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August 7, 2006
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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397 RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION RELATED TO ALTERNATIVE SOURCE TERM LICENSE AMENDMENT REQUEST**

References: 1) Letter dated July 11, 2006 from B Benney (NRC) to JV Parrish (Energy Northwest), "Request for Additional Information (TAC No. MC4570)"

2) Letter dated September 30, 2004, DK Atkinson (Energy Northwest) to NRC, "License Amendment Request – Alternative Source Term"

Dear Sir or Madam:

Transmitted herewith in the attachment is the Energy Northwest response to the subject Request for Additional Information (Reference 1). This response provides additional justification for the Energy Northwest Alternative Source Term (AST) License Amendment Request (LAR) (Reference 2).

There are no new commitments being made. If you have any questions or require additional information, please contact Greg Cullen at (509) 377-6105.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the date of this letter.

Respectfully,

Abby Khampanus for WSO

WS Oxenford
Vice President, Technical Services
Mail Drop PE08

Attachment: Response to Request for Additional Information
Enclosure: Excerpts from Methodology for Flow Correlations

cc: BS Mallett – NRC RIV
BJ Benney – NRC NRR
NRC Senior Resident Inspector/988C
RN Sherman – BPA/1399
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A001

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Proposed Changes

Technical Specification (TS) 3.6.4.1, "Secondary Containment"

1. Revised SR 3.6.4.1.1 to change the minimum required containment vacuum from greater than or equal to 0.25 inch of vacuum water gauge to greater than 0.0 inch of vacuum water gauge.

2. Deleted SR 3.6.4.1.4.

3. Revised the existing SR 3.6.4.1.5 to change the maximum allowed standby gas treatment (SGT) subsystem flow rate from less than or equal to 2240 cubic feet per minute (cfm) to a secondary containment inleakage flow rate of less than or equal to 2430 cfm.

4. Due to the deletion of SR 3.6.4.1.4, SR 3.6.4.1.5 is renumbered as SR 3.6.4.1.4.

TS 3.6.4.3, "Standby Gas Treatment System"

5. Revised SR 3.6.4.3.3 to add the phrase 'and reaches greater than or equal to 4800 cfm within 2 minutes."

Item 1

The current TS require the secondary containment to be maintained at negative 0.25 inches wg during normal operation. The daily surveillance on this requirement assures that the building integrity is being monitored and maintained during the 24 month interval between draw down testing. If the TSs were changed to allow less than or equal to 0.0 wg pressure normally (change No. 1 above) the building would potentially breathe as external pressures changed and integrity could degrade and be undetected. What assurance would this test or any other test provide that secondary containment integrity capability is being maintained?

Also, with the secondary containment being maintained at a negative pressure, the release to the environment is from a single point that is monitored for release. If the secondary containment is allowed to breathe with external pressure changes, how would Columbia meet General Design Criteria (GDC) 64 or its equivalent for monitoring releases?

Response

Maintaining the building at greater than 0.0 inch vacuum water gauge (wg) vs. greater than or equal to 0.25 inch vacuum wg will provide a comparable capability for monitoring building integrity during the 24 month cycle. (As a point of clarification, the Energy Northwest LAR proposed that the value for secondary containment pressure be changed to greater than 0.0 inches of vacuum as opposed to greater than "or equal to" 0.0 inches of vacuum.)

Secondary containment integrity is ensured by a combination of TS requirements (i.e., LCO 3.6.4.1, SRs 3.6.4.1.1, 3.6.4.1.2, 3.6.4.1.3, 3.6.4.1.5, and LCO 3.6.4.2, SRs 3.6.4.2.1, 3.6.4.2.2, 3.6.4.2.3) and programmatic controls.

The SR acceptance criterion for secondary containment pressure of greater than 0.0 inches of vacuum must be met at all locations within the building which, therefore, prevents the building from breathing during applicable modes. To achieve this condition, the less limiting building locations will be more negative relative to the outside conditions. In addition, instrumentation setpoints are established with consideration to uncertainty and drift to ensure the 0.0 inch wg is not reached or exceeded during normal operations. It is important to note that maintaining the 0.25 inch vacuum wg with the non-safety related reactor building ventilation system during non-accident conditions is not necessarily indicative of an operable secondary containment. This is due to the capacity of the reactor building ventilation system exhaust (approximately 75,000-100,000 cfm) which may potentially mask a small leak. Therefore, monitoring for greater than or equal to 0.25 inch wg vacuum versus greater than 0.0 inch wg vacuum does not enhance the effectiveness of this surveillance. Programmatic controls are necessary to provide additional assurance of integrity.

The programmatic controls utilized at Columbia include:

- Configuration control in permanent/temporary plant design change processes, work management processes, and a barrier impairment permit program

- Monitoring for potential deficiencies via daily plant walk downs by Operations/Security, and performance monitoring/trending of the secondary containment by the System Engineer

These requirements and controls are comparable to those established for other passive barriers such as the Primary Containment, Drywell, and Control Room to ensure the integrity of these barriers.

Regarding GDC 64 requirements, the reactor building exhaust ventilation will continue to maintain a negative pressure in the secondary containment and therefore, remain the major release path that is monitored.

To provide assurance that all surfaces of secondary containment remain negative with respect to the outside atmosphere during normal operation, the reactor building pressure control system is operated at that pressure setpoint value that has been adjusted for the effect of extreme inside and outside temperature variations and instrumentation uncertainties and drift. Additionally, the effect of wind is accounted for by the use of eight differential pressure transmitters, four in each division, which measure the differential pressure across the four external sides of the reactor building. The signal which indicates the least differential pressure is the signal used to control the exhaust flow rate from secondary containment, via modulation of the blade pitch on the associated reactor building exhaust fan. Therefore, revising the SR 3.6.4.1.1 value from greater than or equal to 0.25 in wg vacuum to greater than 0.0 in wg vacuum will not create new release paths and will ensure Columbia's continuing capability to monitor releases in accordance with GDC 64.

Item 2

Deleting SR 3.6.4.1.4 (change No. 2) deletes the requirement to measure the time it takes to achieve a secondary containment negative pressure of negative 0.25 inches wg. Section 50.36 of Title 10 of the *Code of Federal Regulations* (10 CFR), Criterion 2, requires a limiting condition for operation (LCO) for a process variable, design feature, or operating restriction that is an initial condition of a design-basis accident. The time at which secondary containment is established is directly input into the loss-of-coolant accident design-basis analysis as the point at which secondary containment and the SGT can be credited. The LCO is relieved by meeting the SR that measures the time at which draw down is achieved as stated in the TS. Please clarify how the requirements of 10 CFR 50.36 are satisfied with respect to removing this SR.

Response

As explained on page 9 of the September 30, 2004 LAR, the 50.36 criteria are adequately satisfied by the combination of existing SRs 3.6.4.1.5 and proposed revision to 3.6.4.3.3.

The draw down analysis assumes the building has leakage characteristics that allow inleakage at a rate of 2430 cfm at 0.25 inches wg vacuum. Given these conditions, the building leakage hydraulics (characteristics) are established. The proposed surveillance testing methodology is designed to evaluate whether the as-tested leakage characteristics of the building are within that assumed by the analysis. This approach accounts for weather conditions when assessing the buildings leakage characteristics. Simply evaluating the time to reach 0.25 inches wg vacuum does not account for adverse or favorable weather conditions that may mask a change in the building leakage characteristics. Furthermore, it does not consider accident heat loads and their impact on the drawdown time. The testing required by the referenced combinations of SRs will ensure the building leakage characteristics are within those assumed in the analysis. Measuring the building leakage as well as the fan start time and performance provides an adequate means to periodically verify that secondary containment required vacuum conditions can be achieved and maintained. This periodic testing improves Energy Northwest's knowledge of the overall secondary containment system characteristics.

Item 3

SR 3.6.4.1.5 verifies the SGT ability to maintain the negative 0.25 inch wg pressure in the secondary containment for a period of 1 hr. The change increases the flow rate from a maximum of 2240 cfm to a maximum of 2430 cfm, and labels this flow as an "inleakage" flow. Please clarify how inleakage flow is measured or provide a basis for labeling it inleakage flow in lieu of the measured quantity which appears to be SGT subsystem flow. Please clarify if the reason to increase this maximum flow results from greater secondary containment inleakage and identify any steps being taken to control the degradation of secondary containment integrity.

Response

The inleakage flow value of 2430 cfm at 0.25 inches of wg vacuum is used to establish the building's leakage characteristics. Specifically, with 0.25 inches of wg vacuum applied to all surfaces of the building the leakage rate into the building will not exceed one air volume per day. This air change rate is prescribed by SRP 6.2.3. The higher inleakage rate is a revision to the originally specified rate of 2240 cfm, and results from the development of more accurate

representation of the secondary containment free air volume. This request for a higher inleakage rate is not the result of a degrading secondary containment boundary. The flow rate that corresponds to that air change rate is 2430 cfm.

The inleakage flow rate is measured indirectly using SGT system flow rate as well as weather and building conditions. This information is correlated to an equivalent inleakage to the building given conditions where all surfaces of the building are exposed to a 0.25 inch wg vacuum. The bounding building leakage characteristics used in the analysis correspond to those that would allow an inleakage value of 2430 cfm if a 0.25 inch wg vacuum were applied evenly across all surfaces of the building. The surveillance test procedure is used to demonstrate equivalence between the buildings actual leakage conditions during the test and the criteria of 2430 cfm with 0.25 inch wg vacuum on all surfaces.

Excerpts from the relevant sections of the Columbia Station methodology used for correlating the measured SGT system's exhaust flow to inleakage flow is provided in the attached enclosure.

Item 4

No question on change No. 4. It is editorial.

Response

No response required.

Item 5

SR 3.6.4.3.3 verifies the ability of each subsystem to start. The proposed additional requirement of achieving 4800 cfm in 2 minutes is more restrictive and conservative. The NRC staff is concerned that Columbia is trying to relate the initial subsystem flow rate (4800 cfm in 2 minutes) to the time it takes to achieve draw down of the secondary containment to the negative 0.25 inches wg. Subsystem flow rate is not related to secondary containment integrity except in the sense that if there was more inleakage such as a door being open there would be less pressure drop on the subsystem and a corresponding increase in flow. Please clarify if Columbia is requesting that a SR on SGT subsystem flow combined with a Gothic analysis be substituted for measuring the draw down time directly and explain how this would identify changes in building leakage and other parameters used in the analysis over the time interval between tests (24 months).

Response

The time to draw down secondary containment for design basis accident conditions cannot be measured directly. The time to draw down the secondary containment to the required differential pressure of 0.25 inches vacuum wg on all surfaces is a function of SGT fan flow rate and secondary containment inleakage, in addition to other influences such as outside meteorological conditions, building heat loads, building inside temperature and humidity and service water temperatures. The 4800 cfm in 2 minutes does not represent the time required to draw down the secondary containment to the 0.25 inches vacuum wg. The test simply confirms

the capacity of the SGT system assumed in the analysis. The draw down time is established analytically using assumed building leakage characteristics as well as the SGT timing and capacity evaluated by this SR. Confirming the SGT capacity and the buildings leakage characteristics (Refer to response to items 2 and 3) ensures that the analysis draw down time remains bounding.

The purpose of these tests is to validate the assumptions used in the analysis that provide input to establishing the off site release. Specifically, system capacity and building leakage characteristics are the parameters of interest. Since weather conditions have a direct impact on the time required to draw down the building, testing for a specific time requirement during non-accident conditions is not appropriate and does not provide an accurate representation of secondary containment integrity. Ensuring availability of minimum required SGT system capacity and building leakage characteristics are the appropriate parameters to validate with the TS SR.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION RELATED TO ALTERNATIVE SOURCE TERM LICENSE AMENDMENT REQUEST
Enclosure

Excerpts from Methodology for Flow Correlations

Project Report For Columbia Station Drawdown Procedure Evaluation Method

ENWC-001-PR-01, Revision 0

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Appendix 3
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Appendix 4
Pages 1-2 of 2

PROJECT REPORT

For

COLUMBIA STATION DRAWDOWN

PROCEDURE

EVALUATION METHOD

Independent Review Required: Yes

Prepared by: Paul N Hansen [signature] Date: September 26, 2005

Reviewed by: NA Date:
Reviewer

Reviewed by: Steve Ku [signature] Date: September 27, 2005
Independent Reviewer

Approved by: Don Shivas [signature] Date: September 27, 2005
Project Manager or Designee

PROJECT REPORT REVISION STATUS		
REVISION	**DATE**	**DESCRIPTION**
0	September 27, 2005	Initial Release

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Background

Technical Specification 3.6.4.1 and 3.6.4.3 are the governing Technical Specifications for secondary containment and Standby Gas Treatment System (SGTS) respectively. Secondary containment in-leakage is periodically measured to ensure that it complies with Technical Specification requirements specified in SR 3.6.4.1.4. Surveillance TSP-RB-B501 (Reference 1) is performed to demonstrate compliance with the Technical Specification. In addition, the results of the surveillance are used to evaluate the leakage hole size margin available as documented in TM-2077 (Reference 2).

The analysis used to demonstrate the time to restore the secondary containment building pressure to technical specification levels following a loss of coolant accident; Calculation NE-02-01-05 (Reference 3) was recently updated and submitted to the NRC for review. This analysis provides part of the technical basis used to support the use of Alternate Source Term (AST) methodology at the Columbia Station. Energy Northwest has requested that the surveillance procedure be modified to provide a means of demonstrating that the Reference 3 analysis building leakage and SGTSperformance assumptions are maintained as demonstrated by the procedure.

This new surveillance will demonstrate that secondary containment integrity and Standby Gas Treatment perform as assumed in the AST draw down model. Since the Reference 3 model conservatively assumes the in-leakage is maximum (one building volume per day = 2430 ACFM) the surveillance will be based on that same value. Once the AST submittal is approved by the NRC, this new surveillance will be used to demonstrate compliance.

Purpose

The purpose of this report is to present the approach to be used as part of the secondary containment surveillance procedure to assess if the surveillance procedure results are acceptable. The method will convert the surveillance leakage rate results into a form that is comparable with the Reference 3 assumptions. This allows for a direct comparison of the surveillance results with the analysis predicted leakage. Specifically, the method demonstrates the test results for the secondary containment building and SGTS conditions are bounded by the assumptions used by the accident analysis documented in Reference 3.

