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Docket No.: STN-52-003

April 29, 1994

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: MR. R. W. BORCHARDT

SUBJECT: AP600 TESTING PROGRAM REPORT (WCAP-14048)

Dear Mr. Borchardt:

Enclosed are copies of a Westinghouse report documenting aspects of the AP600 testing program. The enclosure includes:

1. WCAP-14048, Revision 0, "Passive Containment Cooling System Bench Scale Wind Tunnel Test,"

Enclosed with Mr. Hasselberg's copy of this letter are ten copies of WCAP-14048. The Westinghouse Electric Corporation copyright notice is also attached.

Please contact Brian A. McIntyre on (412) 374-4334 if you have any questions concerning this transmittal.

N. J. Liparulo, Manager
Nuclear Safety & Regulatory Activities

/nja

Enclosure
Attachment

cc: T. Kenyon, NRC (w/o Enclosures/Attachments)
R. Hasselberg, NRC (ten copies of Enclosure)
C. Hoxie, NRC
B. A. McIntyre, Westinghouse (w/o Enclosures/Attachments)

WCAP-14048

PASSIVE CONTAINMENT COOLING SYSTEM BENCH SCALE WIND TUNNEL TEST

L. E. Conway

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AP600 DOCUMENT COVER SHEET

Form 58202F(9/93) [WP xxxx] AP600 CENTRAL FILE USE ONLY: ______ RFS #: ______ RFS ITEM #: ______
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AP600 DOCUMENT NO.	REVISION NO.	PAGES ATTACHED	ASSIGNED TO
PCS-T2R-025	0		

ALTERNATE DOCUMENT NUMBER: WCAP-14048

DESIGN AGENT ORGANIZATION: Westinghouse Electric

PROJECT: AP600

WORK BREAKDOWN #: 2.6.19.1.5

TITLE: Passive Containment Cooling System - Bench Scale Wind Tunnel Test

ATTACHMENTS:

CALCULATION/ANALYSIS REFERENCE:

DCP #/REV. INCORPORATED:

ELECTRONIC FILENAME:

APPLICATION:

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ORIGINATOR	SIGNATURE/DATE	
L. E. Conway	Susan V Fanto for LEC 4/21/94	
AP600 RESPONSIBLE MANAGER	**SIGNATURE***	**APPROVAL DATE**
E. J. Piplica	Eugene J Piplica	4/21/94

*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.

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CATEGORY "E" — Consists of computer programs developed prior to the Effective Date or after the Effective Date but outside the scope of the Work.

CATEGORY "F" — Consists of administrative plans and administrative reports.

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1.0 BACKGROUND

The Bench Scale Wind Tunnel Tests of the Passive Containment Cooling System (PCCS) were conducted in 1987 at the Westinghouse Science and Technology Center, Pittsburgh, PA to support the AP600 conceptual design program. Tests were performed on models of the AP600 shield building, air inlets and outlet, annulus baffle, and containment to establish the proper location of the air inlets on the shield building, and to confirm that with the proper air inlet/exhaust arrangement, wind can always aid containment cooling air flow. Two models were utilized: one consisted of only the shield building and diffuser discharge without inlets and internal flow; the second included the air inlets, air baffle, containment, tank support structure and a fan to simulate convective air flow. Pressures were measured at the inlet, the building side and top, the bottom of the inlet annulus, the top of the containment at the discharge of the air baffle, and in the chimney. Air flow was measured at the inlet to the containment baffle. These tests were run with a uniform wind tunnel air velocity of 85 ft/sec and test Reynolds numbers for the shield building and chimney were demonstrated to be in the transition region. The models used in this test were 10-inches in diameter and 18-inches in overall height. Figure 1 provides an assembly drawing of the model which included the containment and air baffle structures, and also shows the location of Static Pressure Taps (SPTs) and air velocity (anemometer) measurement. The instrumentation was located in a common vertical plane and the model was rotated through 360 degrees to obtain the air pressure profile around the entire structure.

2.0 TEST RESULTS

The results from this test are illustrated in Figures 2 and 3. Figure 2 is typical of data collected using the simple model of the shield building without air inlets, containment, or cooling air baffle around the containment. Static air pressure at several locations on the shield building structure are shown versus the air pressure in the air exhaust structure. This figure illustrates that when the air inlets are located on the top (roof) of the shield building, a "chimney" effect is created over a significant portion of top of the building (this effect became more pronounced when the wind direction was inclined upward); and air inlets located at the top of the shield building sidewalls overall provide the most positive wind induced driving pressure versus air exit pressure.

