Entergy

Entergy Operations, Inc.
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CNRO-2002-00011

March 6, 2002

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555-0001

Subject: Entergy Operations, Inc.
Use of Mechanical Nozzle Seal Assemblies

Waterford Steam Electric Station – Unit 3
Docket No. 50-382
License No. NPF-38

Reference: Letter CNRO-2002-00010 from Entergy Operations, Inc. to the NRC, "Use of Mechanical Nozzle Seal Assemblies," dated March 1, 2002

Ladies and Gentlemen:

In the referenced letter, Entergy Operations, Inc. (Entergy) submitted to the NRC staff a request to use the new design of the Mechanical Nozzle Seal Assembly (MNSA-2) in applications at the Waterford Steam Electric Station – Unit 3 (Waterford 3).

To assist the staff with its review of the request, Entergy is submitting via this letter the revised stress report, Westinghouse Design Report No. DAR-CI-02-1, "Addendum to CENC-1244 Analytical Report for Waterford Unit 3 Pressurizer," which provides methodology used to determine acceptable application of the MNSA-2 in conformance with ASME Code requirements. The revised report is contained in Enclosure 2.

In addition, Entergy is also including responses to issues raised by the staff at the January 31, 2002 meeting at which Entergy discussed the MNSA-2 design and application. These responses are contained in Enclosure 3.

Entergy considers the information contained in Enclosure 2 to be proprietary and confidential pursuant to 10 CFR 2.790(a)(4) and 10 CFR 9.17(a)(4). As such, Entergy requests this information be withheld from public disclosure. The affidavit supporting this request is provided in Enclosure 1. Because the vast majority of the information contained in Enclosure 2 is considered proprietary, Entergy considers it impractical to provide a nonproprietary version.

This letter contains no commitments.

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Should you have any questions regarding this request, please contact Guy Davant at (601) 368-5756.

Very truly yours,

JR Hamilton

John R. Hamilton
Manager, Engineering Programs

JRH/GHD/baa
Enclosures:
1. Affidavit for Withholding Information from Public Disclosure
2. Westinghouse Design Report No. DAR-CI-02-1, "Addendum to CENC-1244 Analytical Report for Waterford Unit 3 Pressurizer"
3. Responses to NRC Issues Regarding the MNSA-2 Design

cc: Mr. W. R. Campbell (ECH) (w/o)
Mr. J. K. Thayer (ECH) (w/o)
Mr. J. E. Venable (W3) (w/o)

Mr. T. R. Farnholtz, NRC Senior Resident Inspector (W3) (w/o)
Mr. N. Kalyanam, NRC Project Manager (W3)
Mr. E. W. Merschoff, NRC Region IV Regional Administrator (w/o)

ENCLOSURE 1

AFFIDAVIT FOR WITHHOLDING INFORMATION FROM PUBLIC DISCLOSURE

AFFIDAVIT
FOR WITHHOLDING INFORMATION FROM PUBLIC DISCLOSURE

I, John R. Hamilton, Manager, Engineering Programs, of Entergy Operations, Inc. (Entergy) do hereby affirm and state:

1. Entergy is providing information in support of a request made to the NRC staff. The document being provided in Enclosure 2 (Westinghouse Design Report No. DAR-CI-02-1, "Addendum to CENC-1244 Analytical Report for Waterford Unit 3 Pressurizer") of this letter contains technical information developed by Entergy and Westinghouse and owned by Entergy regarding the improved Mechanical Nozzle Seal Assembly (MNSA) design.

   Enclosure 2 contains proprietary commercial information that should be held in confidence by the NRC pursuant to 10 CFR 9.17(a)(4) and the policy reflected in 10 CFR 2.790, because:

   i. The information is being held in confidence by Entergy. Because of the substantial investment made to develop this information and its commercial viability, Entergy has not released it to the public.

   ii. The information is of a type that is customarily held in confidence by Entergy and not disclosed to the public.

      ii.1 The information reveals distinguishing aspects of the improved MNSA design where its use by other companies without license or agreement from Entergy would prevent Entergy from recouping its investment in developing the component.

      ii.2 The information contains supporting data relative to the improved MNSA design, the application of which increases Entergy's ability to recoup its investment in developing the component.

      ii.3 The use of the information by another company would reduce its expenditure of resources in the design or licensing of a similar product.