Also presented in this report, are additional analysis results that provide insight into the drawdown time expected under surveillance conditions. These latter results are presented for information only and do not and can not exactly predict the drawdown times expected during a surveillance, but rather present a range for use in evaluating the overall health of the SGTS.

References

1. TSP-RB-B501 SURVEILLANCE - PROCEDURES CONTAINMENT SYSTEMS – REACTOR BUILDING (SECONDARY CONTAINMENT) DRAWDOWN/LEAKAGE FUNCTIONAL TEST
2. TM-2077 Revision 2 “SGT EXCESS CAPACITY”
3. NE-02-01-05 Revision 1 Appendix D and E “Secondary Containment Drawdown”
4. NE-02-92-06 Revision 0 “SGT Annubar Flow Meter Correction Factors” (Relevant pages provided in Appendix 4)
5. ME-02-99-20 Revision 0 “Calculation for SGT Filter Unit Carbon Bed Face Velocity”

Assumptions

Two sets of assumptions are provided below. The first will be associated with the procedure methodology used to compare the surveillance results with the analytical model. The second set of assumptions are associated with changes to the GOTHIC drawdown model used to evaluate the drawdown times expected for a range of conditions. These latter results are presented for information only and do not and can not exactly predict the drawdown times expected during a surveillance, but rather present a range for use in evaluating the overall health of the SGTS.

Procedure Development Assumptions

1. Wind from the South is assumed to correspond to an angle of 180°. This value is selected to be consistent with the Meteorological data.
2. Meteorological tower information is assumed to be taken from 245ft. This value is selected as opposed to the 33ft tower height. The selection is purely arbitrary, but is identified to clearly indicate to the user that the wind speed adjustments are made based on the higher of the tower elevations. Therefore, the Meteorological data from this height must be used with the procedure. A separate set of tables will need to be developed if the 33ft height is to be used instead of the 245ft.
3. The Annubar Temperature Flow Correction Table is based on the maximum set of multipliers available. The use of the maximum values will ensure that the minimum difference exists between the calculated leakage value and the converted indicated SGTS flow. This produces a conservative leakage margin used to establish the secondary containment boundary area available for leakage as part of this effort.
4. When developing the wind pressure tables wind speeds up to 40 mph are used. This value exceeds that assumed in the drawdown analysis (17.2 mph). Wind speeds in excess of 17.2 mph are occasionally experienced at the site. Therefore, to accommodate the possible situation where wind speeds exceed 17.2 mph during a surveillance test the table is extended to 40 mph.
5. The railroad door in-leakage tables are assumed to be applicable for the conditions were the railroad bay doors are open as well as closed. Given that the railroad bay door is a small fraction of the overall wall dimension (approximately 1% of the total area) of the Reactor Building, the wind pressure coefficients are reasonably represented by those established with the door in the closed position. In other words, it is assumed that the opening of the Railroad bay door will not alter the overall flow pattern around the building. Therefore, the pressure conditions developed as the result of wind flowing past the Reactor Building will impose either a suction or pressurizing condition on the open door area as predicted by these coefficients originally developed for the door closed position.

   For a steady air flow condition the pressure difference between the Railroad Bay Area and the outside will be nearly zero. Once a steady state condition is reached for a given wind speed and direction the only steady flow through the open door will be the leakage into the building via this path. If it is assumed that the flow of the SGTS enters the building via the open railroad door a pressure drop can be estimated between the outside and the bay area through the open railroad door. Using the 70%/30% flow split between the roof and the railroad bay door assumed in the accident analysis a pressure drop of approximately 0.0013 inch of water is to be expected with 6720 acfm SGTS flow under steady conditions. This SGTS flow rate is selected to conservatively represent the SGTS flow rate. Lower flow rates would produce smaller pressure drops.

   For the wind directions where suction conditions are developed (north, north west, south, south west, and west) building in-leakage is achieved only when the building pressure at the hatch

location is more negative then that resulting from the wind itself. Therefore, the railroad bay area pressure will need to fall below that produced by the wind on the outer surface of the building. To establish the necessary flow this area will need to exhibit a pressure drop of up to 0.0013 inch of water below the already negative exterior pressure. For the wind directions where a pressurization condition is developed (north east, south east and east), building in-leakage is achieved following an additional pressure drop of up to 0.0013 inch of water. In either case, the direct use of the wind tables developed for conditions when the railroad bay door is closed is conservative. The degree of the conservatism is not viewed to be overly conservative and it is appropriate that the same set of tables be applied for each condition.

Timing Analysis Assumptions

1. The leakage characteristics of the building are the same as that assumed in the Reference 3 analysis. This will result in a bounding response time since the building envelope is expected to be much tighter than is assumed in the Reference 3 analysis.
2. The model will allow leakage out of the building if pressure conditions allow for this to occur. The Reference 3 model conservatively ignores leakage out of the building. Since this analysis is provided to estimate a more realistic building response, that conservatism is removed.
3. The maximum assumed wind speed will be 17.2 mph and the minimum wind speed will be 0.0 mph. The maximum value corresponds to the upper wind speed assumed in the Reference 3 analysis and is appropriately bounding in this effort as well. The minimum wind speed of 0.0 mph is the unquestionable minimum value.
4. The maximum assumed outside air temperature will be 86°F and the minimum outside air temperature will be 28°F. These values represent the range of values evaluated in Reference 3 and represent the appropriate limits for the purpose of this evaluation.
5. The building air temperature will be assumed to be 75°F. This value corresponds to that assumed in the Reference 3 analysis.
6. The minimum SGTS fan flow will be based on 4800 ACFM. This value corresponds to the value assumed in Reference 3, which was established to represent a minimum value for system flow. Such an assumption produces a greater value for time to restore the building to 0.25" water gauge. Therefore, this value is appropriate for this evaluation as well, establishing an upper limit on the time to restore the reactor building to the required pressure values.
7. The maximum SGTS fan flow will be 6720 ACFM. This value is based on the SGTS high flow limiter setpoint of 5378 ICFM (note that this is indicated flow), plus the uncertainty/drift of 434 ICFM, then convert this number to an ACFM value using the conversion tables for ICFM-to-ACFM from Reference 4. Note that this same analysis is documented in calculation ME-02-99-20 (Reference 5), which determines the maximum face velocity that would be experienced by an SGTS carbon bed. The results of this calculation show a final value of 6720 ACFM, so this is the value used. The entry conditions for this conversion assumed a post-accident inlet temperature into SGTS of 105F (ref calc NE-02-94-71) plus a 15F rise across the SGTS heaters, a humidity of 70%RH and a barometric pressure of 14.35 psia.
8. The building initial conditions will be based on 0.0" wg pressure differential at the instrument and the timing will be based on the time required to produce 0.25" wg pressure differential at the same instrument. This is assumed to make the analysis consistent with the surveillance procedure documented in Reference 1. This is an appropriate assumption since the purpose of this analysis is to establish the range of times to reach 0.25" wg at the instrument that may be expected during the surveillance.
9. The building atmospheric heat loads will be based on the normal heat loads identified in Reference 3. Sensitivity values will be developed starting from these values.
10. The drywell and wetwell are assumed to be at 135°F and 95°F respectively. These values correspond to the initial values used in Reference 3 for these values. Since no accident is assumed in this analysis these values are simply maintained constant.

11. Meteorological tower information is assumed to be taken from 33ft. Note that this value differs from that used in the procedure development. This value is selected to be consistent with the Drawdown analysis documented in Reference 3.

Methodology

The methodology used to develop the overall approach is documented in References 2 and 3. The method will use lookup tables to allow the user to apply the weather data at the time of the test along with the measured pressure differential for any of the instruments to determine the leakage that would be predicted by the analysis model under the same conditions as the surveillance test. The resulting leakage is compared with the measured data.

In support of this effort, additional wind pressure coefficients are developed for each of the instruments as well as the Railroad Door as a function of wind direction to augment those already documented in Reference 3. These values are established using the same approach as is outlined in Reference 3 (Appendix 1). The wind pressure coefficients are used to establish the wind-induced pressure values expected at the building leakage locations given the weather conditions during the test. In addition, static pressure adjustment tables are developed using methods documented in Reference 3. The combination of these wind-induced and static pressure tables are used to establish pressures at the building leakage location, based on the measured pressure difference and weather conditions at the time of the test.

Given the pressure differences calculated for the leakage locations, the user can determine the amount of leakage into the building based on the analytical model. A set of tables are developed as part of this report for this purpose. The total analytical leakage flow at the surveillance test conditions is established by adding the leakage flows determined at the leakage locations. If the total analytical leakage exceeds the flow rate measured as part of the test, the building leakage rate is bounded by the analysis assumptions.

The next step in the process is to determine the margin available to the Technical Specification limit. This is accomplished by taking a simple ratio of the measured leakage (ACFM) and the model's predicted leakage. The ratio represents the percent to the analysis limit established by the surveillance results. The Technical Specification leakage rate is then multiplied by the ratio to establish the building leakage at the Technical Specification pressure differential of 0.25 inwg. The difference between the Technical Specification value and the building leakage at this pressure represents the margin. This margin value is then used to establish an equivalent orifice size for use in evaluating as found and maintenance required changes to the secondary containment boundary. A table of values is provided based on the orifice relationship documented in Reference 2.

Analysis – Development of Procedural Guidance Method

Analysis Model Inleakage

1. In order to determine if the measured leakage rate for the surveillance test is acceptable, the measured value is compared with what would be predicted by the analysis model. This is a multiple step process that uses lookup tables developed in this document. The procedure steps and necessary support documentation is provided in Appendix 3. The first step in the process to determine model leakage is to convert the surveillance test measured pressure into pressure values that are applied at the roof and railroad door locations for the surveillance test wind and temperature conditions. With these pressures established the model predicted leakage rates can be determined using lookup tables developed in this document.

2. The first step in establishing the pressures at the leakage locations is to determine the surveillance pressure instruments static pressure differential value. This is accomplished by subtracting the wind-induced pressure from the measured value. The wind-induced pressure for the instrument is obtained using lookup tables (Table A) that are a function of instrument location (Refer to Figure 1), wind speed, wind direction and outside temperature.

$$\Delta Pstatic = \Delta Pmeasured - fTableWindInst(TempOutside, Wind, Location)$$

3. The next step is to take the instrument static pressure difference and make the necessary static pressure differential adjustments to establish static pressure differential values at the roof and railroad door leak locations. This is accomplished using lookup tables (Table B) developed later in this document. These tables are functions of inside and outside temperatures of the building.

$$\Delta PstaticRoof = \Delta Pstatic + fTableStaticChangeRoof(TempInside, TempOutside)$$
$$\Delta PstaticDoor = \Delta Pstatic + fTableStaticChangeDoor(TempInside, TempOutside)$$

4. The third step is to establish the wind pressure values for the roof and railroad door. As with the other steps, these values are obtained using lookup tables (Table C) developed in this document. These tables are functions of wind speed, wind direction and outside air temperature. These values are added to the respective static pressure differences established in the previous step. These new total pressure differences are used with a lookup table to establish the analytical leakage for the roof and railroad door.

$$\Delta PRoof = \Delta PstaticRoof + fTableWindRoof(TempOutside, Wind)$$
$$\Delta PDoor = \Delta PstaticDoor + fTableWindDoor(TempOutside, Wind)$$

5. The leakage predicted by the model under the same conditions as experienced during the surveillance are obtained using lookup tables (Table D). These tables are a function of pressure differential and outside temperature. The leakage at the roof and the door are added together to give the total leakage. This total leakage value is compared with the SGTS measured flow from the test, which is corrected to be in units of ACFM (using Table E).

$$LeakageRoof = fTableLeakageRoof(\Delta PRoof, TempOutside)$$
$$LeakageDoor = fTableLeakageDoor(\Delta PDoor, TempOutside)$$
$$TotalLeakage = LeakageRoof + LeakageDoor$$
$$MeasuredFlow = SGTMeasured * fTableACFM(TempAnnubar)$$

6. The Technical Specification Margin is evaluated based on the ratio of the Measured Flow and the Analytical Flow.

$$TechSpecMargin = 2430cfm * \left(1 - \frac{MeasuredFlow}{(LeakageRoof + LeakageDoor)}\right)$$

7. The additional hole size in the wall of the Reactor Building that would consume the Technical Specification Margin is established using Lookup Tables (Table F) developed in this Report.

$$diameter = fTable(Flow)$$

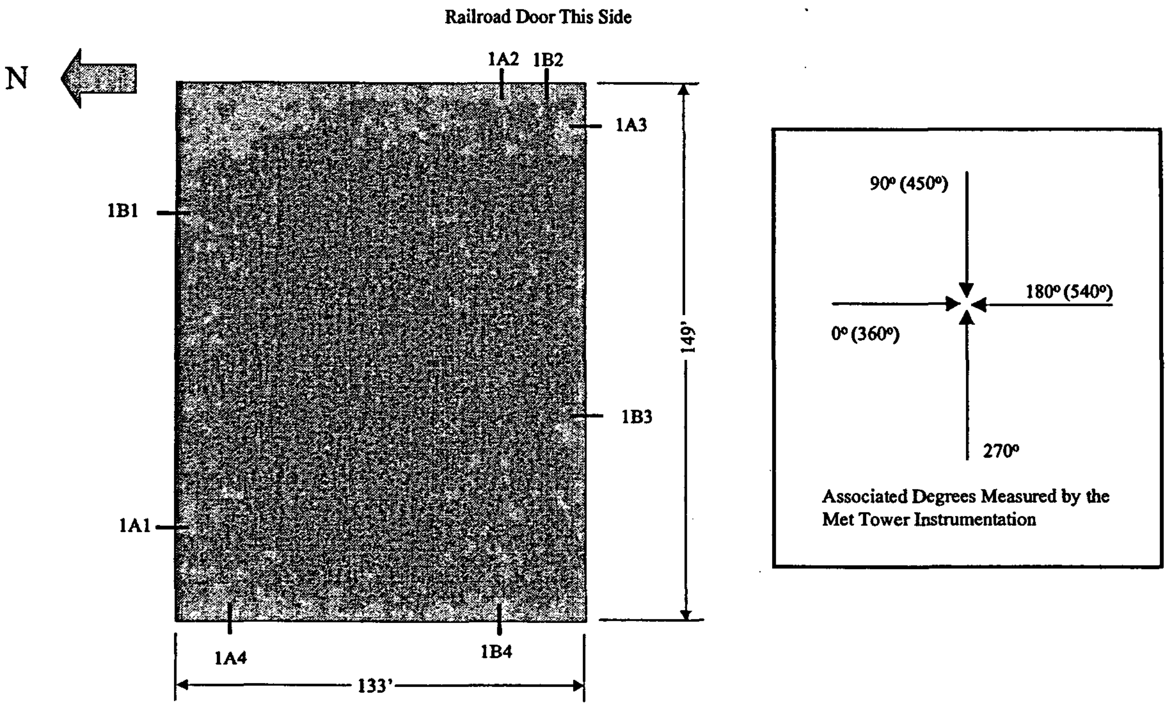

Figure 1 – Instrument Locations

Wind Pressure Coefficients

Wind pressure coefficients are established for each of the instruments as a function of wind direction. These values are used to correlate the measured differential pressure with pressures at the roof and railroad door. The instrument location wind pressure coefficients are determined using a graphical approach similar to what is documented in Reference 3. The evaluation of these inputs is presented in Appendix 1 of this document.

