

AP1000 DOCUMENT COVER SHEET

TDC: _____ Permanent File: _____ APY: _____

RFS#: _____ RFS ITEM #: _____

AP1000 DOCUMENT NO. APP-GW-GLR-007	REVISION NO. 0	Page of	ASSIGNED TO W-A. Sterdis
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ALTERNATE DOCUMENT NUMBER:

WORK BREAKDOWN #:

ORIGINATING ORGANIZATION: Westinghouse Electric Company

TITLE: Main Control Room Inleakage Test Frequency

ATTACHMENTS:		DCP #/REV. INCORPORATED IN THIS DOCUMENT REVISION:
CALCULATION/ANALYSIS REFERENCE:		
ELECTRONIC FILENAME COL007	ELECTRONIC FILE FORMAT Microsoft Word	ELECTRONIC FILE DESCRIPTION

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ORIGINATOR C. Brockhoff	SIGNATURE/DATE <i>C. Brockhoff</i> 3/31/06	
REVIEWERS	SIGNATURE/DATE	
VERIFIER D.A. LINDGREN	SIGNATURE/DATE <i>D.A. Lindgren</i> 3/31/06	VERIFICATION METHOD
AP1000 RESPONSIBLE MANAGER J. Winters	SIGNATURE <i>J. Winters</i>	APPROVAL DATE 3/31/06

* 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-007
Revision 0

March 2006

AP1000 Standard Combined License Technical Report

Main Control Room Inleakage Testing

Revision 0

Westinghouse Electric Company LLC
Nuclear Power Plants
Post Office Box 355
Pittsburgh, PA 15230-0355

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AP1000 Standard Combined License Application Technical Report Main Control Room Inleakage Testing

INTRODUCTION

The description of the main control room habitability system, that provides emergency ventilation and pressurization of the main control room pressure boundary, is included in Section 6.4 of the AP1000 Design Control Document (DCD) (Reference 1).

Operation of the main control room emergency habitability system is automatically initiated by either of the following conditions:

- “High-high” particulate or iodine radioactivity in the main control room supply air duct
- Loss of ac power for more than 10 minutes

Operation can also be initiated by manual actuation.

As discussed in DCD Section 6.4.5.1, preoperational and periodic testing for main control room inleakage during VES operation will be conducted in accordance with ASTM E741 (Reference 2). In addition, periodic testing for main control room inleakage during VES operation will be conducted in accordance with ASTM E741, as discussed in DCD Section 6.4.5.4.

The purpose of this Combined License (COL) Technical Report is to establish the basis for specifying the frequency for the main control room inleakage testing. This will complete AP1000 Combined License Information Item 6.4-3 in Table 1.8-2, as described in DCD Section 6.4.7.

COL Information Item 6.4-3: “The Combined License applicant will provide the testing frequency for the main control room inleakage test discussed in subsection 6.4.5.4.” This is AP1000 FSER (Reference 3) Action Item 6.4-2.

TECHNICAL BACKGROUND

Since the mid-1980s, the NRC has communicated concerns about the adequacy of control room designs. In the mid-1990s, testing of some Control Room Envelopes (CREs) indicated that key assumptions supporting the radiological dose analysis might be non-conservative. CRE integrity tests were performed from 1991 to 2001 by approximately 30 percent of the licensed facilities, and all but one facility have measured greater inleakage than that assumed in the design analyses. In some cases, the measured inleakage exceeded the amount assumed in the design analyses by several orders of magnitude. In 1998, the NRC held a public workshop to address control room habitability concerns. In late 1998, the NRC and the industry agreed to work together on issues affecting control room habitability and develop guidance documents for resolving those issues.

In response to the issues raised, the industry developed Nuclear Energy Institute (NEI) 99-03 (Reference 4) to provide a comprehensive approach to improve overall CRE integrity performance. The process described in NEI 99-03 was designed to verify that the licensing and design bases associated with control room habitability and maintained. The document’s guidance was intended to facilitate adequate protection of control room operators against the effects of postulated releases of radioactive particulates and gases, toxic gas, or external smoke. The document also guided the development of appropriate CRE

integrity testing to facilitate long-term maintenance of the control room envelope. Appendix A to NEI 99-03 provides an overview of the control room habitability regulatory and licensing history.

NRC Generic Letter (GL) 2003-01 (Reference 5) was issued to provide an overview of the regulatory concerns related to main control room habitability leakage testing, which also helped to lead to industry activities to establish better monitoring and assessment of control room leakage, including the use of the ASTM.

The generic letter recognized the generic industry guidance on control room habitability provided in NEI 99-03, as well as that in Regulatory Guide (RG) 1.196 (Reference 6). Rather than fully endorsing NEI 99-03, the NRC developed the information in RG 1.196, which endorses NEI 99-03 to the extent possible, while providing additional guidance. Appendix A to RG 1.196 provides a summary of the RG endorsement of NEI 99-03 by section. The NRC recommended using the guidance in RG 1.196 in responding to the requirements of GL 2003-01.