   iii. The information is being transmitted to the NRC in confidence with the understanding that the NRC will hold the information in confidence while determining if it meets the requirements of 10 CFR 2.790(b)(4). If the NRC determines that the information does not meet the requirements of 10 CFR 2.790(b)(4), the information will be returned to Entergy.

iv. The information is not available in public sources and could not be gathered readily from other publicly available information. The information has been developed by Entergy and Westinghouse and has not been made available to the public by either company.

v. The information sought to be withheld is that which is contained in Enclosure 2 of this submittal. This information is submitted for use by the NRC staff and is expected to be applicable in other license submittals for justification of the use of the improved MNSA design. The information provided in this document represents a substantial investment, public disclosure of which would reduce Entergy's ability to recoup part or all of that investment.

2. Accordingly, Entergy requests that the designated document be withheld from public disclosure pursuant to 10 CFR 2.790(a)(4) and 10 CFR 9.17(a)(4).

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 5, 2002

JR Hamilton

John R. Hamilton

ENCLOSURE 3

RESPONSES TO NRC ISSUES REGARDING THE MNSA-2 DESIGN

RESPONSES TO NRC ISSUES REGARDING THE MNSA-2 DESIGN

BACKGROUND

On January 31, 2002, representatives of Entergy Operations, Inc. (Entergy) met with representatives of the NRC staff to discuss Entergy's intent to request use of an improved Mechanical Nozzle Seal Assembly (MNSA-2) design. At that meeting, the staff raised several issues regarding the MNSA-2 design and requested Entergy to respond in order to support their review of the request. These issues and their associated responses are provided below.

ISSUES

1. The telltale leak-off connection of the MNSA-2 will allow oxygen ingress to the cavity/crevice between the seals. Please address corrosion of all parts. Note the similarity of environment to the control rod drive mechanism (CRDM) corrosion issues and potential for accelerated corrosion of Alloy 600 in potentially oxygenated crevice.

   Response:

   The MNSA-2 design has a primary Grafoil seal that is maintained under constant load using the Belleville washer stacks as a preloading mechanism that can accommodate a fair amount of temperature differential growth between the bolts and compression collar. In the unlikely event of leakage past the primary seal, fluid enters an annulus between the sleeve/nozzle either directly along the sleeve outer diameter (OD), or seeps through the primary seal outward into a narrow passage that is blocked to the outside region by a secondary Grafoil tape seal. The fluid then would be channeled through passages into the previously mentioned cavity between the sleeve/nozzle and compression collar inner diameter (ID). From there, the fluid will escape through a small fitting into a telltale tube. Failure of the secondary seal is unlikely since it is not subjected to any pressure, except in the case of completely clogged leak-off channels, which could only occur if the primary seal failed. A discussion dealing with the specific corrosion issues was provided in Appendix 1 of the Request W3-R&R-002, Rev. 0[1].

2. Reinforcement calculations should show compliance to Code.

   Response:

   The reinforcement calculations are in strict compliance with the ASME Code and are presented as such in the new stress calculations for the pressurizer. The calculations are located in Section 6.3.2 of Attachment C of the Design Report Addendum.

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[1] Letter CNRO-2002-00010 from Entergy to the NRC, "Use of Mechanical Nozzle Seal Assemblies," dated March 1, 2002

3. Regarding the limit of compression, what are the limits for maximum torque and what part(s) are limiting (weakest link)?

Response:

The stress calculations document the installation torque values (e.g. 27 ft-lbs.). The tolerance is +/- 1 ft-lb., which is less than 4% of nominal. Most of the calculation procedures utilize nominal values combined with conservative assumptions; thus, use of nominal figures is justified. Because of different diameters in heater sleeves and in instrument nozzles, different torque values are used for the MNSA-2 attachment points. The weakest areas of the design are the threaded rods (thus also tapped holes in the vessel shell) and the compression collar. For the larger diameter pressurizer penetrations (Waterford 3 heater sleeves) the threaded rods are limiting; for the smaller diameter instrument nozzles, the compression collars are limiting.

For the Waterford 3 MNSA-2s, the following installation torque values are specified and will be incorporated into the installation procedures.

LOCATIONS	**TORQUE VALUES**
Heater Sleeve MNSA-2	27 ft-lbs. $\pm$ 1 lb.
Side Shell Pressurizer MNSA-2	27 ft-lbs. $\pm$ 1 lb.
Lower Level Instrument MNSA-2	24 ft-lbs. $\pm$ 1 lb.