Figure 3 illustrates the typical air pressure profiles developed within the shield building across the cooling air baffle to the air exit with external wind. By comparison to a "no-wind" case where all the cooling air flow was induced by the fan, it was shown that with the selected air inlet arrangement the wind always will increase the containment cooling air flowrate.

3.0 CONCLUSIONS

The significant conclusions from this test are summarized below:

- The observed air pressure just within the shield building air inlets was approximately equal to the average value of the air velocity head measured around the outside of the shield building.

- Deep beams behind the air inlets (as provided in the PCCS water storage tank structure) significantly increase wind induced containment air cooling flow.

- The containment air cooling flow is insensitive to wind direction and to 15 degree downward wind inclination. Cooling flow is increased by a 15 degree upward wind inclination.

- An inlet on the side of the shield building (at the top) aides containment cooling.

- An inlet on the top of the shield building should be avoided.

- The chimney pressure coefficient varies from -0.6 (no flow) to -0.35 (max flow) through the cooling annulus.

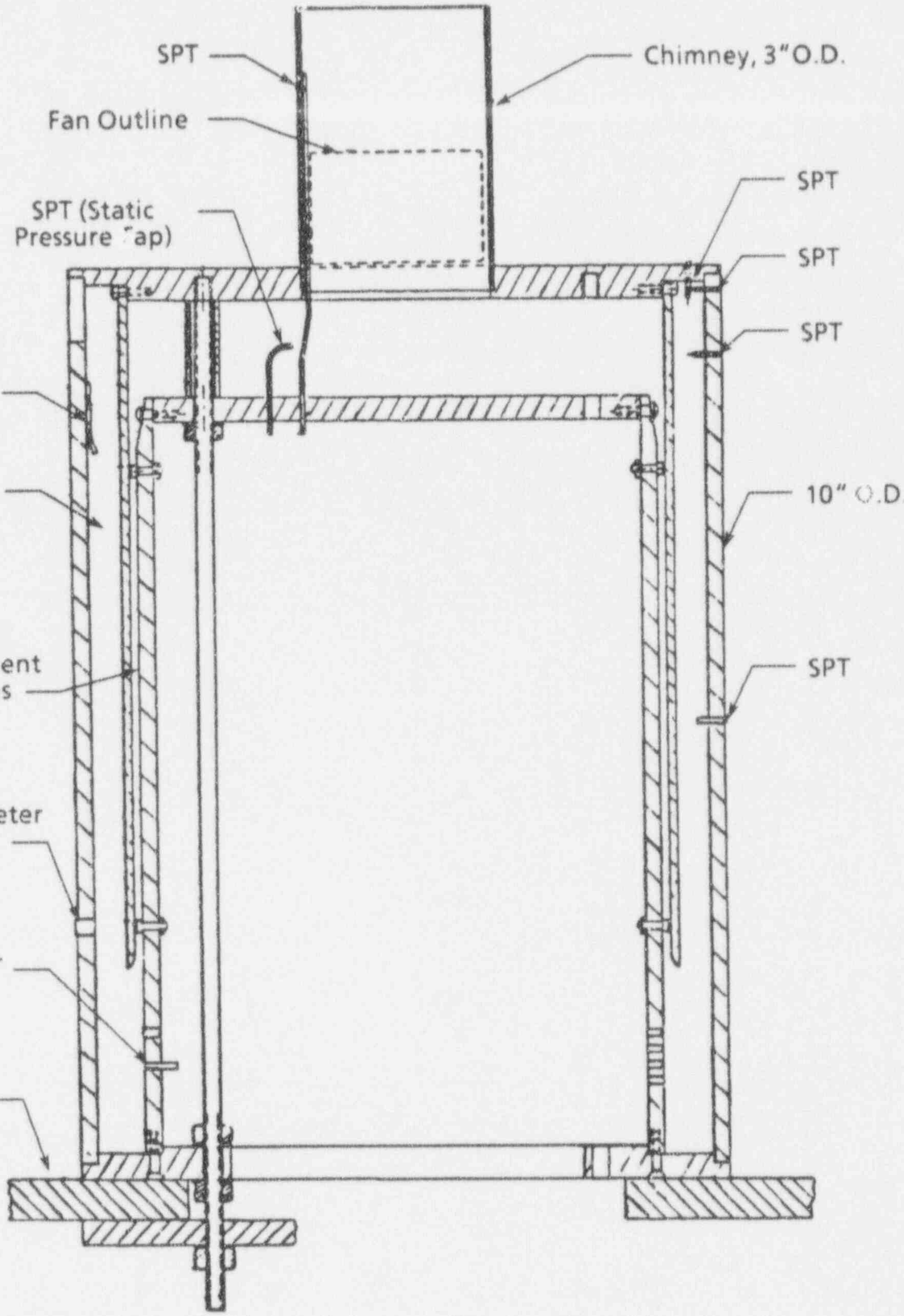

Figure 1. AP600 Shield Building and Containment Wind Tunnel Model

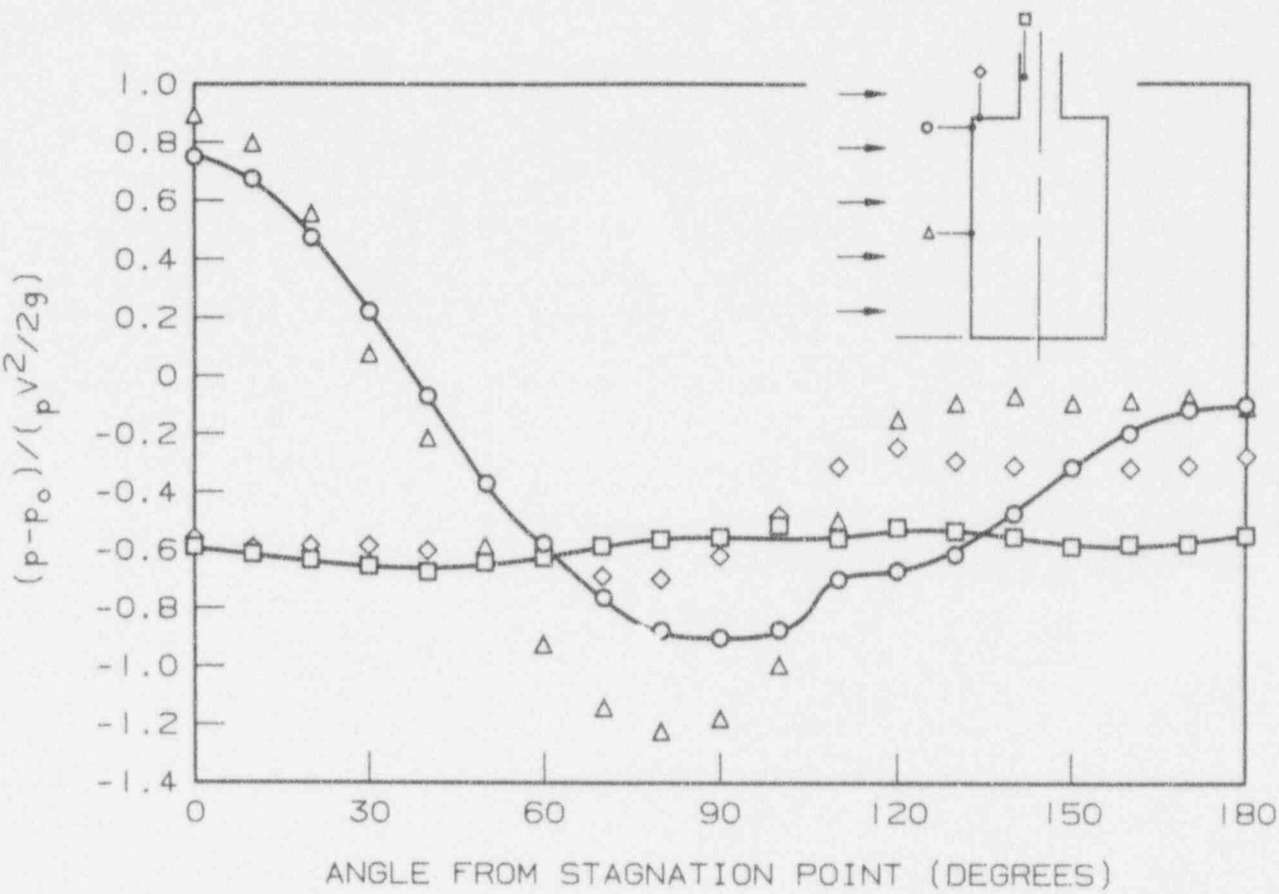

Figure 2. AP600 Model Shield Building and Air Diffuser Pressures in Wind

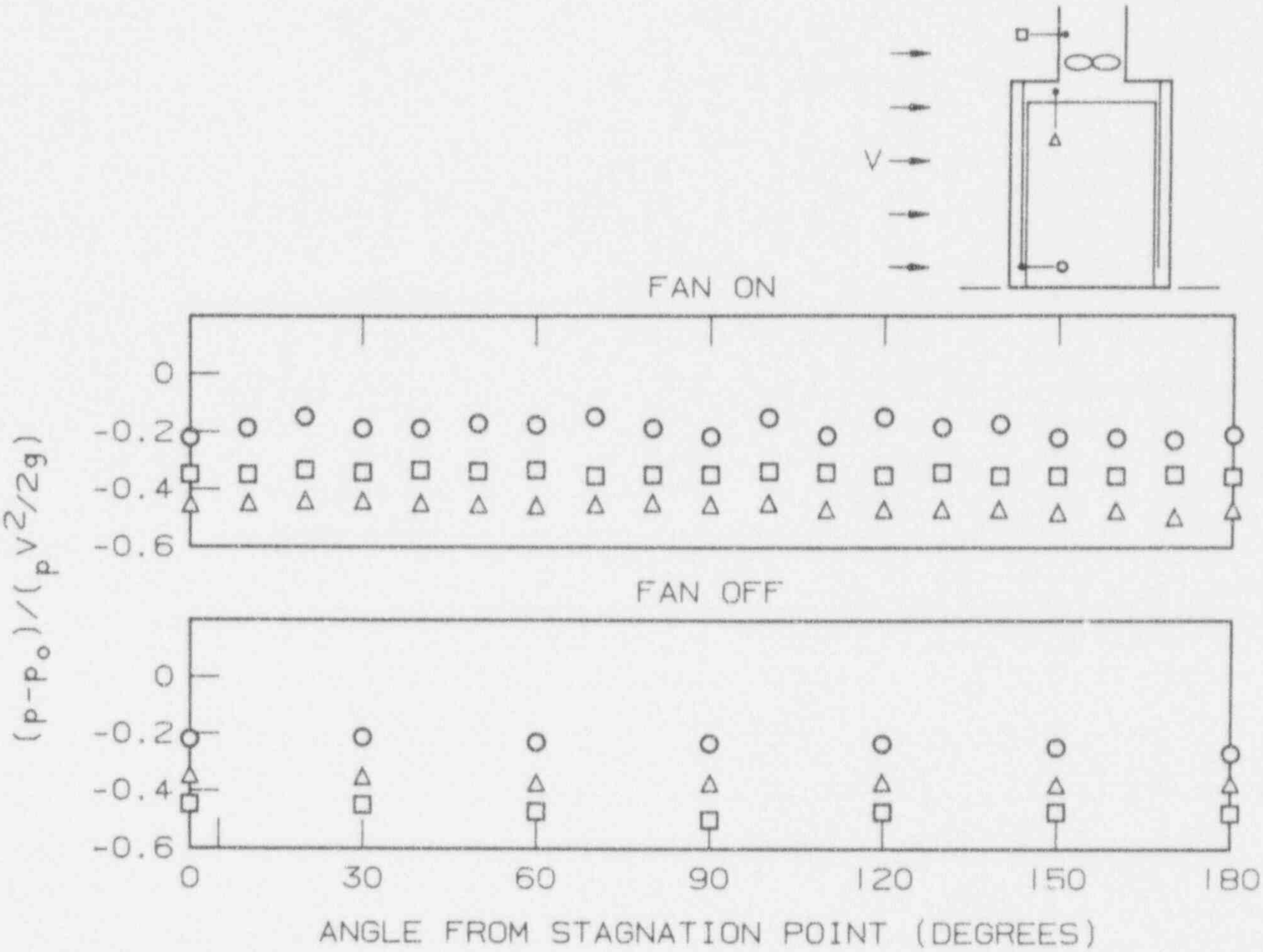

Figure 3. AP600 Model Containment Cooling Annulus Pressures and Air Diffuser Pressure
(No wind - fan driven annulus velocity = 17 ft/sec; With wind - fan driven annulus velocity = 42 ft/sec; With wind - fan off - annulus velocity = 34 ft/sec)