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Your ref: Project Number 740
Our ref: DCP/NRC1820

January 26, 2007

Subject: AP1000 COL Standard Technical Report Submittal

In support of Combined License application pre-application activities, Westinghouse is submitting Revision 0 of AP1000 Standard Combined License Technical Report Number 7. This report addresses and documents, on a generic basis, design activities required to complete the COL Information Item in Section 3.6.4.1 in the AP1000 Design Control Document. Changes to the Design Control Document identified in Technical Report Number 7 are intended to be incorporated into FSARs referencing the AP1000 design certification or incorporated into the design certification using supplemental rulemaking if Part 52 is revised to permit revision of the design certification. This report is submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in this report is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The purpose for submittal of this report was explained in a March 8, 2006 letter from NuStart to the U.S. Nuclear Regulatory Commission.

Pursuant to 10 CFR 50.30(b), APP-GW-GLR-074, Revision 0, "Pipe Break Hazards Analysis," Technical Report Number 7, is submitted as Enclosure 1 under the attached Oath of Affirmation.

The pipe rupture hazard evaluation (for pipe whip and jet impingement) has been performed for the current design configuration of the AP1000 plant, to determine the method of protection that is used for safety related targets located in the vicinity of postulated high energy pipe breaks. In addition, the locations of pipe whip restraints are identified. The detailed locations of jet impingement shields will be performed at a later stage of the design. This evaluation addresses the effects of pipe whip and jet impingement and does not include flooding, environmental and compartment pressurization effects. Loads due to pipe whip impact on concrete walls are not addressed in this evaluation.

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It is expected that when the NRC review of Technical Report Number 7 is complete, the included activities to address the COL Information Item in Section 3.6.4.1 will be considered complete for COL applicants referencing the AP1000 Design Certification.

Questions or requests for additional information related to the content and preparation of this report should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

D. J. Hutchinson for

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Attachment

1. "Oath of Affirmation," dated January 26, 2007

/Enclosure

1. APP-GW-GLR-074, Revision 0, "Pipe Break Hazards Analysis," Technical Report Number 7, dated January 2007.

cc:	S. Bloom	-	U.S. NRC	1E	1A
	S. Coffin	-	U.S. NRC	1E	1A
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ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)
NuStart Bellefonte COL Project	)
NRC Project Number 740	)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 26 day
of January 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Debra McCarthy, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Aug. 31, 2009
Member, Pennsylvania Association of Notaries

Debra McCarthy
Notary Public

ENCLOSURE 1

APP-GW-GLR-074, Revision 0

Pipe Break Hazards Analysis

Technical Report Number 7

AP1000 DOCUMENT COVER SHEET

TDC: Permanent File: APY

RFS#: RFS ITEM #:

AP1000 DOCUMENT NO.	REVISION NO.		ASSIGNED TO
APP-GW-GLR-074	0	Page 1 of 29	W-Sterdis

ALTERNATE DOCUMENT NUMBER: N/A WORK BREAKDOWN #:

ORIGINATING ORGANIZATION: Westinghouse

TITLE: **Pipe Break Hazards Analysis**

ATTACHMENTS:	DCP #/REV. INCORPORATED IN THIS DOCUMENT REVISION:
CALCULATION/ANALYSIS REFERENCE:	

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LEGAL REVIEW	SIGNATURE/DATE	1/25/2007
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ORIGINATOR C. D. Eng	SIGNATURE/DATE	01/24/07
REVIEWERS P. J. Kotwicki	SIGNATURE/DATE	01/24/2007

VERIFIER E. R. Johnson	SIGNATURE/DATE E R Johnsen 01/24/07	VERIFICATION METHOD Detailed Review
AP1000 RESPONSIBLE MANAGER Lee Tunon-Sanjur	SIGNATURE* L. Tunon-Sanjur	APPROVAL DATE 1/24/07

* Approval of the responsible manager signifies that document is complete, all required reviews are complete, electronic file is attached and document is released for use.

APP-GW-GLR-074
Revision 0

January 2007

AP1000 Standard Combined License Technical Report

Pipe Break Hazards Analysis

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Nuclear Power Plants
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REVISION HISTORY

Original document: APP-GW-GLR-074 Revision 0

Revision	Location	Change Description
0	N/A	Original Issue

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1.0 INTRODUCTION

AP1000 Design Control Document (DCD) Section 3.6.4-1. is addressed in this report. The pipe rupture hazard evaluation (for pipe whip and jet impingement) has been performed for the current design configuration of the AP1000 plant. The purpose of this evaluation is to determine the method of protection that is used for safety related targets located in the vicinity of postulated high energy pipe breaks. In addition, the locations of pipe whip restraints are identified. The locations of jet impingement shields will be identified at a later stage of the design as described in Section 2.0.

The combined license information item 3.6.4-1 in the DCD states the following:

> "Combined License applicants referencing the AP1000 certified design will complete the final pipe whip restraint design and address as built reconciliation of the pipe break hazards analysis in accordance with the criteria outlined in subsections 3.6.1.3.2 and 3.6.2.5. The as-built pipe rupture hazard analysis will be documented in an as-built Pipe Rupture Hazards Analysis Report."

The work performed to support the issuance of APP-GW-GLR-074 is deemed adequate to establish the licensing basis in the area of pipe break hazard analysis. As explained in APP-GW-GLR-021 (Reference 7) which discusses AP1000 As-Built COL Information Items, the timing of the reconciliation of the pipe break hazard analysis is such that the reconciliation can not be provided by an applicant for a COL. This reconciliation will be done prior to operation of the plant. A pipe rupture hazard analysis is part of the piping design. It is used to identify postulated break locations and layout changes, support design, whip restraint design and jet shield design. These activities are completed prior to fabrication and installation of the piping and connected components. The AP1000 FSER (NUREG-1793) states the following:

> "The proposed pipe rupture locations will be adequately determined using the above staff-approved criteria and guidelines. The design methods for high-energy mitigation devices and the measures to deal with the subsequent dynamic effects of pipe whip and jet impingement have been sufficiently and adequately defined by the applicant, thus providing adequate assurance that upon completion of the HELB analyses, the ability of safety-related SSCs to perform their safety functions will not be impaired by the postulated pipe ruptures. The as-built inspections of the high-energy mitigation devices will be performed as a part of the ITAAC required by the regulations."