4. What is the increase in cumulative usage factor?

   a. MNSA-2 vs. original design?

   b. MNSA-2 vs. original MNSA-1?

Response:

LOCATIONS	**USAGE FACTORS**			
	MNSA-2	*Original Design*	*MNSA-1*	*Half Nozzle*
Counterbore/Bore	0.846	0.279	N/A	0.106
Tapped Hole	0.539*	N/A	0.539*	N/A

* The usage factor of 0.539 is determined for the side shell temperature nozzle pressurizer MNSA-2, in the tapped hole region, for a conservative number of 500 heat-up and cool-down cycles. The usage factor would be similar for an original MNSA-1. The high usage factor of 0.846 occurring in the counter-bore region of the side shell temperature nozzle location is not applicable for the original MNSA-1.

5. Address life extension considerations, if applicable. Is the number of fatigues cycles chosen for analysis consistent with life extension? Include Part 54 analysis.

   Response:

   Waterford 3 is not yet considering life extension.

6. Provide and compare values of coefficient of thermal expansion for the MNSA-2 clamp and pressurizer vessel materials.

   Response:

   The stress calculations include, in tabular form, thermal expansion coefficients from the ASME Code for the pressurizer vessel material and for all MNSA-2 materials. These tables are included in Section 6.2.4.1 of Attachments A and B of the Design Report Addendum.

7. Address and justify stress concentration values for the counterbore region. Are these values taken from Peterson or finite element analysis (FEA)? Why not use limiting stress concentration factor (SCF) of 5 from ASME?. It appeared the January 31, 2002, presentation was inconsistent. Apparently for some calculations, the ASME limiting value was used, for others Peterson, and for others FEA. Entergy should select, use, and defend the appropriate value.

   Response:

   Section 3.1 of Attachment C of the Design Report, Assumption 4 (page 10) states that the fatigue strength reduction factor (FSRF) for the counterbore region is 3.36 for a spherical shell and 3.01 for a cylindrical shell - both values which come from Peterson. However, the report also states in this same assumption that the FSRF is conservatively assumed to be 4.0. For the tapped hole region, the FSRF value of 4.0 is used, which is the maximum per Paragraph NB-3232.3 (c) of the ASME Code Section III, as recommended by the NRC on the Calvert Cliffs MNSA project.

   For the grooved section in the MNSA-2 clamp a FSRF from Peterson was unknown. Thus, a very conservative FSRF of 5 was used, which is the maximum value per Paragraph NB-3222.4 (e) (2) of the ASME Code Section III for fatigue evaluation. The table below specifies the FSRFs used for the different locations.

FATIGUE STRENGTH REDUCTION FACTORS

Location	Peterson	ASME Code	Values Used
Counter Bore Region	3.36	4	4
Tapped Hole Region	N/A	4	4
Nozzle Groove	<< 5	5	5

8. If FEA was used to determine the stress concentration factor, show that the mesh was fine enough to accurately determine the value.

   Response:

   The intent of the FEA was not to determine the FSRFs. The intent was to use either the ASME Code or the Peterson values to determine the FSRF. The FEAs were performed to determine the interaction between the counterbore and tapped hole stresses, as well as between adjacent MNSA-2 stresses. The current model contains over 539,000 elements, but the mesh is not fine enough to determine a FSRF. The FSRF numbers are explained in the response to Issue #7, above.

9. Regarding the thermal model was the model axy-symmetric? Was the bolting material considered as a heat sink? Is insulation required?

   Response:

   The thermal model used for "steady-state" and "transient" thermal analyses of the pressurizer shell and the MNSA-2 components is an axis-symmetric model. The MNSA-2 was adequately modeled as a symmetric structure. A thin tube section with heat transfer characteristics that simulated those of four "fins" each modeled the four tie rods and the four threaded rods. The pressurizer vessel acts as the heat source with the MNSA-2 components (compression collar, heater sleeve, flanges, tie rods, threaded rods, impact plate, Belleville washers) thermally interconnected where they are in contact with each other. The model permitted heat transfer due to axial conduction and due to radial convection with the environment at 120° F. Based on the spreadsheet computations, it was verified that the non-insulated MNSA-2 would result in less desirable temperature differentials than the insulated MNSA-2 design. Since Entergy desired to have the option of not insulating the MNSA-2 after installation, this more conservative situation was used as the basis for the analyses. The case of insulted MNSA-2 installations is bounded. The comparisons between the spreadsheet computations and the FEA results can be found in Appendix B-5 of Attachments A and B of the Design Report.

