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Your ref: Docket Number 52-006
Our ref: DCP_NRC_003035

September 22, 2010

Subject: Supplementary Information on Proposed Changes for the AP1000 Design Control Document Rev. 18

This letter is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information provided is generic and is expected to apply to all Combined License (COL) applicants referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Westinghouse provided preliminary information on changes which it proposed to include in Revision 18 of the AP1000 Design Control Document (DCD-18) in a January 20, 2010 letter (Reference 1). Supplementary information on some of those changes requested by the NRC was provided in a March 12, 2010 letter (Reference 2). Information was provided in an April 26, 2010 letter (Reference 3) for seven of the changes identified in the January 20, 2010 that were determined to meet one or more of the Interim Staff Guidance-11 (ISG-11) criteria for reporting to the NRC staff. The remaining 50 "elective" items in the January 20 letter are addressed in a letter dated May 21, 2010 (Reference 4). In a letter dated May 10, 2010 (Reference 5), information was provided for seven design changes that met one or more of the ISG-11 criteria and which supported the AP1000 Licensing Finalization schedule. In a letter dated May 25, 2010 (Reference 6), information was provided for two additional design changes that met one or more of the ISG-11 criteria and which supported the AP1000 Licensing Finalization schedule. In letters dated June 14, 2010 (Reference 7), June 18, 2020 (Reference 8), July 6, 2010 (Reference 9), July 8, 2010 (Reference 10), July 28, 2010 (Reference 11) July 29, 2010 (Reference 12), August 12, 2010, (Reference 13), and August 16 (Reference 14) information was provided for additional design changes. Supplementary information for Reference 11 was provided in Reference 15. Supplementary information for CN62 (initial information was provided in Reference 5) was provided in Reference 16. Supplementary information for CN05 (initial information was provided in Reference 3) was provided in Reference 17.

This letter provides supplementary information on the design change (Change Number 73) which addresses the minimum amount of compressed air change for the main control room emergency habitability system (VES). Information on CN73 was initially provided in Reference 12. The supplementary information, AP1000 Main Control Room Emergency Habitability System (VES) Minimum Amount of Stored Compressed Air Change, is provided in Enclosure 1.

As noted previously, the changes described in this and the referenced letters do not constitute all of the changes which Westinghouse proposes to include in DCD-18. Rather, the changes in this letter are in addition to those which Westinghouse either has submitted or will submit to the NRC as responses to Requests for Additional Information or Safety Evaluation Report Open Items.

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Westinghouse will work with the NRC staff to disposition the changes described in this letter as expeditiously as possible. Questions related to the content of this letter should be directed to Westinghouse. Please send copies of such questions to the prospective COL applicants referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

Stanley E. Ritterbusch for

R. F. Ziesing
Director, U.S. Licensing

References:

1. DCP_NRC_002744, Re-submittal of Proposed Changes for AP1000 Design Control Document Rev.18, January 20, 2010
2. DCP_NRC_002818, Supplementary Information to DCP_NRC_002744 – Re-Submittal of Proposed Changes for AP1000 Design Control Document Rev.18, March 12, 2010
3. DCP_NRC_002850, Final Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, April 26, 2010
4. DCP_NRC_002874, Final Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, May 21, 2010
5. DCP_NRC_002863, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, May 10, 2010
6. DCP_NRC_002879, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, May 25, 2010
7. DCP_NRC_002909, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, June 14, 2010
8. DCP_NRC_002918, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, June 18, 2010
9. DCP_NRC_002925, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, July 6, 2010
10. DCP_NRC_002932, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, July 8, 2010
11. DCP_NRC_002939, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, July 28, 2010
12. DCP_NRC_002940, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, July 29, 2010
13. DCP_NRC_002942, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, August 12, 2010
14. DCP_NRC_002941, Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, August 16, 2010
15. DCP_NRC_003014, Supplementary Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, September 3, 2010.
16. DCP_NRC_003033, Supplementary Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, September 9, 2010.
17. DCP_NRC_003036, Supplementary Information on Proposed Changes for the AP1000 Design Control Document Rev. 18, September 16, 2010.