> "The provisions for protection against the dynamic effects associated with pipe ruptures of the reactor coolant pressure boundary inside the containment and the resulting discharging fluid provide adequate assurance that design-basis LOCAs will not be aggravated by the sequential failures of safety-related piping. In addition, the performance of the ECCS will not be degraded as a result of these dynamic effects. These provisions further assure that the consequences of pipe ruptures will be adequately mitigated so that the reactor can be safely shut down, and be maintained in a safe-shutdown condition, in the event of a postulated rupture of a high-energy piping

system or a postulated crack in a moderate-energy piping system inside and outside containment."

The change markup of the COL Information Item in DCD Section 3.6.4.1, addressing pipe break hazard analysis, is found in APP-GW-GLR-021 (Reference 7).

2.0 TECHNICAL BACKGROUND

The locations for the postulated breaks are the terminal ends in the high energy piping (excluding piping that satisfies leak-before-break criteria or is located in the break exclusion zones). The locations for the high stress intermediate breaks are based on the ASME Class 1 piping fatigue evaluation which is to be performed at a later stage of the design. Break locations identified as intermediate breaks will be treated in a manner similar to that described in this report. The coordinates of the break locations are based on the piping isometric drawings.

The break affected zone for each postulated pipe break includes the volumetric regions of the whipping pipes and the steady state jets. This zone is based on the locations of the hinges in the whipping pipe. The hinge locations for the whipping pipe are based on: (a) the distance to the instantaneous hinge, (b) the location of the pipe supports, and (c) the distance to the steady state hinge.

The potential safety related targets are based on the system P&ID's. The locations of the targets are based on the plant 3D model databases as well as the planned location of items that will be added to the databases at a later stage of the design. The design locations for some of the targets (e.g. cables, tubing, and 1-inch diameter piping) are to be determined at a later stage of the design.

The criteria that are used to identify the essential safety related targets are summarized below:

- Components, instrumentation, and cables that are used for accident mitigation or safe shutdown.
- Components that would cause a secondary side blowdown when the initial postulated break is a primary side break.
- Components that would cause a primary side blowdown when the initial postulated break is a secondary side break.
- Components that maintain the pressure boundary integrity of the containment (steel vessel and associated piping and isolation valves).
- Instrumentation that is used for post-accident monitoring.
- Components that would prevent simultaneous blowdown of both steam generators.

For each break location the essential safety related targets are identified as that subset of the potential safety related targets that are needed to mitigate the consequences of the postulated pipe break in combination with the worst credible single failure. For each essential safety related target there are four possible methods of protection as follows:

1) The target is protected by adequate separation from the break affected zone.

2) The target is within the break affected zone and is qualified by analysis at a later stage of the design.

3) The target is within the initial break affected zone but is protected by a pipe whip restraint which leads to a modified break affected zone. The target is now located outside of the break affected zone. This evaluation includes the conceptual design of the pipe whip restraints: preliminary location and characteristics. The complete design of the pipe whip restraints will be

performed at a later stage of the design. The modified break affected zones may need to be revised after the design of the pipe whip restraints is completed. The pipe whip restraints, essential safety related targets, and room numbers are documented in a summary table (Table 4-2).
4) The target is within the jet impingement region of the initial break affected zone but is protected by a jet shield which leads to a modified break affected zone. The target is now located outside of the break affected zone. A jet shield is used to prevent impingement on fragile targets, such as cables, instrumentation, and valve operators. The conceptual and complete design of jet shields will be performed at a later stage of the design.

The current DCD Table 3.6-3, which is provided in Table 4-1, identifies nuclear island rooms that contain high energy line breaks, with corresponding essential targets and pipe whip restraints.

The pipe rupture hazard protection for the steel containment vessel at the penetrations maintains the pressure boundary integrity for postulated high energy line breaks. The containment vessel is designed for loads due to pipe whip and jet impingement.

Table 4-2 (revision to DCD Table 3.6-3) summarizes the nuclear island rooms that contain pipe whip restraints. The hazard source identifies the location of the postulated high energy pipe break. When the pipe break is located in a room other than where the pipe whip restraint is located, this adjacent room is listed in the table. The pipe whip restraints are used to protect essential targets from the effects of pipe whip and jet impingement. When the essential targets are located in different rooms, these rooms are listed in the table.

3.0 REGULATORY IMPACT

The AP1000 FSER (Reference 2) in Subsection 3.6.2 discusses the locations and dynamic effects associated with postulated pipe rupture. The information provided in the present report is consistent with evaluation and procedures considered in the FSER.

The changes to the DCD presented in this report do not represent adverse changes to the design function or how design functions are performed or controlled. The changes to the DCD do not involve revising or replacing a DCD-described evaluation methodology nor involve a test or experiment not described in the DCD. The DCD changes do not require a license amendment per the criteria of VIII.B.5.B of Appendix D to 10 CFR Part 52.

The changes described do not affect design features used to mitigate severe accidents. The as-designed pipe break hazard evaluation does not alter design features used to mitigate severe accidents. Therefore, a license amendment based on the criteria of VII.B.5.C of Appendix D to 10 CFR Part 52 is not required.

The subject changes will not alter barriers or alarms that control access to protected areas of the plant. The subject changes will not alter requirements for security personnel. Therefore, the proposed change does not have an adverse impact on the security assessment of the AP1000.

