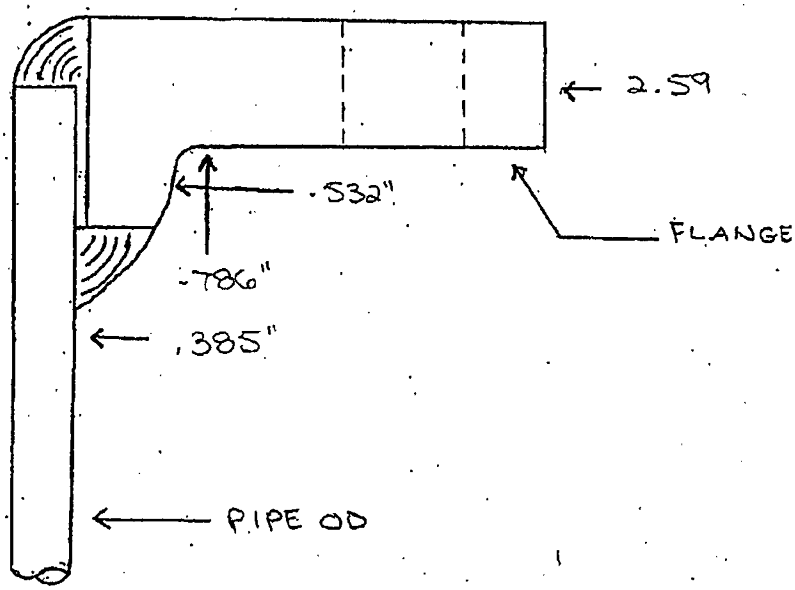
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 10 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 8:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER/ [signature] Level II Date 8/18/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

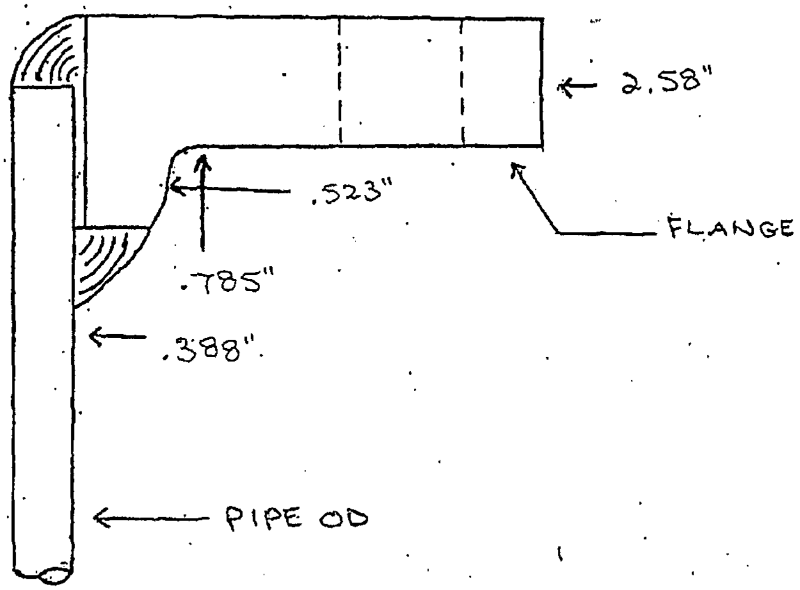
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 11 of 11

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES AT THE 9:00 POSITION



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/18/11

Examiner ~~N/A~~ ~~Level N/A~~ ~~Date N/A~~

Reviewer [signature] for M. Brehler Level II Date 8/18/11

ANII N/A Date N/A

Exam Data Sheet

Millstone Power Station

ULTRASONIC EXAMINATION
STRAIGHT BEAM MEASUREMENTS

Plant Millstone Unit 3	Page 1 of 4
System & Zone No.	Exam Data Sheet No N/A
Component ID Line 10" JGD-4	AWO Number 53102457364
Component Description 10" Flange	Drawing No. 25203-20150 SH. 471
Examination Purpose Engineering Information / CR438193	Line No. N/A