/Enclosure

1. Supplementary Information for CN73, AP1000 Main Control Room Emergency Habitability System (VES) Minimum Amount of Stored Compressed Air Change, Non-Proprietary

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ENCLOSURE 1

Supplementary Information for CN73
AP1000 Main Control Room Emergency Habitability System (VES) Minimum Amount of Stored Compressed Air Change, Non-Proprietary

AP1000 Passive Air Filtration Test Summary and VES Applicability

Background:

To address concerns regarding unfiltered in-leakage into the main control room (MCR) during the operation of the MCR Emergency Habitability System (VES), a passive filtration sub-system design was added to the VES to filter potential contaminated in-leakage. The sub-system incorporates an eductor which uses the VES compressed air flow to induce recirculation of MCR air through a filtration unit. The performance of the added sub-system allows for 15 cfm of unfiltered in-leakage while maintaining operator dose below 5 rem TEDE as required by GDC-19. With the addition of this sub-system, the VES provides compressed clean, breathable air to the MCR, and now also recirculates existing MCR air through a filtration unit to capture potential contaminated air that may leak into the MCR envelope. Westinghouse conducted testing of the passive filtration sub-system at the Westinghouse Waltz Mill facility. The testing was confirmatory testing to show the performance characteristics of the added passive filtration design and to collect data on the performance of the eductor itself.

Test Configuration:

The passive filtration test configuration was a full-scale test that was designed to simulate a portion of the design presented in the VES Piping and Instrumentation Diagram (P&ID). The VES P&ID is shown in DCD Figure 6.4-2 (Sheet 2 of 2) (See DCP_NRC_002940 – Reference 12). Sections A and B in Figure 1 show the portions of the VES passive filtration sub-system that were tested. Figure 2 shows the test configuration modeling Sections A and B. Section A was kept very similar to the actual system design found in the VES. For Section B, the test used a straight length of circular ductwork and a blast gate damper to model what is shown in Figure 1, Section B. The components in Section B will provide a back pressure on the eductor. The blast gate damper allowed the back pressure to be varied on the eductor. This provided the ability to determine the limiting conditions (e.g., resistances) to increase confidence in specifying the air filtration units, balancing dampers, and distribution scheme.

It should be noted that testing was not conducted on the existing system upstream of the eductor shown by Section C on Figure 2. This was not included because this portion of the system is capable of providing 65 ± 5 scfm of breathable air flow from the storage tanks to the inlet of the eductor at the required pressure. The pressure regulating valve in Section C of the system maintains the inlet pressure on the eductor, which will be approximately 110 psig. The flow control orifices that previously existed near the outlet of each regulating valve have been deleted. This is because the orifice contained within the eductor now serves the same purpose as the deleted flow control orifices. The principle of operation remains the same as in the previous design configuration. The pressure regulating valve regulates the pressure provided to the orifice; the choked flow in the orifice controls the flow rate through the system at 65 ± 5 scfm.