10. Address the effect on the thermal analysis of the studs bottomed into the tapped holes. The stud is torqued into the hole and stud expansion is greater than the pressurizer creating interference stresses in the hole.

    Response:

    The stress due to dissimilar materials is now being considered in the fatigue evaluation of the tapped holes with the threaded rods inserted. Utilizing the more conservative stress results from the classical methodology, a maximum usage factor of 0.539 is obtained for a conservative number of 500 heat-up and cool-down cycles combined with 200 leak test cycles. A significant reduction in the usage factors would be realized if the currently specified number of cycles are reduced to reflect actual plant operations. The usage factor calculations for the tapped holes in the pressurizer can be found in Sections 6.3.6, 6.3.10, and 6.3.14 of Attachment C of the Design Report Addendum. The corresponding usage factor calculations for the threaded rods of the MNSA-2 are contained in Section 6.3.4 of both Attachments A and B of the report addendum.

11. Address preload credited to reduce ejection impact.

    Response:

    Each MNSA-2 stress analysis is quite specific about the gap or preload conditions at the anti-ejection plate and the changes of these conditions as a result of heat-up. Typically the worst impact load results when the MNSA-2 assembly is hot since this causes either the gap to increase or the preload to decrease. In case of an initial preload (Waterford 3 heater sleeve MNSA-2), a moderate load of 3,422 lbs. (Section 6.3.1.2.3 of Attachment A of Design Report) is transmitted into the J-weld that is fully accounted for in the evaluations of the pressurizer shell, attachment locations/heater sleeve. At cold conditions this pre-load would reduce based on the ratio of cold versus hot bolt pre-load (3,275 / 4,150 = 0.789). An allowable load of 4,560 lbs. is determined in Section 6.3.17 of Attachment C of the Design Report Addendum. This allowable load is based on a minimum weld shear length and a maximum shear stress allowable of 10% of Yield (based on 1983 conservative directive to utilities to protect J-weld from cracking, with copy included in Appendix B of Attachment C).

    The gap/pre-load conditions determined for the MNSA-2 are being addressed by the installation procedures.

12. Provide an analysis to show the effect of the J-weld present and not present.

    Response:

    The MNSA-2 stress analyses consider the loads throughout the MNSA-2 and those into the pressurizer attachment points for both situations, prior to heater/sleeve or nozzle ejection and after complete failure of the J-weld.

13. Provide or justify Grafoil compression curves used for compression loading.

    Response:

    The Grafoil compression curves are included in the MNSA-2 stress analyses, Appendix B-2 for Attachments A and B of the Design Report. Their use is discussed in the calculation sections of Attachments A and B of the Design Report..

14. Provide a commitment to inspect the MNSA-2 leak-off as part of Generic Letter (GL) 88-05 walkdown.

    Response:

    Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," was issued to ensure that boric acid corrosion is identified and properly addressed to prevent component degradation. Specifically, on page 3 of the generic letter the following was requested of licensee's programs:

2) Procedures for locating small coolant leaks (i.e., leakage rates at less than technical specification limits). It is important to establish the potential path of the leaking coolant and the reactor pressure boundary components it is likely to contact. This information is important in determining the interaction between the leaking coolant and reactor coolant pressure boundary materials.

This is accomplished at Waterford-3 via procedural and program actions established as part of the committed actions to GL 88-05. These actions are maintained as commitments in the Waterford 3 commitment management system.

Procedure UNT-007-027, "Control of Boric Acid Corrosion on the Reactor Coolant System," provides guidance on the conduct of the boric acid inspections for GL 88-05. Specifically, walkdowns are to be conducted of the reactor coolant system (RCS) to identify potential boric acid leakage. Specific areas to be included are the reactor coolant pumps, steam generators (primary), pressurizer, RCS piping (including hot and cold leg nozzles), and the reactor head. The timing for performing the walkdowns is based on accessibility of the RCS.

15. Regarding flaw analysis, justify flaw growth from fatigue and stress corrosion cracking. Include life extension, if applicable. If analysis in the topical report is used, must justify applicability. Address differences from topical report.