Instrument & Settings	
Manufacturer	Panametrics
Model No.	36 DL Plus
Serial No.	002181809
Range	5.00"
Velocity	.2326
Delay	N/A
Zero Value	.4923
Cal Tolerance	±.002"

Calibration Block(s)		
Type	Serial No.	Material
Step Block	061291	C/S
Step Block	99-6791	C/S

Component Data	
Component T_{nom}	N/A
Component Dia.	N/A
Attachments	yes

Calibration Checks		Block Thickness		Instrument Reading	
Type	Time	Min.	Max.	Min.	Max.
Initial	15:30	.100"	4.000"	.100"	4.000"
Intermediate	N/A	N/A	N/A	N/A	N/A
Intermediate	N/A	N/A	N/A	N/A	N/A
Final	16:16	.100"	4.000"	.100"	4.000"

Search Unit Data	
Manufacturer	Panametrics
Type No.	D791-RM
Serial No.	19519
Frequency	5.0 MHz
Size	.312"

Couplant Data	
Brand	Ultragel II
Batch No.	09225 I
SAP Batch Mgmt. No.	N/A

Temperature Data	
Cal. Block Temp.	N/A
Component Temp.	N/A
Thermometer No.	N/A

Sketch/Comments Area - Attach Photo(s) of Relevant Conditions Separately

See Attached Generic Sketch Sheets for UT Test Results

Examiner (print & sign) Todd Bohnenkamper [signature] Level II Date 08/17/2011

Reviewer (sign) [signature] for M. Brehler per telecon Level II Date 8/17/11

ANI/ANII If Required (Sign) N/A Date N/A

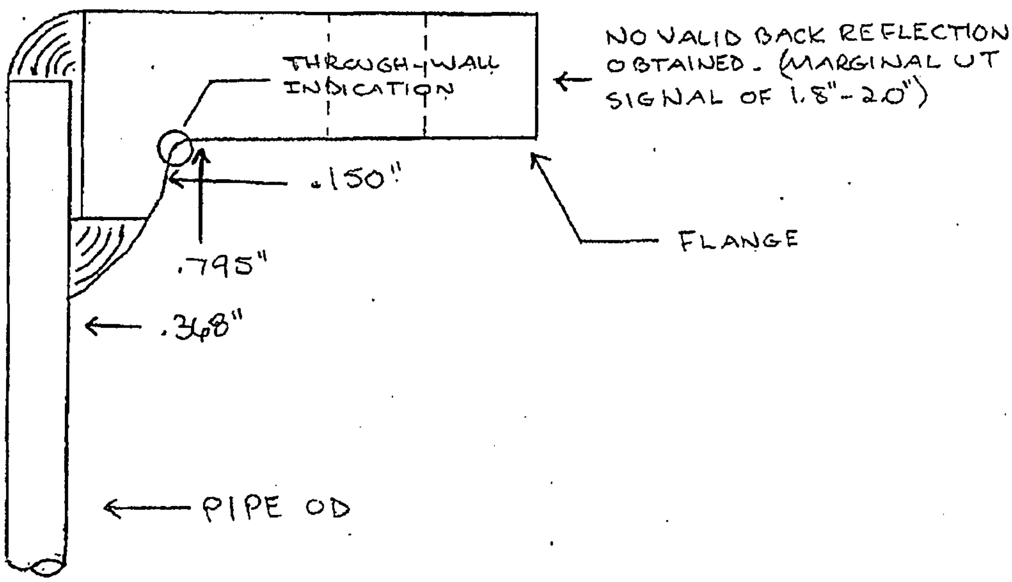
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 2 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

READINGS OBTAINED AT FLAW ZONE (11:00 position)



Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Buehler Level II Date 8/17/11