4.0 REVISIONS TO THE DESIGN CONTROL DOCUMENT (DCD)

Changes to DCD Table 3.6-3:

General:
The format of the table has been revised to clarify the room locations of the pipe whip restraints, hazard sources, and essential safety related targets. The previous table contained two sheets, and the revised table contains seven sheets. Safety related targets that are no longer protected from a break are removed from the table. The title of the table has been revised to indicate the association of the room and pipe whip restraint with the corresponding hazard sources and essential targets. The current contents of DCD Table 3.6-3 are found in Table 4-1, and the proposed contents are in Table 4-2.

Room 11201:
There are no changes in the break locations and pipe whip restraints in room 11201. The previous assumption was that the access platform support steel would not fail as a result of the pipe whip. A pipe whip restraint is needed to assure that the support steel does not fail. The failure of the support steel could cause unacceptable damage to essential safety related targets located below 11201. A pipe whip restraint is already present, and provides adequate protection to the support steel, so only essential targets are added to the table.

Room 11204:
The room is added to the table as a result of the addition of a pipe whip restraint. There are no changes in the break locations in room 11204. The previous assumption was that the access platform support steel would not fail as a result of the pipe whip. A pipe whip restraint is needed

to assure that the support steel does not fail. The failure of the support steel could cause unacceptable damage to the essential safety related targets located in room 11204. A pipe whip restraint is added.

Room 11209 Chase:
There are no changes to the break locations and pipe whip restraints in room 11209 Chase. Essential targets are added.

Room 11300:
The room is added to the table as a result of the addition of a pipe whip restraint. There are no changes in the break locations in room 11300. The previous assumption for the break on the CVS containment isolation module was that the duration of the initial thrust load was small enough such that this load was negligible. The initial thrust duration is large enough, due to the fluid contained in the length of pipe, such that this load can cause pipe whip. Pipe whip restraints are added.

Room 11301:
There is a new break location in room 11301 due to a change in pipe layout and a new terminal connection to the steam generator. For this new break, a pipe whip restraint is used to protect essential safety targets.
An additional pipe whip restraint is added for a break at the SG blowdown terminal end at the steam generator nozzle. A previous assumption was that the steam generator blowdown line did not affect the 11401 floor platform support steel. A pipe whip restraint is needed to assure that the support steel does not fail, as it would cause unacceptable damage to the essential safety related targets in the subcompartments below room 11301.

Room 11302:
The room is added to the table as a result of the addition of a pipe whip restraint. A previous assumption was that the steam generator blowdown line did not affect the 11402 floor platform support steel. A pipe whip restraint is needed to assure that the support steel does not fail, as it would cause unacceptable damage to the essential safety related targets in the subcompartments below room 11302.

Room 11303:
The room is removed as a result of the intermediate break location being removed from an adjacent room. The previous assumption was that there would be high intermediate stresses. The AP1000 design will pursue low intermediate stresses, which eliminates the break location.

Room 11400:
There are no changes in the break locations in room 11400. The previous assumption was that the concrete wall would prevent unacceptable pipe whip. The active seismic pipe supports in combination with the concrete wall will prevent unacceptable pipe whip. These pipe supports are designed for pipe whip loads, and are to be designated SGS002 A/B/C. The former pipe whip restraints in room 11400 are replaced by pipe whip restraints (SGS006 A/B) in room 11402.

Room 11401:
The break location at the in-line anchor is removed from room 11401. The current design does not include an anchor in this room. This room is no longer included in the table.

Room 11402:
There is no change in the break location which is in an adjacent room (11400). The previous assumption was that the pipe layout in the adjacent room could be modified to accommodate a pipe whip restraint in room 11400. The pipe layout will not be modified. The pipe whip restraints are now in room 11402.

Room 11403:
The intermediate break locations in room 11403 are removed. This room is therefore no longer included in the table. The previous assumption was that there would be high intermediate stresses. The AP1000 design will pursue low intermediate stresses.

Room 11503:
There are no changes in room 11503. A more complete target description is provided.

Room 11601:
There are no changes in the break locations in room 11601. The previous assumption was that the access platform support steel would not fail as a result of the pipe whip. A pipe whip restraint is needed to assure that the support steel does not fail. The failure of the support steel could cause unacceptable damage to essential safety related targets in the subcompartments below room 11601.

Room 11602:
There are no changes in the break locations in room 11602. The previous assumption was that the access platform support steel would not fail as a result of the pipe whip. A pipe whip restraint is needed to assure that the support steel does not fail. The failure of the support steel could cause unacceptable damage to essential safety related targets in the subcompartments below room 11602.

Room 11603:
There are no changes in the break locations in room 11603. The previous assumption was that the steel floor plate between room 11603 and room 11703 would be designed to prevent unacceptable pipe whip. The current design replaces the steel floor plate with steel grating. A pipe whip restraint is used to prevent unacceptable pipe whip. Essential targets are added as a result.
The previous assumption was that the downstream broken end of the pipe would not whip excessively since there is no downstream significant energy source (closed valve). The upstream jet load on the downstream broken pipe could cause unacceptable pipe whip. A pipe whip restraint is added. Essential targets are added as a result.

Room 11703:
There are no changes in the break locations in room 11703. The previous assumption was that the downstream broken end of the pipe would not whip excessively since there is no downstream

significant energy source (closed valve). The upstream jet load on the downstream broken pipe could cause unacceptable pipe whip. A pipe whip restraint is added. Essential targets are added.

Room 12244:
There are no changes in the break location and pipe whip restraints in room 12244. A more complete target description is provided.

Changes to List of Tables for DCD Chapter 3

The DCD Chapter 3 List of Tables is revised to address the title change of DCD Table 3.6-3. The change markup of DCD Table 3.6-3 is found in Table 4-6.