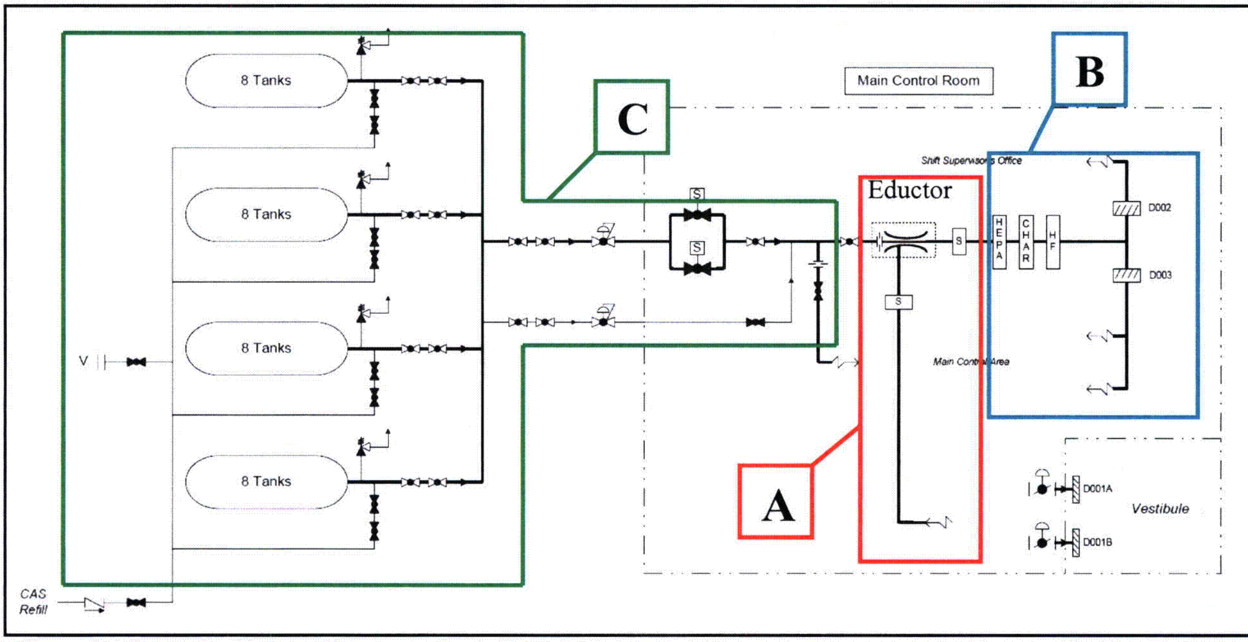

Figure 1: VES Simplified System Sketch (*Sections A and B are analogous to the testing. Section B components were modeled by using the blast gate damper.*)

Referring to the test configuration in Figure 2, the intake grill, HVAC silencers, circular ductwork upstream of the second silencer, and the eductor were the same size and type as those to be used in the AP1000 design. The exact layout is not necessarily prototypic. The layout and components downstream of the second silencer were different than the design of the passive filtration sub-system. This was to simplify the test and to provide the ability to vary downstream resistance during the test. The air filtration unit and distribution scheme were not used in the test configuration.

In order to model varying resistances downstream of the eductor and to see the effects of limiting back pressures on the eductor, a blast gate damper was used to model the total downstream pressure drop after the second silencer. This was done to provide bounding test data that would increase confidence in the selection of the air filtration unit and distribution scheme used in the design and that these selected components would allow the required filtration flow to be met. Since the VES system delivers a constant 65 ± 5 scfm of breathable air flow from the emergency air storage tanks at a fixed pressure set by the pressure regulating valve, the VES breathable air flow was simulated by using a 15 hp, 120 gallon air compressor that was capable of delivering up to 175 psig of delivery air pressure. The pressure into the eductor was controlled by a throttling valve which subsequently controlled the flow through the orifice in the eductor. This throttling valve served the purpose that the VES pressure regulating valve will serve in the actual system when it is in operation.

Test Instrumentation:

As shown in Figure 2, pressure was measured at the following locations: a) the compressed air injection point of the eductor (P-1), b) the eductor suction inlet (P-3), c) the eductor discharge (P-4), and d) immediately upstream of the blast gate damper (P-2). Flow rates and temperatures were measured at the following locations: a) the compressed air injection point of the eductor (Q-1, T-1) and b) immediately upstream of the blast gate damper (Q-2 and T-2). Q-1 is measuring the injected flow rate (analogous to VES breathable air flow) and Q-2 is measuring the combined flow rate of the injected flow and induced flow rates (analogous to combined filtration flow rate).