Table 1 – Pressure Instrument Wind Pressure Coefficients

Measurement Location	N Wind	NE Wind	E Wind	SE Wind	S Wind	SW Wind	W Wind	NW Wind
1A1	0.7	0.09	-0.52	-0.63	-0.35	-0.56	-0.95	0.62
1A2	-0.6	0.15	0.8	0.59	-0.95	-0.57	-0.37	-0.63
1A3	-0.38	-0.56	-0.98	0.62	0.64	0.08	-0.5	-0.64
1A4	-0.98	-0.54	-0.38	-0.64	-0.49	0.07	0.59	0.65
1B1	0.82	0.55	-0.92	-0.58	-0.35	-0.63	-0.68	0.19
1B2	-0.48	0.05	0.6	0.65	-0.98	-0.54	-0.38	-0.64
1B3	-0.37	-0.63	-0.55	0.28	0.79	0.61	-0.94	-0.56
1B4	-0.55	-0.64	-0.36	-0.56	-0.96	0.62	0.69	0.09

Wind pressure coefficients are established for the railroad door as a function of wind direction. These values will be used to establish the wind pressure applied to the door as a function of wind direction and speed. The Railroad Door location wind pressure coefficients are determined using a graphical approach similar to what is documented in Reference 3. The evaluation of these inputs is presented in Appendix 1 of this document.

Table 2 - Railroad Door Wind Pressure Coefficients

Measurement Location	N Wind	NE Wind	E Wind	SE Wind	S Wind	SW Wind	W Wind	NW Wind
Railroad Door	-0.51	0.025	0.42	0.55	-0.92	-0.40	-0.32	-0.47

Wind pressure coefficients for the roof level are documented in Reference 3. Since the wind pressure values are established to be an average of the four sides for the purpose of evaluating building leakage, symmetry is applied and only three values are required to evaluate the entire set of data. These values are obtained from Reference 3 using the wind angles of 90° (East and West), 180° (North and South) and 225°. The values are calculated using the relationship for averaging the roof elevation CpU outlined in Reference 3 (Appendix 1 page 11 of Calculation NE-02-01-05 Appendix E). The data used in this method are also found in Reference 3 (Appendix 3 page 8 of Calculation NE-02-01-05 Appendix E).

Table 3 – Roof Elevation Average Wind Pressure Coefficients

Measurement Location	N Wind	NE Wind	E Wind	SE Wind	S Wind	SW Wind	W Wind	NW Wind
Roof Elevation	-0.285	-0.161	-0.335	-0.161	-0.285	-0.161	-0.335	-0.161

Wind Pressure Tables (Tables A and C)

To evaluate what the Analysis Model would predict for building leakage under the surveillance test conditions, the wind pressure at the instrument (fTableWindInst), roof (fTableWindRoof) and railroad door (fTableWindDoor) must be determined for the given wind speed, wind direction and outside temperature. Using the relationships developed in Reference 3 a set of tables is developed for this purpose. The specific relationship used is as follows.

equation 1

$$Pw(V,Temp,Hmet,HBuild,Cp) = Cp * \rho_{gas}(Patm,Temp) * \frac{(U_H)^2}{2g_c\left(144\frac{in^2}{ft^2}\right)} \frac{27.71in}{psi}$$

$$U_H = V_{met}\left(\frac{900}{Hmet}\right)^{0.14}\left(\frac{HBuild}{900}\right)^{0.14}$$

Where

Cp is the wind pressure coefficient selected from Tables 1 through 3.
Patm is defined to be 14.696psi as described in Reference 3
Temp is the outside air temperature (°F)
ρ is the density of the air calculated based on air at Patm and Temp.
V is the wind speed measured at the meteorological tower (mph).
Hmet is the Met Tower Height assumed to be 245ft.
HBuild is the Building Height associated with either the Instrument, Roof or Railroad Door.
U_H is the velocity (mph) at the building corrected to account for terrain and elevation.

Static Pressure Change Tables (Table B)

The static pressure change between the instrument elevation and the roof (fTableStaticChangeRoof) is simply calculated using the elevation changes and inside and outside density of the air. The following relationship is used to establish the roof level static pressure change.

equation 2

$$\Delta P_{roof} = -g(ELRoof - ELInstrument)(\rho(Patm,TempOutside,"air") - \rho(Patm,TempInside,"air"))\frac{27.71in}{\left(144\frac{in^2}{ft^2}\right)psi}$$

$$\Delta P_{roof} = -g(667ft - 576.5ft)(\rho(Patm,TempOutside,"air") - \rho(Patm,TempInside,"air"))\frac{27.71in}{\left(144\frac{in^2}{ft^2}\right)psi}$$

Similarly, for the Railroad door (fTableStaticChangeDoor) elevation is calculated as follows.

$$\Delta P_{door} = -g(ELRailroad - ELInstrument)(\rho(Patm, TempOutside, "air") - \rho(Patm, TempInside, "air"))\frac{27.71in}{\left(144\frac{in^2}{ft^2}\right)psi}$$

$$\Delta P_{door} = -g(469ft - 576.5ft)(\rho(Patm, TempOutside, "air") - \rho(Patm, TempInside, "air"))\frac{27.71in}{\left(144\frac{in^2}{ft^2}\right)psi}$$

where g = 1

The elevation values are based on Reference 3 values, and the atmosphere pressure is 14.696 psia. The tables are generated using temperature differences.

Model Leakage Flow Tables (Table D)

Once the applied pressures are established for each of the leakage paths, a lookup table is used to determine the leakage flow in ACFM (Table D) at the roof (fTableLeakageRoof) and at the Railroad Door (fTableLeakageDoor). The basic equations used to establish these tables are provided in Reference 3. These equations are provided below for completeness.

*e*quation 3

$$\text{LeakDoor} = \left(416.57(\Delta P_{Door}) + 1249.71(\Delta P_{Door})^{0.5}\right)\frac{\rho_{air}\left(14.696psi, 75^{o}F\right)}{\rho_{air}\left(14.696psi, TempOutside\right)}$$

*e*quation 4

$$\text{LeakRoof} = \left(1344.5(\Delta P_{Roof}) + 2729.75(\Delta P_{Roof})^{0.5}\right)\frac{\rho_{air}\left(14.696psi, 75^{o}F\right)}{\rho_{air}\left(14.696psi, TempOutside\right)}$$

Annubar Temperature Flow Correction Multiplier Table (Table E)

The user of the procedure will need to convert the SGTS indicated flow into ACFM (fTableACFM). The table provided below is based on the data used in Reference 3 to provide the conversion discussed in Appendix D of that reference (Reference 4). The correction multiplier applied in this table are based on 100% humidity and a pressure of 13.84 psia. The low pressure and high humidity have associated with them the highest multipliers. This set of values was selected to be consistent with that used in the drawdown analysis Reference 3 (Procedure Development Assumption 3).

Table 4 – Annubar Correction Multiplier Converting ICFM to ACFM

Temperature (°F)	*Correction Factor*	*Temperature (°F)*	*Correction Factor*	*Temperature (°F)*	*Correction Factor*
50	1.0904	105	1.1617	160	1.2807
55	1.0962	110	1.1696	165	1.2973
60	1.1022	115	1.1778	170	1.3156
65	1.1082	120	1.1864	175	1.3356
70	1.1143	125	1.1956	180	1.3579
75	1.1205	130	1.2053	185	1.3826
80	1.1268	135	1.2157	190	1.4103
85	1.1334	140	1.2268	195	1.4415
90	1.1401	145	1.2387	200	1.4768
95	1.147	150	1.2516		
100	1.1542	155	1.2656		

Excess Leakage Capacity Evaluation Table (Table F)

The user will use the results of the previously calculated and measured flows to determine the excess flow available. This information will be converted to an equivalent orifice size using the model documented in Reference 2.

equation 5

$$OrificeFlow = \frac{24700 * cfh}{lb/\sec} * \frac{Y * d^2 * C * \sqrt{\Delta P * \rho_{air}(14.696 psi, 0^o F)}}{S_g}$$

$OrificeFlow$ = volumetric flow (cfh)

Y = compressibilty factor (1.0 for low pressure drop)

d = diameter of hole (inches)

C = flow coefficient (1.0 for conservatism)

S_g = specific gravity with respect to air (1.0)

ΔP = pressure drop in psi (0.25"w.g. = 0.00902psi)

ρ = density of air (0.08636lbm/ft^3 for air at 0° F)

Rearranging terms, the diameter is determined based on the excess flow (fTableFlow from Table F).

equation 6

$$d = \left(\frac{ExcessFlow * (60) * S_g}{24700 * Y * C * \sqrt{\Delta P * \rho_{air}(14.696 psi, 0^o F)}} \right)^{0.5}$$

where

$$ExcessFlow = 2430\left[1 - \frac{MeasuredFlow(ACFM)}{(LeakageRoof + LeakageDoor)}\right]$$

This relationship is used to develop the Lookup Table 5.

Table 5 – Excess Flow Orifice Lookup Table

Flow (cfm)	*Orifice Diameter (in)*	*Orifice Area (in^2)*	*Flow (cfm)*	*Orifice Diameter (in)*	*Orifice Area (in^2)*
100	2.95	6.84	950	9.09	64.94
125	3.30	8.54	975	9.21	66.65
150	3.61	10.25	1000	9.33	68.36
175	3.90	11.96	1025	9.45	70.07
200	4.17	13.67	1050	9.56	71.78
225	4.43	15.38	1075	9.67	73.48
250	4.66	17.09	1100	9.78	75.19
275	4.89	18.80	1125	9.90	76.90
300	5.11	20.51	1150	10.00	78.61
325	5.32	22.22	1175	10.11	80.32
350	5.52	23.93	1200	10.22	82.03
375	5.71	25.63	1225	10.33	83.74
400	5.90	27.34	1250	10.43	85.45
425	6.08	29.05	1275	10.53	87.16
450	6.26	30.76	1300	10.64	88.86
475	6.43	32.47	1325	10.74	90.57
500	6.60	34.18	1350	10.84	92.28
525	6.76	35.89	1375	10.94	93.99
550	6.92	37.60	1400	11.04	95.70
575	7.07	39.31	1425	11.14	97.41
600	7.23	41.01	1450	11.23	99.12
625	7.38	42.72	1475	11.33	100.83
650	7.52	44.43	1500	11.43	102.54
675	7.66	46.14	1525	11.52	104.24
700	7.81	47.85	1550	11.61	105.95
725	7.94	49.56	1575	11.71	107.66
750	8.08	51.27	1600	11.80	109.37
775	8.21	52.98	1625	11.89	111.08
800	8.34	54.69	1650	11.98	112.79
825	8.47	56.39	1675	12.07	114.50
850	8.60	58.10	1700	12.16	116.21
875	8.73	59.81	1725	12.25	117.92
900	8.85	61.52	1750	12.34	119.63
925	8.97	63.23	1775	12.43	121.33

Analysis – Development of Drawdown Timing Assessment

The Drawdown Timing Assessment is performed using the GOTHIC model developed in Reference 3. The purpose of running the model is to obtain an assessment of the range of time to reach 0.25 in wg at the instrument that would be expected during a surveillance. These values are by nature conservative based on the building leakage that is assumed in this analysis versus the actual building envelope conditions, which are expected to be demonstrated to be better than the analysis model.

The basic GOTHIC model and all of its inputs are documented in Reference 3. The information that follows represents the necessary changes to the inputs as specified in the Assumptions section to provide the evaluation of the surveillance timing.

Case Descriptions

A number of cases are run to bound the range of times that are reasonable to expect for the assumed building leakage characteristics as well as the weather and SGTS performance assumptions. A total of 12 cases are run to establish a range of times that result from a variety of conditions. These cases are described in Table 6.

Table 6 – Case Descriptions

Case Number	Case Description [1]
1	6720ACFM SGTS Flow, No Wind, 86°F Outside Air Temperature, Minimum Internal Electrical Heat Loads.
2	6720ACFM SGTS Flow, No Wind, 28°F Outside Air Temperature, Minimum Internal Electrical Heat Loads.
3	6720ACFM SGTS Flow, No Wind, 75°F Outside Air Temperature, Minimum Internal Electrical Heat Loads.
4	6720ACFM SGTS Flow, No Wind, 28°F Outside Air Temperature, Normal Internal Electrical Heat Loads including HPCS pump operation.
5	6720ACFM SGTS Flow, No Wind, 75°F Outside Air Temperature, Minimal Internal Electrical Heat Loads including HPCS pump operation.
6	4800ACFM SGTS Flow, 17.2mph SE Wind, 86°F Outside Air Temperature, Normal Internal Electrical Heat Loads including HPCS pump operation.
7	4800ACFM SGTS Flow, 17.2mph SE Wind, 28°F Outside Air Temperature, Normal Internal Electrical Heat Loads including HPCS pump operation.
8	4800ACFM SGTS Flow, 17.2mph SE Wind, 75°F Outside Air Temperature, Normal Internal Electrical Heat Loads including HPCS pump operation.
9	4800ACFM SGTS Flow, 17.2mph SE Wind, 28°F Outside Air Temperature, Minimal Internal Electrical Heat Loads.
10	4800ACFM SGTS Flow, 17.2mph SE Wind, 28°F Outside Air Temperature, Minimal Internal Electrical Heat Loads including HPCS pump operation.
11	4800ACFM SGTS Flow, 6mph SE Wind, 79.9°F Outside Air Temperature, Minimal Internal Electrical Heat Loads.
12	6720ACFM SGTS Flow, 17.2mph SE Wind, 86°F Outside Air Temperature, Normal Internal Electrical Heat Loads including HPCS pump operation.