Changes to DCD Table 3.6-2:

The table for subcompartments and postulated pipe ruptures, DCD Table 3.6-2 (Sheet 4 of 7), is revised to reflect the design changes for the pressurizer vessel and the ADS stage 1, 2, and 3 piping, valves, and support steel that are supported by the pressurizer upper lateral support. A 14"x6" tee and valve RCS-V005A were relocated from room 11703 to room 11603. The change markup for Table 3.6-2 (Sheet 4 of 7) is Table 4-3.

The current design does not include the in-line anchor in the 4" pressurizer spray line in room 11403. The terminal end break associated with this anchor is removed from DCD Table 3.6-2 (Sheet 5 of 7). The change markup of DCD Table 3.6-2 (Sheet 5 of 7) is found in Table 4-4.

Sheet 7 of 7 in DCD Table 3.6-2 indicates the top and bottom elevations of each room. The platform elevations for the lower and upper ADS valve areas were modified (affecting rooms 11503, 11603, and 11703) due to the pressurizer vessel design change mentioned above. Also, the top elevations for rooms 11400 and 11403 are revised to reflect the bottom of the concrete slab instead of the top. The change markup for DCD Table 3.6-2 (Sheet 7 of 7) is in Table 4-5.

Changes to DCD Figure 3E-5:

The High Energy Piping – Chemical and Volume Control System drawing in Appendix 3E of the DCD is revised to indicate that an omitted branch between the tee at line L037 and closed valve V024 is high energy. The change markup for DCD Figure 3E-5 (Sheet 1 of 2) is in Figure 4-1. The AP1000 Leak-Before-Break Evaluation of As-Designed Piping topical report (Reference 6), submitted July of 2006, contains markups of two additional drawings in Appendix 3E of the DCD. These DCD figures are High Energy Piping – Passive Core Cooling System (Figure 3E-4) and High Energy Piping – Reactor Coolant System (DCD Figure 3E-3).

Change to COL Information Item, DCD Section 3.6.4.1
The change markup of the COL Information Item addressing Pipe Break Hazard Analysis is found in APP-GW-GLR-021 (Reference 7).

Table 4-1 (Sheet 1 of 2)

NI ROOMS WITH POSTULATED HIGH ENERGY LINE BREAKS/ESSENTIAL TARGETS/PIPE WHIP RESTRAINTS AND RELATED HAZARD SOURCE (Current, DCD Table 3.6-3)

Room Number	Room Description	Essential Target Description	Hazard Source
11201	Steam Generator Compartment-01	Automatic depressurization system (ADS) Stage 4 valves (RCS-V004A, RCS-V004C, RCS-V014A, and RCS-V014C	1) Reactor Coolant System (RCS)-Pressurizer Spray Line, 4" L110A: Terminal End Break at RCS Cold Leg L002A 2) RCS-Pressurizer Spray Line, 4" L106: Terminal End Break at RCS Cold Leg L002B
11209	Pipe Chase to CVS Equipment Room	CVS makeup, CVS letdown, CVS hydrogen supply, and SGS steam generator blowdown piping	1) Steam Generator System (SGS)-Blowdown Line, 4" L009A: Terminal End Break at Containment Penetration P27 2) SGS-Blowdown Line, 4" L009B: Terminal End Break at Containment Penetration P28 3) CVS-Makeup Line, 3" L056: Terminal End Break at In-Line Anchor
11303	Lower Pressurizer Compartment	SGS steam generator blowdown and steam generator drain piping. RCS pressurizer pressure and level instrumentation; pressurizer support steel	1) RCS-CVS Purification Line, 3" L112: Intermediate Break at Outlet to Valve CVS-V082
11400	Maintenance Floor Mezzanine	Steam generator supports	1) SGS-Startup Feedwater Line, 6" L005B: Terminal End Break at Containment Penetration P45
11401	Steam Generator 01 Compartment	ADS Stage 4 valves (RCS-V004A, RCS-V004C, RCS-V014A, and RCS-V014C)	1) RCS Pressurizer Spray Line, 4" L106: Terminal End Break at In-Line Anchor
11403	Pressurizer Spray Valve Room	ADS Stage 4 valves (RCS-V004A, RCS-V004C, RCS-V014A, and RCS-V014C)	1) RCS Pressurizer Spray Line, 4" L213: Intermediate Break at 4x2 Tee Connection to Auxiliary Spray Line 2) RCS CVS Letdown Line, 3" L111: Intermediate Break at Inlet to Valve CVS-V001

Table 4-1 (Sheet 2 of 2)

NI ROOMS WITH POSTULATED HIGH ENERGY LINE BREAKS/ESSENTIAL TARGETS/PIPE WHIP RESTRAINTS AND RELATED HAZARD SOURCE (Current, DCD Table 3.6-3)

Room Number	Room Description	Essential Target Description	Hazard Source
11503	Upper Pressurizer Compartment	ADS Stage 1, 2, and 3 valves, lower tier platform support steel	1) RCS-Pressurizer Spray Line, 4" L215: Terminal End Break at Pressurizer Nozzle
11601	Steam Generator-01 Feed Water Nozzle Area	RCS head vent piping/valves SGS level instrumentation piping	1) SGS-Startup Feedwater Line, 6" L005A: Terminal End Break at Steam Generator MB01 Nozzle 2) SGS-Main Feedwater Line, 20" L003A: Terminal End Break at Steam Generator MB01 20" x 16" Reducing Nozzle
11602	Steam Generator-02 Feedwater Nozzle Area	SGS level instrumentation piping	1) SGS-Main Feedwater line, 20" L003B: Terminal End Break at Steam Generator MB02 20" x 16" Reducing Nozzle
11603	Lower ADS Valve Area	ADS Stage 2 and 3 valves (RCS-V002B, RCS-V003B, RCS-V012B, and RCS-V013B) Raceways and cable for Divisions A/C and B/D	1) RCS-Automatic Depressurization System Stage 1 Line, 4" L010B: Terminal End Break at Inlet to Valve RCS V011B
11703	Upper ADS Valve Area	ADS Stage 2 and 3 valves (RCS-V002A, RCS-V003A, RCS-V012A, and RCS-V013A) Raceways and cables for Division A/C	1) RCS-Automatic Depressurization System Stage 1 Line, 4" L010A: Terminal End Break at Inlet to Valve RCS V011A
12244	Lower Annulus Valve Area	CVS Makeup valve CVS-V090	1) CVS-Makeup Line, 3" L131: Terminal End at In-Line Anchor

