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Paul D. Hinnenkamp
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RBG-45940

May 14, 2002

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

Subject: River Bend Station
Docket No. 50-458
License No. NPF-47
License Amendment Request (LAR) 2001-43, "High Energy Line Break Analysis Method"

Dear Sir or Madam:

Pursuant to 10CFR50.90, Entergy Operations, Inc. (Entergy) hereby requests the following amendment for River Bend Station, Unit 1. The proposed change revises the method of analysis for the High Energy Line Breaks in the subcompartments inside and outside of containment. This change is the result of a change in the method of analysis code from THREED to GOTHIC. This is a change in an evaluation methodology according to the current 10CFR50.59 regulation, and a submittal is required by 10CFR50.59(c)(2) (viii). The proposed changes to the Updated Safety Analysis Report are provided for information.

The proposed change has been evaluated in accordance with 10CFR50.91(a)(1) using criteria in 10CFR50.92(c) and it has been determined that this change involves no significant hazards considerations. The bases for these determinations are included in the attached submittal.

The NRC has approved similar changes using GOTHIC for other plants including Joseph M. Farley Nuclear Plant, Units 1 and 2 and Waterford 3.

This amendment is required to implement a modification during Refueling Outage 11 scheduled to begin March 14, 2003. Entergy requests approval of the proposed amendment prior to this outage. Once approved, the amendment will be implemented prior to startup from the outage.

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The proposed change does not include any new commitments. If you have any questions or require additional information, please contact Barry Burmeister at 225-381-4148.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 14, 2002.

Sincerely,

Paul D. Hinnenkamp
Vice President, Operations

Attachments:

1. Analysis of Proposed change to the method of analysis code
2. Proposed Updated Safety Analysis Report Changes (mark-up)

cc: U. S. Nuclear Regulatory Commission
Region IV
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NRC Senior Resident Inspector
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Mr. David Wrona
U.S. Nuclear Regulatory Commission
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bcc: File Nos.: G9.5, G9.42
RBEXEC-02-008
RBF1-02-0072
RBG-45940

Attachment 1

1.0 DESCRIPTION

River Bend Station (RBS) plans to use the GOTHIC (Generation of Thermal-Hydraulic Information for Containments) code to replace the current vendor THREED code for room pressure-temperature analyses due to High Energy Line Breaks (HELB). The reasons for this change are the lack of support for the THREED code by the vendor and the additional capabilities of the GOTHIC code. Use of the GOTHIC code will allow for these analyses to be performed by Entergy personnel with an established code used widely through the nuclear industry. EOI is also considering future use of this code to perform other containment pressure-temperature examinations in support of RBS Updated Safety Analysis Report (USAR) Section 6.2 licensing basis analyses, which were originally analyzed with the vendor THREED code.

To address plant operational issues and modifications, the HELB analyses require re-analysis. The GOTHIC code will be used to perform this analysis. One planned modification will add additional delay time to the initiation logic for the Leak Detection System temperature setpoints, which provide the isolation signals credited to mitigate HELBs in both the Auxiliary and Containment Buildings. To support these activities, GOTHIC models were constructed to perform the HELB analyses. While the modification to add an additional time delay is a change in an input parameter for the analysis, and would not require NRC approval, the change in the analysis code from THREED to GOTHIC does present a deviation in an evaluation methodology according to the current 10 CFR 50.59 regulation. Therefore, NRC approval of this change in methodology is required. The proposed changes to the Updated Safety Analysis Report (USAR) are provided for information.

Through benchmarking, it has been demonstrated that the use of the GOTHIC computer code for the HELB response analyses produces results that are consistent with the current licensing basis computer code (THREED).

2.0 PROPOSED CHANGE

This amendment request provides the basis for revising the current HELB analysis method for the Auxiliary and the Containment Buildings from the current vendor supplied THREED code to the GOTHIC code. The changes will affect RBS USAR Appendix 3B and USAR Sections 6.2.1.1.3.2.1 and 6.2.1.2 as shown in Attachment 2.

3.0 BACKGROUND

GOTHIC is a general purpose volumetric thermal-hydraulic computer program for design, licensing, safety and operating analysis of nuclear power plant containment and other confinement buildings. GOTHIC has many applications including evaluation of containment response due to Design Basis Accidents such as Loss of Coolant Accidents (LOCA), and containment subcompartment pressurization response to the full spectrum of high energy line breaks. This code is also used for calculation of room temperature response due to failed or degraded room cooling systems, and calculation of temperature profiles for equipment qualification, inadvertent system initiation, and degradation or failure of engineered safety features.

Numerical Applications, Inc. (NAI) developed the GOTHIC code for the Electric Power Research Institute (EPRI). GOTHIC is qualified under the NAI QA program which conforms to the requirements of 10CFR50, Appendix B with error reporting in accordance with 10CFR21. Other plants, such as Joseph M. Farley Nuclear Plant, Units 1 and 2 and Waterford 3 have used the GOTHIC computer code to perform containment response analysis. Other sites have already used GOTHIC for HELB analyses and room heatup analysis. The Waterford 3 GOTHIC models were developed for LOCA analyses. These models were benchmarked against the current licensing containment response analysis code for these plants with good agreement between the two code results.

As part of River Bend initial licensing, pressure response analyses were performed for the various volumes containing high-energy piping. A detailed discussion of the line breaks selected, vent paths, room volumes, analytical methods, pressure results, etc, has been provided in Updated Final Safety Analysis Report (USAR) section 6.2.1.2 for containment subcompartments and in Appendix 3B for subcompartments located outside the containment. The NRC staff reviewed the information and performed an independent analysis of the subcompartment environmental conditions following an HELB as discussed in Supplemental Safety Evaluation Report 3 of NUREG-0989.

USAR Section 3.6A defines the complete set of break locations in the high energy piping outside containment from which the design basis breaks for subcompartment pressurization were selected. The definitions for high energy and criteria for protection against dynamic effects associated with postulated rupture of piping are also given in Section 3.6A. The re-analysis did not affect the break locations previously identified.

USAR Appendix 3B provides the design bases, design features, and design evaluation for the pressure response analyses performed for the structural design basis of the main steam tunnel and other subcompartments in the Auxiliary Building for postulated ruptures of high-energy piping.

In addition to the use of THREED to conduct pressurization analysis, this code was also used to provide equipment qualification (EQ) environmental data. A number of models of Containment and Auxiliary Building areas were constructed to determine the necessary EQ parameters. As with the subcompartment pressurization analysis, GOTHIC will be available for use to conduct future EQ analyses.

The use of the GOTHIC code is proposed for the in-house HELB analyses at River Bend Station since an updated HELB model cannot be maintained with the THREED code. The GOTHIC code also provides improvements in capabilities and modeling when compared to the previous THREED code. In the new analyses, the mass and energy release rates for the postulated HELBs have been updated to account for as-built plant conditions (leak detection system logic delay times, isolation valve stroke times, etc.). The mass and energy releases also account for the effects of pipe friction; this had only been considered in certain cases before. The HELB model description and pressure transient plots in USAR Appendix 3B will be updated correspondingly after NRC approval.

At RBS, a modification was initiated to add additional delay time to the initiation logic for the temperature isolation of high energy lines in the Auxiliary and Containment Buildings. The HELB analyses for line breaks in Auxiliary and Containment Buildings are impacted due to the additional time delays. In order to support the proposed modification, Auxiliary and Containment Building GOTHIC models were constructed to perform the HELB analyses. Although the additional time delay should be treated as an input parameter which does not require explicit NRC approval, the change in the analysis code from THREED to GOTHIC does present a deviation in an evaluation methodology according to the current 10 CFR 50.59 regulation. This deviation in methodology is the result of the detail contained in USAR Section 3.6A "Protection Against Dynamic Effects Associated With The Postulated Rupture Of Piping," Appendix 3B "Pressure Analysis For Subcompartments Outside Containment" and USAR Section 6.2 "Containment Systems."

The THREED computer program used in the initial design and licensing is similar to RELAP4 and will give the same results as RELAP4 if similar options are chosen. THREED was formulated to perform sub-compartment analyses with capabilities and options extended beyond those available in RELAP4. A significant improvement in THREED was that the homogeneous equilibrium model (HEM) was extended to include two-phase, two-component flow that is encountered in sub-compartment analysis.

4.0 TECHNICAL ANALYSIS

The Auxiliary and Containment Building HELB analyses were initially performed using computer code THREED, to support the design basis structural analysis. Several THREED models have been constructed for the Auxiliary and Containment Building HELB cases. The RBS USAR Appendix 6B has a detailed description of the major features of THREED code. The THREED computer program is used to calculate the transient conditions of pressure, temperature, and humidity in various sub-compartments following a postulated rupture in a moderate- or high-energy pipeline. The results obtained from THREED analyses are used to calculate loads on structures and to define environmental conditions for equipment qualification.

The new RBS HELB models use the GOTHIC code, which has been qualified at RBS. GOTHIC and THREED codes are similar in most aspects. Both codes use control volumes (i.e., nodes), flow paths (i.e., junctions), valve/door models, fan models, and thermal conductors (i.e., heat sinks), etc. Both codes have time dependent boundary condition capabilities. Thus, no significant difference would be expected between these two codes when evaluating identical configurations.

The GOTHIC code is a general-purpose thermal-hydraulics computer program developed by NAI (Numerical Applications, Inc.) under EPRI sponsorship for design, licensing, safety and operating analysis of nuclear power plant containments and other confinement buildings. Applications of GOTHIC include evaluation of containment and containment sub-compartment response to the full spectrum of high-energy line breaks within the design basis envelope as described in USAR Chapter 6, Section 2. Applications may include pressure and temperature determination, equipment qualification profiles and thermal-hydraulic responses to inadvertent system initiation, and degradation or failure of engineered safety features.

GOTHIC is qualified under the NAI QA program which conforms to the requirements of 10CFR50 Appendix B with error reporting in accordance with 10CFR21. NAI has validated and verified the GOTHIC code for its intended purpose. The code validation and verification is documented in a code Qualification Report prepared by NAI for EPRI. The validation and verification objective was to demonstrate the applicability of GOTHIC for use as a best-estimate containment analysis code. In addition to the above validation and verification efforts, GOTHIC has been extensively compared to other codes such as CONTEMPT. The GOTHIC code qualification was performed by the comparison of GOTHIC solver predictions to solutions of analytic problems and to experimental data for containment applications. The objective was to approach qualification on the basis that GOTHIC is intended to be used as a best-estimate containment analysis and volumetric thermal-hydraulic analysis code.

4.1 Differences Between GOTHIC and THREED

Based on the description of the GOTHIC and THREED codes, the table below presents a comparison of significant assumptions used in these two codes as applied at RBS. It clearly shows that a more accurate model can be developed by using the GOTHIC code. Due to the improved accuracy in the model, the new analysis results may slightly differ from those obtained with THREED. However, since the GOTHIC code has been extensively studied against both the analytic and experimental problems, no significant change due to the software (vice input parameters or evaluation options utilized) should be expected. The table below is a comparison of assumptions between THREED and GOTHIC:

THREED (USAR App. 6B)	GOTHIC
Homogeneous flow, unless the Moody choking option is chosen	Inter-phase mass, energy and momentum transfer rates obtained through constitutive relation.
Thermodynamic equilibrium in each node	Separate mass equation solved for each fluid phase, gas component and ice phase. Separate energy equation solved for each fluid phase.
Incompressible form of the momentum equation.	Compressible flow for all fluid phases.
Valve open or close instantaneously	Can model valve closure time.
Water, if present, occupies the entire volume, i.e., a homogenous mixture of vapor and liquid is assumed	Water in liquid phase can be accumulated at the bottom of a control volume.
Air is assumed to be perfect gas	Can model actual air properties. But treat air as ideal gas for mixture calculations.
If air & liquid water are present, the water vapor is saturated (RH=100%)	Can have RH values other than 0% or 100%.
If air is present, liquid water conditions are the saturated condition	Water in vapor phase dependent upon momentum, mass and energy equations.

Note: In the GOTHIC HELB model, the drop-liquid conversion option in the GOTHIC code is not active for the benchmark model. With this option active, GOTHIC can have a liquid pool on the control volume floor, which will effectively reduce the drop phase fraction inside the control volume. THREED assumes that the air/steam/liquid are mixed uniformly and suspended in the air, which is conservative.

4.2 Benchmark

The break locations used in the original analysis remain identical for the benchmark. The mass and energy releases for the benchmark were also identical to those used in the initial analysis. For benchmark purpose, the GOTHIC model of the 6 inch Reactor Water Cleanup system (RWCU) line double ended rupture (DER) in the heat exchanger room was constructed, which duplicates the inputs in the THREED models. The 6 inch DER is chosen because it is the limiting long term pressurization case. The Pressure/Temperature transients as well as the peak Pressure/Temperature values from both models were compared to verify that the use of GOTHIC code is consistent with the approved THREED code that was used in the original design calculations.

For the HELB benchmark analysis inside the containment, the GOTHIC code used a Homogeneous Equilibrium Model (HEM), which is also used in THREED. The Uchida heat transfer coefficient was applied and the condensate revaporization is 100 percent.

- The THREED code was used in previous revisions to obtain the pressure transients for the HELB inside the RWCU heat exchanger room model. For benchmark purpose, a GOTHIC benchmark model was constructed, which matched the THREED model as closely as possible. All the run parameters in the GOTHIC benchmark model were forced to simulate THREED run parameters. The results obtained in the GOTHIC benchmark model were then compared to the THREED results to verify that the use of GOTHIC is capable of producing results that do not depart from results obtained with THREED.

- For conservatism, the vertical ventilation duct in the RWCU heat exchanger room was assumed to remain in place and partially block the flow path out of the RWCU heat exchanger room.

- Heat sinks were modeled to consider the effect of concrete and steel slabs inside the containment. For conservatism, the shield building annulus was included in the model and three external thermal conductors have been modeled to connect the shield building annulus with other containment volumes. This creates heat conduction paths that could add more energy into the containment volumes, which is conservative.

As shown by the results the THREED and GOTHIC benchmark models are in close agreement.

4.2.1 Benchmark Model Results

The comparisons of the Pressure/Temperature transient results in both the GOTHIC benchmark and THREED models show no significant difference in peak pressures between the benchmark GOTHIC and the THREED models. The differences in peak pressures are less than 0.5%.

Negligible difference exists between the peak temperatures in the nodes containing the break and those immediately connected for the benchmark GOTHIC and THREED results. For temperatures in these areas consistent results are obtained in the benchmark GOTHIC model.

A larger (less than 2%) difference exists between the peak temperatures for down stream areas in the benchmark GOTHIC and THREED models where the magnitude of the increase is lower. This difference could be a result of the small differences in the vent path (junction) modeling between the GOTHIC and THREED codes. The junction modeling in the GOTHIC code is more accurate than the THREED code, but needs more input parameters.

Results Summary for the GOTHIC Benchmark and THREED Models
6 inch DER of RWCU line

Node	Peak Pressure (psia) THREED	Peak Pressure (psia) GOTHIC	Peak Temperature (F) THREED	Peak Temperature (F) GOTHIC
1	15.86	15.807	213.35	212.85
2	15.49	15.480	200.43	199.38
3	15.52	15.501	188.05	185.34
4	15.49	15.488	103.29	103.08

As shown in the results the original THREED and benchmark GOTHIC models provide close agreement when modeling the same volumes with identical mass and energy inputs. As a result, the GOTHIC models have been successfully benchmarked against the THREED code for the HELB analysis.

4.3 New HELB Models and Revised Results

As discussed above, the HELB GOTHIC code has been qualified at RBS. Also, the break locations used in the original analysis remain identical for the revised analysis conducted with GOTHIC.

For the revised analysis in the Auxiliary and Containment Buildings, the mass and energy release include the proposed addition of a 5-second time delay. This will result in the extension of the upstream steady-state blowdown time due to the proposed additional logic delay time for the isolation valves. Credit has also been taken for friction; the use of friction in the HELB analysis is consistent with previous THREED analysis as identified in USAR Appendix 3B. As a result, the magnitudes of the mass and energy blowdown rates are expected to be reduced after crediting friction.

4.3.1 New HELB GOTHIC Models

In the revised analysis, all the parameters (control volumes, vent paths, thermal conductors) in the GOTHIC model have been updated with current plant conditions and configurations. The high-energy line break locations remain the same as in the THREED HELB analyses. The mass and energy releases are updated with the new blowdown data assuming the additional time delays and crediting flow friction. GOTHIC, unlike THREED, also has the ability to model break flow as liquid or as drop flow.

The room pressurization due to a HELB has the potential to damage the heating and ventilation ducting which can pass through the subcompartment. As a result, pathways can exist which are not normally in communication with the air volume of the subject room. If the HELB pressurization transient is sufficient to cause duct destruction, a new penetration can create an opening to an adjacent room. The duct flow paths added to the HELB model use the most restrictive flow area (duct area or register area) for the purpose of calculating flow area and hydraulic diameter. Small duct flow paths are not considered. Two cases for each line break have been modeled: duct-destruction (DD) case and non-duct-destruction (NDD) case. The DD case generates more limiting pressure / temperature transients for the subcompartments close to the break room, while the NDD case generates more limiting pressure / temperature transients for the subcompartments that are not adjacent to the break room. The most limiting pressure / temperature transient was used for each subcompartment.

4.3.2 Revised HELB Analysis Results

Using the new HELB model the revised mass and energy blowdown calculations for the Containment Building are crediting friction for the upstream steady-state critical flow only. The mass release rates were calculated based on either Moody critical flow model or Henry-Fauske subcooled critical flow model with conservative assumptions on the fluid conditions. The vent path parameters were set to compressible, Critical Flow Model (HEM), and zero entrainment, which is consistent with the NRC Standard Review Plan guidelines for subcompartment analysis (Standard Review Plan Section 6.2). The peak and differential pressures are 16.286 psia and

1.627 psid in the RWCU Heat Exchanger room and 24.969 psia and 10.425 psid in the RWCU filter/demineralizer room. The current calculated pressures are in USAR Tables 6.2-26 and 6.2-29. The results of the revised analysis, which included the additional instrument delay, remain within the subcompartment design limits of 5.0 psid in the RWCU Heat Exchanger room and 21.0 psid in the RWCU filter/demineralizer room.

In the Auxiliary Building, the most limiting case for the subcompartment pressurization in the revised Auxiliary Building HELB analyses is the 8 inch RHR HELB. The peak pressure of 16.5 psia (i.e., 1.8 psid) is about 0.5 psi lower than the originally calculated peak pressure as in USAR Table 3B-3. This peak pressure is also much lower than the design peak differential pressure, which is 3.30 psid and 2.40 psid for all other zones. More conservatism could be credited since the differential pressures were calculated by subtracting the calculated peak pressure with the environmental pressure (assumed 14.7 psia) instead of the pressure of other EDC zones. Therefore, the new results have no significant impact on the subcompartment pressurization analyses.

The 8 inch Residual Heat Removal (RHR) HELB in the Auxiliary Building is not impacted due to the high steam flow isolation signal which can be credited for this line break. The HELB locations in the Drywell and Main Steam Tunnel were not affected by this change in the leak detection system.

5.0 REGULATORY ANALYSIS

Due to the fact that the assumptions and methodology used in mass and energy release calculations slightly deviate from the original design calculations and the code used for the HELB model has been changed from THREED to GOTHIC, the HELB re-analysis represents a deviation in an evaluation methodology as described in the USAR, thus the 50.59 evaluation results in a License Amendment Request.

5.1 Applicable Regulatory Requirements/Criteria

The proposed changes have been evaluated to determine whether applicable regulations and requirements continue to be met.