ANII N/A Date N/A

Level of Use
Reference

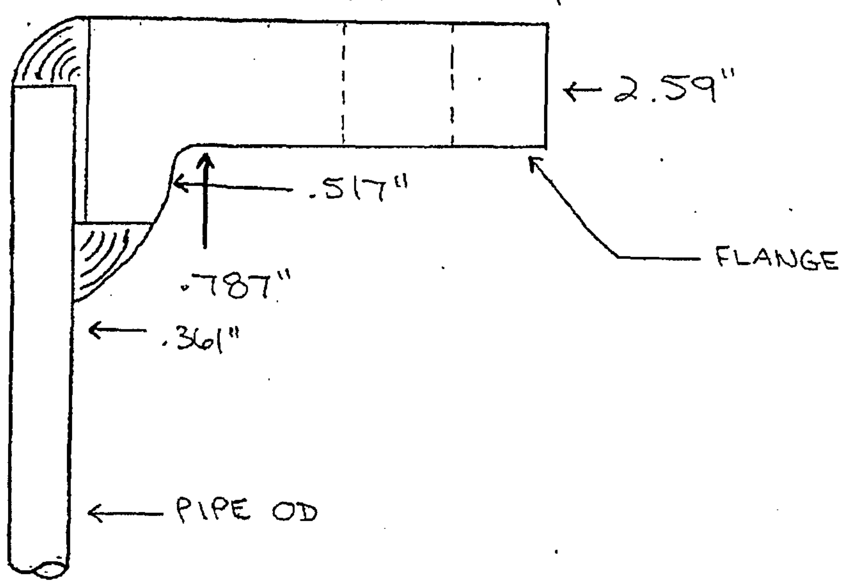
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 3 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

UT READINGS OBTAINED BETWEEN BOLT HOLES ADJACENT TO FLAW ZONE (CW SIDE) AT 1200 POSITION



Examiner Comments: SCANNED EACH POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED.

Examiner TODD BOHNENKAMPER / [signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Brehler Level II Date 8/17/11