Table 4-2 (Sheet 1 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)

Room Number	Room Description	Pipe Whip Restraint	Hazard Source/Room	Essential Target Description/Room
11201	Steam Generator Compartment-01, Below the Lower Manway	PWR-RCS002	Reactor Coolant System (RCS)-Pressurizer Spray Line, 4" L110A: Terminal End Break at RCS Cold Leg L002A.	Raceways and cables. Passive Core Cooling System (PXS) containment level instrumentation. Steam Generator System (SGS) level instrumentation. RCS pressurizer instrumentation. Reactor Coolant Loop (RCL) (steam generator, pumps, hot leg, and cold legs) and branch line piping/valves.
		PWR-RCS003	RCS-Pressurizer Spray Line, 4" L106: Terminal End Break at RCS Cold Leg L002B.	Raceways and cables. PXS containment level instrumentation. SGS level instrumentation. RCS pressurizer instrumentation. RCL branch line piping/valves.
11204	Steam Generator Access Room	PWR-CVS004	Chemical and Volume Control System (CVS) Letdown Line, 3" L002: Terminal End Break at In-Line Anchor.	SGS blowdown and drain piping. RCS pressurizer level piping. Raceways and cables. PXS containment level instrumentation.
11209 Chase	Pipe Chase to CVS Equipment Room	PWR-SGS004	SGS-Blowdown Line, 4" L009A: Terminal End Break at Containment Penetration P27.	SGS blowdown piping (L009B). CVS makeup piping (L056). CVS letdown piping (L049). CVS hydrogen supply piping (L062). Liquid Radwaste System (WLS) containment sump piping (L072).

Table 4-2 (Sheet 2 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)				
Room Number	**Room Description**	**Pipe Whip Restraint**	**Hazard Source/Room**	**Essential Target Description/Room**
		PWR-SGS008	SGS-Blowdown Line, 4" L009B: Terminal End Break at Containment Penetration P28.	CVS makeup piping (L056). CVS letdown piping (L049). CVS hydrogen supply piping (L062).
		PWR-CVS056	CVS-Makeup Line, 3" L056: Terminal End Break at In-Line Anchor.	SGS blowdown piping (L009B). CVS makeup valve (CVS-V091), (Room 11300).
11300	Maintenance Floor	PWR CVS047 A/B	CVS-Letdown Line, 2" L049: Terminal End Break at inlet to Valve V059.	Raceways and cables, (Rooms 11300 and 11400). SGS MB01 level instrumentation piping, (Room 11400). CVS makeup valves (CVS-V091 and V100). CVS hydrogen supply valves (CVS-V065, V094, V095, and V096). WLS containment sump valve (WLS-V055). RCS pressurizer instrumentation.
11301	Steam Generator Compartment-01, Lower Manway Area	PWR-RCS001 A/B	CVS-Makeup Line, 3" RCS L112, Terminal End Break at Steam Generator MB01.	Steam generator MB01 support. RCS Passive Residual Heat Removal (PRHR) Heat Exchanger (HX) return piping (L113).
		PWR-SGS003	SGS- SG Blowdown 4" SGS-L009A (Room 11401)	Raceways and cables. (11201) PXS containment level instrumentation. (11201) SGS level instrumentation. (11201) RCS pressurizer instrumentation. (11201) RCL (steam generator, pumps, hot leg, and cold legs) and branch line piping/valves. (11201) Steam generator MB01 support. RCS PRHR return piping (L113).

Table 4-2 (Sheet 3 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)

Room Number	Room Description	Pipe Whip Restraint	Hazard Source/Room	Essential Target Description/Room
11302	Steam Generator Compartment-02, Lower Manway Area	PWR-SGS007	SGS- SG Blowdown 4" SGS-L009B (Room 11402)	SGS level instrumentation (11202, 11302) RCL and drain line piping/valves (11202, 11302) Steam generator MB02 support (11202, 11302) Raceways and cables (11202, 11302) PXS containment recirculation screen (11202)
11400	Maintenance Floor Mezzanine	PWR-SGS002 A/B/C	SGS-Startup Feedwater Line, 6" L005A: Terminal End Break at Containment Penetration P44.	PXS PRHR HX ME01 upper head. PXS PRHR HX ME01 upper head vent and drain piping and valves (PXS-V102A/B). SGS MB01 level instrumentation piping. Raceways and cables.
11402	Steam Generator Compartment-02, Tube Sheet Area	PWR-SGS006A/B	SGS-Startup Feedwater Line, 6" L005B: Terminal End Break at Containment Penetration P45. (Room 11400.)	Steam generator MB02 and supports. Primary Sampling System (PSS) Core Makeup Tank (CMT) (MT02B) sample piping and valves (PSS V005B/C), (Room 11400). PXS CMT MT02B vent piping and valve (PXS-V030B), (Room 11400). PXS CMT MT02B balance line piping and valve (PXS-V002B), (Room 11400). PXS CMT MT02B sample line piping and valve (PXS-V010B), (Room 11400). PXS CMT MT02B makeup line piping (PXS-L012B), (Room 11400). PXS CMT MT02B sample line piping (PXS-L011B), (Room 11400). Raceways and cables, (Rooms 11400 and 11402).