Response:

Bounding flaw evaluations will be performed for all pressurizer nozzles in accordance with the 1992 ASME Code Section XI, IWB-3600 to address MNSA-2 installation. Existing site-specific heater sleeve flaw evaluations are being updated to address the installation of the MNSA-2 clamp. Flaw growth due to fatigue and stress corrosion cracking has been previously considered and will be re-evaluated for potential MNSA-2 installation effects.

16. Provide information to justify expedited review by NRC based on "four pillars". Address man-rem savings as result of MNSA use and any cost savings.

Response:

The nuclear utility industry has experienced primary water stress corrosion cracking (PWSCC). This cracking phenomenon occurs near the J-groove weld on small bore penetrations on the NSSS. With time, a crack propagates from the ID of the nozzle to the OD causing a primary pressure leak that could potentially result in forced or extended outages. The predictability of these leaks is not well defined. Some industry experts on the subject have stated that the time-to-failure can only be predicted within a 10 to 15-year band. Therefore, it is difficult to determine when and if the existing nozzles should be replaced. The only advantage replacement nozzles have over the original nozzles is the quality of the material used in the replacement nozzles. The replacement nozzle material, Alloy 690, is less susceptible to PWSCC than the original Alloy 600 material.

Replacement/repair methods require at least 5 to 10 days to implement, leave high residual stresses, are very labor intensive, involve high radiation exposure, and are extremely costly. Although the original MNSA design could have been qualified and applied to the Waterford 3 pressurizer nozzles and heater sleeves, Entergy desires a more reliable, standardized design that can be pre-manufactured and ready to install, as opposed to the custom design and machining required on the original MNSA. The benefits to Entergy, and the industry, in approving the MNSA-2 relief request are described below:

1. <u>Installation time</u>

   Installation time should be reduced from 5 to 10 days on a welded repair to approximately 1 day utilizing the proposed MNSA-2. Tooling and equipment can be pre-staged, and maintenance personnel trained in advance for this task. In contrast to the MNSA-2, the original MNSA requires as-built dimensions of the vessel to heater sleeve interface, and for nozzles, the dimensions of connected piping or tubing to allow design of the anti-ejection provisions and seating components. Typical practice is to take action to acquire a MNSA once a leaking nozzle is discovered. Such action involves:

   - Obtaining field measurements of the nozzle area
   - Preparing custom design drawings for the specific application
   - Machining the MNSA components
   - Shipping the MNSA tooling to the site
   - Installing the MNSA

   With the MNSA-2, as-built dimensions are not required, the components can be pre-fabricated and shipped to the site and available for installation prior to an actual need. Therefore, several days can be saved using the MNSA-2 versus the original MNSA.

2. <u>Labor man-hours</u>

   Current nozzle weld repair methods are labor intensive, requiring separate crews for welding, field machining, insulating, scaffolding, HP and QA support. The MNSA-2 design eliminates some field machining and all welding, and reduces the overall repair/replacement period from a maximum of 5 to 10 days to approximately 1 day. This dramatically decreases the required man-hours.

3. <u>Costs</u>

   The cost for repairing 12 heater sleeves at ANO-2 during a mid-cycle outage was approximately $2,000,000, or $166,667 per nozzle. These costs included the stress analyses, Section XI flaw analysis, design change package preparation, and installation costs. Lost generation revenues are not included.

   The estimated costs to design, qualify, and install MNSA-2s on 12 heater sleeves is approximately $950,000. This estimate includes the costs for design, development, and an enveloping qualification that encompass all of the applicable pressurizer nozzle and heater sleeve locations for ANO-1, - 2, and Waterford 3.

This represents potential savings of 50% over welded repairs. Future installations will cost even less since the one-time expenses will not be included. Therefore, total costs for fabricating and installing the MNSA-2 are expected to be less than $13,000 per nozzle, which is significantly less than the $166,667 per welded nozzle described above. This significant cost reduction is due the reduction in labor hours, one-time design, testing, and enveloping analyses for all locations, and onsite personnel performing installation.