ANII N/A Date N/A

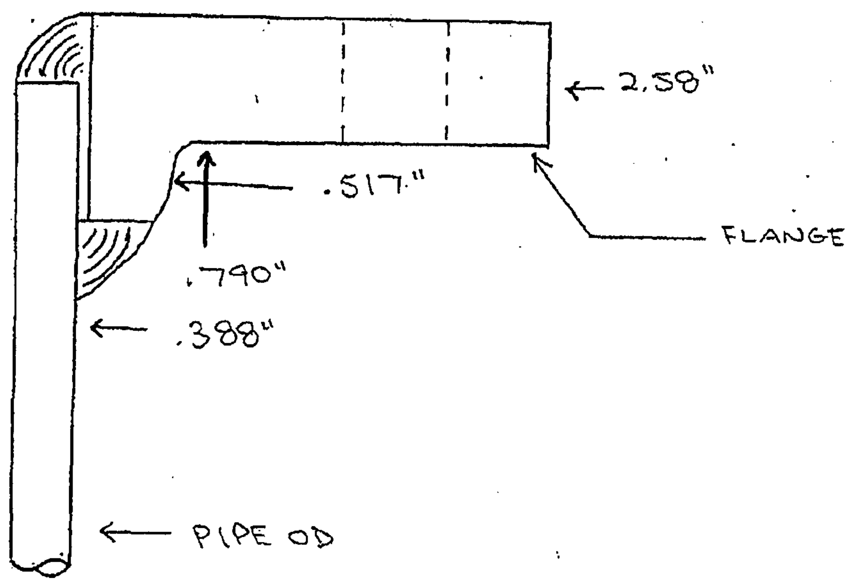
GENERIC SKETCH SHEET

Plant Millstone Unit 2 Page 4 of 4

System "A" Train Service Water Zone N/A Exam Package N/A

Component ID Line 10" JGD-4

READINGS OBTAINED BETWEEN BOLT HOLES ADJACENT TO FLAW ZONE (CCW SIDE) AT 10:00 POSITION



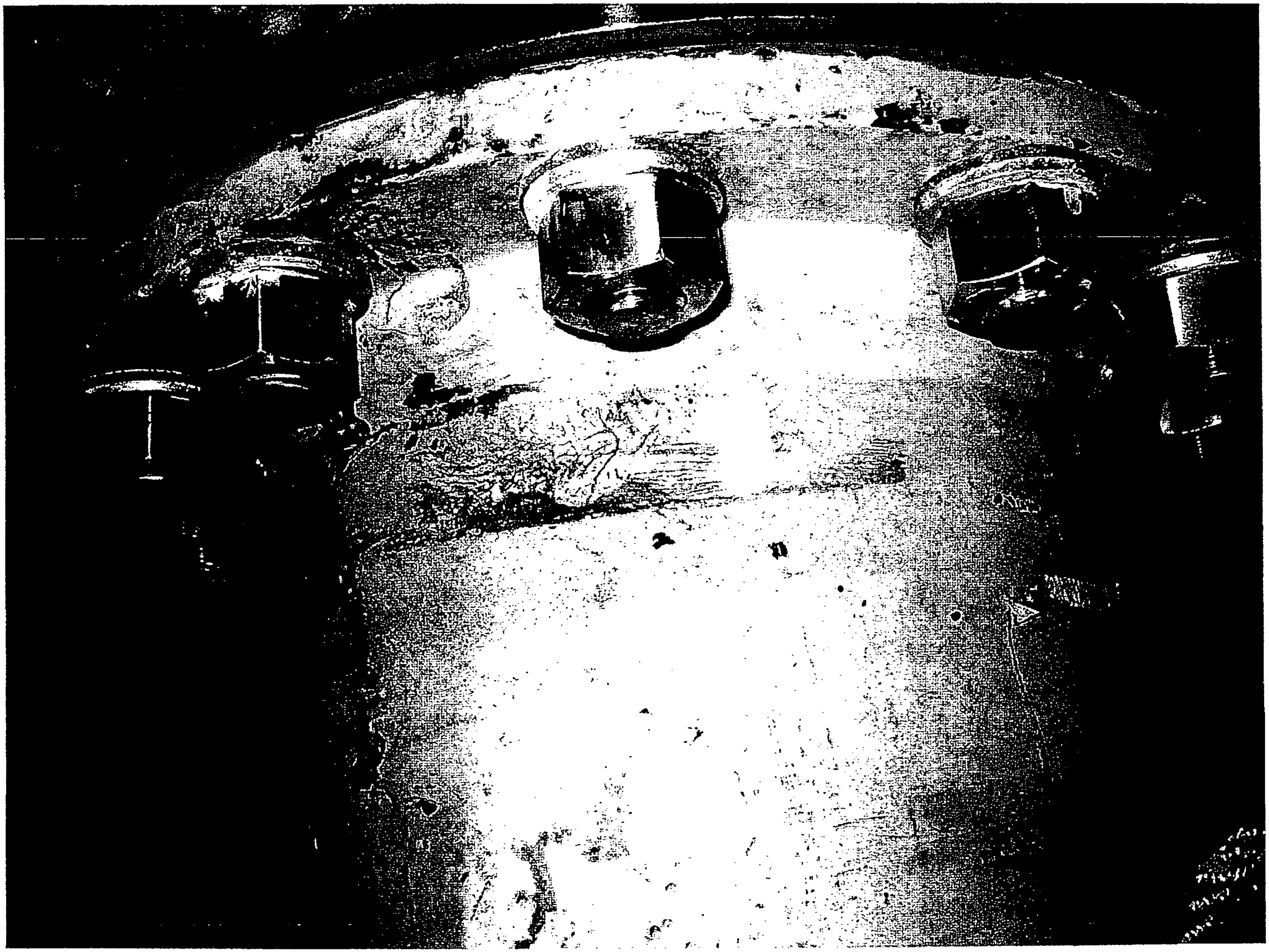
Examiner Comments: SCANNED EACH UT POINT BETWEEN BOLT HOLES AND RECORDED MIN. THICKNESS DETECTED

Examiner TODD BOHNENKAMPER/[signature] Level II Date 8/17/11

Examiner N/A Level N/A Date N/A

Reviewer [signature] for M. Bretter Level II Date 8/17/11

ANII N/A Date N/A




Attachment B


Attachment B
18