Table 4-2 (Sheet 4 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)

Room Number	Room Description	Pipe Whip Restraint	Hazard Source/Room	Essential Target Description/Room
11503	Upper Pressurizer Compartment	PWR-RCS006	RCS-Pressurizer Spray Line, 4" L215: Terminal End Break at Pressurizer Nozzle.	ADS Stage 1, 2, and 3 valves (RCS-V001B, RCS-V002B, RCS-V003B, RCS-V011B, RCS-V012B, and RCS-V013B), (Room 11603). ADS Stage 1, 2, and 3 valves (RCS-V001A, RCS-V002A, RCS-V003A, RCS-V011A, RCS-V012A, and RCS-V013A), (Room 11703). ADS Stage 1, 2, and 3 support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel, (Room 11503).
11601	Steam Generator-01, Feedwater Nozzle Area	PWR-SGS001	SGS-Startup Feedwater Line, 6" L005A: Terminal End Break at Steam Generator MB01 Nozzle.	RCS head vent piping/valves. RCS ADS stage 1, 2, 3 discharge header (RCS-L064B). SGS level instrumentation piping, (Rooms 11601, 11501, 11401, 11301, and 11201). RCS ADS stage 4 valves (RCS-V004A, RCS-V004C, RCS-V014A, and RCS-V014C), (Room 11401). Raceways and cables, (Rooms 11601, 11501, 11401, 11301, 11201, 11603, and 11703). Steam generator MB01 supports, (Rooms 11601, 11401, 11301, and 11201). Reactor Coolant Loop (steam generator, pumps, hot leg, and cold legs) and branch line piping/valves, (Rooms 11601, 11501, 11401, 11301, and 11201).

Table 4-2 (Sheet 5 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)				
Room Number	**Room Description**	**Pipe Whip Restraint**	**Hazard Source/Room**	**Essential Target Description/Room**
				RCS ADS Stage 1, 2, and 3 piping, valves and support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel, (Room 11503). RCS pressurizer spray line, (Room 11503). RCS pressurizer level instrumentation, (Room 11503).
		PWR-SGS021	SGS-Main Feedwater Line, 16" L003A: Terminal End Break at Steam Generator MB01 Nozzle.	RCS ADS stage 1, 2, 3 discharge header (RCS-L064B). SGS level instrumentation piping, (Rooms 11601, 11501, 11401, 11301, and 11201). RCS ADS stage 4 valves (RCS-V004A, RCS-V004C, RCS-V014A, and RCS-V014C), (Room 11401). Raceways and cables, (Rooms 11601, 11501, 11401, 11301, 11201, 11603, and 11703). Steam generator MB01 supports, (Rooms 11601, 11401, 11301, and 11201). RCL and branch line piping/valves, (Rooms 11601, 11501, 11401, 11301, and 11201). RCS ADS Stage 1, 2, and 3 piping, valves and support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel, (Room 11503). RCS pressurizer spray line, (Room 11503). RCS pressurizer level instrumentation, (Room 11503).

Table 4-2 (Sheet 6 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)				
Room Number	**Room Description**	**Pipe Whip Restraint**	**Hazard Source/Room**	**Essential Target Description/Room**
11602	Steam Generator-02, Feedwater Nozzle Area	PWR-SGS005	SGS-Startup Feedwater Line, 6" L005B: Terminal End Break at Steam Generator MB02 Nozzle	SGS level instrumentation piping, (Rooms 11602, 11502, 11402, 11302, and 11202). RCS ADS stage 4 valves (RCS-V004B, RCS-V004D, RCS-V014B, and RCS-V014D), (Room 11402). Raceways and cables, (Rooms 11602, 11502, 11402, 11302, 11202). Steam generator MB02 supports, (Rooms 11602, 11402, 11302, and 11202). RCL and branch line piping/valves, (Rooms 11602, 11502, 11402, 11302, and 11202). PXS containment recirculation screen (11202)
		PWR-SGS022	SGS-Main Feedwater line, 16" L003B: Terminal End Break at Steam Generator MB02 Nozzle.	SGS level instrumentation piping, (Rooms 11602, 11502, 11402, 11302, and 11202). RCS ADS stage 4 valves (RCS-V004B, RCS-V004D, RCS-V014B, and RCS-V014D), (Room 11402). Raceways and cables, (Rooms 11602, 11502, and 11402). Steam generator MB02 supports, (Rooms 11602, 11402, 11302, 11202). RCL and branch line piping/valves, (Rooms 11602, 11502, 11402, 11302, and 11202). PXS containment recirculation screen (11202)

Table 4-2 (Sheet 7 of 7)

NI ROOMS WITH PIPE WHIP RESTRAINTS AND CORRESPONDING HAZARD SOURCES AND ESSENTIAL TARGETS (Revised, DCD Table 3.6-3)

Room Number	Room Description	Pipe Whip Restraint	Hazard Source/Room	Essential Target Description/Room
11603	Lower ADS Valve Area	PWR-RCS108 A/B	RCS-Automatic Depressurization System Stage 1 Line, 4" L010B: Terminal End Break at Inlet to Valve RCS V011B.	ADS Stage 2 and 3 valves (RCS-V002B, RCS-V003B, RCS-V012B, and RCS-V013B). ADS Stage 1, 2, and 3 support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel, (Room 11503). Raceways and cables, (Rooms 11603 and 11703).
		PWR-RCS107	RCS-Automatic Depressurization System Stage 1 Line, 4" L010B: Terminal End Break at Outlet of 14x4" Tee.	RCS ADS Stage 3 valve (RCS-V013B). ADS Stage 1, 2, and 3 support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel (Room 11503). Raceways and cables (Rooms 11603 and 11703).
11703	Upper ADS Valve Area	PWR-RCS106 A/B	RCS-Automatic Depressurization System Stage 1 Line, 4" L010A: Terminal End Break at Inlet to Valve RCS V011A.	RCS ADS Stage 2 and 3 valves (RCS-V002A, RCS-V003A, RCS-V012A, and RCS-V013A). ADS Stage 1, 2, and 3 support steel, (Rooms 11503, 11603, and 11703). RCS pressurizer support steel, (Room 11503). Raceways and cables, (Rooms 11603, 11703).
		PWR-RCS105	RCS-Automatic Depressurization System Stage 1 Line, 4" L010A: Terminal End Break at Outlet of 14x4" Tee.	ADS Stage 1, 2, and 3 support steel, (Rooms 11503, 11603, 11703). RCS ADS Stage 3 valve (RCS-V013A). RCS pressurizer support steel, (Room 11503). Raceways and cables, (Rooms 11603, 11703).
12244	Lower Annulus Valve Area	PWR-CVS061	CVS-Makeup Line, 3" L131: Terminal End Break at In-Line Anchor	CVS makeup valve (CVS-V090) and WLS containment isolation valve WLS-V057.