As discussed in RG 1.196, RG 1.197 (Reference 7) was developed to provide an approach acceptable to the NRC staff to determine CRE integrity. As discussed in Section C of RG 1.197, CRE integrity testing is performed to demonstrate that the CRE leakage characteristics are consistent with the "licensing bases" and "design bases" for a facility. Appendix I of NEI 99-03 provides guidance on the attributes of an acceptable test program, the prerequisites to testing, and the determination of the system modes of operation for testing. Per the RG, this NEI guidance is considered useful when supplemented with the clarifications and exceptions noted in the RG.

RG 1.197 identifies an approach acceptable to the NRC staff for measuring leakage into the control room and associated rooms and areas at nuclear power reactors, recommending the use of ASTM E741 for this testing. RG 1.197 also provides a recommended testing frequency and approach for CRE testing. RG 1.197 recommends establishing a baseline value for leakage and testing thereafter on a performance-based periodic frequency, based on the process in Figure 1 of the RG. In addition, CRE testing should be performed when changes are made to the structures, systems, components, and procedures that could impact CRE integrity.

The guidelines for testing frequency in Figure 1 of RG 1.197 specify that baseline ASTM testing be performed, with a self-assessment at three (3) years after successful baseline testing, and a periodic test at six (6) years. If periodic testing is successful, then the assessment / testing cycle continues with a self-assessment three (3) years later and periodic testing three (3) years after the self-assessment.

If a periodic testing is unsuccessful, then a periodic test is required three (3) years after repair and successful re-testing following the unsuccessful periodic testing.

In addition to periodic tests, CRE testing will also be performed when changes are made to structures, systems, and components that could impact CRE integrity, including systems internal and external to the CRE. The tests must be commensurate with the types and degrees of modifications and repairs and the potential impact upon integrity. Additional CRE testing will also be performed if a new limiting condition or alignment arises for which no leakage data is available (e.g., a toxic gas source appears where previously there was none). Test failure is considered to be leakage in excess of the licensing basis value for the particular challenge to CRE integrity.

The AP1000 CRE integrity testing frequency discussed above and included in the DCD markup below follows the guidelines provided in Figure 1 of RG 1.197.

REGULATORY IMPACT

The FSER discusses the CRE integrity testing in Subsection 6.4. Defining the frequency of inleakage testing prior to Combined License application will impact the AP1000 FSER write-up about CRE integrity testing. The conclusions in the FSER about control room habitability are not impacted.

The changes to the DCD presented in this report do not represent an adverse change to the design function or to how design functions are performed or controlled. The changes to the DCD do not involve revising or replacing a DCD-described evaluation methodology. The changes to the DCD do not involve a test or experiment not described in the DCD, where a structure system or component is utilized or controlled in a manner that is outside the reference bounds of the design. The DCD change does not require a license amendment per the criteria of VIII.B.5.b. of Appendix D to 10 CFR 52.

The changes to the DCD presented in this report do not affect resolution of a severe accident issue and do not require a license amendment based on the criteria of VIII.B.5.c of Appendix D to 10 CFR 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. "Standard Test Methods for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution," ASTM E741, 2000.
3. NUREG-1793, Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design, September 2004.
4. NEI 99-03, "Control Room Habitability Assessment Guidance," June 2001.
5. NRC Generic Letter 2003-01, "Control Room Habitability," June 12, 2003.
6. Regulatory Guide 1.196, "Control Room Habitability at Light-Water Nuclear Power Reactors, May 2003.
7. Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors, May 2003.

DCD Mark-Up

The following DCD markups identify how COL application FSARs should incorporate the subject change.

Revise Subsection 6.4.5.4 as follows:

6.4.5.4 Air Inleakage Testing

Testing for main control room inleakage during VES operation will be conducted in accordance with ASTM E741 (Reference 4).

Baseline Control Room Envelope (CRE) testing as discussed in DCD Section 6.4.5.1 will be performed, with a self-assessment at three (3) years after successful baseline testing,

and a periodic test at six (6) years. If periodic testing is successful, then the assessment / testing cycle continues with a self-assessment three (3) years later and periodic testing three (3) years after the self-assessment.

If a periodic testing is unsuccessful, then a periodic test is required three (3) years after repair and successful re-testing following the unsuccessful periodic testing.

In addition to periodic tests, CRE testing will also be performed when changes are made to structures, systems, and components that could impact CRE integrity, including systems internal and external to the CRE. The tests must be commensurate with the types and degrees of modifications and repairs and the potential impact upon integrity. Additional CRE testing will also be performed if a new limiting condition or alignment arises for which no inleakage data is available (e.g., a toxic gas source appears where previously there was none). Test failure is considered to be inleakage in excess of the licensing basis value for the particular challenge to CRE integrity.

Revise the third paragraph of 6.4.7 as follows:

Completed. The ~~Combined License applicant will provide the testing frequency for the main control room inleakage test discussed is~~ **defined** in subsection 6.4.5.4.