NRC regulatory guidance applicable to this change includes Standard Review Plan (SRP), NUREG-0800 Sections 3.6.2 "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," and 6.2.3 "Secondary Containment Functional Design." Both of these sections discuss the requirement for the systems and structure to demonstrate compliance with General Design Criteria 4 as it relates to the ability to accommodate the effects of postulated accidents. The requirements and guidance contained in these documents continue to be applied and no changes are needed.

Additional guidance for the analysis models and calculational methods is provided in SRP Section 6.2.1.2. A comparison of the compliance to this SRP guidance is summarized below.

SRP compliance of the THREED and GOTHIC Models:

SRP Section	**THREED Models (Auxiliary and Containment Buildings)**	**GOTHIC HELB Models**
SRP 6.2.1.2, Section II.B.1:	Same as SRP guidelines. To maximize the differential pressure, the 0% relative humidity is assumed. To maximize the peak temperatures for EQ purpose, 100% relative humidity is assumed.	GOTHIC HELB model is the same as THREED model
SRP 6.2.1.2, Section II.B.2:	Different models have been developed to obtain pressure / temperature responses for both sub-compartment pressurization and EQ purposes.	The GOTHIC models are consistent with the THREED models.
SRP 6.2.1.2, Section II.B.3:	Conservative assumptions are used in the THREED HELB Models	The GOTHIC HELB models are updated with the as-built plant configurations.
SRP 6.2.1.2, Section II.B.4:	HEM for nodes and vent paths, 100% water entrainment, HEM critical flow model, uniformly water-steam mixture which occupies the whole volume, etc.	Same as the THREED models except that the drop-liquid conversion option is used in Containment. The three phase modeling option was used in the Auxiliary Building. A comparison of the change showed negligible difference.
SRP 6.2.1.2, Section II.B.5:	The peak pressures in the sub-compartments and the peak differential pressures across the walls have been verified to be within the acceptance limits.	The peak pressures in the sub-compartments and the peak differential pressures across the walls have been verified to be within the acceptance limits.
Heat Transfer Coefficient Type	Uchida	Uchida specified in Containment. The GOTHIC default model (similar to Uchida) has been used in the Auxiliary Building case. Sensitivity studies indicate negligible impact due to this difference.
Heat Sinks	Most THREED models credited heat sinks	Heat sinks credited

As discussed above, this change to the method of evaluation used break locations consistent with the original basis of the plant. The mass and energy inputs remain consistent with the initial licensing with updates to current plant configuration. The change to the methodology for determining the pressure-temperature response to the HELB is changed to a more current and available code. Therefore, this change continues to demonstrate compliance with General Design Criteria 4.

Generic Letter (GL) 83-11 Supplement 1, provides guidance regarding licensee qualification for performing their own safety analyses including containment response analysis. This guidance includes a requirement to institute a program which includes training, procedures, comparison calculations (benchmarking) and continued quality controls. EOI application of this version of GOTHIC is controlled through established EOI procedures which include Software Control and

Calculation Procedures. These procedures include independent verification and review under EOI's Quality Control program. EOI training on GOTHIC has included:

- The code developer, NAI, has provided training to EOI engineers both in training sessions conducted in conjunction with GOTHIC Advisory Group meetings and in an EOI sponsored training session conducted at corporate headquarters.
- Example test cases compiled by NAI are modeled and run by engineers as part of the code familiarization process. Before performing calculations using GOTHIC, engineers read and become familiar with the GOTHIC Users Manual and other technical background information for the GOTHIC application.
- Lessons learned and expertise regarding GOTHIC is shared with EOI plants, including through periodic discussions of GOTHIC issues as part of regular EOI Safety Analysis conference calls. Note that an EOI engineer previously served as the Chairman of the GOTHIC Advisory Group.
- Consistent with GL 83-11 Supplement 1, Entergy's software control procedure contains provisions for evaluating vendor code, updates and for informing code vendors of any problems or errors discovered while using the code.

Thus, Entergy has established expectations for developing and demonstrating capabilities for use of analysis codes such as GOTHIC which are consistent with Generic Letter 83-11 supplement 1. Additionally, as a member of the GOTHIC Advisory Group, EOI and River Bend have the ability to consult and exercise the GOTHIC code developer (NAI) on GOTHIC model development or detailed coding issues.

Based on the above discussions, Entergy has determined that the proposed changes do not require any exemptions or relief from regulatory requirements, including the Technical Specifications, and do not affect conformance with any GDC differently than described in the SAR.

6.0 NO SIGNIFICANT HAZARDS CONSIDERATION

The proposed change will revise Appendix 3B and Section 6.2.1.2 of the Updated Safety Analysis Report pertaining to the method of analysis. The proposed change will replace the current vendor THREED code for room pressure-temperature analyses due to High Energy Line Breaks (HELB) with GOTHIC (Generation of Thermal-Hydraulic Information for Containments). The proposed change will allow EOI to update the analysis and to evaluate additional changes to the plant.

The proposed changes described above have been evaluated in accordance with 10CFR 50.92(c). The changes shall be deemed to involve a significant hazards consideration if there is a positive finding in any of the following areas:

1. Will the operation of the facility in accordance with these proposed changes involve a significant increase in the probability or consequence of an accident previously evaluated?

Response:

The proposed change involves no increase in the probability of the accidents previously evaluated since no physical change to the plant will be made. The change of the High Energy Line Break (HELB) analysis method does not affect the probability of the analyzed event occurring. The line break locations have not been affected and remain as originally designed.

This submittal is required due to the change of HELB analysis code from the vendor code THREED to the modern industry standard analysis code GOTHIC. This is a change in the methodology for determining the effects of the mass and energy release in the plant as a result of currently postulated events. The change in the evaluation methodology has been benchmarked and reviewed to confirm the results remain consistent with the current analysis. The changes to the model used for the additional analysis allow the use of new, more physically realistic models for Containment and Auxiliary Building pressure / temperature responses and will demonstrate continued qualification of the equipment in these buildings. Mass and energy releases for some cases have also been recalculated to credit pipe friction, which was only credited for certain cases previously.

With these new results the equipment has been reviewed and remains qualified per current programs established at RBS. Therefore, the plant will continue to function as designed and thus there will be no impact on consequences.

2. Will the operation of the facility in accordance with these proposed changes create the possibility of a new or different kind of accident from any accident previously evaluated?

Response:

No physical change to the plant will be made. The HELB locations were identified by reviewing all the possible break locations in each Auxiliary and Containment Building volume containing high-energy lines. The locations of the breaks remain the same as the previous HELB analyses. The HELB analyses have been evaluated for the current plant configuration. The new HELB analysis has been benchmarked against the previous accepted methods and found to correlate with the previous analysis. Therefore the results can be used to predict plant responses to events. The proposed change uses improved methods for mass and energy release calculation and pressure / temperature responses to determine the EQ qualification envelopes. Therefore, no new or different interaction would be created.

3. Will the operation of the facility in accordance with these proposed changes involve a significant reduction in a margin of safety?

Response:

The operation of the facility in accordance with the proposed changes will not involve a significant reduction in a margin of safety.

The GOTHIC code has been successfully benchmarked versus the vendor THREED code, which was used in the original design calculations. The HELB analysis results with the benchmarking GOTHIC model are consistent with the THREED results. Therefore, the use of GOTHIC code will not involve a reduction in an identified margin of safety. Given that GOTHIC code is an improved methodology and it has been extensively qualified against the solved analytical problems and testing results, the use of GOTHIC code will produce more accurate pressure / temperature responses for the HELB analyses. The use of the GOTHIC code has been approved for pressure/temperature responses analysis at various other plants including Joseph M. Farley Nuclear Plant, Units 1 and 2, and Waterford 3.

The results with the revised methods will be used to show that safety equipment meets the EQ requirements. The peak temperatures and pressures in the HELB GOTHIC benchmark model are within the existing EDC envelopes. Therefore, the pressure / temperature responses from the HELB benchmark analyses have no impact on the equipment qualification.

The methodology in the original design calculations is very conservative. The mass and energy releases without crediting friction introduce excessive amount of high-energy fluid into the break rooms, which is unrealistic. Some HELB calculations have credited both the frictional flows and the additional zone to eliminate excessive conservatism in the pressure/temperature responses. There is no reduction in a margin of safety and the design room differential pressure limits continue to be meet.

The use of this method by EOI RBS is consistent with the guidance given in NRC Generic Letter 83-11 and Supplement 1, addressing the performance of safety analyses by licensees. EOI has implemented this guidance for the GOTHIC methodology consistent with the intended application. The GOTHIC methodology has been verified and validated by the software vendor. In addition this methodology is controlled by EOI procedures and under the EOI quality assurance program. This includes EOI and RBS specific verification and validation of this application of GOTHIC and review of the calculations performed.

Based on the above review, it is concluded that: (1) the proposed change does not constitute a significant hazards consideration as defined by 10 CFR 50.92; and (2) there is a reasonable assurance that the health and safety of the public will not be endangered by the proposed change; and (3) this action will not result in a condition which significantly alters the impact of the station on the environment as described in the NRC Final Environmental Statement.

7.0 ENVIRONMENTAL CONSIDERATIONS

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

References

- NUREG-0800, USNRC Standard Review Plan.
- USAR Section 3.6.1, Plant Design for Protection Against Postulated Piping Failures in Fluid System Outside Containment.
- USAR Section 3.6.2, Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping.
- USAR Section 6.2.1.2, Containment Subcompartments.
- NEDO-20533, Mark III Containment System Analytical Model, Appendix B, Pipe Inventory Blowdown, June 1974.
- Lahey, R.T. and Moody, F.J., The Thermal-Hydraulics of a Boiling Water Nuclear Reactor, ANS, 1977.

USAR Sections

PROPOSED (MARKED-UP) USAR SECTIONS: See Attachment 2

ATTACHMENT 2

PROPOSED MARKED-UP USAR SECTIONS

USAR Section 6.2.1.2

CHAPTER 6

LIST OF TABLES (Cont)

CHAPTER 6

LIST OF FIGURES (Cont)

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CHAPTER 6

LIST OF FIGURES (Cont)

Deleted: NODAL PRESSURE DIFFERENTIALS 6-IN RWCU LINE¶ . BREAK RWCU HEAT EXCHANGER ROOM

Deleted: NODAL PRESSURE DIFFERENTIALS 8-IN RWCU LINE¶ . BREAK RWCU FILTER DEMINERALIZER ROOM therefore, guard pipes are not provided for these systems. Other process lines with check valves inside the drywell such as RCIC head spray and RHR shutdown cooling have guard pipes because these lines can be used during normal plant operation, after which it could be postulated that the check valve sticks in the open position.

6.2.1.1.3.2.1 Reactor Water Cleanup Break

The reactor water cleanup (RWCU) pumps are located outside the containment. RWCU heat exchangers and filter demineralizers are located inside the containment. This system, when operating, is in direct communication with the reactor coolant system, taking suction on the recirculation lines inside the drywell and injecting back into the feedwater lines.

Breaks in this system result in the release of high energy fluid into the containment. The mass loss into the containment is terminated by automatic isolation of the RWCU suction and discharge lines upon detection of the leak. Isolation valves immediately inboard and outboard of the drywell and containment penetrations are provided to perform this function. Check valves in the discharge line prohibit back flow from the feedwater line in the event of a break inside the containment.

•→12

Automatic isolation of the RWCU system in the event of a postulated line break is initiated by two separate leak detection systems. First, leakage is detected by means of flow comparison between RWCU system inlet and outlet. If the inlet flow exceeds the outlet flow by approximately 7 percent of rated flow, an alarm is actuated and an automatic isolation of the system initiated. In addition to the flow comparison method, leakage is detected by means of temperature sensing elements. Redundant temperature sensors are located locally to monitor the ambient temperature in all compartments containing equipment and piping for this system. Signal times to initiate closure of the system isolation valves are on the order of 1 sec for both detection systems described.

12←• •→6

The analyses show that the local temperature in the RWCU heat exchanger room rises from 103°F to 153°F in 0.4 sec, and the local temperature in the RWCU filter/demineralizer room rises from 105°F to 113°F in 0.5 sec. Thus, the leak detection system high ambient temperature signal to isolate the RWCU system would be generated in less than 1 sec.

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6←•

The postulated DER of the 4-in RWCU pump discharge line between the inboard containment isolation valve and the regenerative heat exchangers is the limiting case for containment pressurization. This break location is shown schematically on Fig. 6.2-26.

Deleted: the analysis, the instrument delay time is assumed to be 1 sec. ¶

Blowdown from the RWCU pump discharge side of the break is initially choked at the 0.0192-sq ft flow restrictor in the pump discharge line. The leak detection signal initiates automatic isolation of the system within. When the isolation valves have closed sufficiently such that the isolation valve flow area equals the flow restrictor area, the critical flow location changes from the flow restrictor to the isolation valves. Flow from the heat exchanger side of the break is limited to critical flow through the pipe cross-sectional area and is assumed to terminate when the contents of the heat exchangers and Filter/Demineralizers are exhausted. For all pipe breaks considered in the RWCU system, the peak subcompartment pressures occur before isolation valve closure begins to limit the blowdown. It should be noted that the valve closure does not influence the blowdown until the valve open area equals the flow restrictor area of 0.0192 sq ft, as flow is choked at the flow restrictor. Accordingly, the assumed linear valve closure characteristic is conservative for the gate valves used in this application.

Deleted: 1 sec after the break. At 5.5 sec,

Deleted: . At that time,

Deleted: Subsequent closure of the valves terminates flow at 6.0 sec.

Deleted: regenerative

Table 6.2-12 summarizes the 4-in RWCU pump discharge line blowdown used in this analysis. Based on the initial conditions given in Table 6.2-3, this break produces an increase in containment internal pressure of less than 1.0 psig which is well below the design internal pressure of 15 psig.

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6.2.1.1.3.2.2 Instrument Line Break

Instrument lines penetrating the drywell wall are provided with 1/4-in orifices located upstream of the drywell penetrations to preclude containment over-pressurization. In the event of a rupture, containment pressure increases until shortly after the operator starts reactor cooldown. Under the assumption that the operator takes 1/2 hr to detect an instrument line rupture and start reactor cooldown, the rise in containment pressure is only 0.42 psig for a liquid line. For a steam line break, the pressure rise is less.

within the prescribed limits and the action to be taken if these conditions are exceeded is discussed in Section 9.4.6. The loss of these systems does not result in exceeding the design operating conditions for the safety-related equipment inside the containment. The safety-related containment systems described in Sections 6.2.2 and 6.5 maintain required containment atmosphere conditions after a LOCA.

6.2.1.1.3.7.5 Instrumentation

Refer to Sections 6.2.1.7, 7.2, 7.3, 7.5, and 7.6 for a discussion of instrumentation inside the containment used for monitoring various containment parameters.

6.2.1.2 Containment Subcompartments

6.2.1.2.1 Design Bases

The containment subcompartments are designed in accordance with the following criteria:

1. A pressure response analysis is given for each containment subcompartment containing high energy piping in which breaks are postulated. The definition of high energy piping and the criteria for postulating breaks are outlined in Section 3.6.

   The break which, by virtue of its size and location, produced the greatest release of blowdown mass and energy into the subcompartment, during normal operation and hot standby condition, is selected for the design evaluation.

   The breaks used in the design evaluations are listed in Section 6.2.1.2.3.

2. All circumferential breaks are considered to be fully double-ended and no credit for limiting blowdown generation is taken due to pipe restraint locations.

   The effective cross-sectional flow area of the pipe is used in the jet discharge evaluation for breaks.

3. The design pressure differentials for all subcompartments are higher than the calculated peak pressure differentials resulting from the design basis pipe breaks.

6.2.1.2.2 Design Features

The containment includes the following four subcompartments:

1. Reactor Pressure Vessel-Shield Wall Annulus - The 2 ft thick cylindrical primary shield wall which surrounds the RPV has an outside diameter of 29 ft 10 in and extends from the vessel pedestal to el 147 ft 6 in. Breaks in the recirculation water outlet piping and feedwater piping are analyzed.

•→12

2. Drywell Head - The drywell head is located above the RPV head and surrounds the RPV head, connecting to the drywell bulkhead at el 162 ft 3 in. Five normally open ventilation exhaust hatches are located in the bulkhead at azimuths 30, 75, 165, 225, and 345 deg venting into the drywell. (These hatches are closed only during refueling.) Line Breaks were evaluated for the RCIC head spray line. Although the head spray line was removed, the break analysis will remain in place because the analysis bounds a vessel head vent line break.

12←•

3. RWCU Heat Exchanger Room - The RWCU heat exchanger room, located at el 147 ft 3 inches in the containment, vents through the wire door in the south wall and through two 13 ft x 2 ft 2 in openings in the north wall into the containment. RWCU line breaks are analyzed in this room.

4. RWCU Filter/Demineralizer Rooms - The RWCU filter/demineralizer rooms are located at azimuth 270 deg and el 162 ft 3 in. The HVAC vent openings provide the only vents from the filter/demineralizer rooms. RWCU piping is routed to and from the demineralizers through the east wall of the cubicles which separates them from the holding pump room and valve nest area. Complete circumferential DER of the 8-in diameter RWCU line connected to the bottom of the demineralizer is analyzed in this subcompartment.

Deleted: Piping penetration sleeves

Drawings depicting piping, equipment, and compartment/venting locations are provided in Section 3.6. The volumes and vent areas are discussed in Section 6.2.1.2.3.

Deleted: The subcompartments described do not incorporate blowout panels. No credit is taken for vent areas that become available after the pipe break occurs.

6.2.1.2.3 Design Evaluation

The breaks utilized in the design evaluation of the containment subcompartments are listed in Table 6.2-13. The tables and figures which contain the nodal parameters and results for each analysis are also listed in Table 6.2-13.

•→14

The containment subcompartment design evaluations use the THREED, RELAP4/MOD5(8) and GOTHIC computer codes. Both THREED and RELAP4/MOD5 codes consider two-phase, two-component (steam-water-air) flow through the vents and account for the fluid inertia effects. A detailed description of the THREED analytical model is provided in Appendix 6B. The GOTHIC code considers the liquid, vapor and drop phases. The blowdown mass and energy releases for each of the breaks are provided in the tables which are cross-referenced in Table 6.2-13, which are calculated based on the uprated power conditions (3100 MWt) and maximum reactor pressure (1090 psia). An additional 5-second time delay in the isolation logic has been assumed for the RWCU line breaks.

Deleted: and

Deleted: . For all cases, the blowdown data is based upon conservative methodology developed by GE using the Moody steady-slip flow model with subcooling, as described in Reference 9. The blowdown mass and energy used in the subcompartment calculation

Deleted: 102% of the original reactor power and original reactor pressure. Evaluations performed at 102% of current rated power and 1072 psia reactor pressure demonstrated that due to the conservatisms in the methodology, the break mass and energy flows calculated at the original reactor power and pressure remain conservative for application to current rated power conditions.¶

The assumed initial conditions for the subcompartment volumes are conservatively chosen so as to maximize transient pressure responses. The initial conditions are given in the subcompartment nodal description tables.

The description of and justification for the subsonic and sonic flow model, and the degree of entrainment used in vent flow calculations are given in Appendix 6B.

The piping systems assumed to rupture in the subcompartments are identified in Table 6.2-13. Break locations are discussed in Section 3.6. The need to determine the impact of a RCIC head spray line break inside the drywell head is eliminated with the reroute modification for the RCIC line. Changing the injection line from the reactor spray nozzle to the 'A' feedwater line eliminates the RCIC break in the drywell head as an event and therefore this break does not need to be evaluated.