Table 4-3

SUBCOMPARTMENTS AND POSTULATED PIPE RUPTURES (Revised, DCD Table 3.6-2, Sheet 4 of 7)					
Compartment		**Lines Evaluated to LBB**		**Lines Not Evaluated to LBB**	
Name	**Room Number**	**Description**	**Terminal End Break Location Excluded by LBB**	**Description**	**Terminal End Break Location**
Lower Pressurizer Compartment	11303	18 in. Surge Line (RCS)	Pressurizer Nozzle	None	
Upper Pressurizer Compartment	11503	14 in. ADS (RCS)	Pressurizer Nozzle (2)	4 in. Pressurizer Spray (RCS)	Pressurizer Nozzle
Lower ADS Valve Area	11603	14 in. & 8 in. ADS (RCS) 6 in. Pressurizer Safety (RCS)	Valves: V012B & V013B ~~14 in. x 6 in. Tee, Valve V005B~~ **14 in. x 6 in. Tees (2), Valves V005A and V005B**	4 in. ADS (RCS)	Valve V0011B & 14 in. x 4 in. Branch
Upper ADS Valve Area	11703	14 in. & 8 in., ADS (RCS) ~~6 in. Pressurizer Safety (RCS)~~	Valves: V012A & V013A ~~14 in. x 6 in. Tee, Valve V005A~~	4 in. ADS (RCS)	Valve V0011A & 14 in. x 4 in. Branch
Maintenance Floor/ Mezzanine	11400	38 in. Main Steam (SGS)	Non-terminal End Location (2) at Boundary of Break Exclusion Zone	6 in. Startup Feedwater (SGS)	Anchors (2) at Containment Penetration
		14 in. Passive RHR (PXS)	PRHR HX Inlet Nozzle		
		8 in. CMT Balance Line Piping	CMT Nozzles (2)		

Table 4-4

SUBCOMPARTMENTS AND POSTULATED PIPE RUPTURES (Revised, DCD Table 3.6-2, Sheet 5 of 7)					
Compartment		**Lines Evaluated to LBB**		**Lines Not Evaluated to LBB**	
Name	**Room Number**	**Description**	**Terminal End Break Location Excluded by LBB**	**Description**	**Terminal End Break Location**
SG01 Access Room	11304	None		None	
Pressurizer Spray Valve Room	11403	None		~~4 in. Pressurizer Spray (RCS)~~ **None**	~~Anchor (both sides)~~
Maintenance Floor	11300	14 in. Passive RHR (PXS)	PRHR HX Outlet Nozzle	None	
Operating Deck	11500	None		None	
CVS Room	11209	None		3 in. Purification from Pressurizer Spray to Regen HX (CVS)	Regen HX Nozzle
				3 in. Return, Auxiliary Spray (CVS)	Regen HX Nozzle
				3 in. Return to RNS from Regen HX (CVS)	Valve: V079
				3 in. Supply from RNS to Letdown HX (CVS)	Valve: V072
				3 in. Supply from Regen HX to Letdown HX (CVS)	Nozzles: Regen HX, Letdown HX
CVS Room	11209 Pipe Chase	None		3 in. Purification from Anchor to Regen HX	Anchor
				3 in. Return from Regen HX to Anchor (CVS)	Anchor
				4 in. SG Blowdown (SGS)	Anchors (2) at Containment Penetration

Table 4-5

SUBCOMPARTMENTS AND POSTULATED PIPE RUPTURES (Revised, DCD Table 3.6-2, Sheet 7 of 7)			
Room #	**Description**	**Bottom Elevation**	**Top Elevation**
11104	RCDT Room	66′-6″	81′-0″
11105	Reactor Vessel Cavity	66′-6″	98′
11205	Reactor Vessel Nozzle Area	98′	107′-2″
11201	SG Compartment 1	83′	104′-7″
11202	SG Compartment 2	83′	104′-7″
11204	Vertical Access	83′	107′-2″
11206	PXS Valve Room A	87′-6″	105′-2″
11300	Maintenance Floor	107′-2″	118′-6″
11301	SG Compartment 1	104′-7″	116′-6″
11302	SG Compartment 2	104′-7″	116′-6″
11400	Maintenance Floor/Mezzanine	118′-6″	~~135′-3″~~ **133′ 3”**
11401	SG Compartment 1	116′-6″	135′-3″
11402	SG Compartment 2	116′-6″	135′-3″
11501	SG Compartment 1	135′-3″	153′-0″
11502	SG Compartment 2	135′-3″	153′-0″
11601	SG Compartment 1	153′-0″	166′-4″
11602	SG Compartment 2	153′-0″	166′-6″
11701	SG Compartment 1	166′-4″	----
11702	SG Compartment 2	166′-4″	----
11500	Operating Deck	135′-3″	281′-8 3/8″
11303	Pressurizer Lower Compartment	107′-2″	135′-3″
11304	SG01 Access Room	107′-2″	118′-6″
11403	Pressurizer Spray Valve Room	118′-6″	~~135′-3″~~ **133′ 3”**
11503	Pressurizer Upper Compartment	135′-3″	~~174′-4″~~ **166’-1.5”**
11603	Lower ADS Valve Area	~~174′-4″~~ **166’-1.5”**	~~185′-1″~~ **176’-10.5”**
11703	Upper ADS Valve Area	~~185′-1″~~ **176’-10.5”**	----
11207 ACCUM	Accumulator Room B	87′-6″	105′-2″
11207 PXS	PXS Valve Room B	87′-6″	105′-2″
11208	RNS Valve Room	94′	105′-2″
11209	CVS Room	80′-6″	105′-2″
11209 PIPE	CVS Room Pipe Tunnel	100′-0″	105′-2″
12306	Valve/Piping Penetration Room	100′-0″	117′-6″
12504/12404	MSIV Compartment B (Upper/Lower)	117′-6″	153′-0″
12506/12406	MSIV Compartment A (Upper/Lower)	117′-6″	153′-0″