[1] Wind Speed measured at 33 ft tower height per Timing Analysis Assumption 11

Initial Conditions

The GOTHIC model initial conditions are established using the same methods outlined in Reference 3 with the exception that the governing instrument provides the basis for the initial conditions as described previously. To establish the initial conditions for the volumes, the conditions at the measuring instrument (1A4) are specified to be 0.0 in wg. The inside pressure at the 576.5ft elevation are then defined to equal the total pressure on the outside face of the building at the location of the instrument for the conditions specified in Table 6. The inside pressure is then corrected to correspond to the center elevation of the corresponding volume.

$\Delta Pmeasured = 0.0in$ - Obtained at the 576.5ft elevation

Poutside used below represents the total pressure (static plus dynamic)

The function Pw is previously defined in Reference 3 and earlier in this document.

$$Pinside = Poutside = 14.696psi - \rho outside(g)(576.5ft - 441ft) + Pw(V, Temp, Hmet, HBuild, Cp)$$

$$PVolumeIC = Pinside - \rho inside(g)(ElVolumeCenter - 576.5ft)$$

The volumes of interest are defined in Reference 3 and have centers at the following elevations.
Volume 1 Center Elevation = 522.937ft
Volume 2 Center Elevation = 577.75ft
Volume 4 Center Elevation = 445.625ft
Volume 5 Center Elevation = 636.018ft

The initial pressures are summarized in Table 7.

Table 7 –Initial Conditions

Case Number	Volume 1 (psia)	Volume 2 (psia)	Volume 4 (psia)	Volume 5 (psia)	Internal Temperature All Volumes (°F)
1	14.65519	14.62694	14.69502	14.59692	75
2	14.64705	14.61881	14.68689	14.58878	75
3	14.65378	14.62553	14.69362	14.59551	75
4	14.64705	14.61881	14.68689	14.58878	75
5	14.65378	14.62553	14.69362	14.59551	75
6	14.65037	14.62212	14.6902	14.5921	75
7	14.64166	14.61341	14.68149	14.58339	75
8	14.64886	14.62061	14.6887	14.59059	75
9	14.64166	14.61341	14.68149	14.58339	75
10	14.64166	14.61341	14.68149	14.58339	75
11	14.65382	14.62558	14.69366	14.5955	75
12	14.65037	14.62212	14.6902	14.5921	75

Boundary Conditions

The boundary conditions within the model that are associated with building leakage as well as SGTS discharge are defined in Reference 3. The methods used to determine their initial conditions are established in that same document. The method simply establishes the total pressure at the building surface in question using the pressure relationships defined previously and wind pressure coefficients assigned to the corresponding surfaces. The wind pressure coefficients are assigned based on wind direction, as defined in Table 2 and 3. The elevations used in establishing these conditions are based on those documented in Reference 3.

Elevation Railroad Door = 469ft
Elevation Roof = 667ft

Table 8 – Boundary Conditions

Case Number	Roof Elevation Leakage (psia)	Railroad Door Elevation Leakage (psia)	Elevated [2] Release (psia)	Outside Temperature (°F)
1	14.58189	14.68186	14.58189	86
2	14.56832	14.68018	14.56832	28
3	14.57954	14.68157	14.57954	75
4	14.56832	14.68018	14.56832	28
5	14.57954	14.68157	14.57954	75
6	14.58052	14.68425	14.58189	86
7	14.56678	14.68285	14.56832	28
8	14.57814	14.68401	14.57954	75
9	14.56678	14.68285	14.56832	28
10	14.56678	14.68285	14.56832	28
11	14.58043	14.682	14.5806	79.9
12	14.58052	14.68425	14.58189	86

[2] Per Reference 3 this value is calculated to correspond to the Roof elevation with no wind. It conservatively ignores any elevation difference between the opening and the roof elevation.

Control Variables

The model uses control variables to establish the leakage into the building as a function of pressure difference across the leakage locations. To accommodate leakage out of the building (Timing Analysis Assumption 2) the logic was modified. Additional logic was added to the control variables to convert the potentially negative pressure difference across the surface (associated with leakage out of the building) to a positive value. This first step is required to ensure that the square root term will accept the differential pressure as defined in Equations 3 and 4 (i.e., avoid attempts to calculate the square root of a negative number). The logic is further modified to then assign a negative value to the flow if the pressure value was determined to be negative in the previous step. The control variable logic changes can be seen by comparing Reference 3 control variable inputs with those documented in Tables 11 and 12. Specifically, Control Variables 11 through 19 represent the newly defined logic. Case-specific input values for the leakage flow control variables are documented in Tables 9 and 10.

The values provided in Table 9 are the case-specific values used for the pressure related control variables. The determination of these values is unchanged from that documented in Reference 3. The cv6 initial condition is simply the calculation of the pressure at the top of the Railroad Door based on the initial pressure in the control volume 1.

Control Variable 6 is used to calculate the inside pressure at the railroad door leakage elevation (469ft). The initial value is calculated based on the initial pressure in volume 1. The control variable 7 represents the calculated pressure at the railroad door used for leakage calculations. The initial condition is simply the initial difference between the pressure calculated for control variable 6 and the boundary condition pressure applied at the door. The a0 coefficient associated with this control variable is set to equal the boundary condition pressure at the Railroad Door. Therefore, this value corresponds with Table 8 values for the railroad door outside pressure. Control Variables 8 and 9 are similarly calculated for the Roof Elevation (667ft) leakage location. Control Variable 10 is the average pressure applied at the roof elevation using wind coefficients documented in Table 3. The basic relationships used in this effort are defined below. The control variable 15 is basically a reproduction of control variable 7 and therefore, uses the same coefficient input value.

$$\Delta P = Pinside - Poutside$$

$$Pinside = PVolume\# - \rho inside(ELInside - ELVolume\#)g$$

Table 9 –Leakage Pressure Conditions Control Variable Inputs

Case Number	cv6 Initial Condition Door Inner Press.	cv7 Initial Condition Door Diff. Press.	cv7 a0 Coefficient Door Diff. Press.	cv8 Initial Condition Roof Level Inner Press.	cv9 Initial Condition Roof Min. Diff. Press.	cv9 a0 Coefficient Roof Min. Diff. Press.	cv10 a0 Coefficient Roof Leak Diff. Press	cv15 a0 Coefficient Door Diff. Press.
1	14.68298	-0.03094	14.68186	14.58095	0.026	14.58189	14.58189	14.68186
2	14.67484	0.14793	14.68018	14.57282	-0.125	14.56832	14.56832	14.68018
3	14.68157	0	14.68157	14.57954	0	14.57954	14.57954	14.68157
4	14.67484	0.14793	14.68018	14.57282	-0.125	14.56832	14.56832	14.68018
5	14.68157	0	14.68157	14.57954	0	14.57954	14.57954	14.68157
6	14.67816	0.1687	14.68425	14.57613	0.026893	14.5771	14.58052	14.68425
7	14.66945	0.37132	14.68285	14.56742	-0.1236	14.56296	14.56678	14.68285
8	14.67665	0.20375	14.68401	14.57463	0.000861	14.57466	14.57814	14.68401
9	14.66945	0.37132	14.68285	14.56742	-0.1236	14.56296	14.56678	14.68285
10	14.66945	0.37132	14.68285	14.56742	-0.1236	14.56296	14.56678	14.68285
11	14.68161	0.01063	14.682	14.57959	0.012	14.58001	14.58043	14.682
12	14.67816	0.1687	14.68425	14.57613	0.026893	14.5771	14.58052	14.68425

The values provided in Table 10 are the case-specific corrected coefficients defined in Equations 3 and 4.

$$cv18 = (416.57)\frac{\rho_{air}(14.696psi, 75^{o}F)}{\rho_{air}(14.696psi, TempOutside)}$$

$$cv19 = (1249.71)\frac{\rho_{air}(14.696psi, 75^{o}F)}{\rho_{air}(14.696psi, TempOutside)}$$

$$cv13 = (1344.5)\frac{\rho_{air}(14.696psi, 75^{o}F)}{\rho_{air}(14.696psi, TempOutside)}$$

$$cv12 = (2729.75)\frac{\rho_{air}(14.696psi, 75^{o}F)}{\rho_{air}(14.696psi, TempOutside)}$$

Table 10 – Leakage Flow Control Variable Inputs

Case Number	cv18 Variable Coefficient	cv17 a0 Coefficient	cv13 Variable Coefficient	cv12 a0 Coefficient
1	425.14	1275.43	1372.16	2785.91
2	379.95	1139.86	1226.31	2489.79
3	416.57	1249.71	1344.5	2729.75
4	379.95	1139.86	1226.31	2489.79
5	416.57	1249.71	1344.5	2729.75
6	416.57	1249.71	1344.5	2729.75
7	425.14	1275.43	1372.16	2785.91
8	379.95	1139.86	1226.31	2489.79
9	379.95	1139.86	1226.31	2489.79
10	379.95	1139.86	1226.31	2489.79
11	420.39	1261.17	1356.82	2754.77
12	425.14	1275.43	1372.16	2785.91

Table 11 Leakage Calculation Control Variables Overview

Control Variables								
CV #	Description	Func. Form	Initial Value	Coeff. G	Coeff. a0	Min	Max	Upd. Int. Mult.
6	IP Top Door	sum	14.67816	1	0	-1E+32	1E+32	0
7	DPLow	sum	0.1687	27.71	14.68425	-1E+32	1E+32	0
8	IP Upper	sum	14.57613	1	0	-1E+32	1E+32	0
9	DPUpper	sum	0.026893	27.71	14.5771	-1E+32	1E+32	0
10	Leakage DP Upper	sum	0	27.71	14.58052	-5	5	0
11	Abs Roof Press	if	0	1	0	-1E+32	1E+32	0
12	Turb Flow Upper	exp	0	2785.91	0.5	0	1E+32	0
13	Leak Flow Up	sum	0	1	0	0	1E+32	0
14	Upper Flow Dir	if	0	1	0	-1E+32	1E+32	0
15	Leak DP Lower	sum	0	27.71	14.68425	-5	5	0
16	Abs Door Pres	if	0	1	0	-1E+32	1E+32	0
17	Turb Flow Low	exp	0	1275.43	0.5	-10000	1E+32	0
18	Leak Flow Low	sum	0	1	0	-10000	1E+32	0
19	Lower Flow Dir	if	0	1	0	-1E+32	1E+32	0

Table 12 – Leakage Control Variables Specifics

Function Components			
Control Variable 11			
Abs Roof Press			
if(a1X1+a0<0 a1X1+a0=0 a1X1+a0>0)			
Y=Ga2X2 Y=Ga3X3 Y=Ga4X4			
#	Gothic_s Name	Variable location	Coef. a
1	Cvval	cv10	1
2	Cvval	cv10	-1
3	Cvval	cv10	1
4	Cvval	cv10	1

Function Components			
Control Variable 12			
Turb Flow Upper			
exp			
Y=G*(a0+a1X1)^a2X2 or G*(a1X1)^a0			
#	Gothic_s Name	Variable location	Coef. a
1	Cvval	cv11	1

Function Components			
Control Variable 13			
Leak Flow Up			
sum			
Y=G*(a0+a1X1+a2X2+...+anXn)			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv11	1372.16
2	Cvval	cv12	1

Function Components			
Control Variable 14			
Upper Flow Dir			
if(a1X1+a0<0 a1X1+a0=0 a1X1+a0>0)			
Y=Ga2X2 Y=Ga3X3 Y=Ga4X4			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv10	1
2	Cvval	cv13	-1
3	Cvval	cv13	1
4	Cvval	cv13	1

Function Components			
Control Variable 15			
Leak DP Lower			
sum			
Y=G*(a0+a1X1+a2X2+...+anXn)			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv6	-1

Function Components			
Control Variable 16			
Abs Door Pres			
if(a1X1+a0<0 a1X1+a0=0 a1X1+a0>0)			
Y=Ga2X2 Y=Ga3X3 Y=Ga4X4			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv15	1
2	Cvval	cv15	-1
3	Cvval	cv15	1
4	Cvval	cv15	1

Function Components			
Control Variable 17			
Turb Flow Low			
exp			
Y=G*(a0+a1X1)^a2X2 or G*(a1X1)^a0			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv16	1
Function Components			
Control Variable 18			
Leak Flow Low			
sum			
Y=G*(a0+a1X1+a2X2+...+anXn)			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv16	425.14
2	Cvval	cv17	1
Function Components			
Control Variable 19			
Leak Flow Low			
if(a1X1+a0<0 a1X1+a0=0 a1X1+a0>0)			
Y=Ga2X2 Y=Ga3X3 Y=Ga4X4			
	Gothic_s	Variable	Coef.
#	Name	location	a
1	Cvval	cv15	1
2	Cvval	cv18	-1
3	Cvval	cv18	1
4	Cvval	cv18	1

Heater Inputs

For all cases, Decay Heat (2H) to the Fuel Pool is included along with the heat load associated with operation of Fuel Pool Cooling (24H). For the remainder of the cases, the heat loads are developed using Reference 3 documented heat loads. The nine heaters included in the model to represent the electrical and decay heat loads are summarized in the table. The Pump Room heaters represented by 23H and 25H are either turned off or set to values that represent the operation of HPCS pumps only (Refer to Table 40 of Reference 3). Heat loads associated with Main Building fan cooler operation (21H) are either turned off or in full operation, as defined in the table below (Refer to Table 39 of Reference 3). The Main Building equipment represented by 26H is either turned off or set to a steady state value. The steady state value is based on the value documented as the zero time value for equation 15 of Reference 3. This Reference 3 equation 15 relationship is appropriately used in Reference 3 to represent the release of stored heat from normally operating equipment that is assumed to trip following a LOCA. Since this analysis is associated with normal conditions, the steady state value is appropriate. The Refueling Floor heat load associated with a spent fuel canister is represented by Heater 22H (Refer to Table 39 of Reference 3). The value is either set to zero or to that assumed in the Reference 3 analysis.