Test Performance:

The test had 3 objectives. The first objective was to determine the performance of the eductor when it is subjected to varying levels of injected flow rates and downstream resistances, the second objective was to determine off nominal condition response, and the third objective was to determine the sound intensity of the eductor's operation. Objectives 1 and 3 were the most significant to determine the operating characteristics of passive filtration in the VES.

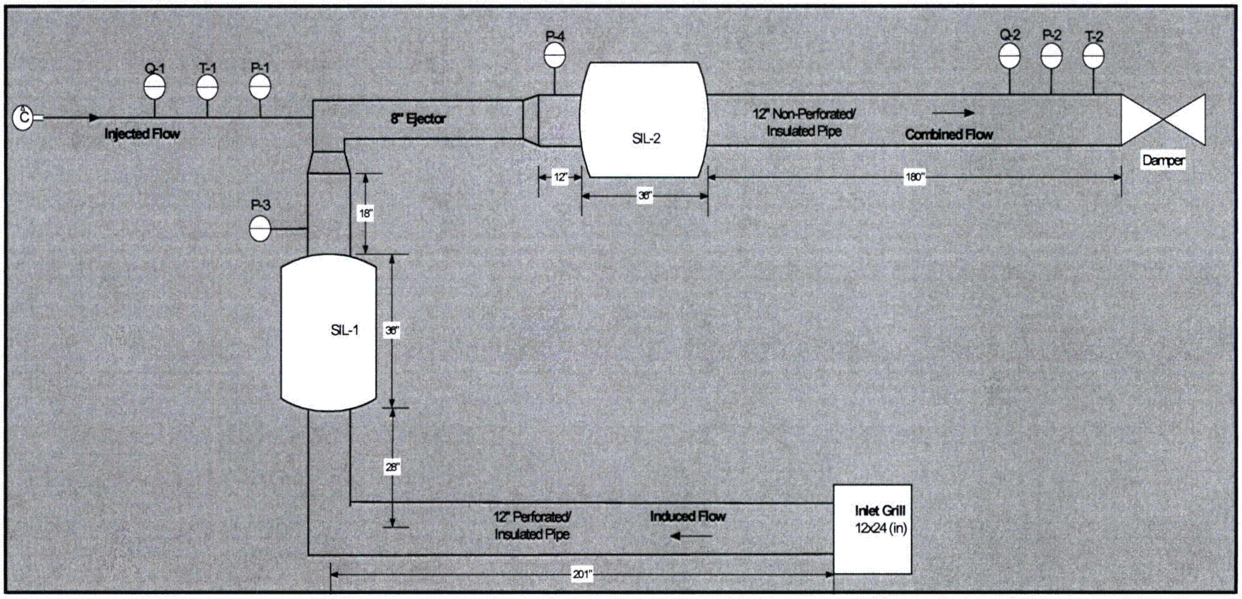

Figure 2: Passive Filtration Eductor Test Configuration

Objective 1:

Objective 1 involved a parametric study to examine the effects of varied injected flows (representing the VES breathable air flow) and the response of the induced flow with varying levels of downstream resistance (representing the air filtration unit and distribution scheme resistances). The design injected flow rate (VES breathable air) was 65 ± 5 scfm. The design induced flow rate (recirculation/filtration) is 600 scfm minimum. For clarity, the combined filtration flow rate dictated by the system design must be 600 scfm greater than the VES breathable air flow rate.

The effect of varying breathable air flow on induced flow was demonstrated by placing the blast gate damper in a full-open position and varying the injected flow rate starting with 60 scfm and increasing in 5 scfm increments to 70 scfm. This test shows the maximum induced flow rate capable with minimum downstream system resistance.

The effect of downstream system resistance was demonstrated by closing the blast gate damper incrementally to increase back pressure on the eductor. The downstream resistance was varied for each of the injected flow rates of 60 scfm, 65 scfm, and 70 scfm respectively. The variation of the blast gate damper was done such that pressure data could be collected at 800 scfm, 700 scfm, and 600 scfm induced flow rates. This parametric study provides data that shows what downstream resistance the system can withstand while still inducing the required 600 scfm minimum of induced flow.

