AP1000 DOCUMENT COVER SHEET

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TITLE: **Benchmark Program for Piping Analysis Computer Programs**

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Revision 0

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AP1000 Standard Combined License Technical Report

Benchmark Program for Piping Analysis Computer Programs

Revision 0

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Record of Revisions

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INTRODUCTION

The purpose of this topical report is to close out the COL information item 3.9-6 of the AP1000 Design Control Document (DCD) (Reference 1). This is FSER (Reference 2) COL Action Item 3.12.5.10-1. Section 3.9.8.6 of the DCD states the following:

3.9.8.6 Piping Benchmark Program

> The Combined License applicant will implement a benchmark program as described in subsection 3.9.1.2 if a piping analysis computer program other than one of those used for the design certification is used. The piping benchmark problems identified in Reference 20 for the Westinghouse AP600 are also representative for the AP1000 and can be used for the AP1000 piping benchmark program if required.

Additionally, per Section 3.9.1.2 of the DCD:

> The Combined License applicant will implement the NRC benchmark program using AP1000 specific problems (Reference 20) if a piping analysis computer program other than those used for the design certification (PIPESTRESS, GAPPIPE, WECAN, and ANSYS) is used.

Reference 20 is identified in the DCD as:

> "Piping Benchmark Problems for the Westinghouse AP600 Standardized Plant" NURGE/CR-6414 (BNL-NUREG-52487), Brookhaven National Laboratory, January 1997, Prepared for the U.S. Nuclear Regulatory Commission.

All piping analysis performed for the AP1000 are being completed using only programs that have already been benchmarked to NRC satisfaction. PIPESTRESS, GAPPIPE, WECAN, and ANSYS require no additional benchmarking by the COL applicant and the NRC should consider the COL information item identified in DCD Section 3.9.8.6 to be closed, acceptable, and generically applicable to COL applications referencing the AP1000 Design Certification.

TECHNICAL BACKGROUND

Piping analysis performed to support the AP1000 piping and support design for COL applications are being performed using computer programs PIPESTRESS, GAPPIPE, WECAN, or ANSYS.

PIPESTRESS is being used for the qualification of all auxiliary lines. NUREG/CR-6414 (BNL-NUREG-52487) identifies three dynamic benchmark problems that are applicable to the AP600 and AP1000 benchmarking program. These three sample confirmatory piping analysis problems were provided by Westinghouse for the AP600 and reviewed by the NRC and Brookhaven National Laboratory (BNL). The three sample problems were:

- Confirmatory Problem 1: Enveloped Response Spectra Analysis
- Confirmatory Problem 2: Multi-Level Response Spectra Analysis

- Confirmatory Problem 3: Time-History Analysis

Comparison of these results utilizing the PIPESTRESS computer code were reviewed by Westinghouse, BNL, and the NRC and found to be acceptable. Subsequent to the publication of NUREG/CR-6414, these confirmation problems were incorporated into the formal library of verification test set (VTS) problems for program PIPESTRESS as documented in the user's manual. These problems are maintained as part of the formal quality assurance program for updates to the PIPESTRESS program.

Analysis code GAPPIPE is used to justify the replacement of snubbers with limit stops, where feasible.

Analysis codes WECAN and ANSYS are used to perform analysis of the reactor coolant loop piping and class 1 components.

Other analysis codes are not being used for piping analysis.

REGULATORY IMPACT

The FSER (Reference 2) discusses the computer codes used for piping analysis in Subsection 3.12.4.1. It includes information on verification of these codes. This discussion addresses what to do if piping analysis computer codes are used that have not been reviewed and benchmarked by the NRC. Only piping analysis computer codes that have been reviewed and approved by the NRC are being used for AP1000. No additional benchmarking of piping analysis computer codes is required. The information on computer codes discussed in the FSER is not altered if additional benchmarking is not required. The information in FSER Subsection 3.12.4.3 about what is required for a benchmark program, if one is needed, is not altered if additional benchmarking is not required. The conclusions about the applicability and validity of the design methods and computer programs used for the design and analysis of seismic Category I piping in FSER Subsection 3.12.4.5 are not altered if additional benchmarking is not required.

If no additional benchmarking is required for piping analysis computer programs, there is no impact on the design of the piping or supports. There is no impact to the design function of the piping, and supports. There is no impact to any procedure that might adversely affect how the design functions of the systems containing the seismic Category I piping are performed or controlled. The methodology for piping analysis is not altered. There is no impact on any test or experiment. If the DCD is changed to eliminate the requirement for a piping benchmark program, the change will not require a license amendment per the criteria of VIII. B. 5.b. of Appendix D to 10 CFR Part 52.

The DCD change does not affect resolution of a severe accident issue and does not require a license amendment based on the criteria of VIII. B. 5.c of Appendix D to 10 CFR Part 52.

The closure of the COL Information Item will not alter barriers or alarms that control access to protected areas of the plant. The closure of the COL Information Item will not alter requirements for security personnel. Therefore, the closure of the COL Information Item does not have an adverse impact on the security assessment of the AP1000.

REFERENCES

1. APP-GW-GL-700, AP1000 Design Control Document, Revision 15
2. NUREG-1793, Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design, September 2004.

DCD MARK-UP

The following DCD markup identifies how COL application FSARs should be prepared to incorporate the subject change.

3.9.8.6 Piping Benchmark Program

Completed. The ~~Combined License applicant will implement a~~ benchmark program ~~as~~ described in subsection 3.9.1.2 **for use** if a piping analysis computer program other than one of those used for design certification is used **is not required. The piping analysis computer programs described in 3.7.3 of the AP1000 Design Control Document are the programs used to complete piping and support analysis for the COL application.** ~~The piping benchmark problems identified in Reference 20 for the Westinghouse AP600 are also representative for the AP1000 and can be used for the AP1000 piping benchmark program.~~