Although the RCIC break is eliminated with respect to drywell pressurization, another high energy line, the vessel head drain line, is also present in the drywell head. This line is connected between the vessel head and one of the steam lines and is used to purge non-condensable gases from the vessel. A break in this line will result in the discharge of high energy steam to the drywell head and cause pressurization of the drywell head. However, the break area associated with a break in the vessel drain line is significantly smaller than the break area used to calculate the mass and energy release rates applied in the USAR RCIC break calculation. The reduction in break flow rate due to the smaller break area is much more significant than the effect

TABLE 6.2-12

BLOWDOWN DATA
4-IN RWCU PUMP DISCHARGE LINE BREAK
CONTAINMENT HIGH ENERGY LINE BREAK ANALYSIS

Time (sec)	Blowdown Mass Flow Rate (lbm/sec)	Blowdown Enthalby (Btu/lbm)
0.0	956	529
0.92	956	529
0.921	707	529
1.60	707	529
1.601	707	448
3.06	707	448
3.061	651	442
3.20	651	442
3.201	651	367
4.5	651	367
4.501	173	529
5.5	173	529
6.0	0	0

replaced with new data

TABLE 6.2-12

BLOWDOWN DATA
4-IN RWCU PUMP DISCHARGE LINE BREAK
CONTAINMENT HIGH ENERGY LINE BREAK ANALYSIS

Time (sec)	Blowdown Mass Flow Rate (lbm/sec)	Enthalpy (Btu/lbm)
	Upstream Blowdown	
0.0000	0.0	531.44
0.0001	564.7	531.44
0.5774	564.7	531.44
0.5775	212.1	531.44
13.4380	212.1	531.44
15.0000	0.00	531.44
	Downstream Blowdown	
0.0000	0.0	472.02
0.0001	610.2	472.02
0.7315	610.2	472.02
0.7316	610.2	361.60
1.5297	610.2	361.60
1.5298	610.2	257.54
2.3788	610.2	257.54
2.3789	610.2	150.17
4.6461	610.2	150.17
4.6462	610.2	93.91
21.9969	610.2	93.91
21.9970	610.2	146.46
23.5400	610.2	146.46
23.5401	610.2	252.64
25.0137	610.2	252.64
25.0138	610.2	362.04
26.3952	610.2	362.04
26.3953	610.2	419.00
28.3703	610.2	419.00
28.3704	0.0	0.00

TABLE 6.2-13

CONTAINMENT SUBCOMPARTMENT ANALYSIS SUMMARY

Subcompartment	Model	Design Basis Line Break	Tables: Nodal Description	Tables: Vent Path Description	Figures: Blowdown Data	Figures: Nodalization Diagram	Nodal Pressures	Nodal Pressure Differentials
RPV - Shield Wall Annulus	27 Node[1]	Feedwater	6.2-14	6.2-15	6.2-16	6.2-38	6.2-39	6.2-40
RPV - Shield Wall Annulus	25 Node[1]	Feedwater	6.2-17	6.2-18	6.2-19	6.2-41	6.2-42	6.2-43
RPV - Shield Wall Annulus	26 Node[2]	Recirculation water outlet	6.2-20	6.2-21	6.2-22	6.2-44	6.2-45	6.2-46
•→12 Drywell Head	2 Node	RCIC head [3] spray	6.2-23	6.2-24	6.2-25	6.2-47	6.2-48	6.2-49
12←• RWCU Heat Exchanger Room	2 Node	RWCU	6.2-26	6.2-27	6.2-28 6.2-12	6.2-50	6.2-51	6.2-52
RWCU Filter/ Demineralizer Rooms	4 Node	RWCU	6.2-29	6.2-30	6.2-31	6.2-53	6.2-54	6.2-55

deleted

4-in blowdown data table added in new table

(1) Model of complete (360°) annulus

(2) Model of half (180°) of annulus due to summary

(3) The RCIC head spray line has been deleted and the associated high energy line breaks are no longer possible. However this failure and information is being provided as the bounding conditions that were established as part of the original plant design and licensing basis.

TABLE 6.2-13

CONTAINMENT SUBCOMPARTMENT ANALYSIS SUMMARY

		Tables			Figures		
Subcompartment	Design Basis Line Break	Nodal Description	Vent Path Description	Blowdown Data	Nodalization Diagram	Nodal Pressures	Nodal Pressure Differentials
RPV - Shield Wall Annulus	Feedwater[1]	6.2-14	6.2-15	6.2-16	6.2-38	6.2-39	6.2-40
RPV - Shield Wall Annulus	Feedwater[1]	6.2-17	6.2-18	6.2-19	6.2-41	6.2-42	6.2-43
RPV - Shield Wall Annulus	Recirculation water outlet[2]	6.2-20	6.2-21	6.2-22	6.2-44	6.2-45	6.2-46
•→12 Drywell Head	RCIC head [3] spray	6.2-23	6.2-24	6.2-25	6.2-47	6.2-48	6.2-49
12←• RWCU Heat Exchanger Room	RWCU	6.2-26	6.2-27	6.2-28 6.2-12	6.2-50	6.2-51	N/A
RWCU Filter/ Demineralizer Rooms	RWCU	6.2-29	6.2-30	6.2-31	6.2-53	6.2-54	N/A

(1) Model of complete (360°) annulus

(2) Model of half (180°) of annulus due to summary

(3) The RCIC head spray line has been deleted and the associated high energy line breaks are no longer possible. However this failure and information is being provided as the bounding conditions that were established as part of the original plant design and licensing basis.

TABLE 6.2-26

SUBCOMPARTMENT NODAL DESCRIPTION
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

		Initial Conditions			DBA Break Conditions				Calculated[1] Peak Pressure Difference
Volume No.	Volume (cu ft)	Temp. (°F)	Pressure (psia)	Humidity (%)	% Break in Vol.	Break Line	Break Area (sq ft)	Break Type	(psid)
1	13,250	103	14.7	0	100	RWCU	(See Table 6.2-28)	DER	1.3
2	7,149	103	14.7	0	0.0				0.3
3	6,312	103	14.7	0	0.0				0.3
4	1,164,879	103	14.7	0	0.0				0.0

replaced with new data

[1] Nodal peak pressure minus pressure in node 4 ($P_i - P_4$)

TABLE 6.2-26

SUBCOMPARTMENT NODAL DESCRIPTION
4-IN and 6-IN RWCU LINE BREAKS
RWCU HEAT EXCHANGER ROOM

Volume No.	Volume (cu ft)	Initial Conditions Temp. (°F)	Pressure (psia)	Humidity (%)	DBA Break Conditions % Break in Vol.	Break Line	Break Type	Calculated Peak Pressure Difference (psid)
•→6								
1	13,250	103	14.7	0	100	RWCU	DER	1.627 (4-in) 1.488 (6-in)
2	7,059	90	14.7	0	0.0			< 0.5
3	6,153	90	14.7	0	0.0			< 0.5
4	1,165,128	90	14.7	0	0.0			< 0.5
5	358,000	120	14.7	100	0.0			N/A (see note 1)
6←•								

Note: 1. The Volume No. 5 is included for conservatism. This volume has no vent path connection with other volumes. The steel containment is modeled as thermal conductors to connect this volume with other volumes except the break room, which has high temperatures after the break. By assuming a high initial temperature for Volume No. 5, more heat is transferred into the other volumes, which generates more limiting pressure/temperature responses.

TABLE 6.2-27

SUBCOMPARTMENT VENT PATH DESCRIPTION
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

Vent Path No.	From Vol. Node No.	To Vol. Node No.	Description of Vent Path Flow (Choked/Unchoked)	Vent Area (sq ft)	L/A (ft^{-1})	Head Loss Coefficient: Friction	Head Loss Coefficient: Turning	Head Loss Coefficient: Expansion	Head Loss Coefficient: Contraction	Loss Due to Thick Edged Oriface	Total
1_A	1	2	Unchoked	1.628	0.168	0.036	-	0.998	0.5	0.04	1.573
	2	1	Unchoked	1.628	0.168	0.036	-	0.998	0.5	0.04	1.573
1_B	1	2	Unchoked	15.56	0.168	-	3.38	-	0.497	-	3.877
	2	1	Unchoked	15.56	0.168	-	3.38	-	0.978	-	4.358
1_C	1	2	Unchoked	11.024	0.168	0.013	-	0.985	0.496	0.766	2.260
	2	1	Unchoked	11.024	0.168	0.013	-	0.985	0.496	0.766	2.260
2_A	1	2	Unchoked	1.628	0.724	0.036	-	0.998	0.5	0.04	1.573
	2	1	Unchoked	1.628	0.724	0.036	-	0.998	0.5	0.04	1.573
2_B	1	2	Unchoked	1.628	0.724	-	1.327	-	0.5	-	1.827
	2	1	Unchoked	1.628	0.724	-	1.327	-	0.998	-	2.325
2_C	1	2	Unchoked	2.806	0.724	-	0.963	-	0.5	-	1.463
	2	1	Unchoked	2.806	0.724	-	0.963	-	0.996	-	1.959
2_D	1	2	Unchoked	2.965	0.724	0.09	-	0.996	0.499	-	1.585
	2	1	Unchoked	2.965	0.724	0.09	-	0.996	0.499	-	1.585
2_E	1	2	Unchoked	1.18	0.724	0.009	-	0.998	0.5	-	1.507
	2	1	Unchoked	1.18	0.724	0.009	-	0.998	0.5	-	1.507
3	1	4	Unchoked	15.75	0.833	2.15	0.133	1.0	0.164	0.33	3.780
	4	1	Unchoked	15.75	0.833	2.15	0.133	1.0	0.164	0.33	3.780
4	2	3	Unchoked	194.02	0.092	-	-	0.590	-	-	0.590
	3	2	Unchoked	194.02	0.092	-	-	0.436	-	-	0.436
5	2	4	Unchoked	148.6	0.233	0.027	-	0.933	0.0325	0.148	1.141
	4	2	Unchoked	148.6	0.233	0.027	-	0.0042	0.483	0.0382	0.552
6	2	4	Unchoked	148.6	0.233	0.027	-	0.933	0.0325	0.148	1.141
	4	2	Unchoked	148.6	0.233	0.027	-	0.0042	0.483	0.0382	0.552
7	2	4	Unchoked	14.94	0.261	0.053	-	0.996	0.458	-	1.507
	4	2	Unchoked	14.94	0.261	0.053	-	0.831	0.499	-	1.389
8	3	4	Unchoked	172.5	0.162	-	-	0.922	-	-	0.922
	4	3	Unchoked	172.5	0.162	-	-	0.490	-	-	0.490

replaced with new table

TABLE 6.2-27 (Cont)

Vent Path No.	From Vol. Node No.	To Vol. Node No.	Description of Vent Path Flow (Choked/Unchoked)	Vent Area (sq ft)	L/A (ft^{-1})	Head Loss Coefficient Friction	Turning	Expansion	Contraction	Loss Due to Thick Edged Oriface	Total
9	3	4	Unchoked	172.5	0.162	-	-	0.922	-	-	0.922
	4	3	Unchoked	172.5	0.162	-	-	0.490	-	-	0.490

replaced with new table

NOTES:

1. Vent paths 1_a , 1_b, and 1_c are combined into one vent path (vent path 1).
2. Vent paths 2_A, 2_B, 2_C, 2_D and 2_E are combined into one vent path (vent path 2).

TABLE 6.2-27

SUBCOMPARTMENT VENT PATH DESCRIPTION
4-IN and 6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

Vent[1] Path No.	Vol. A No.	Vol. B No.	Vent Area (ft^2)	Forward Loss Coeff.	Reverse Loss Coeff.	Choked / unchoked	Junct. Length (ft)	Hydraulic Diameter (ft)	Inertia Length (ft)
1	1	2	28.210	3.131	2.902	Choked	2	3.719	11.000
2	1	2	28.210	4.918	4.651	Choked	2	3.719	11.000
3	1	4	23.333	11.708	8.196	Choked	13.292	4.516	39.792
4	2	3	192.260	0.630	0.397	Choked	0	8.670	23.875
5	2	4	162.828	1.706	1.706	Choked	9.014	8.041	39.431
6	2	4	162.828	1.706	1.706	Choked	9.014	8.041	39.431
7	2	4	14.708	2.670	1.550	Choked	1.750	0.655	57.000
8	3	4	166.678	1.000	0.500	Choked	0	11.800	38.917
9	3	4	166.678	1.000	0.500	Choked	0	11.800	38.917

Note: (1) Vent paths #10 through #13 simulate the break junctions for the upstream and downstream blowdown for the 4-in and 6-in RWCU line breaks in the RWCU heat exchanger room.

TABLE 6.2-28

BLOWDOWN DATA
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

Time (sec)	Blowdown Mass Flow Rate (lbm/sec)	Blowdown Enthalpy (Btu/lbm)	Blowdown Energy Release Rate (Btu/sec)	Total Effective Break Area (sq ft)
0.0	0.0	-	0.0	0.0
0.0001	873.6	416	363,418	0.181
0.021	873.6	416	363,418	0.181
0.022	1310.3	416	545,085	0.2715
1.110	1310.3	416	545,085	0.2715
1.111	1259.1	416	523,786	0.2609
1.513	1259.1	416	523,786	0.2609
1.514	771.2	416	320,820	0.1598
1.888	771.2	416	320,820	0.1598
1.889	385.6	416	160,410	0.0799
5.997	385.6	416	160,410	0.0799
5.998	841.3	416	349,981	0.0799
9.442	841.3	416	349,981	0.0799
9.443	841.3	88	74,035	0.0799
16.657	841.3	88	74,035	0.0799
16.658	202.2	88	17,794	0.0192
23.595	202.2	88	17,794	0.0192
25.157	0.0	-	-	0.0

replaced with new data

TABLE 6.2-28

BLOWDOWN DATA
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

Time After Break (sec)	Mass Flow Rate (lbm/sec)	Revised h (Btu/lbm)
	Upstream Blowdown	
0.0000	0.0	419.00
0.0001	892.5	419.00
0.9446	892.5	419.00
0.9447	394.0	419.00
3.2271	394.0	419.00
3.2272	394.0	419.00
5.6170	394.0	419.00
5.6171	1129.4	419.00
9.6189	1129.4	419.00
9.6190	1129.4	93.91
14.9907	1129.4	93.91
14.9908	1129.4	93.91
17.7895	1129.4	93.91
17.7896	212.1	93.91
31.2276	212.1	93.91
32.7896	0.0	93.91
	Downstream Blowdown	
0.0000	0.0	419.00
0.0001	446.2	419.00
2.0263	446.2	419.00
2.0264	394.0	419.00
2.7902	394.0	419.00

TABLE 6.2-29

SUBCOMPARTMENT NODAL DESCRIPTION
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

		Initial Conditions			DBA Break Conditions				Calculated[1]
Volume No.	Volume (cu ft)	Temp. (°F)	Pressure (psia)	Humidity (%)	% Break in Vol.	Break Line	Break Area (sq ft)	Break Type	Peak Pressure Difference (psid)
•→6									
1	2,165.6	105	14.7	0	100	RWCU	(See Table 6.2.-31)	DER	21.18
2	2,165.6	105	14.7	0	0				0.0
3	8,278.9	105	14.7	0	0				0.0
4	1,120,000[2]	105	14.7	0	0			0.0	
6←•									

replaced with new data

---

[1] Nodal peak pressure minus pressure in Node 4 (P_i-P_4).
[2] Assumed value to maximize pressure differential across RWCU filter/demineralizer room.

TABLE 6.2-29

SUBCOMPARTMENT NODAL DESCRIPTION
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Volume No.	Volume (cu ft)	Initial Conditions Temp. (°F)	Initial Conditions Pressure (psia)	Humidity (%)	DBA Break Conditions % Break in Vol.	DBA Break Conditions Break Break Line	Break Type	Calculated[1] Peak Pressure Difference (psid)
•→6 1	2,163.2	105	14.7	0	100	RWCU	DER	10.425
2	2,163.2	105	14.7	0	0			0.0
3	8,085.0	100	14.7	0	0			0.0
4 6←•	1,120,000[2]	90	14.7	0	0			0.0

[1] Maximum differential pressure across the RWCY Filter / Demineralizer room walls.
[2] Assumed value to maximize pressure differential across RWCU filter/demineralizer room.

TABLE 6.2-30

SUBCOMPARTMENT VENT PATH DESCRIPTION
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Vent Path No.	From Vol. Node No.	To Vol. Node No.	Description of Vent Path Flow (Choked/Unchoked)	Vent Area (sq ft)	L/A (ft^{-1})	Head Loss Coefficient						
						Friction	Thick Edge	Turning	Grating	Expansion	Contraction	Total
1	1	3	Unchoked	1.37	2.579	-	-	-	-	0.996	0.497	1.493
1	3	1	Unchoked	1.37	2.579	-	-	-	-	0.989	0.499	1.488
2	3	2	Unchoked	1.811	1.957	-	-	-	-	0.986	0.499	1.485
2	2	3	Unchoked	1.811	1.957	-	-	-	-	0.995	0.496	1.491
3	3	4	Unchoked	2.6	0.785	-	-	-	-	0.994	0.498	1.492
3	4	3	Unchoked	2.6	0.785	-	-	-	-	0.993	0.498	1.491
4	3	4	Unchoked	1.6	2.338	-	-	-	-	0.999	0.498	1.497
4	4	3	Unchoked	1.6	2.338	-	-	-	-	0.991	0.500	1.491
5	3	4	Unchoked	31.5	0.871	0.687[1]	0.163	0.95	0.494	0.776	0.477	2.890
5	4	3	Unchoked	31.5	0.871	0.694[1]	0.170	0.95	0.494	0.911	0.440	2.995

Replaced with new data

(1) Includes losses due to grating and thick edged orifice.

TABLE 6.2-30

SUBCOMPARTMENT VENT PATH DESCRIPTION
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Vent[1] Path No.	Vol. A No.	Vol. B No.	Vent Area (ft^2)	Forward Loss Coeff.	Reverse Loss Coeff.	Choked / unch-oked	Junct. Length (ft)	Hyd. D. (ft)	Inertia Length (ft)
1	1	3	0.25	1.953	1.927	Choked	3.5	0.5	13.665
2	2	3	0.25	1.953	1.927	Choked	3.5	0.5	13.665
3	3	4	0.25	1.500	1.500	Choked	2	0.167	14.125
4	3	4	31.5	4.742	3.642	Choked	7	4.667	31.917
6	1	2	0.167	2.000	1.500	Choked	5.25	0.4	21.167
7	1	2	0.167	1.500	1.500	Choked	4	0.167	19.917
8	2	3	0.25	2.954	2.954	Choked	16.25	0.5	43.125

Note: (1) Vent paths #5 and #9 simulate the break junctions for the upstream and downstream blowdown for the 8-in RWCU line break in the Filter / Demineralizer room.