Table 13 – Heater Inputs

Case Number	Pump Room Heater 23H (BTU/sec)	Pump Room Heater 25H (BTU/sec)	Main Building 1H (BTU/sec)	Main Building 21H (BTU/sec)	Main Building 24H (BTU/sec)	Main Building Equipment 26H (BTU/sec)	Main Building Emergency Lighting 20H (BTU/sec)	Refueling Floor 22H (BTU/sec)	Refueling Floor (Fuel Pool Decay Heat) 2H (BTU/sec)
1	0	0	0	0	4.37	0	0	0	2,720.56
2	0	0	0	0	4.37	0	0	0	2,720.56
3	0	0	0	0	4.37	0	0	0	2,720.56
4	127.33	6.65	43.24	10.95	4.37	73.14	0	21.8	2,720.56
5	127.33	6.65	0	0	4.37	0	0	0	2,720.56
6	127.33	6.65	43.24	10.95	4.37	73.14	0	21.8	2,720.56
7	127.33	6.65	43.24	10.95	4.37	73.14	0	21.8	2,720.56
8	127.33	6.65	43.24	10.95	4.37	73.14	0	21.8	2,720.56
9	0	0	0	0	4.37	0	0	0	2,720.56
10	127.33	6.65	0	0	4.37	0	0	0	2,720.56
11	0	0	0	0	4.37	0	0	0	2,720.56
12	127.33	6.65	43.24	10.95	4.37	73.14	0	21.8	2,720.56

Primary Containment Heat Sources

The Reference 3 model simulates the heat transfer of Primary Containment to the Secondary Containment. Under the conditions in this analysis, these effects are neglected, since no accident is assumed. The Drywell is assumed to be at 135°F and the Wetwell is assumed to be 95°F.

Analysis Results

The drawdown time is established based on the time required to reach 0.25 in wg pressure differential at the instrument. The time to reach the drawdown condition will be based on the volume 1 value that is 0.25 in wg below its initial value (Table 7). Recall that the volume's initial conditions are established based on the instrument reading 0.0 in wg. Therefore, provided the volume has only a minor temperature change during the analysis period (<5°F), this 0.25 in wg pressure differential shift is appropriate.

$$\mathrm{Pr}essureGoal = \mathrm{Pr}essICVol1 - \frac{0.25in}{27.71in/psi}$$

The pressures and times they occur are documented in Table 14.

Table 14 – Drawdown Time Study Results

Case Number	Time For Instrument to reach 0.25 in wg (sec)	Volume 1 pressure that corresponds with Instrument Reading at 0.25 in wg (psia)
1	42.9233	14.64617799
2	31.1233	14.63807799
3	40.4233	14.64477799
4	62.1431	14.63807799
5	40.6233	14.63807799
6	532.178	14.64137799
7	268.143	14.63267799
8	478.143	14.63987799
9	56.1431	14.63267799
10	92.1431	14.63267799
11	56.1431	14.64477799
12	402.143	14.64137799

Conclusions

The procedural steps and tables developed in this report can be included as an attachment to the Reference 1 procedure. The time to drawdown the building during a surveillance test to reach 0.25 in wg will range between 30 and 532 seconds. The exact time will be dependent upon the weather conditions as well as building internal heat loads as can be seen in Table 14.

Appendices

1. Instrument location and Railroad Door wind pressure coefficient evaluations (9 pages)
2. GOTHIC Model Input Deck (30 pages)
3. Procedure and Tables (174 pages)
4. Annubar Correction Factor Data (2 pages)
5. Design Verification (3 pages)

Appendix 1

Wind Pressure Coefficient Development

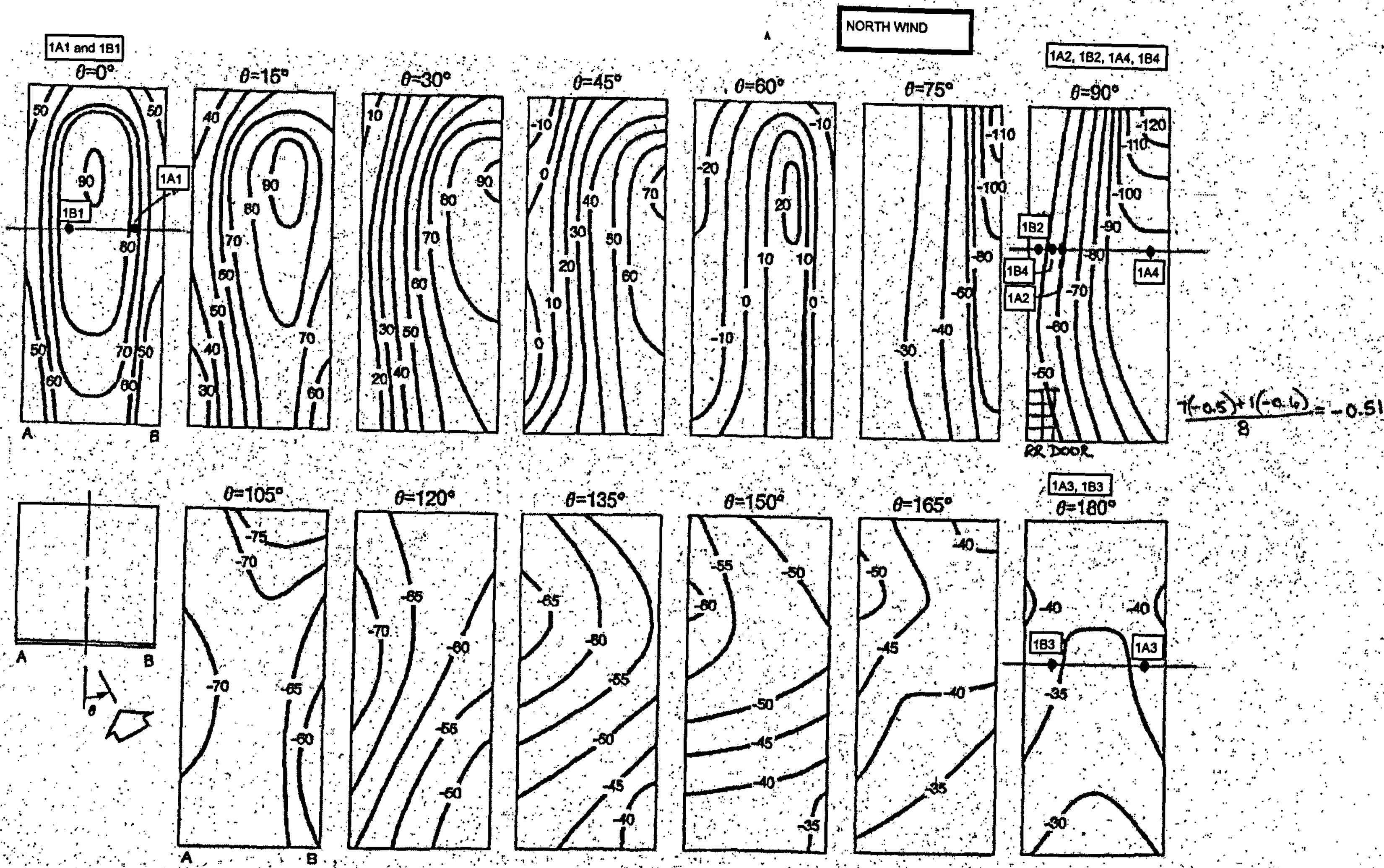

Fig. 4 Local Pressure Coefficients ($C_p \times 100$) for a Tall Building with Varying Wind Direction
(Davenport and Hui 1982)

APPENDIX 2

GOTHIC INPUT DECK

Control Volumes										
Vol		Vol	Elev	Ht	Hyd. D.	L/V IA	Burn			
#	Description	(ft3)	(ft)	(ft)	(ft)	(ft2)	Opt			
1	Reactor Building	1804568.96	441	163.875	28.9	DEFAULT	NONE			
2	SGTS Fan Inlet	1000	577	1.5	1.5	DEFAULT	NONE			
3	Fuel Pool Piping	10	568.125	1	1	DEFAULT	NONE			
4	Pump Rooms	345121.1	422.25	46.75	69.07	DEFAULT	NONE			
5	Fuel Pool Floor	1321336.77	604.367	63.303	31.34	1360	NONE			
Laminar Leakage										
	Lk Rate	Ref	Ref	Ref	Sink				Leak	
Vol	Factor	Press	Temp	Humid	/Src	Model	Rep	Subvol	Area	
#	(%/hr)	(psia)	(F)	(%)	BC	Option	Wall	Option	(ft2)	
1	0					CNST T		UNIFORM	DEFAULT	
2	0					CNST T		UNIFORM	DEFAULT	
3	0					CNST T		UNIFORM	DEFAULT	
4	0					CNST T		UNIFORM	DEFAULT	
5	0					CNST T		UNIFORM	DEFAULT	
Turbulent Leakage										
	Lk Rate	Ref	Ref	Ref	Sink				Leak	
Vol	Factor	Press	Temp	Humid	/Src	Model	Rep	Subvol	Area	
#	(%/hr)	(psia)	(F)	(%)	BC	Option	Wall	Option	(ft2)	fL/D
1	0					CNST T		UNIFORM	DEFAULT	
2	0					CNST T		UNIFORM	DEFAULT	
3	0					CNST T		UNIFORM	DEFAULT	
4	0					CNST T		UNIFORM	DEFAULT	
5	0					CNST T		UNIFORM	DEFAULT	

Appendix 3

Procedural Steps

and

Supporting Tables

Procedural Steps

The procedural steps to be used in the procedure are provided below. The numbering scheme referenced in the steps are associated with the current procedure documented in Reference 1.

Steps 1 through 7 record and then average the data values determined in the main portions of the procedure. The averaging of the data is a simple numeric averaging of the values (Sum of values divided by the number of values recorded).

		Value/Time			Average Value
1.	Record Wind Speed (mph) and time obtained from Step 7.1.28				
2.	Record Wind Direction (i.e., SE, W, etc.) and time (i.e., 180° = South)				
3.	Record Outside Air Temperature and Time				
4.	Record Inside Air Temperature and Time obtained from SGTS Entrance				
5.	Record SGTS Flow Rate (ICFM)				
6.	Record SGTS Temperature Rise (°F)				
7.	Identify DP Instrument Location as indicated in Figure 1 .				
8.	Record the identified DP Instrument Reading (inwg)				

The remainder of this evaluation will use the averaged values provided in Steps 1 through 8 above.

9. Determine Wind Induced DP (inwg)
   Using Instrument Wind Pressure Tables (Table A) ______________________

10. Subtract Line 9 from Line 8 to obtain the Static Pressure Differential at the instrument location (Record Result) ________ - ________ = ________

Determination of Leakage Rate at Roof Level:

11. Determine the Change of Static Pressure Differential between Roof Level and Instrument Location, using Surface Static Pressure Adjustment Tables (Table B) (Record Value) ______________________

12. Determine the Static Pressure Differential at the Roof Level by adding Line 10 and 11. ________ + ________ = ________

13. Determine Wind Induced Average DP, using Surface Wind Pressure Tables (Table C) for the Roof Level (inwg)______________________

14. Determine the total DP at the Roof Level by adding Lines 13 and 12. ________ + ________ = ________

15. Determine the Roof Level Leakage Flow (ACFM), using Leakage Flow Tables (Table D) for the Roof Level ______________________

Determination of Leakage Rate at Railroad Door:

16. Determine the Change of Static Pressure Differential between Railroad Door Level and Instrument Location Using Surface Static Pressure Adjustment Tables (Table B) (Record Value) ______________________

17. Determine the Static Pressure Differential at the Railroad Door by adding Lines 10 and 16. ________ + ________ = ________

18. Determine Wind Induced DP, using Surface Wind Pressure Tables (Table C) for the Railroad Door (inwg) ______________

19. Determine the total DP at the Railroad Door Level by adding Lines 18 and 17. ________ + ________ = ________

20. Determine the Railroad Door Level Leakage Flow (ACFM), using Level Leakage Flow Table (Table D) for the Railroad Door. ______________________

Determination of Total Building Leakage Rate:

21. Determine the Analytical Leakage Flow by adding Lines 20 and 15. ________ + ________ = ________

22. Determine the Annubar Temperature by adding Lines 4 and 6. ________ + ________ = ________

23. Using the SGTS Flow Correction Factors For ACFM Table (Table E), convert SGTS Flow (line 5) to ACFM ________ * ________ = ________

24. Is the value in Step 21 greater than or equal to Step 23? ______________________

If the answer to Step 24 is yes, then the test successfully demonstrated the analytical model bounds of the actual plant leakage characteristics. If the answer to Step 24 is no, then the plant conditions are outside of the drawdown analysis assumptions.

Penetration Margin Available

This step in the procedure converts the leakage flow into an equivalent flow at 0.25"wg on all surfaces of the building. The flow is converted and used to establish a flow margin. Information will be provided to convert the flow margin into an equivalent orifice size to account for changes or modifications that will penetrate the building boundary.