4. <u>Radiation Exposure</u>

   Levels of radiation exposure associated with current weld repair methods are high because the nozzle penetrations are part of the primary pressure boundary, and also due to the time required for the repair process. The "stay time" and number of personnel required is significantly reduced by eliminating welding and some field machining activities. This results in a reduced estimated radiation exposure of approximately 66%. This does not include the elimination of potential airborne contaminants since welding is not required. Additionally, potential for personnel contamination is significantly reduced because the pressure boundary is not breached. Specific dose information is provided in the response to Issue #17, below.

5. <u>Forced or Extended Outages</u>

   The MNSA-2 is expected to reduce outage time significantly in the event a failure were to occur on one or more of the pressurizer nozzles or heater sleeves. The schedule impact on a forced outage could be reduced from 5 to 10 days for a welded repair to approximately 1 day for a MNSA-2 installation.

6. <u>Lost revenue</u>

   The cost of lost generating revenue and outage expenses for a single nuclear unit may be as high as $1 million per day. Thus, the total cost impact of weld repairing a leaking nozzle could range from $5 to 10 million. Using the MNSA-2 design, the impact would be reduced substantially assuming a one-day installation period.

7. <u>Safety</u>

   The MNSA-2 is designed with redundancy, essentially eliminating concern for PWSCC. The design does not credit the J-weld, assuming that the nozzle is completely severed at or near the weld. Additionally, the design provides a reactor coolant leak-off feature diverting potential leakage that could occur if the primary seal were to degrade. The original MNSA design includes leak-off provisions. However, leakage is significantly less likely on the MNSA-2 due to the superior seal seating design and the live loading of the seal. (See the discussion regarding the leak-off connection in the response to Issue #1, above.)

   Beyond the MNSA-2 component itself, safety concerns associated with core off-load or operation at reduced inventory are also minimized because the RCS does not have to be drained to install the MNSA-2. Field machining tooling is designed to allow the counterbore for the seal to be installed without disconnecting the connected piping or tubing from instrument nozzles and without removing heater elements from heater sleeves.

17. Provide a list of previous MNSA installations, with Man-rem savings.

Responses:

MNSA repairs have been installed at the following plants and locations:

- Maine Yankee - side pressurizer
- SONGS 2 - 2 Steam Generator, 2 Bottom Pressurizer, 2 Hot Leg
- SONGS 3 - 2 Bottom Pressurizer, Side Pressurizer
- Waterford 3 - 3 hot leg nozzles
- Calvert Cliffs 2 - Pressurizer side RTD nozzle, 2 Bottom Pressurizer Nozzles
- Calvert Cliffs 1 - Pressurizer side RTD nozzle, 2 Bottom Pressurizer Nozzles, 4
- Top Pressurizer Nozzles
- Palo Verde 3 - 1 hot leg RTD nozzle
- Fort Calhoun - 1 Pressurizer Upper Head RTD Nozzle

Entergy does not have access to the exposure records for these plants, but for comparison purposes a simplistic dose savings analysis is performed below. The analysis uses actual data from the 12 heater sleeves repaired at ANO-2 and an assumed total of 50 man-hours/nozzle if Entergy had installed the MNSA-2 instead of the welded repair.

Dose Received	27,345 milli-rem (mr)
Radiation Work Permit Hours	1,748 man-hrs
Hours / Nozzle	1,748 man-hrs / 12 nozzles = 145 man-hr/nozzle
Dose Rate	27, 345 mr / 1,748 man-hr = 15.64 mr/man-hr
Dose / Nozzle	15.64 mr/man-hr x 145 man-hrs/nozzle = 2,267.8 mr/nozzle
Estimated Time to Install a MNSA-2	50 man-hrs
Dose per Nozzle for MNSA-2	15.64 mr x 50 man-hrs = 782 mr/nozzle

Dose Savings using MNSA-2	2,267.8 mr/nozzle – 782 mr/nozzle = 1,485.8 mr/nozzle
Total Dose using MNSA-2 Instead of Welded Repair	782 mr/nozzle x 12 nozzles = 9,384 mr

If the MNSA2 design had been available at ANO-2, a total dose of 17,961 mr (27,345 mr – 9,396 mr) would have been realized. This is approximately a 66% savings in radiation exposure.

18. Prepare road map showing the various calculations, test reports, and other documents that will be a part of the submittal and how they relate to each other and the relief request, including submittal schedule for each part.

Response:

This document was provided to the NRC in Attachment 3 of Entergy letter CNRO-2002-00010, "Use of Mechanical Nozzle Seal Assemblies," dated March 1, 2002.