TABLE 6.2-31

BLOWDOWN DATA
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Time (sec)	Blowdown Mass Flow Rate (lbm/sec)	Blowdown Enthalpy (Btu/lbm)	Blowdown Energy Release Rate (Btu/sec)	Total Effective Break Area (sq ft)
0.0	0.0	-	0.0	0.0
0.0001	2378.4	88	2.093×10^5	0.3016
0.0006	2378.4	88	2.093×10^5	0.3016
0.0007	3567.6	88	3.14×10^5	0.4524
0.0097	3567.6	88	3.14×10^5	0.4524
0.0098	4756.8	88	4.186×10^5	0.6032
0.1305	4756.8	88	4.186×10^5	0.6032
0.1306	2378.4	88	2.093×10^5	0.3016
1.3925	2378.4	88	2.093×10^5	0.3016
1.3926	592.1	88	5.21×10^4	0.07509
9.9675	592.1	88	5.21×10^4	0.07509
9.9676	592.1	196.8	1.165×10^5	0.07509
15.2075	592.1	196.8	1.165×10^5	0.07509
15.2076	592.1	303.5	1.797×10^5	0.07509
18.6275	592.1	303.5	1.797×10^5	0.07509
18.6276	592.1	389.2	2.304×10^5	0.07509
18.8375	592.1	389.2	2.304×10^5	0.07509
18.8376	592.1	472.0	2.795×10^5	0.07509
19.7275	592.1	472.0	2.795×10^5	0.07509
19.7276	447.4	453.6	2.03×10^5	0.05675
22.8975	447.4	453.6	2.03×10^5	0.05675
22.8976	151.4	529.2	8.012×10^4	0.0192
26.6655	151.4	529.2	8.012×10^4	0.0192
28.2275	0.0	-	0.0	0.0
60.0	0.0	-	0.0	0.0

replaced with new data

Note: Data based on assumed constant mass flux of 7,884 lbm/sec-ft for critical flow of saturated liquid at 1,000 psia

TABLE 6.2-31

BLOWDOWN DATA
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Time After Break (sec)	Blowdown Mass Flow Rate (lbm/sec) Upstream Blowdown	Enthalpy (Btu/lbm)
0.0000	0	93.9106
0.0001	2241.04	93.9106
0.0007	2241.04	93.9106
0.0008	4482.09	93.9106
1.0048	4482.09	93.9106
1.0049	1061.53	93.9106
6.0424	1061.53	93.9106
6.0425	721.681	93.9106
7.0940	721.681	93.9106
7.0941	721.681	135.29
8.9119	721.681	135.29
8.9120	721.681	149.192
9.7007	721.681	149.192
9.7008	463.649	211.803
11.6003	463.649	211.803
11.6004	418.496	263.453
13.7403	418.496	263.453
13.7404	372.771	305.284
13.8435	372.771	305.284
13.8436	372.771	359.662
16.1949	372.771	359.662
16.1950	372.771	388.65
17.9879	372.771	388.65
17.9880	266.015	331.346
18.5536	266.015	331.346
18.5537	266.015	409.861
22.9688	266.015	409.861
22.9689	266.015	450.744
29.2812	266.015	450.744
29.9296	75.0972	531.441
32.9880	0	531.441

TABLE 6.2-31

BLOWDOWN DATA
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

Time After Break (sec)	Blowdown Mass Flow Rate (lbm/sec) Downstream Blowdown	Enthalpy (Btu/lbm)
0	0	93.91
0.0001	806.11	93.91
0.0098	806.11	93.91
0.0099	1612.2	93.91
0.1999	1612.2	93.91
0.2000	0	93.91

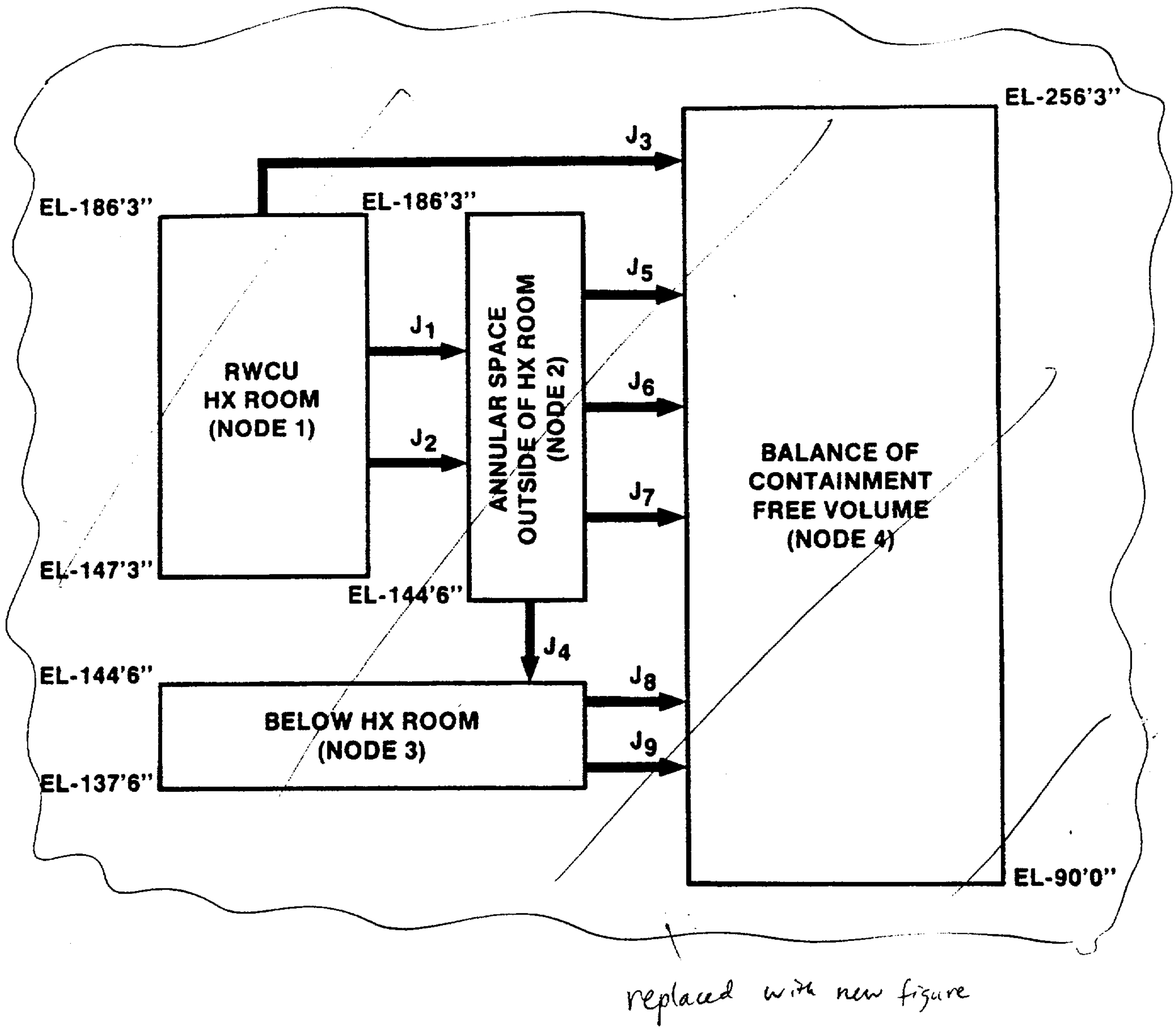


FIGURE 6.2-50

NODALIZATION DIAGRAM
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

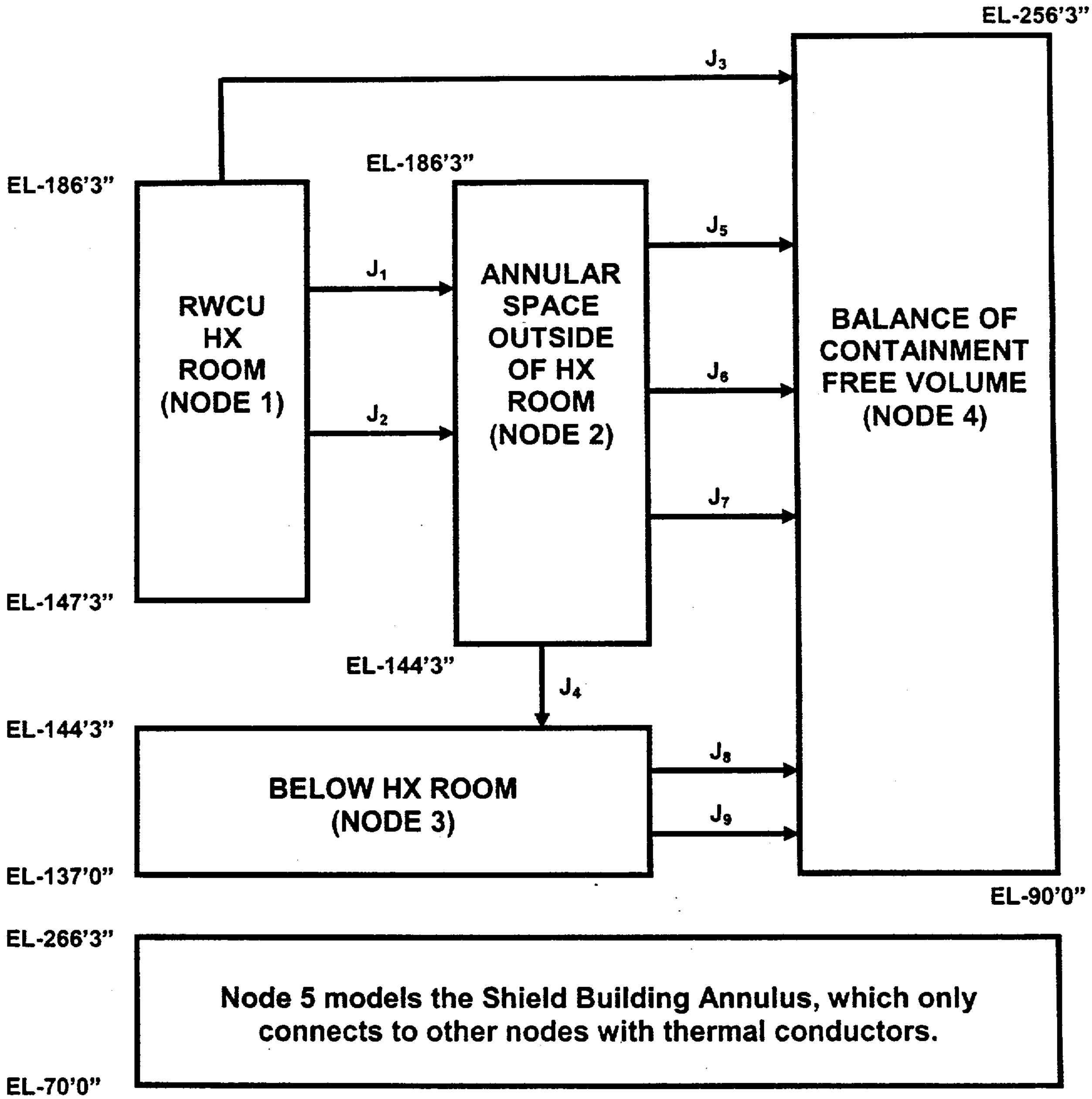
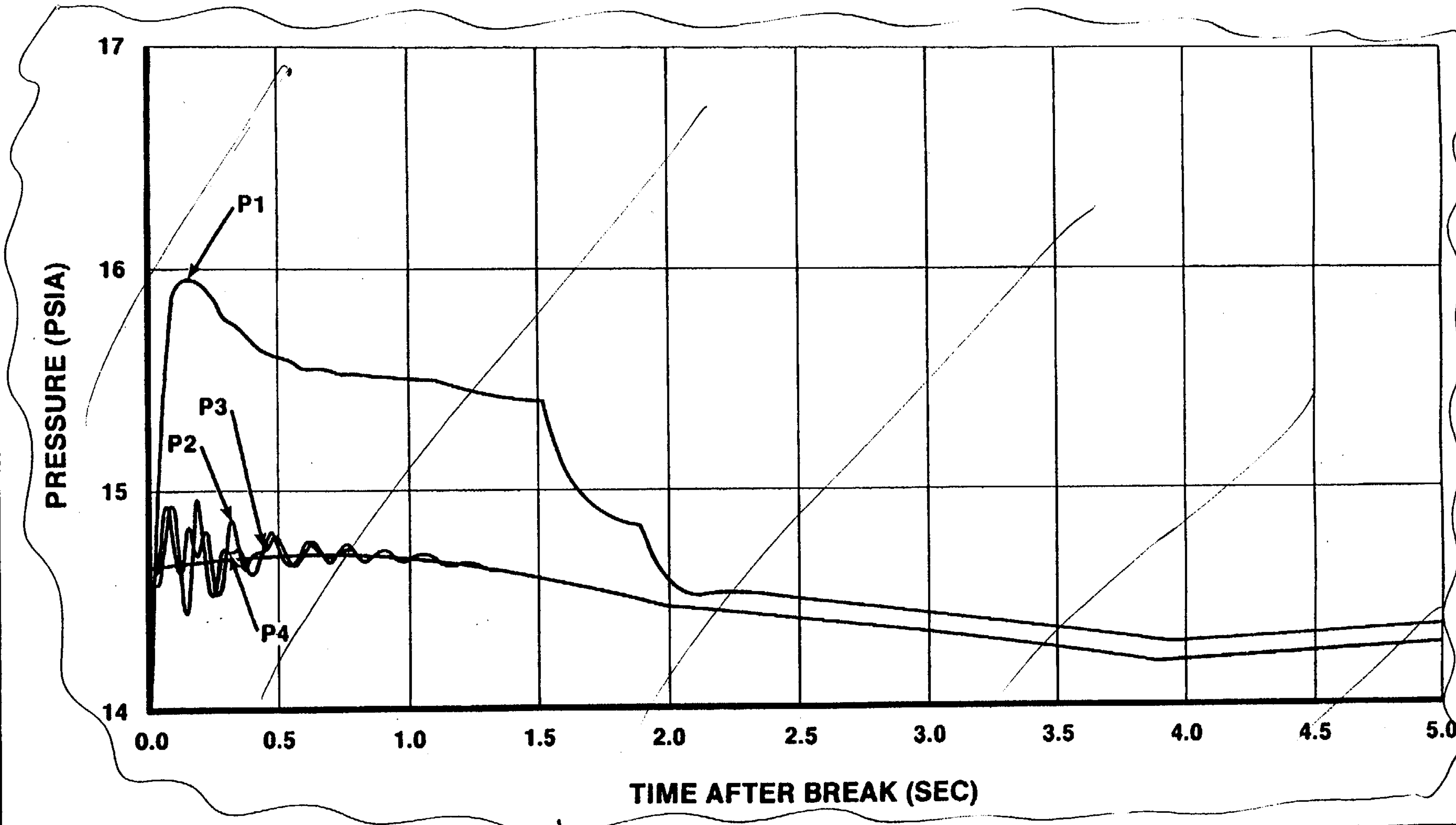


FIGURE 6.2-50
NODALIZATION DIAGRAM
4-IN AND 6-IN RWCU LINE BREAKS
RWCU HEAT EXCHANGE ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT



replaced with new curve

FIGURE 6.2-51

NODAL PRESSURES
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

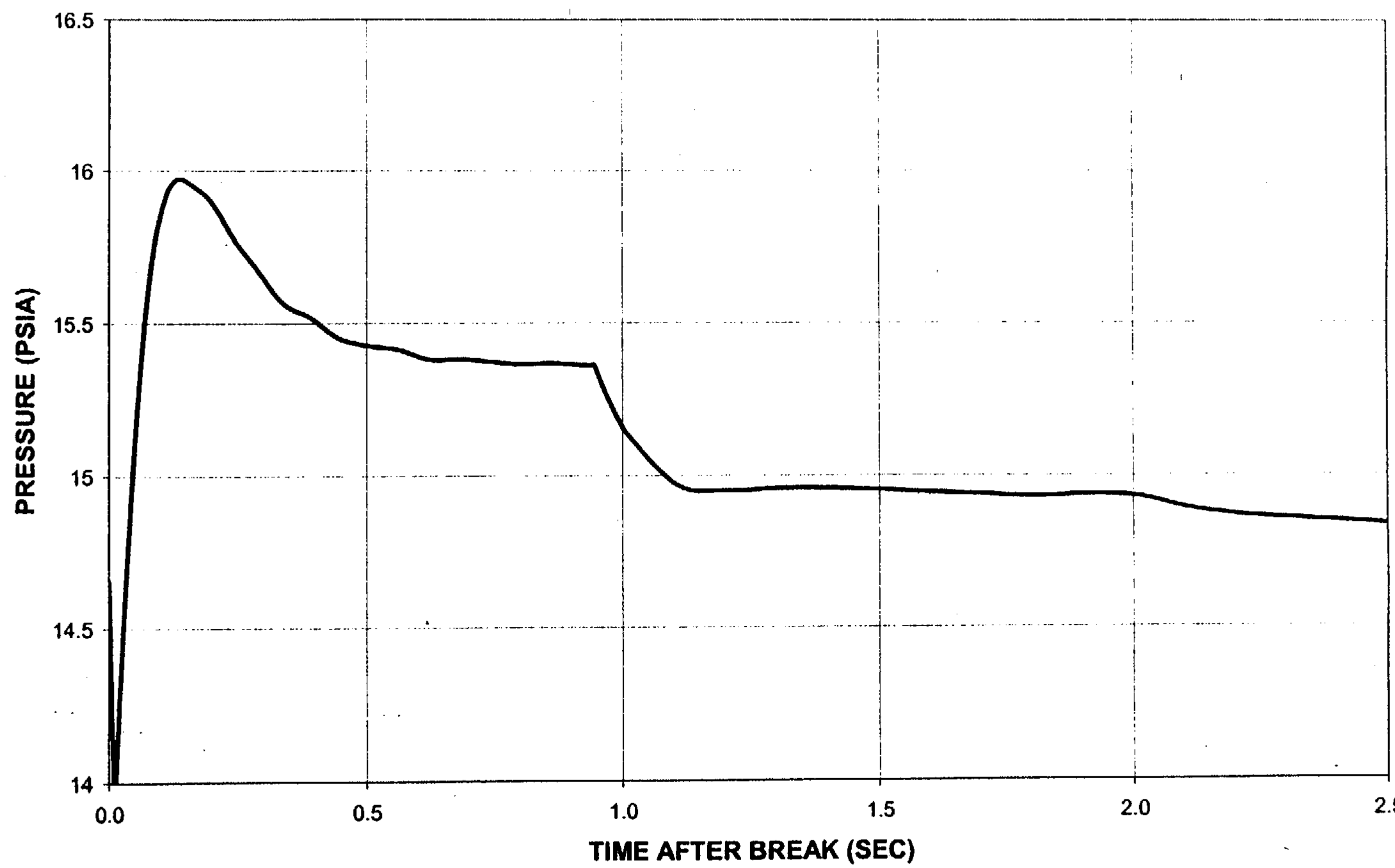


FIGURE 6.2-51

NODAL PRESSURE
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

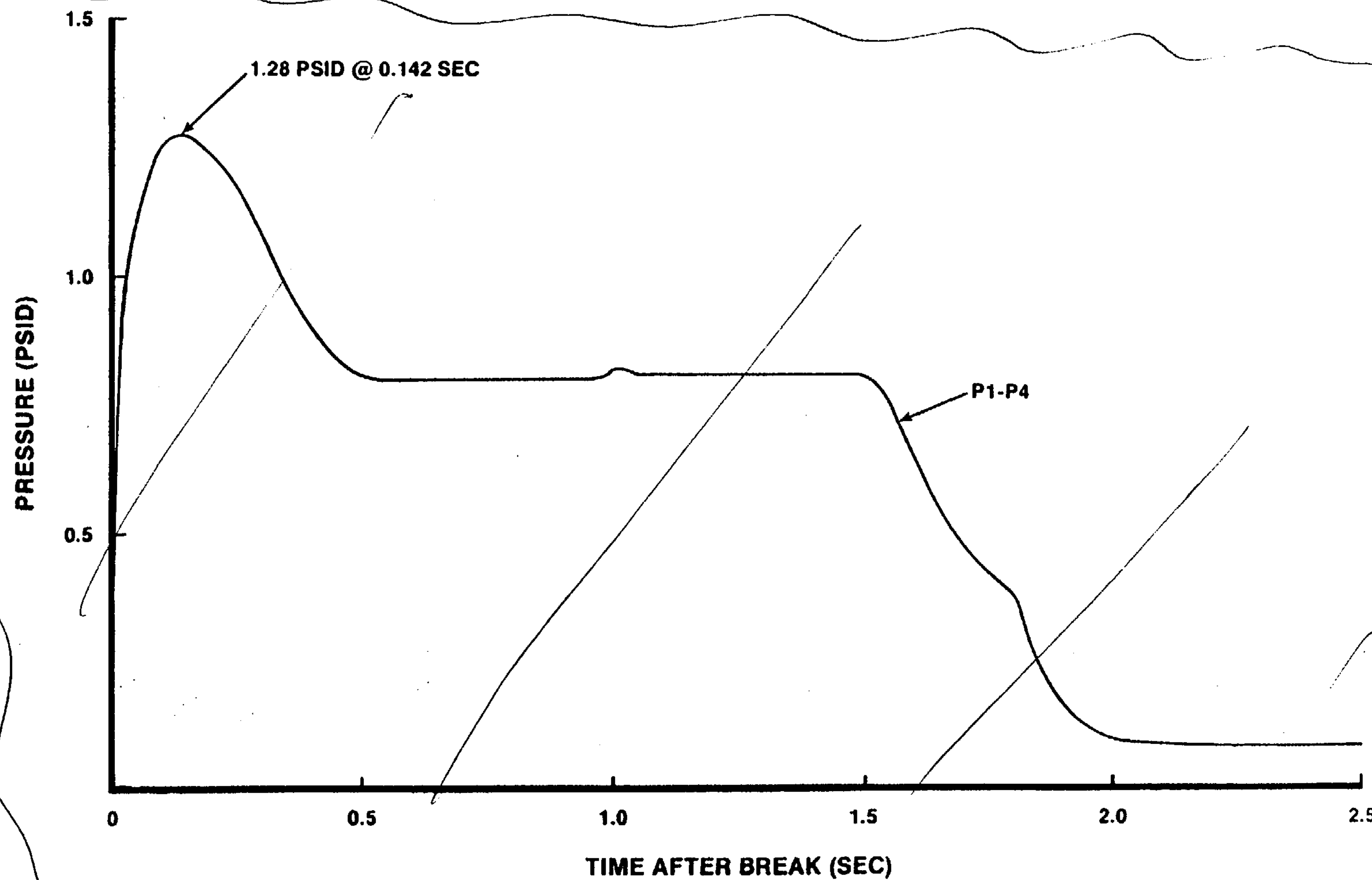


Figure deleted.
Information has been presented in table 6.2-26.