25. Roof Level Leakage Flow Calculated in Step 15 (ACFM) ____________

26. Railroad Door Leakage Flow Calculated in Step 20 (ACFM) ____________

27. Total the Calculated leakage by adding lines 25 and 26 ________ + ________ = ________

28. Take the Ratio of Measured Leakage Flow (Step 23) and the total Calculated Leakage (Step 27) ________ / ________ = ________

29. Multiply the allowable leakage limit (2430cfm) by the ratio established in Step 28. 2430cfm * ________ = ________

30. Subtract the allowable Leakage limit (2430cfm) from the value calculated in Step 29 to establish the margin. 2430cfm - ________ = ________

31. Using the margin (Step 30), and the Equivalent Orifice Size Table (Table F) record the penetration margin area (in^2) ____________

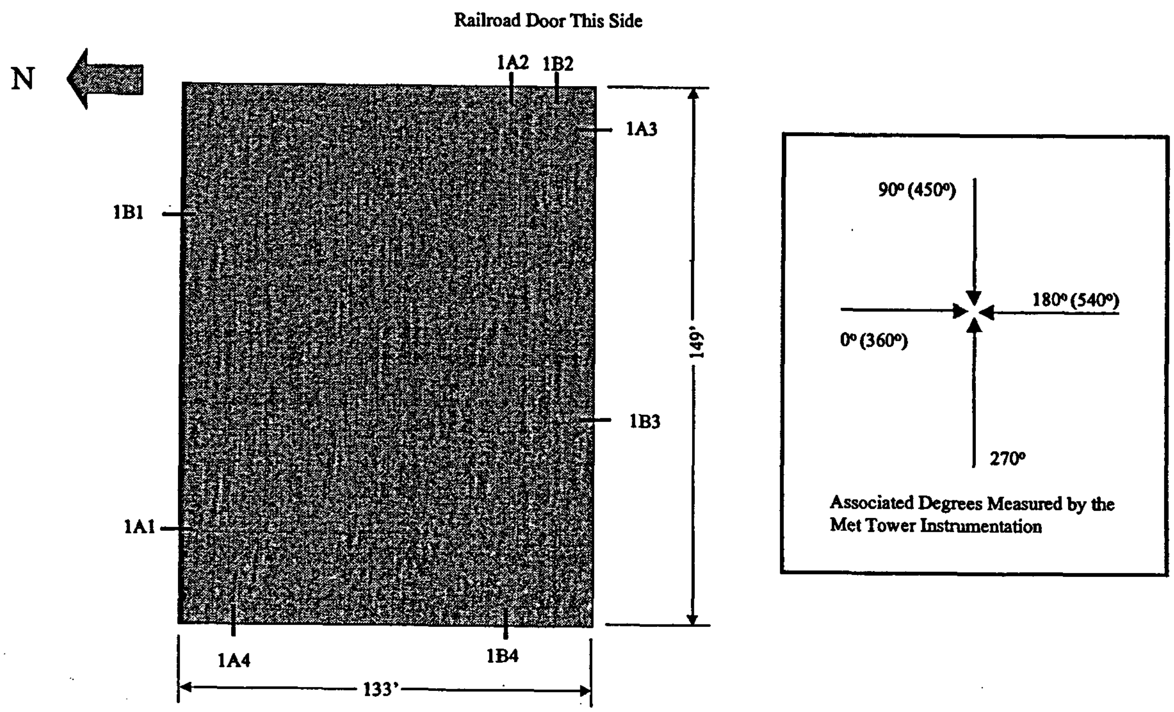

Figure 1 – Instrument Locations

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INSTRUMENT DESIGNATION AND WIND DIRECTION

1A1 EAST

MPH	-20F	-10F	0F	10F	20F	30F	40F	50F	60F	70F	75F	80F	85F	90F	95F	100F	105F
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	-0.00026	-0.00025	-0.00024	-0.00024	-0.00023	-0.00023	-0.00023	-0.00022	-0.00022	-0.00021	-0.00021	-0.00021	-0.00021	-0.00020	-0.00020	-0.00020	-0.0002
2	-0.00102	-0.00100	-0.00098	-0.00096	-0.00094	-0.00092	-0.00090	-0.00088	-0.00087	-0.00085	-0.00084	-0.00083	-0.00083	-0.00082	-0.00081	-0.00080	-0.0008
3	-0.00230	-0.00225	-0.00220	-0.00215	-0.00211	-0.00207	-0.00203	-0.00199	-0.00195	-0.00191	-0.00189	-0.00187	-0.00186	-0.00184	-0.00182	-0.00181	-0.00179
4	-0.00409	-0.00400	-0.00391	-0.00383	-0.00375	-0.00367	-0.00360	-0.00353	-0.00346	-0.0034	-0.00336	-0.00333	-0.00330	-0.00327	-0.00324	-0.00321	-0.00319
5	-0.00639	-0.00625	-0.00611	-0.00598	-0.00586	-0.00574	-0.00563	-0.00551	-0.00541	-0.00531	-0.00526	-0.00521	-0.00516	-0.00511	-0.00507	-0.00502	-0.00498
6	-0.00921	-0.00900	-0.00881	-0.00862	-0.00844	-0.00827	-0.00810	-0.00794	-0.00779	-0.00764	-0.00757	-0.0075	-0.00743	-0.00736	-0.0073	-0.00723	-0.00717
7	-0.01253	-0.01225	-0.01198	-0.01173	-0.01149	-0.01125	-0.01103	-0.01081	-0.01060	-0.01040	-0.01030	-0.01021	-0.01011	-0.01002	-0.00993	-0.00984	-0.00976
8	-0.01637	-0.01600	-0.01565	-0.01532	-0.01500	-0.01469	-0.01440	-0.01412	-0.01385	-0.01358	-0.01346	-0.01333	-0.01321	-0.01309	-0.01297	-0.01286	-0.01274
9	-0.02071	-0.02025	-0.01981	-0.01939	-0.01899	-0.0186	-0.01823	-0.01787	-0.01752	-0.01719	-0.01703	-0.01687	-0.01672	-0.01657	-0.01642	-0.01627	-0.01613
10	-0.02557	-0.02500	-0.02446	-0.02394	-0.02344	-0.02296	-0.02250	-0.02206	-0.02163	-0.02123	-0.02103	-0.02083	-0.02064	-0.02045	-0.02027	-0.02009	-0.01991
11	-0.03094	-0.03025	-0.0296	-0.02896	-0.02836	-0.02778	-0.02723	-0.02669	-0.02618	-0.02568	-0.02544	-0.02521	-0.02498	-0.02475	-0.02453	-0.02431	-0.02409
12	-0.03682	-0.03600	-0.03522	-0.03447	-0.03375	-0.03306	-0.03240	-0.03177	-0.03115	-0.03057	-0.03028	-0.03	-0.02972	-0.02945	-0.02919	-0.02893	-0.02867
13	-0.04322	-0.04225	-0.04134	-0.04046	-0.03961	-0.03880	-0.03803	-0.03728	-0.03656	-0.03587	-0.03554	-0.03521	-0.03488	-0.03457	-0.03426	-0.03395	-0.03365
14	-0.05012	-0.04901	-0.04794	-0.04692	-0.04594	-0.04500	-0.04410	-0.04324	-0.04240	-0.04160	-0.04121	-0.04083	-0.04046	-0.04009	-0.03973	-0.03937	-0.03902
15	-0.05754	-0.05626	-0.05503	-0.05386	-0.05274	-0.05166	-0.05063	-0.04963	-0.04868	-0.04776	-0.04731	-0.04687	-0.04644	-0.04602	-0.04561	-0.0452	-0.0448
16	-0.06546	-0.06401	-0.06261	-0.06128	-0.06000	-0.05878	-0.05760	-0.05647	-0.05539	-0.05434	-0.05383	-0.05333	-0.05284	-0.05236	-0.05189	-0.05143	-0.05097
17	-0.07390	-0.07226	-0.07069	-0.06918	-0.06774	-0.06636	-0.06503	-0.06375	-0.06252	-0.06134	-0.06077	-0.06021	-0.05965	-0.05911	-0.05858	-0.05806	-0.05754
18	-0.08285	-0.08101	-0.07925	-0.07756	-0.07594	-0.07439	-0.07290	-0.07147	-0.0701	-0.06877	-0.06813	-0.0675	-0.06688	-0.06627	-0.06567	-0.06509	-0.06451
19	-0.09231	-0.09026	-0.0883	-0.08642	-0.08461	-0.08289	-0.08123	-0.07963	-0.07810	-0.07663	-0.07591	-0.07521	-0.07452	-0.07384	-0.07317	-0.07252	-0.07188
20	-0.10229	-0.10001	-0.09783	-0.09575	-0.09376	-0.09184	-0.09000	-0.08824	-0.08654	-0.08491	-0.08411	-0.08333	-0.08257	-0.08182	-0.08108	-0.08035	-0.07964
21	-0.11277	-0.11026	-0.10786	-0.10557	-0.10337	-0.10125	-0.09923	-0.09728	-0.09541	-0.09361	-0.09273	-0.09187	-0.09103	-0.09020	-0.08939	-0.08859	-0.08781
22	-0.12377	-0.12101	-0.11838	-0.11586	-0.11344	-0.11113	-0.10890	-0.10677	-0.10471	-0.10274	-0.10177	-0.10083	-0.09991	-0.099	-0.09810	-0.09723	-0.09637
23	-0.13527	-0.13226	-0.12939	-0.12663	-0.12399	-0.12146	-0.11903	-0.11669	-0.11445	-0.11229	-0.11124	-0.11021	-0.10919	-0.10820	-0.10723	-0.10627	-0.10533
24	-0.14729	-0.14402	-0.14088	-0.13788	-0.13501	-0.13225	-0.12960	-0.12706	-0.12462	-0.12226	-0.12112	-0.12	-0.1189	-0.11782	-0.11675	-0.11571	-0.11469
25	-0.15982	-0.15627	-0.15287	-0.14961	-0.14649	-0.14350	-0.14063	-0.13787	-0.13522	-0.13266	-0.13142	-0.13021	-0.12901	-0.12784	-0.12669	-0.12555	-0.12444
26	-0.17286	-0.16902	-0.16534	-0.16182	-0.15845	-0.15521	-0.15211	-0.14912	-0.14625	-0.14349	-0.14215	-0.14083	-0.13954	-0.13827	-0.13702	-0.1358	-0.1346

Table B
Surface Static Pressure Adjustment Tables

Railroad Door – Static DP Adjustment 139
Roof Level – Static DP Adjustment 140

Railroad Door – Static DP Adjustment

Temperature Inside	**Temperature Outside**																
	-20°F	*-10°F*	*0°F*	*10°F*	*20°F*	*30°F*	*40°F*	*50°F*	*60°F*	*70°F*	*75°F*	*80°F*	*85°F*	*90°F*	*95°F*	*100°F*	*105°F*
60°F	0.287354	0.245843	0.206139	0.168125	0.131696	0.096755	0.063212	0.030986	0.000000	-0.029816	-0.044306	-0.058527	-0.072487	-0.086193	-0.099652	-0.112871	-0.125855
62°F	0.293409	0.251898	0.212193	0.174179	0.137750	0.102809	0.069267	0.037041	0.006055	-0.023761	-0.038251	-0.052472	-0.066432	-0.080139	-0.093598	-0.106816	-0.119801
64°F	0.299417	0.257906	0.218202	0.180188	0.143759	0.108818	0.075275	0.043049	0.012063	-0.017753	-0.032243	-0.046464	-0.060424	-0.074130	-0.087589	-0.100808	-0.113792
66°F	0.305380	0.263869	0.224164	0.186150	0.149721	0.114780	0.081238	0.049012	0.018026	-0.011790	-0.026280	-0.040501	-0.054461	-0.068168	-0.081627	-0.094845	-0.107830
68°F	0.311297	0.269786	0.230082	0.192068	0.155639	0.120698	0.087155	0.054929	0.023943	-0.005873	-0.020363	-0.034584	-0.048544	-0.062250	-0.075709	-0.088928	-0.101912
70°F	0.317170	0.275659	0.235954	0.197941	0.161512	0.126571	0.093028	0.060802	0.029816	0.000000	-0.014490	-0.028711	-0.042671	-0.056377	-0.069836	-0.083055	-0.096039
72°F	0.322999	0.281488	0.241783	0.203769	0.167340	0.132399	0.098857	0.066631	0.035645	0.005829	-0.008661	-0.022882	-0.036843	-0.050549	-0.064008	-0.077226	-0.090211
74°F	0.328783	0.287273	0.247568	0.209554	0.173125	0.138184	0.104642	0.072415	0.041429	0.011614	-0.002876	-0.017097	-0.031058	-0.044764	-0.058223	-0.071441	-0.084426
76°F	0.334525	0.293014	0.253310	0.215296	0.178867	0.143926	0.110383	0.078157	0.047171	0.017355	0.002865	-0.011356	-0.025316	-0.039022	-0.052481	-0.065700	-0.078684
78°F	0.340224	0.298713	0.259009	0.220995	0.184566	0.149625	0.116082	0.083856	0.052870	0.023054	0.008564	-0.005657	-0.019617	-0.033323	-0.046782	-0.060001	-0.072985
80°F	0.345881	0.304370	0.264665	0.226652	0.190223	0.155282	0.121739	0.089513	0.058527	0.028711	0.014221	0.000000	-0.013960	-0.027666	-0.041125	-0.054344	-0.067328
82°F	0.351496	0.309985	0.270280	0.232267	0.195838	0.160897	0.127354	0.095128	0.064142	0.034326	0.019836	0.005615	-0.008345	-0.022051	-0.035510	-0.048729	-0.061713
84°F	0.357070	0.315559	0.275854	0.237840	0.201411	0.166470	0.132928	0.100702	0.069716	0.039900	0.025410	0.011189	-0.002771	-0.016478	-0.029937	-0.043155	-0.056140
86°F	0.362602	0.321092	0.281387	0.243373	0.206944	0.172003	0.138461	0.106234	0.075248	0.045432	0.030943	0.016721	0.002761	-0.010945	-0.024404	-0.037622	-0.050607
88°F	0.368095	0.326584	0.286879	0.248865	0.212436	0.177495	0.143953	0.111727	0.080741	0.050925	0.036435	0.022214	0.008254	-0.005452	-0.018912	-0.032130	-0.045115
90°F	0.373547	0.332036	0.292332	0.254318	0.217889	0.182948	0.149405	0.117179	0.086193	0.056377	0.041888	0.027666	0.013706	0.000000	-0.013459	-0.026678	-0.039662
92°F	0.378960	0.337449	0.297745	0.259731	0.223302	0.188361	0.154818	0.122592	0.091606	0.061790	0.047300	0.033079	0.019119	0.005413	-0.008046	-0.021265	-0.034249
94°F	0.384334	0.342823	0.303118	0.265105	0.228676	0.193735	0.160192	0.127966	0.096980	0.067164	0.052674	0.038453	0.024493	0.010787	-0.002672	-0.015891	-0.028875
96°F	0.389669	0.348158	0.308454	0.270440	0.234011	0.199070	0.165527	0.133301	0.102315	0.072499	0.058009	0.043788	0.029828	0.016122	0.002663	-0.010556	-0.023540
98°F	0.394966	0.353455	0.313750	0.275736	0.239308	0.204367	0.170824	0.138598	0.107612	0.077796	0.063306	0.049085	0.035125	0.021419	0.007960	-0.005259	-0.018243
100°F	0.400225	0.358714	0.319009	0.280995	0.244567	0.209626	0.176083	0.143857	0.112871	0.083055	0.068565	0.054344	0.040384	0.026678	0.013219	0.000000	-0.012984
102°F	0.405446	0.363936	0.324231	0.286217	0.249788	0.214847	0.181305	0.149078	0.118092	0.088276	0.073787	0.059566	0.045605	0.031899	0.018440	0.005222	-0.007763