Objective 1 determined that if downstream resistance is less than roughly 5 inches W.G., then the passive filtration sub-system will deliver the proper amount of induced flow under the VES system design breathable air flow rates.

Objective 2:

Objective 2 provided useful data in showing the response of the induced flow rate when higher injected flows and pressures were explored (off-nominal conditions). This test collected data showing the changes to the induced flow rate when the blast gate damper is in a fixed position (providing fixed downstream resistance) and the feed flow and pressure is increased incrementally. This data is useful because it can be extrapolated, if necessary, to determine the effects of different pressure regulating valve's failure modes.

Objective 2 test data confirms the eductor vendor's information that the injected conditions and induced conditions relate in a linear fashion.

Objective 3:

Objective 3 measured the sound intensity that the eductor emits under operating conditions. The blast gate damper was set to provide 860 scfm of induced flow with an injected flow of 60 scfm and an initial sound measurement was taken. Since the noise generated at the eductor would be related to the amount of airflow injected through the eductor, the sound intensity was measured for varying feed flows between 60 scfm and 80 scfm in increments of 5 scfm.

Objective 3 determined that noise canceling characteristics should be considered in layout of the eductor in the control room.

Results and Conclusions:

These tests conducted gave data on how the added passive filtration sub-system would perform when integrated into the VES design. Recall that Figure 1, Sections A and B, show the portion of the VES design that was tested.

Objective 1:

In the test configuration, the inlet at the eductor (known as "injected flow" in the test) was kept at conditions that the VES system design provides. The conditions are 65 ± 5 scfm at a pressure slightly less than the outlet of the pressure regulating valve (due to line losses) which will be approximately 110 psig at the eductor. Since the orifice in the eductor is a flow control orifice, at the given fixed orifice size, the inlet pressure determines the flow rate through the orifice. For this test and considering the orifice size in the eductor, the pressure was varied between 100 psig to 115 psig to deliver 60 to 70 scfm. Recognizing variations due to manufacturing tolerances on the orifice hole size, it is expected that a similar range of inlet pressures will produce the required injected flow rate in the plant design. The pressure regulator provides that adjustability.

The passive filtration testing was successful in confirming that an air filtration unit and distribution scheme (as represented in Section B of Figure 1) subjecting less than 5" W.G. back pressure on the eductor will be able to provide and exceed the minimum design flow rate of 660 scfm combined filtration flow rate. The air filtration unit and distribution scheme incorporated into the plant design downstream of the eductor are estimated to provide a back pressure on the eductor at the design flow rates of approximately 3.5" W.G. Therefore, based on the expected as-built VES passive filtration system design, the testing provides bounding data that the combined recirculation flow rate can be achieved.

Objective 2:

By placing the blast gate damper in a fixed position and increasing the injected flow rate incrementally while collecting data, the response of the induced flow rate confirmed eductor vendor information. As the injected flow rate is increased incrementally, the induced flow rate increases in a linear fashion. The injected flow rate was increased incrementally by increasing the pressure upstream of the eductor's flow control orifice. The inlet pressure was varied from 110 psig up to 125 psig producing injected flow rates of approximately 65 to 80 scfm. The combined flow rates ranged from approximately 775 scfm to 822 scfm under these conditions. This provides useful information that can be extrapolated to investigate the effects of a potential regulating valve failure mode where the injected flow rate may increase due to the valve's failure.

Objective 3:

The testing provided useful information on the layout requirements of the passive filtration sub-system within the MCR envelope. Particularly, since noise within the main control area is of concern, the eductor was placed behind the wall separating the main control area from the shift manager's office. This wall will act as a sound barrier separating the noise generated from the eductor from the critical tasks taking place at the operator workstations. Also, the inline HVAC silencers suppress much of the noise in the passive filtration line to limit the amount of noise that is distributed throughout the MCR envelope.