FIGURE 6.2-52

NODAL PRESSURE DIFFERENTIAL
6-IN RWCU LINE BREAK
RWCU HEAT EXCHANGER ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

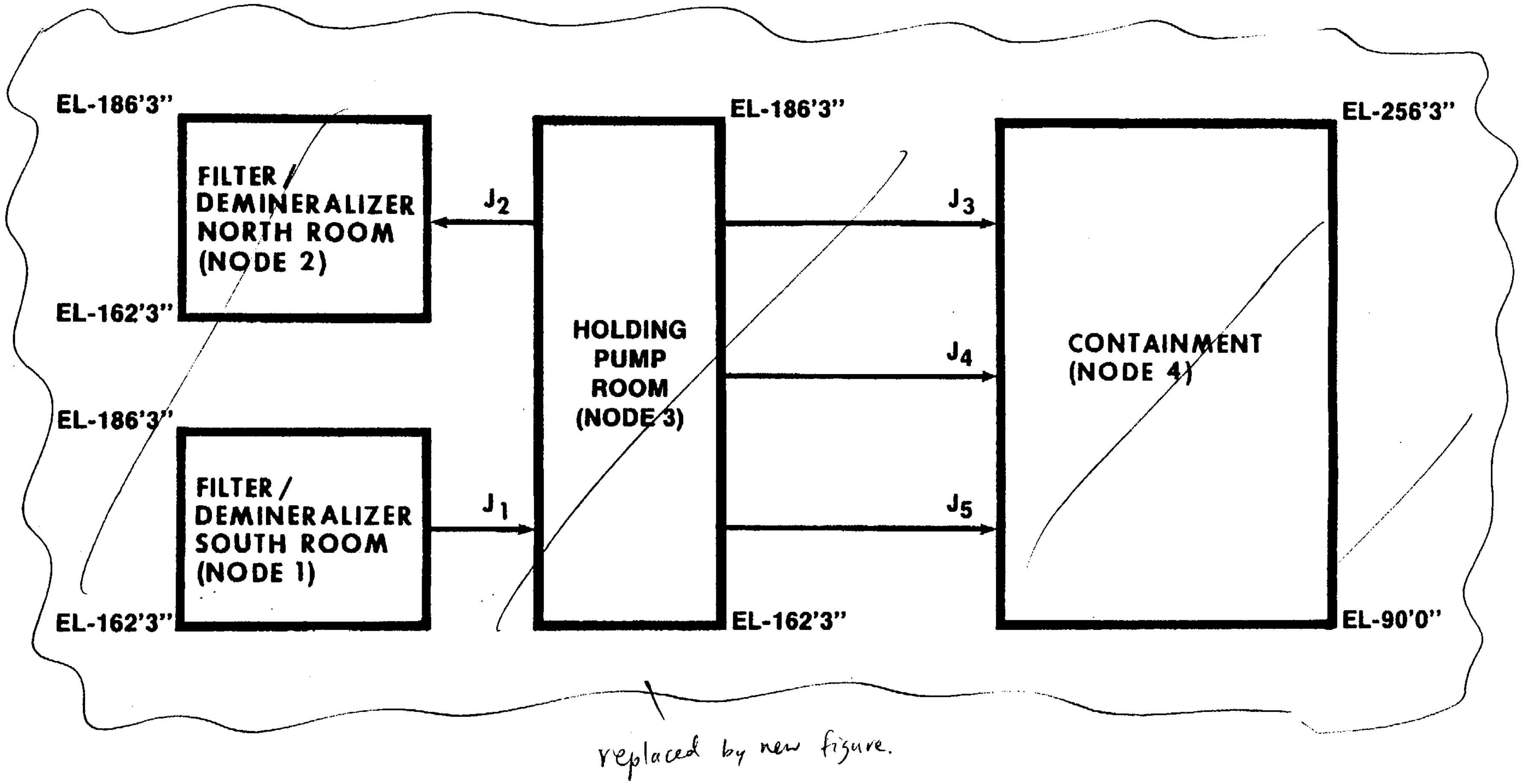


FIGURE 6.2-53

NODALIZATION DIAGRAM
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZATION ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

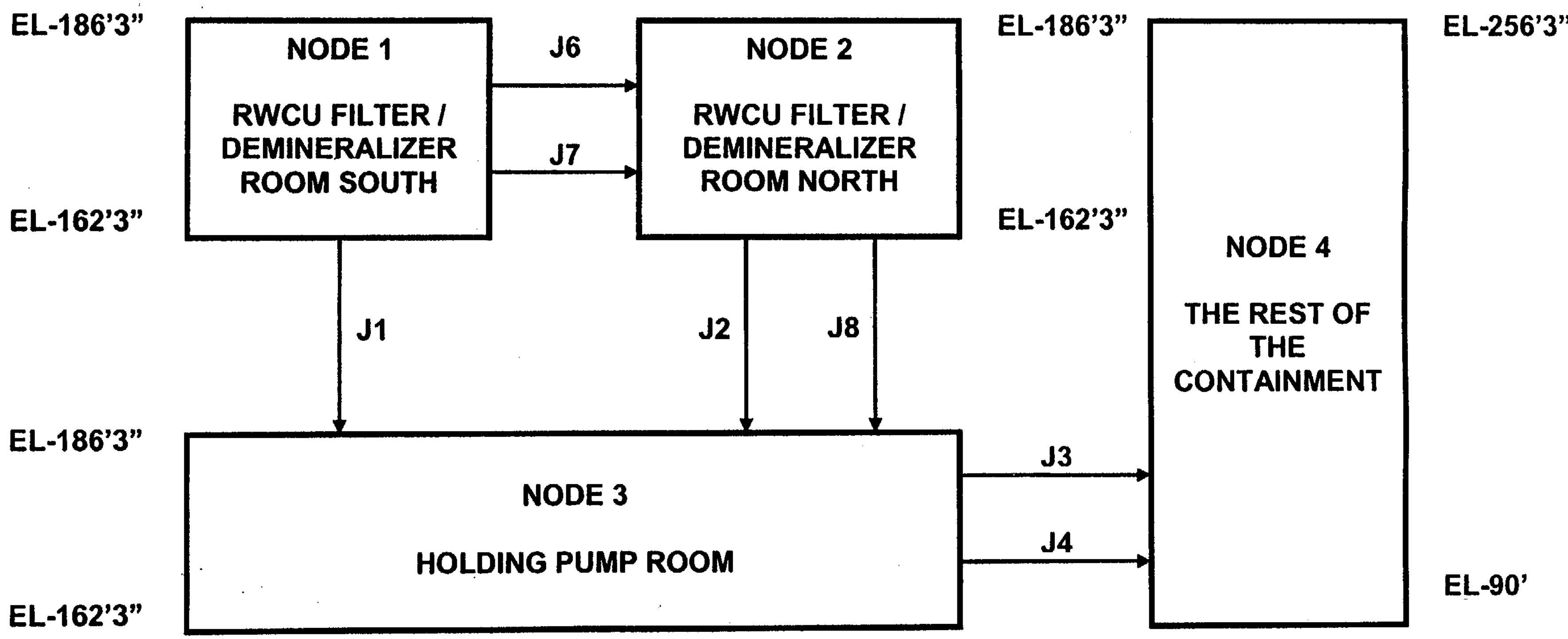
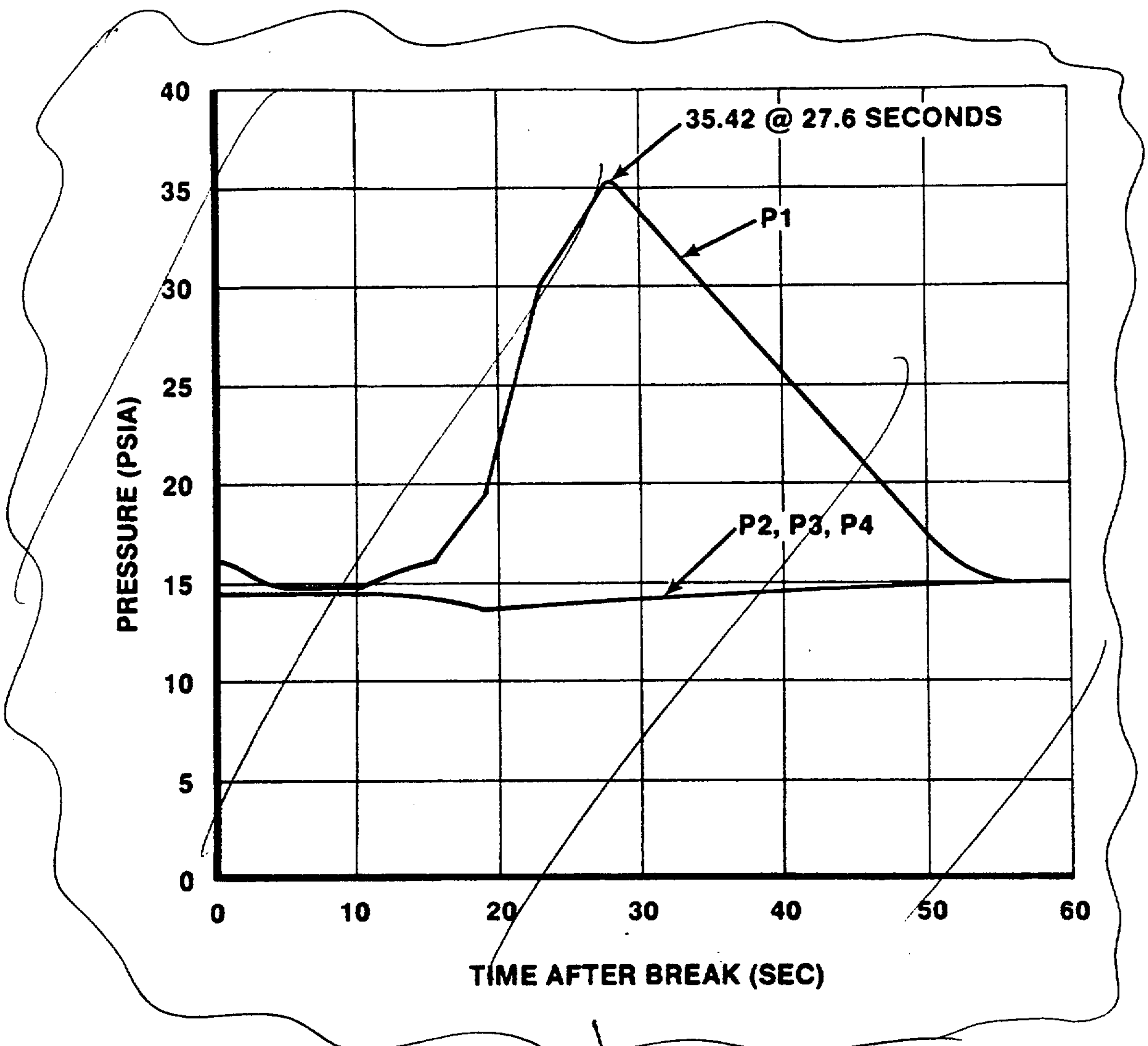


FIGURE 6.2-53

NODALIZATION DIAGRAM
8-IN RWCU LINE BREAK
RWCU FILTER / DEMINERALIZER ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT



Curves updated in the new figure.

FIGURE 6.2-54

NODAL PRESSURES
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZATION ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

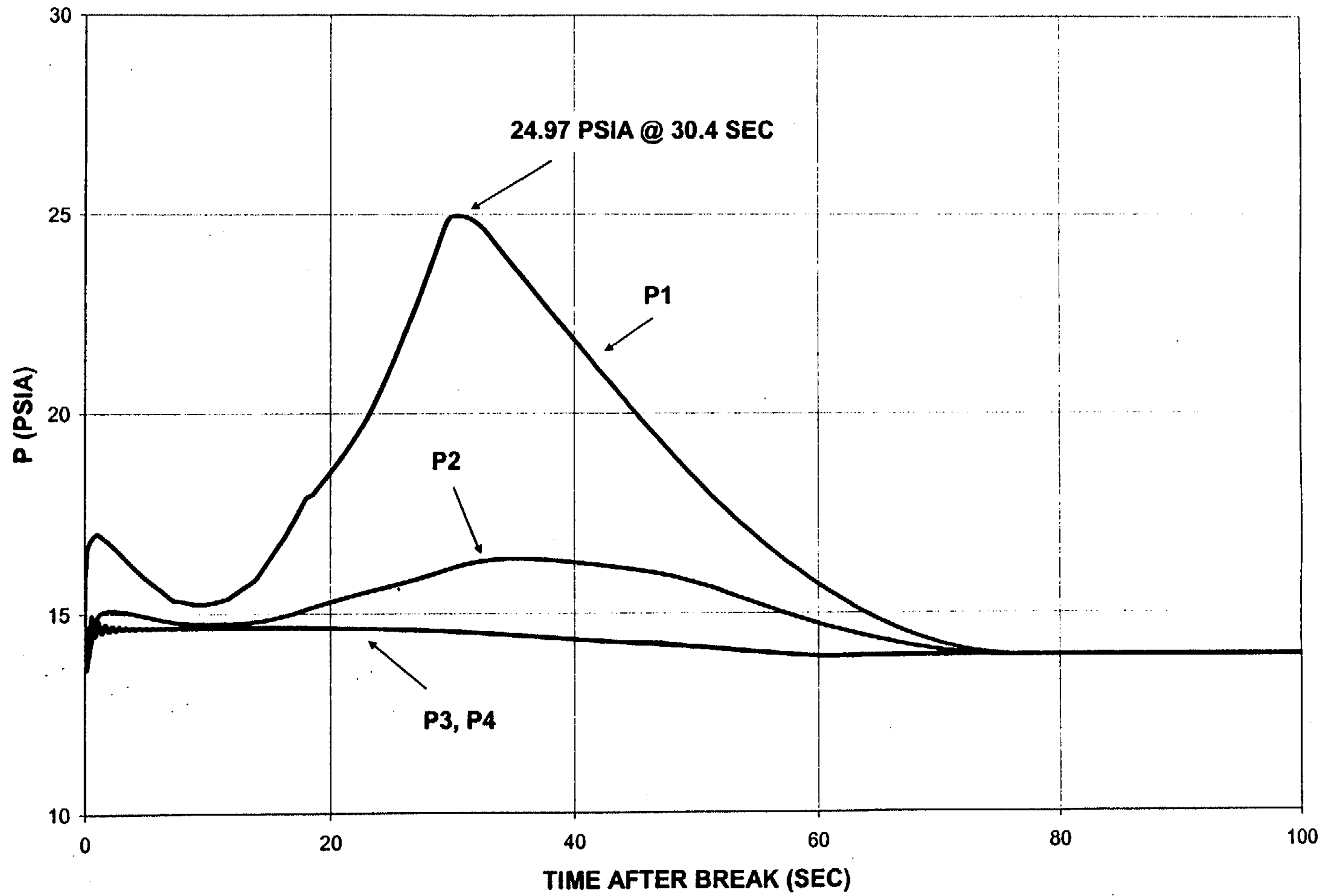


FIGURE 6.2-54

NODAL PRESSURES
8-IN RWCU LINE BREAK
RWCU FILTER / DEMINERALIZER ROOM

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

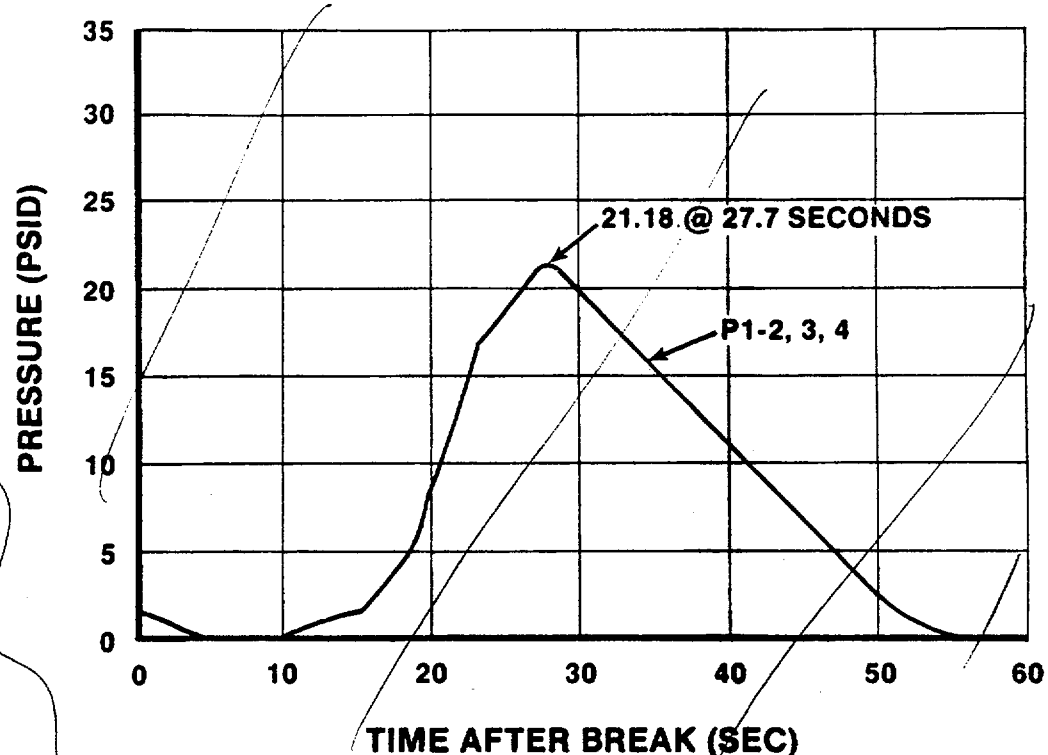


Figure deleted.
Information has been presented in Table 6.2-29.