Roof Level – Static DP Adjustment

Temperature Inside	Temperature Outside																
	-20°F	*-10°F*	*0°F*	*10°F*	*20°F*	*30°F*	*40°F*	*50°F*	*60°F*	*70°F*	*75°F*	*80°F*	*85°F*	*90°F*	*95°F*	*100°F*	*105°F*
60°F	-0.242000	-0.207000	-0.174000	-0.142000	-0.111000	-0.081000	-0.053000	-0.026000	0.000000	0.025000	0.037000	0.049000	0.061000	0.073000	0.084000	0.095000	0.106000
62°F	-0.247000	-0.212000	-0.179000	-0.147000	-0.116000	-0.087000	-0.058000	-0.031000	-0.005097	0.020000	0.032000	0.044000	0.056000	0.067000	0.079000	0.090000	0.101000
64°F	-0.252000	-0.217000	-0.184000	-0.152000	-0.121000	-0.092000	-0.063000	-0.036000	-0.010000	0.015000	0.027000	0.039000	0.051000	0.062000	0.074000	0.085000	0.096000
66°F	-0.257000	-0.222000	-0.189000	-0.157000	-0.126000	-0.097000	-0.068000	-0.041000	-0.015000	0.009926	0.022000	0.034000	0.046000	0.057000	0.069000	0.080000	0.091000
68°F	-0.262000	-0.227000	-0.194000	-0.162000	-0.131000	-0.102000	-0.073000	-0.046000	-0.020000	0.004944	0.017000	0.029000	0.041000	0.052000	0.064000	0.075000	0.086000
70°F	-0.267000	-0.232000	-0.199000	-0.167000	-0.136000	-0.107000	-0.078000	-0.051000	-0.025000	0.000000	0.012000	0.024000	0.036000	0.047000	0.059000	0.070000	0.081000
72°F	-0.272000	-0.237000	-0.204000	-0.172000	-0.141000	-0.111000	-0.083000	-0.056000	-0.030000	-0.004907	0.007291	0.019000	0.031000	0.043000	0.054000	0.065000	0.076000
74°F	-0.277000	-0.242000	-0.208000	-0.176000	-0.146000	-0.116000	-0.088000	-0.061000	-0.035000	-0.009777	0.002421	0.014000	0.026000	0.038000	0.049000	0.060000	0.071000
76°F	-0.282000	-0.247000	-0.213000	-0.181000	-0.151000	-0.121000	-0.093000	-0.066000	-0.040000	-0.015000	-0.002412	0.009560	0.021000	0.033000	0.044000	0.055000	0.066000
78°F	-0.286000	-0.251000	-0.218000	-0.186000	-0.155000	-0.126000	-0.098000	-0.071000	-0.045000	-0.019000	-0.007210	0.004762	0.017000	0.028000	0.039000	0.051000	0.061000
80°F	-0.291000	-0.256000	-0.223000	-0.191000	-0.160000	-0.131000	-0.102000	-0.075000	-0.049000	-0.024000	-0.012000	0.000000	0.012000	0.023000	0.035000	0.046000	0.057000
82°F	-0.296000	-0.261000	-0.228000	-0.196000	-0.165000	-0.135000	-0.107000	-0.080000	-0.054000	-0.029000	-0.017000	-0.004727	0.007025	0.019000	0.030000	0.041000	0.052000
84°F	-0.301000	-0.266000	-0.232000	-0.200000	-0.170000	-0.140000	-0.112000	-0.085000	-0.059000	-0.034000	-0.021000	-0.009419	0.002333	0.014000	0.025000	0.036000	0.047000
86°F	-0.305000	-0.270000	-0.237000	-0.205000	-0.174000	-0.145000	-0.117000	-0.089000	-0.063000	-0.038000	-0.026000	-0.014000	-0.002325	0.009214	0.021000	0.032000	0.043000
88°F	-0.310000	-0.275000	-0.242000	-0.210000	-0.179000	-0.149000	-0.121000	-0.094000	-0.068000	-0.043000	-0.031000	-0.019000	-0.006948	0.004590	0.016000	0.027000	0.038000
90°F	-0.314000	-0.280000	-0.246000	-0.214000	-0.183000	-0.154000	-0.126000	-0.099000	-0.073000	-0.047000	-0.035000	-0.023000	-0.012000	0.000000	0.011000	0.022000	0.033000
92°F	-0.319000	-0.284000	-0.251000	-0.219000	-0.188000	-0.159000	-0.130000	-0.103000	-0.077000	-0.052000	-0.040000	-0.028000	-0.016000	-0.004557	0.006774	0.018000	0.029000
94°F	-0.324000	-0.289000	-0.255000	-0.223000	-0.193000	-0.163000	-0.135000	-0.108000	-0.082000	-0.057000	-0.044000	-0.032000	-0.021000	-0.009081	0.002250	0.013000	0.024000
96°F	-0.328000	-0.293000	-0.260000	-0.228000	-0.197000	-0.168000	-0.139000	-0.112000	-0.086000	-0.061000	-0.049000	-0.037000	-0.025000	-0.014000	-0.002242	0.008887	0.020000
98°F	-0.333000	-0.298000	-0.264000	-0.232000	-0.201000	-0.172000	-0.144000	-0.117000	-0.091000	-0.065000	-0.053000	-0.041000	-0.030000	-0.018000	-0.006701	0.004427	0.015000
100°F	-0.337000	-0.302000	-0.269000	-0.237000	-0.206000	-0.176000	-0.148000	-0.121000	-0.095000	-0.070000	-0.058000	-0.046000	-0.034000	-0.022000	-0.011000	0.000000	0.011000
102°F	-0.341000	-0.306000	-0.273000	-0.241000	-0.210000	-0.181000	-0.153000	-0.126000	-0.099000	-0.074000	-0.062000	-0.050000	-0.038000	-0.027000	-0.016000	-0.004396	0.006535

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Roof Wind Direction

East, West

MPH	-20F	-10F	0F	10F	20F	30F	40F	50F	60F	70F	75F	80F	85F	90F	95F	100F	105F
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	-0.00019	-0.00019	-0.00018	-0.00018	-0.00017	-0.00017	-0.00017	-0.00016	-0.00016	-0.00016	-0.00016	-0.00015	-0.00015	-0.00015	-0.00015	-0.00015	-0.00015
2	-0.00076	-0.00074	-0.00073	-0.00071	-0.0007	-0.00068	-0.00067	-0.00066	-0.00064	-0.00063	-0.00063	-0.00062	-0.00061	-0.00061	-0.00060	-0.0006	-0.00059
3	-0.00171	-0.00167	-0.00164	-0.00160	-0.00157	-0.00154	-0.00151	-0.00148	-0.00145	-0.00142	-0.00141	-0.00139	-0.00138	-0.00137	-0.00136	-0.00134	-0.00133
4	-0.00304	-0.00297	-0.00291	-0.00285	-0.00279	-0.00273	-0.00268	-0.00262	-0.00257	-0.00252	-0.00250	-0.00248	-0.00246	-0.00243	-0.00241	-0.00239	-0.00237
5	-0.00475	-0.00465	-0.00455	-0.00445	-0.00436	-0.00427	-0.00418	-0.0041	-0.00402	-0.00395	-0.00391	-0.00387	-0.00384	-0.00380	-0.00377	-0.00373	-0.00370
6	-0.00684	-0.00669	-0.00655	-0.00641	-0.00627	-0.00615	-0.00602	-0.00590	-0.00579	-0.00568	-0.00563	-0.00558	-0.00552	-0.00547	-0.00542	-0.00538	-0.00533
7	-0.00932	-0.00911	-0.00891	-0.00872	-0.00854	-0.00836	-0.0082	-0.00804	-0.00788	-0.00773	-0.00766	-0.00759	-0.00752	-0.00745	-0.00738	-0.00732	-0.00725
8	-0.01217	-0.0119	-0.01164	-0.01139	-0.01115	-0.01093	-0.01071	-0.0105	-0.01029	-0.0101	-0.01001	-0.00991	-0.00982	-0.00973	-0.00964	-0.00956	-0.00947
9	-0.0154	-0.01506	-0.01473	-0.01442	-0.01412	-0.01383	-0.01355	-0.01328	-0.01303	-0.01278	-0.01266	-0.01255	-0.01243	-0.01232	-0.01221	-0.0121	-0.01199
10	-0.01901	-0.01859	-0.01818	-0.0178	-0.01743	-0.01707	-0.01673	-0.0164	-0.01608	-0.01578	-0.01563	-0.01549	-0.01535	-0.01521	-0.01507	-0.01494	-0.01480
11	-0.02300	-0.02249	-0.02200	-0.02153	-0.02109	-0.02065	-0.02024	-0.01984	-0.01946	-0.0191	-0.01892	-0.01874	-0.01857	-0.0184	-0.01823	-0.01807	-0.01791
12	-0.02738	-0.02677	-0.02619	-0.02563	-0.02509	-0.02458	-0.02409	-0.02362	-0.02316	-0.02272	-0.02251	-0.02230	-0.0221	-0.0219	-0.0217	-0.02151	-0.02132
13	-0.03213	-0.03141	-0.03073	-0.03008	-0.02945	-0.02885	-0.02827	-0.02772	-0.02718	-0.02667	-0.02642	-0.02618	-0.02594	-0.0257	-0.02547	-0.02524	-0.02502
14	-0.03726	-0.03643	-0.03564	-0.03488	-0.03415	-0.03346	-0.03279	-0.03214	-0.03153	-0.03093	-0.03064	-0.03036	-0.03008	-0.02981	-0.02954	-0.02927	-0.02901
15	-0.04277	-0.04182	-0.04091	-0.04004	-0.03921	-0.03841	-0.03764	-0.0369	-0.03619	-0.03551	-0.03517	-0.03485	-0.03453	-0.03421	-0.03391	-0.03360	-0.03331
16	-0.04867	-0.04759	-0.04655	-0.04556	-0.04461	-0.0437	-0.04282	-0.04198	-0.04118	-0.0404	-0.04002	-0.03965	-0.03929	-0.03893	-0.03858	-0.03823	-0.03789
17	-0.05494	-0.05372	-0.05255	-0.05143	-0.05036	-0.04933	-0.04834	-0.0474	-0.04648	-0.04561	-0.04518	-0.04476	-0.04435	-0.04395	-0.04355	-0.04316	-0.04278
18	-0.0616	-0.06023	-0.05892	-0.05766	-0.05646	-0.05531	-0.0542	-0.05314	-0.05211	-0.05113	-0.05065	-0.05018	-0.04972	-0.04927	-0.04883	-0.04839	-0.04796
19	-0.06863	-0.06710	-0.06564	-0.06425	-0.06291	-0.06162	-0.06039	-0.05920	-0.05806	-0.05697	-0.05644	-0.05591	-0.0554	-0.0549	-0.0544	-0.05391	-0.05344
20	-0.07604	-0.07435	-0.07274	-0.07119	-0.06970	-0.06828	-0.06691	-0.0656	-0.06434	-0.06312	-0.06253	-0.06195	-0.06138	-0.06083	-0.06028	-0.05974	-0.05921
21	-0.08384	-0.08197	-0.08019	-0.07848	-0.07685	-0.07528	-0.07377	-0.07232	-0.07093	-0.06959	-0.06894	-0.06830	-0.06768	-0.06706	-0.06646	-0.06586	-0.06528
22	-0.09201	-0.08997	-0.08801	-0.08614	-0.08434	-0.08262	-0.08096	-0.07938	-0.07785	-0.07638	-0.07566	-0.07496	-0.07428	-0.0736	-0.07294	-0.07228	-0.07164
23	-0.10057	-0.09833	-0.09619	-0.09414	-0.09218	-0.0903	-0.08849	-0.08676	-0.08509	-0.08348	-0.0827	-0.08193	-0.08118	-0.08044	-0.07972	-0.07901	-0.07831
24	-0.10950	-0.10707	-0.10474	-0.10251	-0.10037	-0.09832	-0.09635	-0.09446	-0.09265	-0.0909	-0.09005	-0.08921	-0.08839	-0.08759	-0.0868	-0.08602	-0.08526
25	-0.11882	-0.11618	-0.11365	-0.11123	-0.10891	-0.10669	-0.10455	-0.1025	-0.10053	-0.09863	-0.09771	-0.09680	-0.09591	-0.09504	-0.09418	-0.09334	-0.09252
26	-0.12851	-0.12566	-0.12292	-0.12031	-0.1178	-0.11539	-0.11308	-0.11086	-0.10873	-0.10668	-0.10568	-0.1047	-0.10374	-0.1028	-0.10187	-0.10096	-0.10007
27	-0.13859	-0.13551	-0.13256	-0.12974	-0.12703	-0.12444	-0.12195	-0.11956	-0.11725	-0.11504	-0.11397	-0.11291	-0.11187	-0.11086	-0.10986	-0.10887	-0.10791

Table D

Leakage Flow Tables

Railroad Door – Leakage Flow Rate (ACFM) 167
Roof Level – Leakage Flow Rate (ACFM) 169

Railroad Door – Leakage Flow Rate (ACFM)

Railroad Door – Leakage Flow Rate (ACFM)