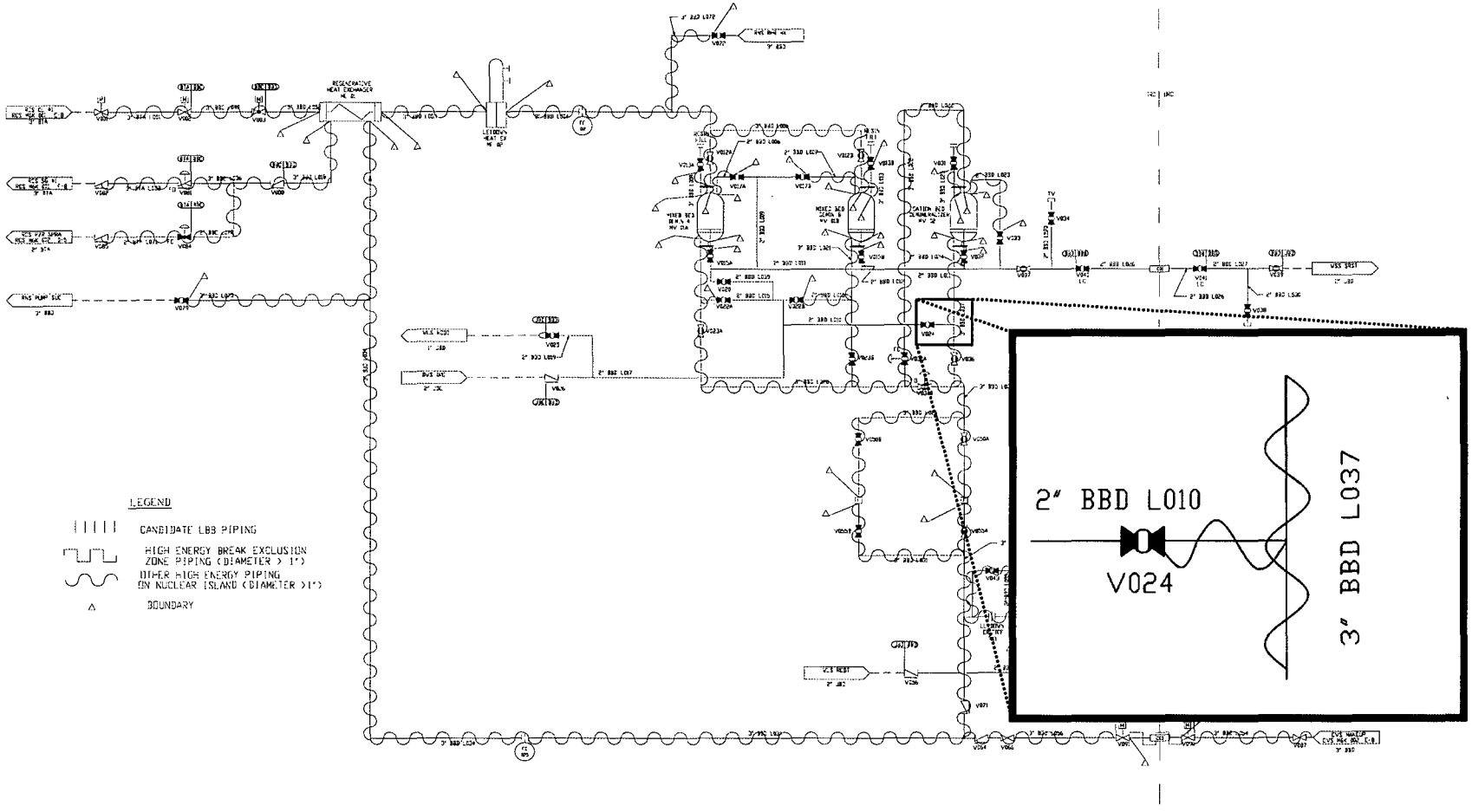

Figure 4-1

High Energy Piping – Chemical and Volume Control System (Revised, DCD Figure 3E-5 – Sheet 1 of 2)

Table 4-6

LIST OF TABLES (Revised, List of Tables for DCD Chapter 3)

5.0 REFERENCES

1. APP-GW-GL-700, Revision 15, AP1000 Design Control Document
2. NUREG-1793, September 2004, Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design.
3. APP-GW-P0C-004, Revision 0, AP1000 Break Locations for High Energy Pipe Break Hazard Evaluation
4. APP-GW-P0C-005, Revision 0, AP1000 Thrust and Geometry of Fluid Jets for Pipe Breaks
5. APP-GW-P0C-007, Revision 0, AP1000 High Energy Pipe Break Hazard Evaluation
6. APP-GW-GLR-022, Revision 1, AP1000 Leak-Before-Break Evaluation of As-Designed Piping
7. APP-GW-GLR-021, Revision 0, AP1000 As-Built COL Information Items