FIGURE 6.2-55

NODAL PRESSURE DIFFERENTIAL
8-IN RWCU LINE BREAK
RWCU FILTER/DEMINERALIZER ROOM

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

USAR Appendix 3B

APPENDIX 3B

PRESSURE ANALYSIS FOR SUBCOMPARTMENTS OUTSIDE CONTAINMENT

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APPENDIX 3B

PRESSURE ANALYSIS FOR SUBCOMPARTMENTS OUTSIDE CONTAINMENT

3B.1 DESIGN BASES

Pressure response analyses were performed for the structural design basis of the main steam tunnel and other subcompartments in the auxiliary building for postulated ruptures of high-energy piping. The definitions for high energy and criteria for protection against dynamic effects associated with postulated rupture of piping are given in Section 3.6A. The analyses were performed using SWEC computer code THREED (Appendix 6B) for the main steam tunnel and the GOTHIC (Generation of Thermal-Hydraulic Information for Containments) code (developed by NAI) for the Auxiliary Building.

The auxiliary building was divided into a large number of separate subcompartments for the purpose of analysis. The main steam tunnel was divided into four separate subcompartments for its design evaluation. A fifth node was used to represent the turbine building, and a sixth node represents the outside atmosphere. The subcompartment boundaries were chosen to represent physical restrictions to flow and to reflect additional detail in the vicinity of the high-energy lines.

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Breaks were postulated in each auxiliary building volume containing a high-energy line. Breaks were postulated in the main team tunnel on both sides of the jet impingement shield wall which bounds the break exclusion zone. All breaks were considered to be instantaneous circumferential double-ended ruptures (DER), i.e., the break area was equal to twice the effective cross-sectional flow area of the pipe, except that single-ended ruptures (SER) were considered in the main team tunnel break exclusion zone. Section 3.6A defines the complete set of break locations in high-energy piping outside containment from which the design basis breaks for subcompartment pressurization were selected.

During isolation valve closure, the flow area used for mass and energy release calculations was assumed to be constant until the valve area equaled the flow limiting area. Subsequently, the limiting flow area was linearly reduced to zero.

Auxiliary building high-energy lines were identified in the reactor water cleanup (RWCU) system, the reactor core isolation cooling (RCIC) system, and the residual heat

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removal (RHR) system. A total of four break locations were postulated and analyzed. Peak calculated pressure differentials were generated for all four postulated breaks. Table 3B-1 lists all postulated breaks. The accident prifiles were generated to bound the most limiting pressure responses.

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The main steam tunnel analysis considered feedwater, RCIC, and main steam line breaks. Main steam line break analyses were performed assuming a two-phase blowdown. Four combinations of break locations and blowdown conditions were postulated and analyzed. Peak differential pressure values were generated by the two-phase blowdown breaks. Table 3B-2 lists the postulated line breaks and identifies the two breaks that determined the design differential pressures for the steam tunnel.

3B.2 DESIGN FEATURES

Fig. 1.2-13 through 1.2-19 show the piping and equipment in the subcompartments. Fig. 1.2-18 shows the louver arrangement in the main steam tunnel chimney area. There are six louvered panels, three on the east side and three on the west side of the chimney (el 170'-0"). These louvers open at a differential pressure of 3.25 psi, with an opening time of 0.3 sec.

All high-energy piping with a potential for producing high pressure and/or temperature environmental conditions in the auxiliary building is routed from the primary containment through the main steam tunnel. The RWCU pump rooms and RCIC turbine pump room are located directly below the steam tunnel, thus minimizing the length of high-energy piping outside the tunnel.

Fast closing, motor-operated isolation valves are located inside and outside containment on each high-energy line except feedwater lines, which utilize check valves to isolate reverse flow from the reactor to postulated pipe breaks outside containment. The outboard isolation valves are located in the steam tunnel break exclusion zone. The isolation valves are automatically closed by signals from the leak detection system, e.g., high local area temperature. To avoid inadvertent isolation signals, time delay relays have been installed in the isolation logics and an additional 5-second time delay has been assumed for the RCIC / RWCU line breaks. Isolation of pipe breaks is also initiated by system high flow and other signals as described in Section 6.2.4.

Pressure tight doors designed to withstand a differential pressure of 3.0 psi are utilized to isolate ECCS equipment cubicles from the effects of high-energy line breaks. These doors are administratively controlled closed.

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Two fire doors, A95/8 and A95/9, are maintained open for pressure relief purposes by fusible links which allow the doors to close at temperatures of 225° F or more. The pressure analysis assumed these doors to be only 50-percent open, and the maximum temperature in this area after the worst-case high-energy line break is less than 225° F.

3B.3 DESIGN EVALUATION

Subcompartment nodalization schemes were selected to maximize differential pressures across node boundaries. Structural components were selected as node boundaries. The differential pressure transients across node boundaries are used to determine the structural adequacy and component support design.

Table 3B-3 provides the nodal descriptions and gives the peak calculated and design differential pressures within the auxiliary building. Table 3B-4 similarly shows the subcompartment nodal descriptions for the main steam tunnel and identifies the calculated and design peak differential pressures. Figure 3B-22 shows the nodalization scheme for the main steam tunnel. Table 3B-6 presents the vent path description corresponding to that shown on Fig. 3B-22 for the main steam tunnel.

In calculating the pressure differentials across the auxiliary building subcompartment walls, it is possible to take credit for the pressurization of the volume on the opposite side of the wall in question. This procedure, however, leads to slightly different pressure differentials for all walls of the subcompartment in question. To minimize the number of differential pressures to be considered and for conservatism, a single differential pressure was calculated for each volume by subtracting 14.7 psia from each of the calculated nodal absolute pressures.

Peak pressure values for the main steam tunnel subcompartments also were calculated by subtracting 14.7 psia from the peak pressure values.

Tables 3B-7 through 3B-10 provide the mass and energy release data for the breaks that determine the design differential pressures within the auxiliary building.

In general, Moody[1] or Henry-Fauske[2] flow was assumed (for saturated and subcooled flows, respectively) at the limiting downstream and upstream flow areas crediting friction. During the inventory period, the mass and energy release data were calculated using the methodology of NEDO-20533[3], except that the Henry-Fauske model was used to calculate subcooled flow.

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Fig. 3B-1 shows the nodalization scheme used in the auxiliary building analysis and identifies the node numbers referred to in the remainder of this section. Fig. 3B-22 similarly shows the nodalization scheme for the main steam tunnel.¶

Deleted: Table 3B-5 gives vent flow path data for the auxiliary building corresponding to the nodalization scheme shown on Fig. 3B-1. Table 3B-6 presents the vent path description corresponding to that shown on Fig. 3B-22 for the main steam tunnel.¶

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Deleted: For the 4-in RCIC line break, partial credit was taken for the effect of friction on reducing the rate of blowdown. Considering only the 4-in diameter portion of the RCIC steam supply line, the total loss coefficient for the fittings and straight pipe was determined to be K=5. In this case, frictional Moody flow[4] with fL/D=5 is assumed and yields the blowdown time history given in Table 3B-9.¶
¶
For the 8-in RHR line break, credit was also taken for friction. Considering piping from the main steam line to the break and choked flow at the break, the total loss coefficient was calculated to be K = 5.41. Therefore, frictional Moody flow[4] with fL/D = 5.41 is used and the blowdown time history is given in Table 3B-10.¶

The mass and energy release data used for the postulated main steam tunnel pipe breaks are presented in Tables 3B-11 through 3B-14. These blowdowns were based entirely on frictionless Moody flow with a constant reservoir pressure. The blowdown was considered to be all steam for the first second after the accident. After 1 sec, the two-phase froth level rising in the vessel was assumed to discharge through the main steam lines. The quality of this part of the blowdown was assumed to be 7 percent.

The exposed surfaces of concrete and steel in each auxiliary building node were modeled as heat sinks in the analysis. The 2-ft thick concrete walls, ceiling, and floors were assumed to be only 1-ft thick, absorbing heat from the transient thermal environment in the respective node and insulated on the other side. The steel heat sinks include the beams, columns, posts, stairs, and platforms in the respective node. An equivalent steel slab was derived by dividing the total steel volume by the total exposed steel surface area. Concrete and steel heat sinks were modeled similarly in the steam tunnel 6-node model, except that the concrete slabs were assumed to be 1-ft thick, based on actual slabs which are 4-ft thick. Table 3B-16 summarizes these heat slabs.

Deleted: The UCHIDA heat transfer coefficient was applied, and condensate revaporization was assumed to be limited to 8 percent. The heat sink slabs for the auxiliary building 20-node model are defined in Table 3B-15.¶

Section Break (Continuous)

The initial conditions in each node were assumed to be the maximum normal temperature, 14.7-psia pressure, and maximum relative humidity based on the Environmental Design Criteria (EDC).

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Fig. 3B-23 through 3B-26 provide the absolute pressure transient plots for the two main steam tunnel subcompartments within the auxiliary building portion of the tunnel.

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Fig. 3B-2 through 3B-21A provide the absolute pressure transient plots for the 20 subcompartments in the auxiliary building.¶
¶

Fig. 3B-27 through 3B-30 provide the HELB pressure transients for the most limiting sub-compartments (typically the break rooms) in the Auxiliary Building.

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References - 3B.4

1. Moody, F. J. Maximum Flow Rate of a Single Component Two-Phase Mixture, Journal of Heat Transfer, Trans. ASME, 87, February 1965, p 134-142.

2. Henry, R. E. and Fauske, H. K. The Two-Phase Critical Flow of One Component Mixtures in Nozzles, Orifices, and Short Tubes, Journal of Heat Transfer, Trans. ASME, 93, May 1971, p 179-187.

3. NEDO-20533, Mark III Containment System Analytical Model, Appendix B, Pipe Inventory Blowdown, June 1974.

•→1

4. Lahey, R. T. and Moody, F. J. The Thermal-Hydraulics of a Boiling Water Nuclear Reactor, ANS, 1977.

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Page 6: [1] Deleted	**Unknown**
3B-12	PRESSURE TRANSIENTS IN NODE 11 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-12A	PRESSURE TRANSIENTS IN NODE 11 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-13	PRESSURE TRANSIENTS IN NODE 12 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-13A	PRESSURE TRANSIENTS IN NODE 12 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-14	PRESSURE TRANSIENTS IN NODE 13 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-14A	PRESSURE TRANSIENTS IN NODE 13 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-15	PRESSURE TRANSIENTS IN NODE 14 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-15A	PRESSURE TRANSIENTS IN NODE 14 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-16	PRESSURE TRANSIENTS IN NODE 15 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-16A	PRESSURE TRANSIENTS IN NODE 15 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-17	PRESSURE TRANSIENTS IN NODE 16 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)

Page 6: [2] Deleted	**Unknown**
3B-17A	PRESSURE TRANSIENTS IN NODE 16 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (8" RHR)
3B-18	PRESSURE TRANSIENTS IN NODE 17 AUXILIARY BUILDING - HIGH ENERGY LINE BREAK ANALYSIS (3" & 6" RWCU AND 4" RCIC)
3B-18A	PRESSURE TRANSIENTS IN NODE 17

TABLE 3B-1

HIGH-ENERGY LINE BREAKS
AUXILIARY BUILDING
20-NODE MODEL

Break No.	Line[1]	Break in Node	Design Break for Nodes[2]
1	3" RWCU	10[3]	9,10,15
2	6" RWCU	6	[4]
3	4" RCIC	2	[4]
4	8" RHR	12	1,2,3,4,5,6 7,8,11,12,13 14,16,17,18,19 20

[1] All breaks are assumed to be double-ended ruptures.

[2] Subcompartment nodes are defined in Table 3B-3 and on Fig. 3B-1.

[3] This break also could occur in Node 9. Consequently, the results for Node 10 are applied to Node 9 considering symmetry.

[4] Break does not generate design pressure for any node.

replaced with new table

TABLE 3B-1

HIGH-ENERGY LINE BREAKS
AUXILIARY BUILDING

Break No.	Line[1]	Break Room
1	3" RWCU	The RWCU Pump Room (EDC Zone AB-095-3)
2	6" RWCU	The RWCU Hoist Compartment (EDC Zone AB-095-4)
3	4" RCIC	The RCIC Pump Room (EDC Zone AB-070-3)
4	8" RHR	The RHR Equipment Removal Cubicle (EDC Zone AB-114-8A or 8B)

[1] All breaks are assumed to be double-ended ruptures.

TABLE 3B-3
SUBCOMPARTMENT NODAL DESCRIPTION
AUXILIARY BUILDING
20-NODE MODEL

Node Number	Net Volume (ft^3)	Description of Volume	Break Location	Break Type	Break Line (1)	Absolute Peak Pressure (psia)	Calculated Peak Pressure Differential (2) (psid)	Design Peak Differential Pressure (psid)
1	9,685	RHR 'C' Equipment Room, EDC Zone AB-070-4	Node 12	Steam	8" RHR	17.03	2.33	2.40
2	12,524	RCIC Pump Room, EDC Zone AB-070-3	Node 12	Steam	8" RHR	17.03	2.33	2.40
3	22,845	RPCCW Equipment Area, EDC Zone AB-095-8	Node 12	Steam	8" RHR	17.03	2.32	2.40
4	1,181	East-West Passageway, EDC Zone AB-095-4	Node 12	Steam	8" RHR	17.02	2.32	2.40
5	4,980	Unit Cooler Area, EDC Zone AB-095-4	Node 12	Steam	8" RHR	17.02	2.32	2.40
6	6,453	RCIC Access Area, EDC Zone AB-095-4	Node 12	Steam	8" RHR	17.02	2.32	2.40
7	2,535	Hoist Area, EDC Zone AB-095-4	Node 12	Steam	8" RHR	17.02	2.32	2.40
8	21,864	Elevator Area, EDC Zone AB-095-7	Node 12	Steam	8" RHR	17.02	2.32	2.40
9	627	RWCU 'A' Pump Room, EDC Zone AB-095-3	Node 9(3)	Liquid	3" RWCU	17.94	3.24	3.30
10	627	RWCU 'B' Pump Room, EDC Zone AB-095-3	Node 10	Liquid	3" RWCU	17.94	3.24	3.30
11	71,439	RPCCW Equipment Area, EDC Zone AB-070-8	Node 12	Steam	8" RHR	17.03	2.33	2.40
12	86,570	MCC Area (East), EDC Zones AB-114-3,5, and 8B	Node 12	Steam	8" RHR	17.01	2.31	2.40
13	90,157	MCC Area (West), EDC Zones AB-114-1,6, and 8A	Node 12	Steam	8" RHR	17.01	2.31	2.40

replaced with new table

TABLE 3B-3
SUBCOMPARTMENT NODAL DESCRIPTION
AUXILIARY BUILDING
20-NODE MODEL

Node Number	Net Volume (ft^3)	Description of Volume	Break Location	Break Type	Break Line[1]	Absolute Peak Pressure (psia)	Calculated Peak Pressure Differential[2] (psid)	Design Peak Differential Pressure (psid)
14	212,931	General Area, EDC Zones AB-141-1,2,3, 4, and G	Node 12	Steam	8" RHR	17.00	2.30	2.40
15	313	RWCU Piping Area, EDC Zone AB-095-3	Node 10	Liquid	3" RWCU	17.13	2.43	3.30
16	10,084	Annulus Mixing Fan Area,Node 12 EDC Zone AB-170-1	Steam	8" RHR	16.98	2.28	2.40	2.40
17	3,443	Stairwell to Elev. Mach. Room, EDC Zone AB-170-1	Node 12	Steam	8" RHR	16.98	2.28	2.40
18	3,336	Rad. Monitor Area, EDC Zone AB-170-1	Node 12	Steam	8" RHR	16.98	2.28	2.40
19	6,040	Continuous Filter Room, EDC Zone AB-170-2	Node 12	Steam	8" RHR	16.99	2.29	2.40
20	3,922	Continuous Filter Room, EDC Zone AB-170-2	Node 12	Steam	8" RHR	16.99	2.29	2.40

(1) All breaks are double-ended ruptures (i.e., break flow area is twice the pipe cross-sectional area).
(2) Calculated by subtracting 14.7 psia from the maximum absolute pressure for each node.
(3) Break in Node 9 was not analyzed, but by symmetry the results are assumed to be the same as those for Node 10.

replaced with new table

TABLE 3B-3
SUBCOMPARTMENT NODAL DESCRIPTION
AUXILIARY BUILDING

EDC Zone	Description of Volume	Vol. (ft^3)	Absolute Peak Pressure (psia)	Calculated Peak Diff. Pressure[(1) (2)] (psid)
AB-070-1	CSL Area	13992	16.49	1.79
AB-070-2	RHS-P1A Pump Room	22733	16.49	1.79
AB-070-3	ICS Pump Room	12524	16.49	1.79
AB-070-4	RHS-P1C Pump Room	9685	16.48	1.78
AB-070-5	RHS-P1B Pump Room	22733	16.48	1.78
AB-070-6	HPCS Pump Room	13927	16.48	1.78
AB-070-7	Elevator Area	35720	16.48	1.78
AB-070-8	RPCCW Area	35720	16.49	1.79
AB-095-1	CSL Hatch Area	11548	16.48	1.78
AB-095-2	RHS Heat Exchanger Area (West)	16402	16.48	1.78
AB-095-3	WCS Area	1567	16.48	1.78
AB-095-4	Hoist Area (Sub-Volume #1)	12614	16.47	1.77
AB-095-4	Hoist Area (Sub-Volume #2)	2535	16.47	1.77
AB-095-5	RHS Heat Exchanger Area (East)	16402	16.47	1.77
AB-095-6	HPCS Hatch Area	22734	16.47	1.77
AB-095-7	Elevator Area	21864	16.47	1.77
AB-095-8	RPCCW Area	22845	16.48	1.78
AB-114-1& 8A	MCC Area and RHR Equipment Removal Cubicle (west)	55573	16.47	1.77
AB-114-2	Main Steam Tunnel (North)	26775	14.70	0.00
AB-114-3	MCC Area (East)	30381	16.46	1.76
AB-114-4	Post Accident Sampling Station	1945	16.46	1.76
AB-114-5	Elevator Room	31873	16.46	1.76
AB-114-6	RPCCW Area	34584	16.47	1.77
AB-114-8B	RHR Equipment Removal Cubicle (East)	24613	16.46	1.76

TABLE 3B-3
SUBCOMPARTMENT NODAL DESCRIPTION
AUXILIARY BUILDING

EDC Zone	Description of Volume	Vol. (ft^3)	Absolute Peak Pressure (psia)	Calculated Peak Diff. Pressure[(1) (2)] (psid)
AB-141-1	Equipment Area (West)	62074	16.45	1.75
AB-141-2	Equipment Area (East)	70772	16.45	1.75
AB-141-3	Elevator Area	39813	16.45	1.75
AB-141-4	RPCCW Area	40273	16.45	1.75
AB-141-5	Standby Gas Treatment Filter (West)	45330	16.45	1.75
AB-141-6	Standby Gas Treatment Filter (East)	42256	16.45	1.75
AB-170-1	Annulus Mixing System Fan Area (Sub-Volume #1)	12172	16.44	1.74
AB-170-1	Annulus Mixing System Fan Area (Sub-Volume #2)	3336	16.44	1.74
AB-170-1	Annulus Mixing System Fan Area (Sub-Volume #3)	1930	16.43	1.73
AB-170-2	Continuous Filter Room	9962	16.44	1.74
AB-170-3	Elevator Machine Room	1313	16.43	1.73

Note: (1) The calculated peak differential pressures were calculated by subtracting 14.7 psia from the maximum absolute pressure for each node.
(2) The design peak differential pressure acceptance criteria are 3.30 psid for EDC Zone AB-095-3 and 2.40 psid for the rest of Auxiliary Building.