Temp Outside

ΔP	-20	-10	0	10	20	30	40	50	60	70	75	80	85	90	95	100	105
0.1	359.23	367.40	375.57	383.74	391.91	400.08	408.25	416.43	424.60	432.77	436.85	440.94	445.02	449.11	453.19	457.28	461.36
0.15	449.40	459.62	469.84	480.06	490.28	500.50	510.72	520.94	531.17	541.39	546.50	551.61	556.72	561.83	566.94	572.05	577.16
0.2	528.10	540.11	552.12	564.13	576.14	588.15	600.16	612.18	624.19	636.20	642.20	648.21	654.21	660.22	666.23	672.23	678.24
0.25	599.47	613.11	626.74	640.38	654.01	667.64	681.28	694.91	708.55	722.18	729.00	735.82	742.63	749.45	756.27	763.09	769.90
0.3	665.64	680.78	695.92	711.06	726.20	741.34	756.48	771.62	786.76	801.90	809.47	817.04	824.61	832.18	839.75	847.32	854.89
0.35	727.87	744.42	760.98	777.53	794.09	810.64	827.20	843.75	860.31	876.86	885.14	893.42	901.70	909.97	918.25	926.53	934.81
0.4	786.97	804.87	822.77	840.67	858.57	876.47	894.37	912.27	930.17	948.07	957.02	965.97	974.92	983.87	992.82	1000.00	1010.00
0.45	843.53	862.71	881.90	901.09	920.27	939.46	958.64	977.83	997.01	1020.00	1030.00	1040.00	1040.00	1050.00	1060.00	1070.00	1080.00
0.5	897.95	918.37	938.79	959.22	979.64	1000.00	1020.00	1040.00	1060.00	1080.00	1090.00	1100.00	1110.00	1120.00	1130.00	1140.00	1150.00
0.55	950.54	972.16	993.78	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1150.00	1160.00	1170.00	1180.00	1190.00	1200.00	1210.00	1220.00
0.6	1000.00	1020.00	1050.00	1070.00	1090.00	1120.00	1140.00	1160.00	1180.00	1210.00	1220.00	1230.00	1240.00	1250.00	1260.00	1270.00	1290.00
0.65	1050.00	1080.00	1100.00	1120.00	1150.00	1170.00	1190.00	1220.00	1240.00	1270.00	1280.00	1290.00	1300.00	1310.00	1330.00	1340.00	1350.00
0.7	1100.00	1120.00	1150.00	1170.00	1200.00	1220.00	1250.00	1270.00	1300.00	1320.00	1340.00	1350.00	1360.00	1370.00	1390.00	1400.00	1410.00
0.75	1150.00	1170.00	1200.00	1230.00	1250.00	1280.00	1300.00	1330.00	1360.00	1380.00	1390.00	1410.00	1420.00	1430.00	1450.00	1460.00	1470.00
0.8	1190.00	1220.00	1250.00	1270.00	1300.00	1330.00	1360.00	1380.00	1410.00	1440.00	1450.00	1460.00	1480.00	1490.00	1510.00	1520.00	1530.00
0.85	1240.00	1270.00	1290.00	1320.00	1350.00	1380.00	1410.00	1440.00	1460.00	1490.00	1510.00	1520.00	1530.00	1550.00	1560.00	1580.00	1590.00
0.9	1280.00	1310.00	1340.00	1370.00	1400.00	1430.00	1460.00	1490.00	1520.00	1550.00	1560.00	1580.00	1590.00	1600.00	1620.00	1630.00	1650.00
0.95	1330.00	1360.00	1390.00	1420.00	1450.00	1480.00	1510.00	1540.00	1570.00	1600.00	1610.00	1630.00	1640.00	1660.00	1670.00	1690.00	1700.00
1	1370.00	1400.00	1430.00	1460.00	1490.00	1530.00	1560.00	1590.00	1620.00	1650.00	1670.00	1680.00	1700.00	1710.00	1730.00	1740.00	1760.00
1.05	1410.00	1440.00	1480.00	1510.00	1540.00	1570.00	1610.00	1640.00	1670.00	1700.00	1720.00	1730.00	1750.00	1770.00	1780.00	1800.00	1810.00
1.1	1450.00	1490.00	1520.00	1550.00	1590.00	1620.00	1650.00	1690.00	1720.00	1750.00	1770.00	1790.00	1800.00	1820.00	1840.00	1850.00	1870.00
1.15	1500.00	1530.00	1560.00	1600.00	1630.00	1670.00	1700.00	1730.00	1770.00	1800.00	1820.00	1840.00	1850.00	1870.00	1890.00	1900.00	1920.00
1.2	1540.00	1570.00	1610.00	1640.00	1680.00	1710.00	1750.00	1780.00	1820.00	1850.00	1870.00	1890.00	1900.00	1920.00	1940.00	1960.00	1970.00
1.25	1580.00	1610.00	1650.00	1680.00	1720.00	1760.00	1790.00	1830.00	1860.00	1900.00	1920.00	1940.00	1950.00	1970.00	1990.00	2010.00	2030.00
1.3	1620.00	1650.00	1690.00	1730.00	1760.00	1800.00	1840.00	1870.00	1910.00	1950.00	1970.00	1980.00	2000.00	2020.00	2040.00	2060.00	2080.00
1.35	1660.00	1690.00	1730.00	1770.00	1810.00	1840.00	1880.00	1920.00	1960.00	2000.00	2010.00	2030.00	2050.00	2070.00	2090.00	2110.00	2130.00
1.4	1700.00	1730.00	1770.00	1810.00	1850.00	1890.00	1930.00	1970.00	2000.00	2040.00	2060.00	2080.00	2100.00	2120.00	2140.00	2160.00	2180.00
1.45	1730.00	1770.00	1810.00	1850.00	1890.00	1930.00	1970.00	2010.00	2050.00	2090.00	2110.00	2130.00	2150.00	2170.00	2190.00	2210.00	2230.00
1.5	1770.00	1810.00	1850.00	1890.00	1930.00	1970.00	2010.00	2050.00	2090.00	2140.00	2160.00	2180.00	2200.00	2220.00	2240.00	2260.00	2280.00
1.55	1810.00	1850.00	1890.00	1930.00	1980.00	2020.00	2060.00	2100.00	2140.00	2180.00	2200.00	2220.00	2240.00	2260.00	2280.00	2300.00	2330.00
1.6	1850.00	1890.00	1930.00	1970.00	2020.00	2060.00	2100.00	2140.00	2180.00	2230.00	2250.00	2270.00	2290.00	2310.00	2330.00	2350.00	2370.00
1.65	1890.00	1930.00	1970.00	2010.00	2060.00	2100.00	2140.00	2190.00	2230.00	2270.00	2290.00	2310.00	2340.00	2360.00	2380.00	2400.00	2420.00
1.7	1920.00	1970.00	2010.00	2050.00	2100.00	2140.00	2180.00	2230.00	2270.00	2320.00	2340.00	2360.00	2380.00	2400.00	2430.00	2450.00	2470.00

Table E

SGTS FLOW CORRECTION FACTORS FOR ACFM

SGTS FLOW CORRECTION FACTORS FOR ACFM					
ANNUBAR TEMPERATURE (°F)	CORRECTION FACTOR	ANNUBAR TEMPERATURE (°F)	CORRECTION FACTOR	ANNUBAR TEMPERATURE (°F)	CORRECTION FACTOR
50	1.0904	105	1.1617	160	1.2807
55	1.0962	110	1.1696	165	1.2973
60	1.1022	115	1.1778	170	1.3156
65	1.1082	120	1.1864	175	1.3356
70	1.1143	125	1.1956	180	1.3579
75	1.1205	130	1.2053	185	1.3826
80	1.1268	135	1.2157	190	1.4103
85	1.1334	140	1.2268	195	1.4415
90	1.1401	145	1.2387	200	1.4768
95	1.147	150	1.2516		
100	1.1542	155	1.2656		

Table F
EQUIVALENT ORIFICE SIZE TABLE

Flow (cfm)	Orifice Diameter (in)	Orifice Area (in^2)	Flow (cfm)	Orifice Diameter (in)	Orifice Area (in^2)
100	2.95	6.84	950	9.09	64.94
125	3.30	8.54	975	9.21	66.65
150	3.61	10.25	1000	9.33	68.36
175	3.90	11.96	1025	9.45	70.07
200	4.17	13.67	1050	9.56	71.78
225	4.43	15.38	1075	9.67	73.49
250	4.66	17.09	1100	9.78	75.19
275	4.89	18.80	1125	9.90	76.90
300	5.11	20.51	1150	10.00	78.61
325	5.32	22.22	1175	10.11	80.32
350	5.52	23.93	1200	10.22	82.03
375	5.71	25.63	1225	10.33	83.74
400	5.90	27.34	1250	10.43	85.45
425	6.08	29.05	1275	10.53	87.16
450	6.26	30.76	1300	10.64	88.87
475	6.43	32.47	1325	10.74	90.58
500	6.60	34.18	1350	10.84	92.28
525	6.76	35.89	1375	10.94	93.99
550	6.92	37.60	1400	11.04	95.70
575	7.07	39.31	1425	11.14	97.41
600	7.23	41.02	1450	11.23	99.12
625	7.38	42.72	1475	11.33	100.83
650	7.52	44.43	1500	11.43	102.54
675	7.66	46.14	1525	11.52	104.25
700	7.81	47.85	1550	11.61	105.96
725	7.94	49.56	1575	11.71	107.66
750	8.08	51.27	1600	11.80	109.37
775	8.21	52.98	1625	11.89	111.08
800	8.34	54.69	1650	11.98	112.79
825	8.47	56.40	1675	12.07	114.50
850	8.60	58.10	1700	12.16	116.21
875	8.73	59.81	1725	12.25	117.92
900	8.85	61.52	1750	12.34	119.63
925	8.97	63.23	1775	12.43	121.34

Appendix 4

SGTS FLOW RECORDER CORRECTION FACTOR

Annubar Correction Factors

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

MANUAL CALCULATION

PAGE 5.009 CONT'D ON PAGE 5.010

CALCULATION NO. NE-02-92-06

PREPARED BY/DATE W. D. Bainard 2/25/92

VERIFIED BY/DATE [signature] 3-5-92

REVISION NO. 0

REV. BAR

SGT FLOW RECORDER CORRECTION FACTORS TO ACFM

For Pressure = 13.84 psia, low barometric pressure at the flow element

Multiply recorder reading by the appropriate M-value to get ACFM

M-value depends on temperature and relative humidity

WD Bainard 2/25/92

T, Deg. F	Relative Humidity M=100	M=90	M=80	M=70	M=60	M=50	M=40	M=30	M=20	M=10	M=0
50	1.0904	1.0902	1.0899	1.0897	1.0894	1.0892	1.0889	1.0887	1.0884	1.0881	1.0879
55	1.0962	1.0959	1.0956	1.0953	1.0950	1.0947	1.0944	1.0941	1.0938	1.0935	1.0932
60	1.1022	1.1018	1.1014	1.1011	1.1007	1.1003	1.1000	1.0996	1.0992	1.0989	1.0985
65	1.1082	1.1077	1.1073	1.1069	1.1064	1.1060	1.1055	1.1051	1.1047	1.1042	1.1038
70	1.1143	1.1137	1.1132	1.1127	1.1122	1.1117	1.1111	1.1106	1.1101	1.1096	1.1090
75	1.1205	1.1199	1.1193	1.1186	1.1180	1.1174	1.1168	1.1161	1.1155	1.1149	1.1142
80	1.1268	1.1261	1.1254	1.1247	1.1239	1.1232	1.1224	1.1217	1.1209	1.1202	1.1194
85	1.1334	1.1325	1.1317	1.1308	1.1299	1.1291	1.1282	1.1273	1.1264	1.1255	1.1246
90	1.1401	1.1391	1.1381	1.1371	1.1360	1.1350	1.1340	1.1329	1.1319	1.1308	1.1298
95	1.1470	1.1459	1.1447	1.1435	1.1423	1.1411	1.1399	1.1386	1.1374	1.1361	1.1349
100	1.1542	1.1529	1.1515	1.1501	1.1487	1.1473	1.1458	1.1444	1.1429	1.1415	1.1400
105	1.1617	1.1601	1.1585	1.1569	1.1553	1.1536	1.1520	1.1503	1.1485	1.1468	1.1451
110	1.1696	1.1677	1.1659	1.1640	1.1621	1.1602	1.1582	1.1562	1.1542	1.1522	1.1501
115	1.1778	1.1757	1.1735	1.1714	1.1691	1.1669	1.1646	1.1623	1.1600	1.1576	1.1551
120	1.1864	1.1840	1.1816	1.1790	1.1765	1.1739	1.1712	1.1685	1.1658	1.1630	1.1602
125	1.1956	1.1928	1.1900	1.1871	1.1842	1.1812	1.1781	1.1750	1.1718	1.1685	1.1651
130	1.2053	1.2022	1.1989	1.1956	1.1922	1.1888	1.1852	1.1816	1.1779	1.1740	1.1701
135	1.2157	1.2121	1.2084	1.2047	1.2008	1.1968	1.1927	1.1885	1.1841	1.1797	1.1751
140	1.2268	1.2227	1.2186	1.2143	1.2099	1.2053	1.2006	1.1957	1.1906	1.1854	1.1800
145	1.2387	1.2342	1.2295	1.2246	1.2196	1.2143	1.2089	1.2032	1.1974	1.1913	1.1849
150	1.2516	1.2465	1.2413	1.2358	1.2300	1.2240	1.2178	1.2113	1.2044	1.1973	1.1898
155	1.2656	1.2599	1.2540	1.2479	1.2414	1.2346	1.2274	1.2199	1.2119	1.2035	1.1946
160	1.2807	1.2745	1.2680	1.2611	1.2538	1.2461	1.2379	1.2292	1.2199	1.2100	1.1995
165	1.2973	1.2905	1.2833	1.2757	1.2675	1.2587	1.2494	1.2394	1.2286	1.2169	1.2043
170	1.3156	1.3082	1.3003	1.2918	1.2827	1.2729	1.2623	1.2507	1.2381	1.2243	1.2091
175	1.3356	1.3277	1.3192	1.3100	1.2999	1.2889	1.2768	1.2635	1.2488	1.2323	1.2139
180	1.3579	1.3496	1.3405	1.3305	1.3195	1.3073	1.2936	1.2784	1.2611	1.2414	1.2187
185	1.3826	1.3740	1.3645	1.3540	1.3421	1.3287	1.3135	1.2960	1.2757	1.2519	1.2234
190	1.4103	1.4017	1.3921	1.3811	1.3687	1.3543	1.3375	1.3176	1.2938	1.2647	1.2282
195	1.4415	1.4333	1.4239	1.4131	1.4005	1.3855	1.3674	1.3453	1.3175	1.2815	1.2329
200	1.4768	1.4696	1.4612	1.4513	1.4394	1.4248	1.4065	1.3828	1.3510	1.3061	1.2376

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