TABLE 3B-5

SUBCOMPARTMENT VENT PATH DESCRIPTION
AUXILIARY BUILDING
20-NODE MODEL

From Vent Path No.	To Vol. Node No.	Vol. Node No.	Inertia Vent Area (ft^2)	Factor, L/A (ft^{-1})	Head Loss Coefficient					
					Contraction	Expansion	Obstruction(1)	Friction	Turning Loss	Total
J1	9	15	21.0	0.204	0.279	0.693	0.747	0.005	-	1.724
J2	10	15	21.0	0.204	0.279	0.693	0.747	0.005	-	1.724
J3	15	5	15.75	0.156	0.234	0.504	0.980	0.006	-	1.724
J4	5	8	13.1	0.4342	-	-	-	-	-	3.926
J5	5	4	57.0	0.176	0.464	0.010	-	-	-	0.474
J6(2)	5	7	21.0	0.208	0.442	0.781	0.906	0.010	-	2.130
J7(3)	5	7	3.0	0.779	0.492	0.966	0.176	0.023	-	1.657
J8(2)	5	6	21.0	0.494	0.473	0.755	0.005	0.046	1.050	2.329
J9(3)	5	6	3.0	3.223	0.496	0.963	-	0.111	0.880	2.450
J10	4	6	92.29	0.169	0.399	0.179	-	-	-	0.578
J11	3	4	10.75	0.5883	-	-	-	-	-	3.150
J12	7	1	105.0	0.091	0.205	0.552	0.571	0.005	-	1.333
J13	6	2	114.75	0.059	0.186	0.284	0.893	0.002	-	1.365
J14(4)	2	1	23.88	0.104	0.484	0.937	0.981	0.009	-	2.411
J15	3	11	271.3	0.019	0.209	0.436	1.026	0.002	-	1.673
J16	8	11	115.0	0.032	0.458	0.925	1.104	0.005	-	2.492
J17	3	13	272.43	0.018	0.209	0.455	1.037	0.002	-	1.703
J18	8	12	115.0	0.031	0.458	0.937	1.110	0.005	-	2.510

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TABLE 3B-5

SUBCOMPARTMENT VENT PATH DESCRIPTION
AUXILIARY BUILDING
20-NODE MODEL

From Vent Path No.	To Vol. Node No.	Vol. Node No.	Inertia Vent Area (ft²)	Factor, L/A (ft⁻¹)	Head Loss Coefficient: Contraction	Expansion	Obstruction[1]	Friction	Turning Loss	Total
J19	12	14	115.0	0.027	0.484	0.970	1.163	0.024	-	2.641
J20	13	14	391.0	0.012	0.446	0.903	1.121	0.003	-	2.473
J21	16	17	203.2	0.0563	0.282	0.012	-	-	-	0.294
J22	14	17	21.0	0.0415	0.454	0.988	-	-	-	1.442
J23	16	18	146.62	0.0566	0.343	0.118	-	-	-	0.461
J24	18	20	21.0	0.0652	0.453	0.838	-	-	-	1.291
J25	20	19	207.0	0.0592	0.084	0.141	-	-	-	0.225
J26	14	16	28.0	0.0315	0.495	0.856	-	-	-	1.351

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(1) This term includes grating, orifice, mesh door, and any other form loss blocking the vent path.
(2) Closed door (with 3.0-ft.² ventilation louver) modeled to open at 3.5 psid.
(3) Door louver modeled to close at 3.5 psid when door opens.
(4) Watertight door modeled to open at 3.5 psid.

deleted

TABLE 3b-7

MASS AND ENERGY RELEASE
3-IN RWCU DER
IN AUXILIARY BUILDING - NODE 10

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Enthalpy Flow Rate (Btu/sec)
0.0	0.0	0.0
0.001	522.4	277,000
2.120	522.4	277,000
2.121	494.3	262,000
4.150	494.3	262,000
4.151	354.5	188,000
6.940	354.5	188,000
8.000	255.0	135,000
8.500	208.5	110,000
19.810	208.5	110,000
22.000	0.0	0.0

replaced with new data

TABLE 3B-7

MASS AND ENERGY RELEASE
3-IN RWCU DER
IN AUXILIARY BUILDING

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Energy Flow Rate (Btu/sec)
0.000	0.0	0
0.001	357.8	198956
1.900	357.8	198956
2.000	336.9	187344
3.800	336.9	187344
3.900	275.3	153069
12.000	275.2	153059
13.200	275.2	153053
13.700	258.1	143550
14.000	228.3	126940
14.300	211.4	117534
14.400	183.7	102146
14.500	164.2	91283
14.700	158.2	87974
15.000	117.2	65169
19.500	117.0	65060
24.300	115.8	64415
25.300	114.2	63495
27.300	79.4	44135
27.400	46.9	26106
27.900	40.3	22407
28.300	0.0	0

TABLE 3b-8

MASS AND ENERGY RELEASE
6-IN RWCU DER
IN AUXILIARY BUILDING - NODE 6

Total Mass Time (sec)	Total Enthalpy Flow Rate (lbm/sec)	Flow Rate (Btu/sec)
0.0	0.0	0.0
0.001	1373.24	728,000
1.000	1373.24	728,000
1.001	686.62	364,000
1.170	686.62	364,000
1.171	208.47	110,000
19.810	208.47	110,000
22.000	0.0	0.0

replaced with new data

TABLE 3B-8

MASS AND ENERGY RELEASE
6-IN RWCU DER
IN AUXILIARY BUILDING

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Energy Flow Rate (Btu/sec)
0.000	0.0	0
0.001	1411.9	785159
0.900	1411.9	785159
1.000	706.0	392579
1.100	165.2	91845
26.500	165.2	91845
28.300	0.0	0

TABLE 3b-9

MASS AND ENERGY RELEASE
4-IN RCIC DER
IN AUXILIARY BUILDING - NODE 2

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Enthalpy Flow Rate (Btu/sec)
0.0	0.0	0.0
0.001	53.86	64,126
0.082	53.86	64,126
0.083	71.82	85,509
12.738	71.82	85,509
13.768	0.0	0.0

replaced with new data

TABLE 3B-9

MASS AND ENERGY RELEASE
4-IN RCIC DER
IN AUXILIARY BUILDING

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Energy Flow Rate (Btu/sec)
0.000	0.0	0
0.001	134.8	160373
0.245	134.8	160373
0.250	72.9	86666
12.000	72.9	86666
13.000	72.8	86636
14.000	72.8	86571
15.000	72.7	86461
16.000	72.5	86260
17.000	72.2	85861
18.000	71.6	85166
19.000	70.2	83530
19.900	67.6	80442
20.900	55.2	65663
21.000	44.1	52481
21.100	37.6	44733
21.200	33.8	40242
21.400	28.8	34273
21.500	3.1	3737
21.900	0.0	0

TABLE 3B-10

MASS AND ENERGY RELEASE
8-IN RHR DER
IN AUXILIARY BUILDING - NODE 12

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Enthalpy Flow Rate (Btu/sec)
0.0	0.0	0.0
0.001	241.4	287,845
2.0	241.4	287,845
4.5	229.4	273,536
7.0	209.1	249,331
9.5	138.0	164,551
12.0	0.0	0.0

replaced with new data

TABLE 3B-10

MASS AND ENERGY RELEASE
8-IN RHR DER
IN AUXILIARY BUILDING

Time (sec)	Total Mass Flow Rate (lbm/sec)	Total Energy Flow Rate (Btu/sec)
0.000	0.0	0
0.001	509.4	605951
0.100	509.4	605951
0.200	266.8	317333
1.900	266.8	317333
2.500	266.0	316362
3.000	265.1	315348
3.500	263.7	313613
4.000	262.1	311740
4.500	259.9	309137
5.000	256.6	305216
5.500	252.2	300010
6.000	246.6	293348
6.500	237.9	282938
7.000	227.4	270446
7.500	212.8	253096
7.800	204.0	242686
7.900	198.8	236440
8.000	192.0	228343
8.200	181.2	215506
8.300	179.4	213416
8.500	175.9	209237
8.600	174.2	207148
8.900	167.3	198999
9.800	132.2	157301
9.900	125.7	149558
10.000	116.9	139004
10.200	102.9	122340
10.800	72.8	86547
10.900	53.5	63645
11.000	43.0	51106
11.300	28.8	34273
11.400	3.1	3737
11.800	0.0	0

TABLE 3B-15

HEAT SINK SLAB DESCRIPTION
AUXILIARY BUILDING
20-NODE MODEL

Slab No.	Node Left	Exposure[1] Right	Exposed Surface Area (ft^2)	Material	Thickness (ft)
1	1	0(2)	2,877	Concrete[3]	1.0
2	2	0	3,320	Concrete[3]	1.0
3	3	0	5,076	Concrete[3]	1.0
4	4	0	664	Concrete[3]	1.0
5	5	0	1,750	Concrete[3]	1.0
6	6	0	2,347	Concrete[3]	1.0
7	7	0	947	Concrete[3]	1.0
•→1 8 1←•	8	0	5780	Concrete[3]	1.0
9	11	0	15,949	Concrete[3]	1.0
10	12	0	19,844	Concrete[3]	1.0
11	13	0	17,880	Concrete[3]	1.0
12	14	0	38,632	Concrete[3]	1.0
13	15	0	1,106	Concrete[3]	1.0
14	16	0	3,235	Concrete[3]	1.0
15	17	0	830	Concrete[3]	1.0
16	18	0	1,287	Concrete	1.0
17	20	0	1,662	Concrete	1.0
18	19	0	2,209	Concrete	1.0
19	1	1	743	Carbon Steel[3]	0.0306
20	2	2	935	Carbon Steel[3]	0.0307

table deleted

TABLE 3B-15 (Cont)

Slab No.	Node Left	Exposure(1) Right	Exposed Surface Area (ft2)	Material	Thickness (ft)
21	3	3	1,875	Carbon Steel[3]	0.05
22	5	5	278	Carbon Steel[3]	0.0403
23	6	6	476	Carbon Steel[3]	0.0439
24	8	8	1,214	Carbon Steel[3]	0.0610
25	11	11	7,344	Carbon Steel[3]	0.0460
26	16	16	1,894	Carbon Steel[3]	0.04
27	17	17	108	Carbon Steel[3]	0.04
•→1					
28[4]	12	0	1,798	Carbon Steel[3]	0.00529
29[4]	13	0	982.5	Carbon Steel[3]	0.00529
30[4]	14	0	2,943	Carbon Steel[3]	0.00529
1←•					

table deleted

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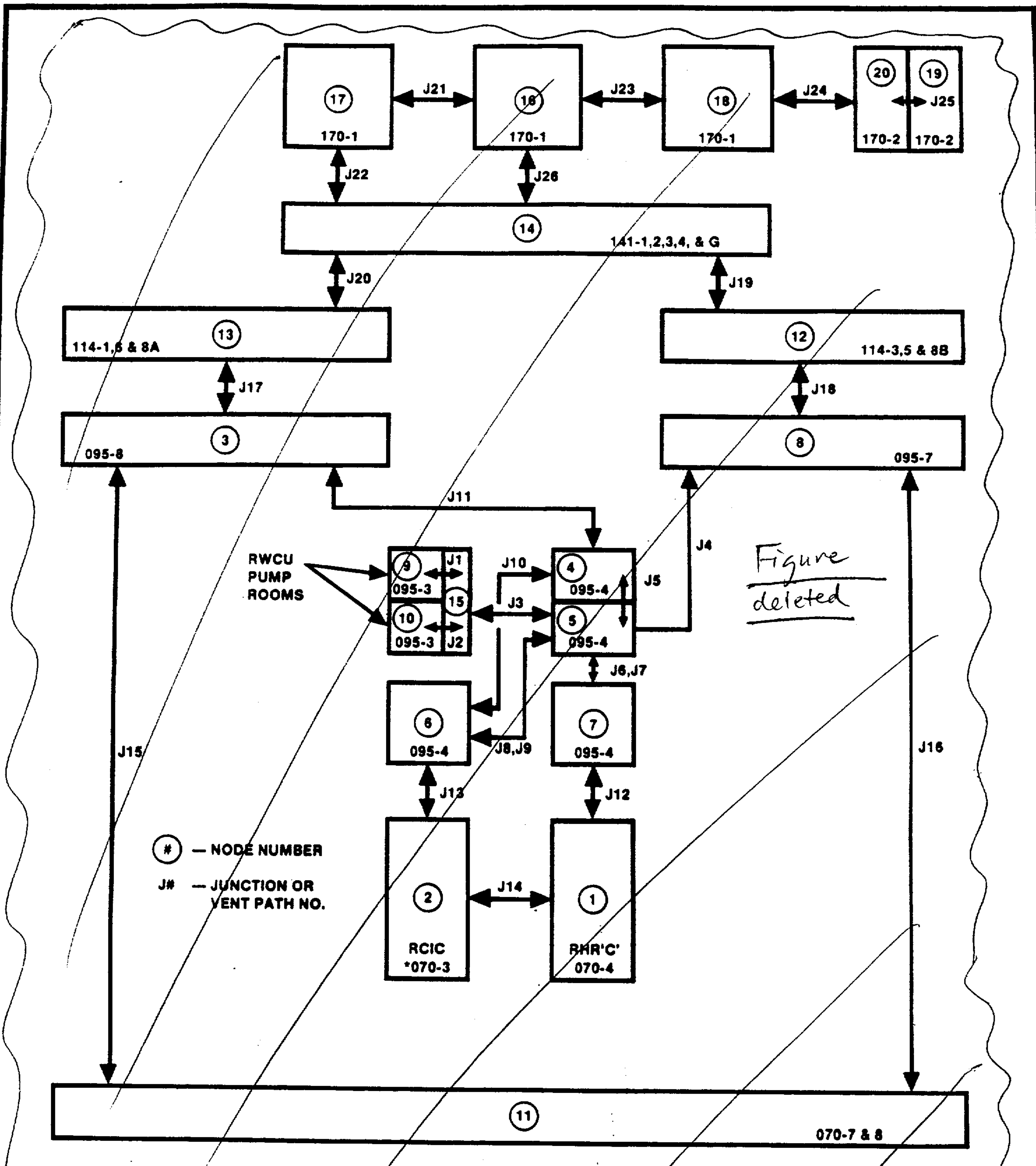
(1) Node numbers are defined in Table 3B-3 and on Fig. 3B-1.
(2) Zero exposure indicates an insulated boundary assumption with zero heat transfer at this boundary.
(3) Thermal Properties:

	Concrete	Carbon Steel
Conductivity, Btu/hr-°F-ft^3	0.8	26.0
Volumetric heat capacity, Btu/°F-ft^3	23.2	53.9

•→1
(4) Heat sinks only applicable to 8" RHR HELB analysis.
1←•

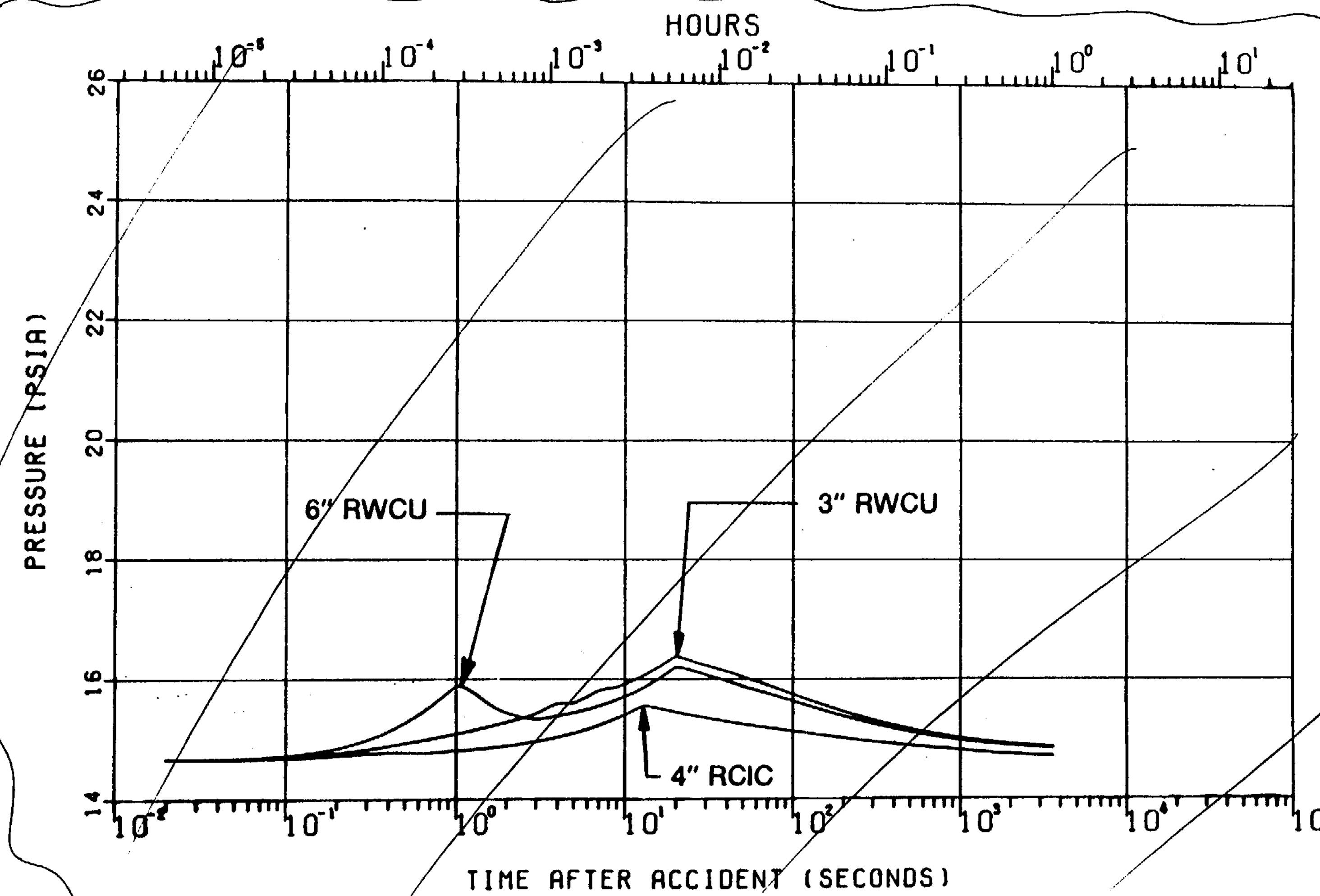


NOTE:
*THE NOTATION 070-3 FOR EXAMPLE, REFERS TO ENVIRONMENTAL ZONE 3 ON ELEVATION 70'0" OF THE AUXILIARY BUILDING

FIGURE 3B-1

NODALIZATION DIAGRAM
AUXILIARY BUILDING
20 NODE MODEL

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT



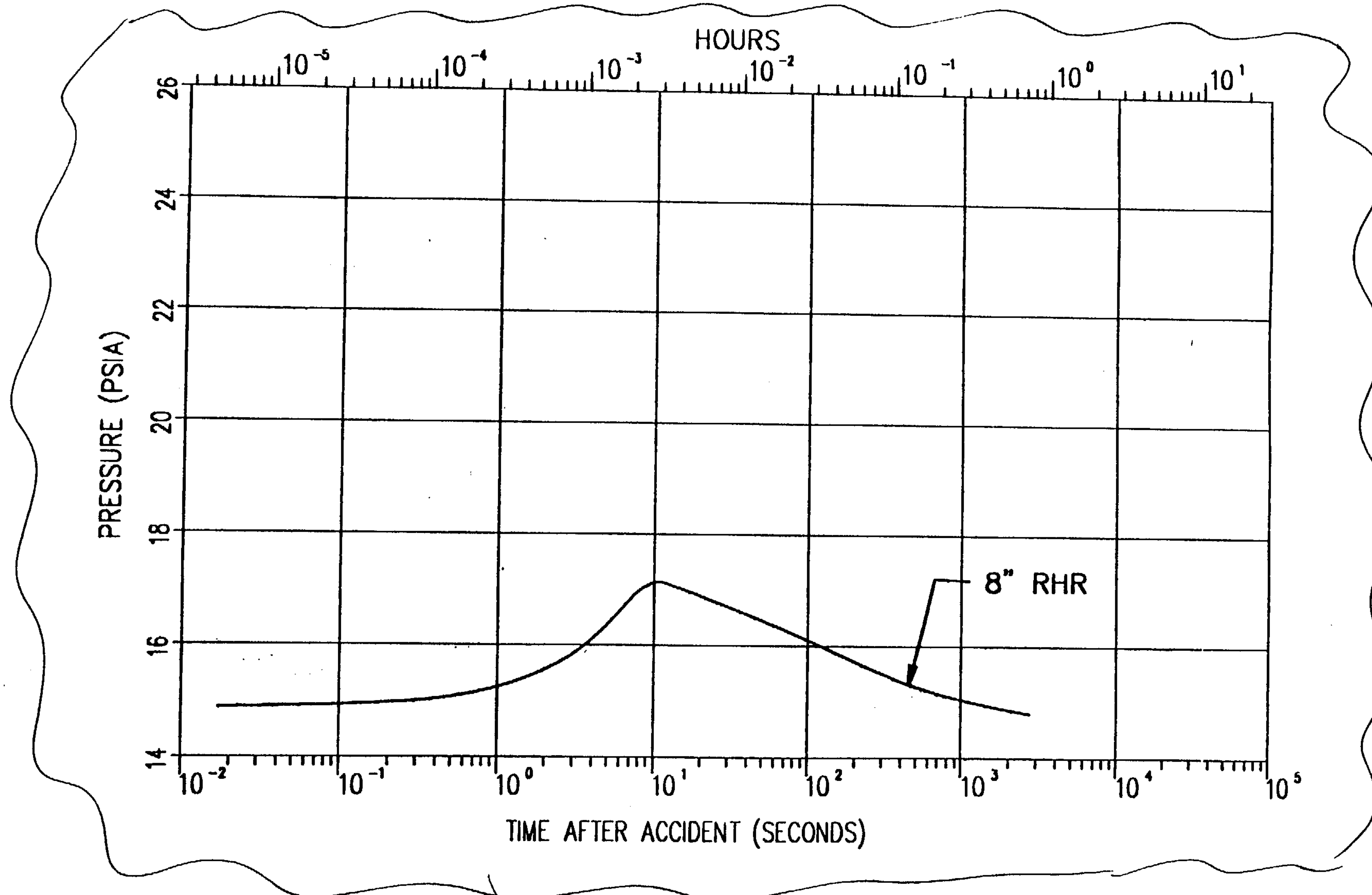
Figures 3B-2 through 3B-21A deleted

New data presented in Figures 3B-27 through 3B-30

FIGURE 3B-2

PRESSURE TRANSIENTS IN NODE 1
AUXILIARY BUILDING
HIGH ENERGY LINE BREAK ANALYSIS

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT



Figures 3B-2 through 3B-21A deleted

(Figures 3B-3 through 3B-21A are similar to Figures 3B-2 and 3B-3)

FIGURE 3B-2A

PRESSURE TRANSIENTS IN NODE 1
AUXILIARY BUILDING
HIGH ENERGY LINE BREAK ANALYSIS

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

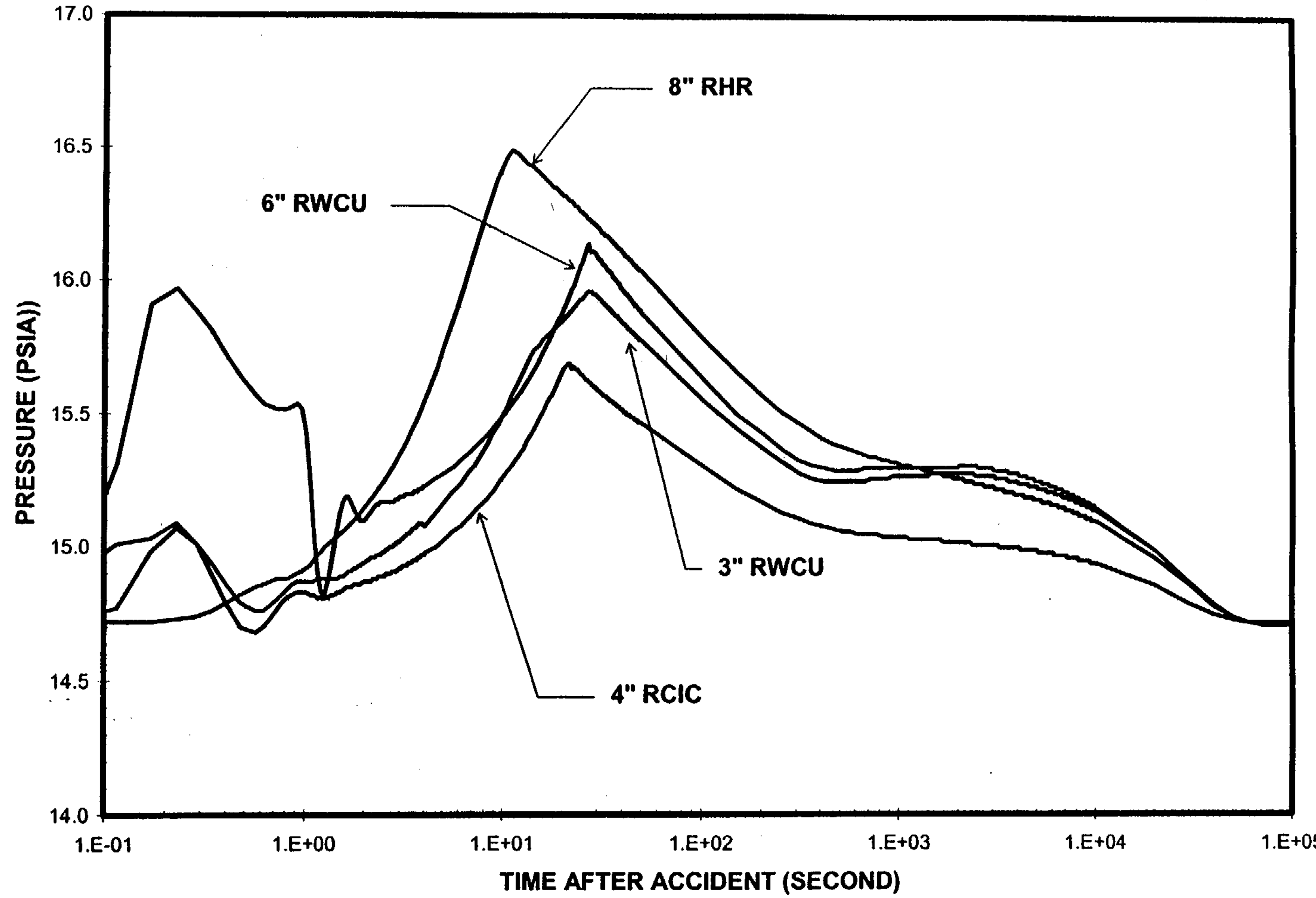


FIGURE 3B-27

PRESSURE TRANSIENTS FOR EDC ZONE AB-070-3

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

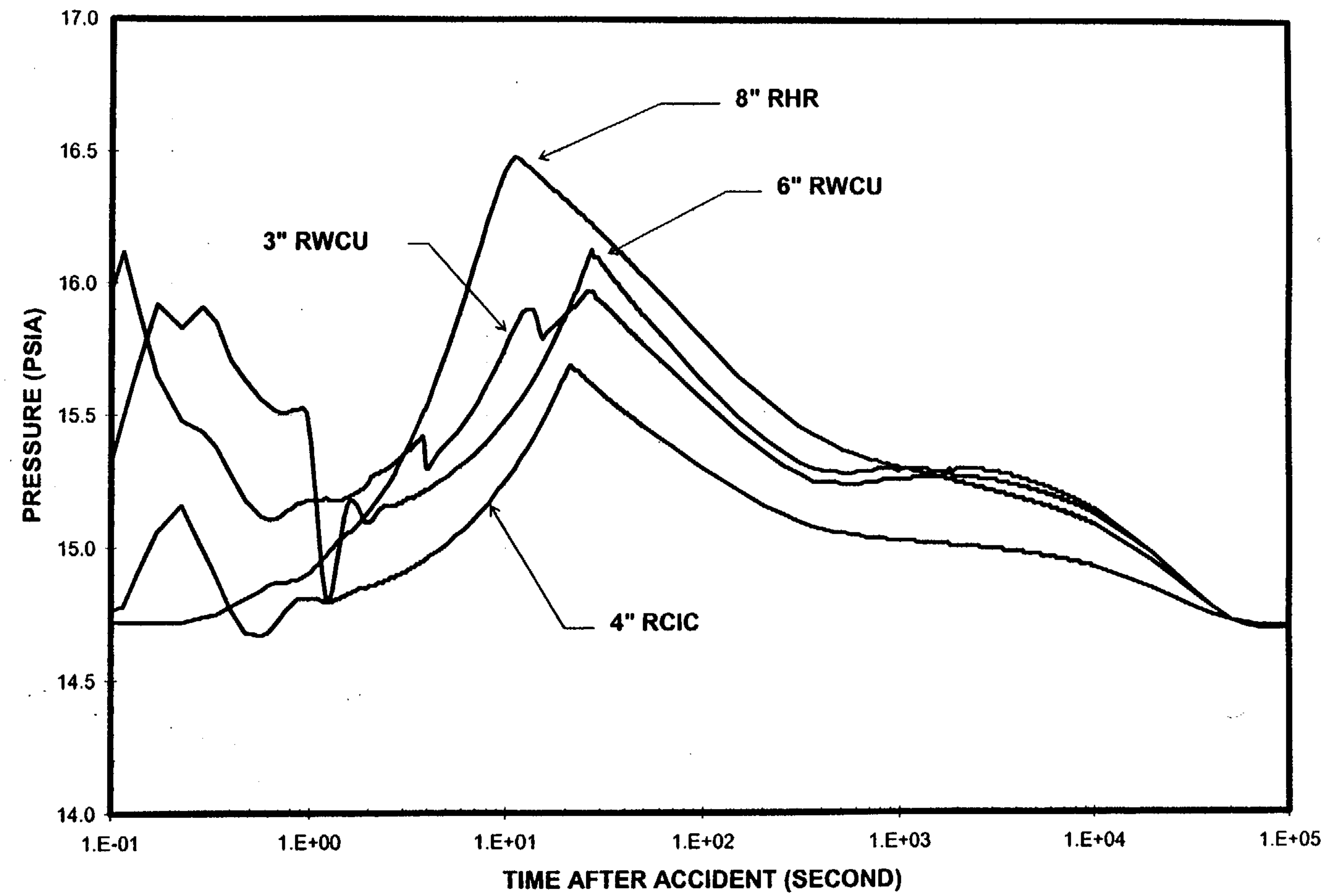


FIGURE 3B-28

PRESSURE TRANSIENTS FOR EDC ZONE AB-095-3

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

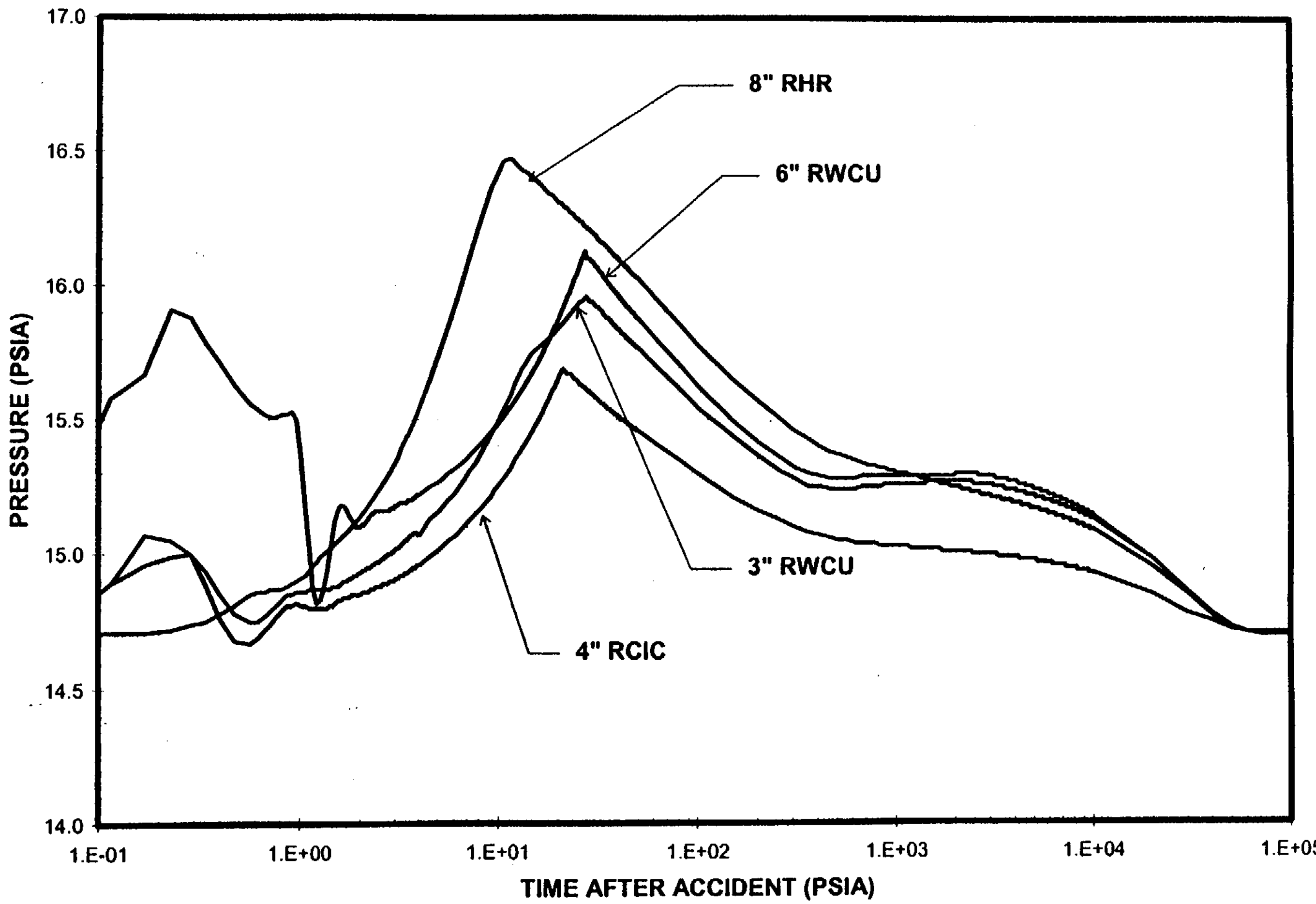


FIGURE 3B-29

PRESSURE TRANSIENTS FOR EDC ZONE AB-095-4

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

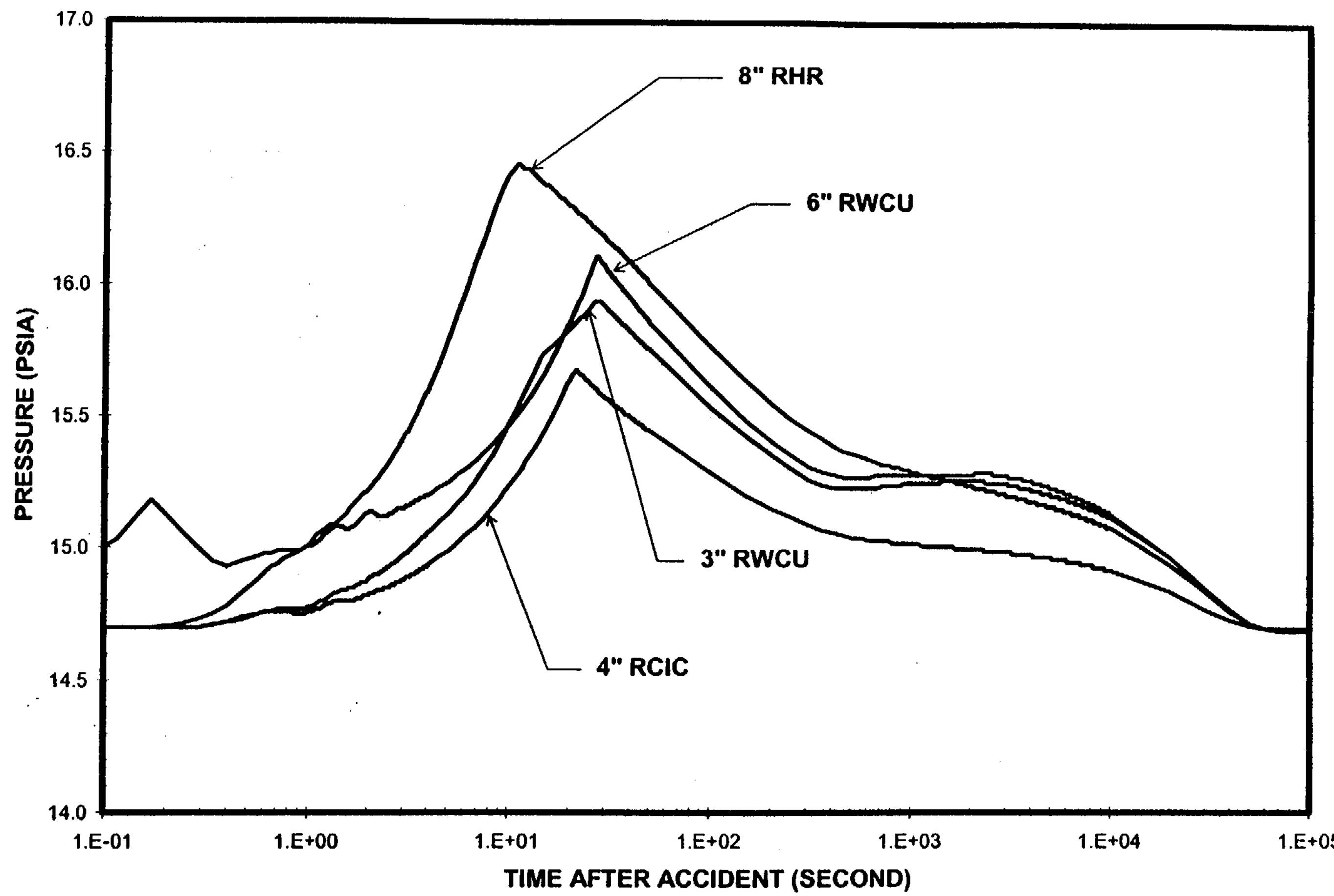


FIGURE 3B-30

PRESSURE TRANSIENTS FOR EDC ZONE AB-114-8A & 8B

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT