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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term

References:

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendments Related to Application of Alternative Source Term," dated October 10, 2002
2. Letter from L. W. Rossbach (U. S. NRC) to C. M. Crane (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 – Request for Additional Information (RAI) Regarding Alternative Source Term Amendment Request (TAC Nos. MB6530, MB6531, MB6532, and MB6533)," dated June 15, 2004
3. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term," dated August 4, 2003
4. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term," dated October 31, 2003

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to the facility operating licenses for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The proposed changes support application of an alternative source term (AST) methodology.

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In Reference 2, the NRC documented details regarding a telephone call between EGC and the NRC on May 26, 2004. Specifically, during the telephone call, EGC confirmed that there were errors in the meteorological data files previously submitted to the NRC, and stated our intent to correct the errors and recalculate the atmospheric dispersion factors (X/Q).

The X/Q values have been recalculated. Attachment 1 to this letter provides details regarding the corrections and revisions to the modeling analyses previously submitted in Reference 1. Attachments 2 and 3 provide a summary of the X/Q values for DNPS and QCNPS, respectively.

In References 3 and 4, EGC submitted responses to NRC requests for additional information regarding meteorological data and X/Q calculation assumptions. Since new X/Q calculations have been completed, some of the information previously submitted in References 3 and 4 is no longer accurate. Therefore, EGC is submitting revised responses that supersede References 3 and 4 in their entirety. The revised responses are provided in Attachments 4 and 5. In addition, a CD-ROM containing electronic files referenced in Attachments 4 and 5 is enclosed.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously provided to the NRC in Attachment C of Reference 1. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration.

If you have any questions concerning this letter, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 5th day of November 2004.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachments:
1. Response to Request for Additional Information
2. Summary of X/Q Values for Dresden Nuclear Power Station
3. Summary of X/Q Values for Quad Cities Nuclear Power Station
4. Revised Response to Request for Additional Information Dated August 4, 2003
5. Revised Response to Request for Additional Information Dated October 31, 2003

Enclosure:
CD-ROM Containing Input Files and Meteorological Data

cc (without enclosure):
Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Dresden Nuclear Power Station
NRC Senior Resident Inspector - Quad Cities Nuclear Power Station
Illinois Emergency Management Agency - Division of Nuclear Safety

ATTACHMENT 1
Response to Request for Additional Information

Background

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to the facility operating licenses for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The proposed changes support application of an alternative source term (AST) methodology. During a telephone call between EGC and the NRC on May 26, 2004, EGC confirmed that there were errors in the meteorological data files previously submitted to the NRC.

The errors in the meteorological data files have been corrected, and the atmospheric dispersion factors (X/Q) have been recalculated. A description of the changes from the original AST X/Q modeling to the revised X/Q modeling is provided below.

Description of Changes

The following modifications to the original AST X/Q modeling have been made.

Correction of Meteorological File Formatting Error

The primary difference between the original and revised AST X/Q modeling input data is the meteorological database. Due to a formatting error in the original meteorological data files, erroneous data was used for calculating the original X/Q values. Specifically, wind direction data from the 150 ft level was erroneously used to model the 35 ft level wind direction. Additionally, wind speed data from the 150 ft level was erroneously used to model the 300 ft level wind speed. As a result, the ARCON96 meteorological input files used for the DNPS and QCNPS X/Q calculations reflected these errors. The formatting errors described above were corrected for the revised AST X/Q modeling, and new ARCON96 meteorological input files were created.

Revised Delta-T Temperature Data Levels

For each of the original modeling release scenarios, atmospheric stability class input was based on the temperature difference (i.e., delta-T) between the lower and upper tower level measurement heights. In accordance with Regulatory Guide 1.194 (i.e., Reference 2), which states that atmospheric stability should be determined by the vertical temperature difference measured over the difference in height appropriate for the projected release height, the most appropriate delta-T was utilized for each of the revised modeling scenarios (i.e., lower and mid-level delta-T for all scenarios except for the DNPS and QCNPS station chimneys, which use the lower and upper level delta-T). Releases from the station chimneys are elevated releases.

Re-analysis Using Only ARCON96 and PAVAN

Following correction of the meteorological database as described above, release scenarios for DNPS and QCNPS were rerun using the ARCON96 and PAVAN models. The models previously utilized for the release scenarios are listed in Attachments 2 and 3 for DNPS and QCNPS, respectively.

Revised Station Chimney to Control Room X/Q Modeling

The original modeling of station chimney to control room X/Q was performed using the Stone & Webster computer program EN-113, "SWEC Computer Code for Calculation of Short-Term and Annual Average X/Q Values." The revised station chimney to control room X/Q modeling was performed using the NRC-recommended PAVAN model.

In the EN-113 model scenarios for the chimney release, a fumigation X/Q value was calculated and incorporated as an integral part of the required methodology. For the revised chimney release and control room intake scenario using the PAVAN model, no fumigation X/Q calculation is employed in accordance with Regulatory Guide 1.194, Section 3.2.2.

Additional Refinements

In conjunction with the present re-analysis, additional refinements to the model input parameters were also incorporated as described below. These additional refinements had a relatively small effect on the resulting X/Q values when compared to the changes discussed above.

Building Area

The building area values input to the original ARCON96 runs were modified to represent the projected vertical cross-sectional area perpendicular to the wind direction (i.e., the release to intake direction), as specified in Regulatory Guide 1.194, Table A-2. Building area values input to PAVAN represent the minimum area as required by Regulatory Guide 1.145 (i.e., Reference 3). The specific changes to building area for DNPS and QCNPS are shown in the summary tables provided in Attachments 2 and 3, respectively.

Surface Roughness Length

In accordance with Regulatory Guide 1.194, Table A-2, a constant value of 0.2 meters for surface roughness length was input to ARCON96 in lieu of the default value of 0.1 meters.

Averaging Sector Width Constant

In accordance with Regulatory Guide 1.194, Table A-2, a constant value of 4.3 for the averaging sector width constant was input to ARCON96 in lieu of the default value of 4.0.

Minimum Wind Speed

In accordance with Regulatory Guide 1.194, Table A-2, the default value of 0.5 meters per second for minimum wind speed was input to ARCON96 in lieu of the actual wind instrumentation starting speed value.

Release Point/Control Room Intake Locations

Certain ARCON96 input parameter values that relate the location of the release points to the control room intake were found to need slight refinement based on examination of plant

drawings. The specific changes for DNPS and QCNPS are shown in the summary tables provided in Attachments 2 and 3, respectively.

Results

Attachments 2 and 3 provide the X/Q summaries for DNPS and QCNPS, respectively. Each summary table presents the X/Q values that were originally contained in Reference 1, as well as the corresponding revised results obtained in the re-analysis with the corrected input data. The X/Q summary tables identify the impact of the X/Q data correction and assumption changes.

The worst-case X/Qs for both the original and revised analyses are highlighted to allow an assessment of the impacts on existing dose consequence analyses performed to support the AST amendment request (i.e., Reference 1). Based on the comparison of the worst-case X/Qs, the calculated dose consequences would be reduced for the limiting event, release path, and receptor combination (i.e., loss-of-coolant accident with release from main steam isolation valve leakage to the control room). However, certain non-limiting calculated dose consequences could increase slightly. Additionally, a review of a ground level and elevated release was performed, and the results indicate that control room, exclusion area boundary, and low population zone doses are generally decreased.

A sampling of post-accident dose consequences has been re-evaluated considering the change in X/Q values. Based on this re-evaluation, the post-accident dose consequences presented in Reference 1 for the control room, exclusion area boundary, and low population zone bound the dose consequences resulting from the revised X/Q calculations.

References

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendments Related to Application of Alternative Source Term," dated October 10, 2002

2. NRC Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," dated June 2003

3. NRC Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, dated November 1982

ATTACHMENT 2
Summary of X/Q Values for Dresden Nuclear Power Station

	Model Utilized	Release Point	Intake/ Receptor	Used for DBA	Horizontal Distance (m)	Direction from Intake to Source (°)	Release Height (m above grade[11])	Intake Height (m above grade[11])	Building Area (m²)	X/Q (sec/m³) 0-0.5 hr (Fumigation)	0-2 hrs[9]	2-8 hrs	8-24 hrs	1-4 days	4-30 days	Notes
Original X/Q Calculated with Erroneous Data	ARCON96	Unit 2 MSIV	Control Room	LOCA, CRDA	67.1	270	0	12.7	Reactor Building 1544.7	N/A	1.24E-03	**1.08E-03**	**5.29E-04**	**3.43E-04**	**2.72E-04**	
	ARCON96	Unit 3 MSIV	Control Room	LOCA, CRDA	118.9	270	0	12.7	Reactor Building 1544.7	N/A	4.32E-04	**3.85E-04**	**1.85E-04**	**1.22E-04**	**9.64E-05**	
	EN-113/Hand Calculation	Station Chimney	Control Room	LOCA, CRDA	80.8	48	94.6	12.7	N/A	4.17E-04	1.41E-08	**5.57E-09**	**3.50E-09**	1.28E-09	3.01E-10	
	ARCON96	Reactor Building Exhaust Stack	Control Room	FHA	92	269	48.6	12.7	Reactor Building 1544.7	N/A	**6.62E-04**	**5.31E-04**	**2.47E-04**	**1.64E-04**	**1.23E-04**	
	EN-113	Unit 2 and 3 MSIV	EAB	LOCA, CRDA	800	N/A	UA	N/A	Reactor Building 1544.7	N/A	2.02E-04	**1.35E-04**	**1.11E-04**	**7.16E-05**	**3.83E-05**	
	EN-113/Hand Calculation	Station Chimney	EAB	LOCA, CRDA	800	N/A	94.6	N/A	N/A	6.98E-05	3.59E-06	**2.15E-06**	**1.67E-06**	**9.57E-07**	**4.32E-07**	
	PAVAN	Reactor Building Exhaust Stack	EAB	FHA	800	N/A	10	N/A	Reactor Building 1545	N/A	1.85E-04 (NE)	9.41E-05 (NE)	6.70E-05 (NE)	3.21E-05 (NE)	1.15E-05	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	EN-113	Unit 2 and 3 MSIV	LPZ	LOCA, CRDA	8000	N/A	UA	N/A	Reactor Building 1544.7	N/A	2.10E-05	9.08E-06	5.98E-06	2.41E-06	6.56E-07	
	EN-113/Hand Calculation	Station Chimney	LPZ	LOCA, CRDA	8000	N/A	94.6	N/A	N/A	8.72E-06	**2.48E-06**	**1.17E-06**	**8.08E-07**	**3.58E-07**	**1.12E-07**	
	PAVAN	Reactor Building Exhaust Stack	LPZ	FHA	8000	N/A	10	N/A	Reactor Building 1545	N/A	1.88E-05	8.10E-06	5.31E-06	2.13E-06	5.71E-07	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
Revised X/Q Calculated with Corrected Data	ARCON96	Unit 2 MSIV	Control Room	LOCA, CRDA	67.1	268	0	11.3	Reactor Building 1680	N/A	**1.30E-03**	1.06E-03	4.49E-04	2.96E-04	2.44E-04	· Intake height was revised to 11.3 m and direction from intake source was revised to 268°. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	ARCON96	Unit 3 MSIV	Control Room	LOCA, CRDA	118.9	269	0	11.3	Reactor Building 1613	N/A	**4.48E-04**	3.74E-04	1.57E-04	1.04E-04	8.42E-05	· Intake height was revised to 11.3 m and direction from intake source was revised to 269°. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	ARCON96 and PAVAN	Station Chimney	Control Room	LOCA, CRDA	80.8	48	94.6 (ARCON96); 83.3 (PAVAN)	11.3	Turbine Building 6457.1 (ARCON96); Reactor Building 1545 (PAVAN)	N/A	**6.42E-06**	1.00E-18	4.19E-16	**3.41E-08**	**1.00E-08**	· Intake height was revised to 11.3 m. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2. · ARCON96 and PAVAN were used together to determine X/Q values according to RG 1.194, Section 3.2.2.
	ARCON96	Reactor Building Exhaust Stack	Control Room	FHA	95.5	273	48.6	11.3	Reactor Building 1745.8	N/A	6.44E-04	4.91E-04	2.02E-04	1.36E-04	1.05E-04	· Intake height was revised to 11.3 m, horizontal distance was revised to 95.5 m, and direction from intake source was revised to 273°. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	PAVAN	Unit 2 and 3 MSIV	EAB	LOCA, CRDA	800	N/A	10	N/A	Reactor Building 1545	N/A	**2.51E-04 (NE)**	1.21E-04 (NE)	8.43E-05 (NE)	3.83E-05 (NE)	1.29E-05 (SE)	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Station Chimney	EAB	LOCA, CRDA	800	N/A	94.6	N/A	Reactor Building 1545	**7.07E-05 (NNW)**	**4.01E-06**	1.84E-06	1.24E-06	5.32E-07	1.57E-07	· The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Reactor Building Exhaust Stack	EAB	FHA	800	N/A	10	N/A	Reactor Building 1545	N/A	**2.51E-04 (NE)**	**1.21E-04 (NE)**	**8.43E-05 (NE)**	**3.83E-05 (NE)**	**1.29E-05 (SE)**	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Unit 2 and 3 MSIV	LPZ	LOCA, CRDA	8000	N/A	10	N/A	Reactor Building 1545	N/A	**2.63E-05 (SE)**	**1.09E-05 (SE)**	**7.02E-06 (SE)**	**2.70E-06 (SE)**	**6.86E-07 (SE)**	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Station Chimney	LPZ	LOCA, CRDA	8000	N/A	94.6	N/A	Reactor Building 1545	**8.84E-06 (NNW)**	1.78E-06	8.50E-07	5.87E-07	2.63E-07	8.31E-08	· The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Reactor Building Exhaust Stack	LPZ	FHA	8000	N/A	10	N/A	Reactor Building 1545	N/A	**2.63E-05 (SE)**	**1.09E-05 (SE)**	**7.02E-06 (SE)**	**2.70E-06 (SE)**	**6.86E-07 (SE)**	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.

Notes:
1. N/A = not applicable
2. UA = unavailable
3. MSIV = main steam isolation valve
4. EAB = exclusion area boundary
5. LPZ = low population zone
6. LOCA = loss-of-coolant accident
7. CRDA = control rod drop accident
8. FHA = fuel handling accident
9. The PAVAN X/Q values are for 0-8 hours.
10. Shading and bolding indicates the higher of the X/Q values that were calculated with the erroneous meteorological data compared to those calculated with the corrected meteorological data.
11. Plant grade elevation = 517.0 ft

ATTACHMENT 3
Summary of X/Q Values for Quad Cities Nuclear Power Station

	Model Utilized	Release Point	Intake/ Receptor	Used for DBA	Horizontal Distance (m)	Direction from Intake to Source (°)	Release Height (m above grade[11])	Intake Height (m above grade[11])	Building Area (m²)	X/Q (sec/m³)[1] 0-0.5 hr (Fumigation)	0-2 hrs[9]	2-8 hrs	8-24 hrs	1-4 days	4-30 days	Notes
Original X/Q Calculated with Erroneous Data	ARCON96	Unit 1 MSIV	Control Room	LOCA, CRDA	68.6	30	0	8.8	Reactor Building 1563.8	N/A	**1.13E-03**	**9.45E-04**	**4.54E-04**	**2.68E-04**	**1.67E-04**	
	ARCON96	Unit 2 MSIV	Control Room	LOCA, CRDA	115.8	17	0	8.8	Reactor Building 1563.8	N/A	**4.25E-04**	**3.49E-04**	**1.60E-04**	**9.66E-05**	**5.89E-05**	
	EN-113/Hand Calculation	Station Chimney	Control Room	LOCA, CRDA	123.5	344	94.6	8.8	N/A	4.16E-04	2.35E-09	**1.15E-09**	**8.02E-10**	3.69E-10	1.21E-10	
	ARCON96	Reactor Building Exhaust Stack	Control Room	FHA	94.5	18	48.6	8.8	Reactor Building 3015	N/A	5.58E-04	**4.50E-04**	**2.04E-04**	**1.21E-04**	**7.91E-05**	
	EN-113	Unit 1 and 2 MSIV	EAB	LOCA, CRDA	380	N/A	UA	N/A	Reactor Building 1563.8	N/A	1.25E-03	**8.46E-04**	**6.97E-04**	**4.57E-04**	**2.49E-04**	
	EN-113/Hand Calculation	Station Chimney	EAB	LOCA, CRDA	380	N/A	94.6	N/A	N/A	1.37E-04	3.21E-06	2.02E-06	**1.60E-06**	**9.63E-07**	**4.66E-07**	
	PAVAN	Reactor Building Exhaust Stack	EAB	FHA	380	N/A	10	N/A	Reactor Building 3015	N/A	7.87E-04 (NNE)	4.14E-04 (NNE)	3.00E-04 (NNE)	1.49E-04 (NNE)	5.49E-05 (NNE)	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	EN-113	Unit 1 and 2 MSIV	LPZ	LOCA, CRDA	4828	N/A	UA	N/A	Reactor Building 1563.8	N/A	6.68E-05	3.07E-05	2.08E-05	8.95E-06	**2.67E-06**	
	EN-113/Hand Calculation	Station Chimney	LPZ	LOCA, CRDA	4828	N/A	94.6	N/A	N/A	1.38E-05	**3.09E-06**	**1.52E-06**	**1.07E-06**	**4.95E-07**	**1.64E-07**	
	PAVAN	Reactor Building Exhaust Stack	LPZ	FHA	4828	N/A	10	N/A	Reactor Building 3015	N/A	4.69E-05 (NNE)	2.09E-05 (NNE)	1.39E-05 (NNE)	5.77E-06 (NE)	1.63E-06 (NNE)	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
Revised X/Q Calculated with Corrected Data	ARCON96	Unit 1 MSIV	Control Room	LOCA, CRDA	72.9	31	0	8.8	Reactor Building 3355.0	N/A	1.02E-03	8.23E-04	3.55E-04	2.32E-04	1.38E-04	· Horizontal distance was revised to 72.9 m and direction from intake source was revised to 31°. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	ARCON96	Unit 2 MSIV	Control Room	LOCA, CRDA	121.5	17	0	8.8	Reactor Building 2639.0	N/A	3.88E-04	3.00E-04	1.24E-04	7.99E-05	4.87E-05	· Horizontal distance was revised to 121.5 m. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	ARCON96 and PAVAN	Station Chimney	Control Room	LOCA, CRDA	127.1	344	94.6 (ARCON96); 85.8 (PAVAN)	8.8	Turbine Building 3000.4 (ARCON96); Reactor Building 1564 (PAVAN)	N/A	**5.84E-06**	1.00E-13	6.46E-11	**3.34E-08**	**1.05E-08**	· Horizontal distance was revised to 127.1 m. · Building area perpendicular to wind direction was used per RG 1.194, Table A-2. · ARCON96 and PAVAN were used together to determine X/Q values according to RG 1.194, Section 3.2.2.
	ARCON96	Reactor Building Exhaust Stack	Control Room	FHA	94.5	18	48.6	8.8	Reactor Building 2696.3	N/A	**5.82E-04**	4.43E-04	1.87E-04	1.10E-04	7.71E-05	· Building area perpendicular to wind direction was used per RG 1.194, Table A-2.
	PAVAN	Unit 1 and 2 MSIV	EAB	LOCA, CRDA	380	N/A	10	N/A	Reactor Building 1564	N/A	**1.36E-03 (W)**	6.68E-04 (W)	4.69E-04 (W)	2.18E-04 (W)	7.22E-05 (W)	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Station Chimney	EAB	LOCA, CRDA	380	N/A	94.6	N/A	Reactor Building 1564	**1.43E-04 (NNW)**	**4.73E-06**	**2.17E-06**	1.47E-06	6.33E-07	1.88E-07	· The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Reactor Building Exhaust Stack	EAB	FHA	380	N/A	10	N/A	Reactor Building 1564	N/A	**1.36E-03 (W)**	**6.68E-04 (W)**	**4.69E-04 (W)**	**2.18E-04 (W)**	**7.22E-05 (W)**	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Unit 1 and 2 MSIV	LPZ	LOCA, CRDA	4828	N/A	10	N/A	Reactor Building 1564	N/A	**1.04E-04 (W)**	**4.14E-05 (W)**	**2.62E-05 (W)**	**9.96E-06 (WNW)**	2.52E-06 (WNW)	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Station Chimney	LPZ	LOCA, CRDA	4828	N/A	94.6	N/A	Reactor Building 1564	**1.44E-05 (NNW)**	2.72E-06	1.32E-06	9.25E-07	4.24E-07	1.38E-07	· The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.
	PAVAN	Reactor Building Exhaust Stack	LPZ	FHA	4828	N/A	10	N/A	Reactor Building 1564	N/A	**1.04E-04 (W)**	**4.14E-05 (W)**	**2.62E-05 (W)**	**9.96E-06 (WNW)**	**2.52E-06 (WNW)**	· PAVAN requires a ground-level release height of 10 m. · The higher of the max sector X/Q (wind direction sector specified) and site limit X/Q (wind direction independent) value was selected.

Notes:
1. N/A = not applicable
2. UA = unavailable
3. MSIV = main steam isolation valve
4. EAB = exclusion area boundary
5. LPZ = low population zone
6. LOCA = loss-of-coolant accident
7. CRDA = control rod drop accident
8. FHA = fuel handling accident
9. The PAVAN X/Q values are for 0-8 hours.
10. Shading and bolding indicates the higher of the X/Q values that were calculated with the erroneous meteorological data compared to those calculated with the corrected meteorological data.
11. Plant grade elevation = 594.5 ft

NRC Request 1 – Meteorological Measurement Program

Confirm that, overall, the 1995 through 1999 meteorological data used in the assessment are of high quality, representative of long term conditions, and suitable for use in the assessment of atmospheric dispersion to which they were applied. The intent of these questions is to assess the overall quality of the meteorological data as collected and as processed for use in the atmospheric dispersion calculations.

During the period of data collection did the measurement program meet the guidelines of Regulatory Guide 1.23, "Onsite Meteorological Programs?" Was the tower base area on the natural surface (e.g., short natural vegetation) and tower free from obstructions (e.g., trees, structures) and micro-scale influences to ensure that the data were representative of the overall site area? In the case of possible obstructions, were trees, structures, etc., at least 10 times their height away from the meteorological tower? Were calibrations properly performed and systems found to be within guideline specifications? What types of quality assurance audits were performed on the meteorological measurement systems to ensure that data were of high quality, to identify any problems and questionable data, and correct problems in a timely manner? What additional checks and at what frequency were the checks performed on data following collection and prior to archival? If deviations occurred, describe the deviations and why the data are still deemed to be adequate. A detailed response for each individual data point is not expected. Were the data compared with other site historical or regional data? If so, what were the findings?

What additional reviews of the data were performed prior to its input into the atmospheric dispersion calculations? What checks were made between the reformatted data (e.g., data in PAVAN or ARCON96 formats) and the raw data to ensure that reformatting, conversions, etc., were properly performed?

Response

The meteorological measurement program used at Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) during the period of data collection met the guidance of Safety Guide 23 (i.e., Reference 1). Additionally, as stated in Reference 2, the meteorological tower is equipped with instrumentation that conforms with the system accuracy recommendations of Reference 1.

Onsite calibrations of measurement equipment were routinely performed every other month through the middle of 1997 and quarterly thereafter. The calibrations were performed by experienced technicians using approved procedures and challenged the total system from sensors to data loggers.

The data were collected daily by remotely accessing the onsite data logger. As part of the daily collection procedure, the computer flagged suspect data on a printout that was then reviewed by an experienced meteorologist. As part of this daily review, the data were evaluated for consistency within the tower and to assure that the data reported were reasonable with respect to local conditions. Suspect data were reported to the field crew for investigation and/or corrective action. The average response by the field crew to a situation was within 24 to 48 hours.

A technician visited each site to verify operation of the instrumentation. The frequency of the visits at DNPS was weekly until July 1997, then biweekly until June 1998, and monthly thereafter. The frequency of the visits at QCNPS was weekly until 1997, and monthly thereafter.

When chart data were received or data were downloaded from the digital recorder, the data were inspected and reviewed for indications of instrumentation problems. Any abnormalities were logged, evaluated, and corrective actions taken as appropriate.

After the initial review and edits had been made, a second more refined computer scan was performed to identify unusual occurrences. The flagged data were evaluated on a case-by-case basis. As an additional check, an environmental meteorologist independently compared at least one day in every five to local National Weather Service reported data.

An environmental meteorologist also reviewed the data in light of reported actions by the field technicians, logged comments from the strip chart or digital recorder review, and any other relevant sources of information concerning the site or its equipment. Final decisions concerning validity of the data were made at that time.

Both DNPS and QCNPS have always had either a strip chart recorder or digital chart recorder. The digital recorders replaced the strip chart recorder at QCNPS in June 1997 and at DNPS in June 1998. These digital recorders also had the capability to record and store 10-second data for later retrieval. Strip charts were replaced biweekly and the data from the digital recorders were downloaded on a weekly basis. Strip charts or digital recorder traces were used to validate or replace suspect hourly values obtained from the data logger. When strip charts were used, one day of data (i.e., all recorded parameters) each week was manually digitized and compared to the data from the data logger. Any discrepancies were investigated and resolved by the environmental meteorologist. With the introduction of the digital recorders, the 10-second data were processed into hourly values and all data in the period were compared to verify that both the data logger and digital recorder systems were working in tandem. Again, any discrepancies were evaluated and resolved.

The meteorological tower at DNPS is located within a fenced compound (i.e., approximately 40 feet x 40 feet) that houses both the meteorological instrument shelter and a communications shelter. The meteorological tower at QCNPS is also located within a fenced compound (i.e., approximately 10 feet x 20 feet) that houses the instrument shelter.

For both DNPS and QCNPS, the base area of the towers is bare earth and gravel. Natural vegetation surrounds the fenced compounds. The meteorological towers were sited to meet the guidance of Reference 1 (i.e., in an area where plant structures have little or no influence on the meteorological measurements) to ensure that the data were representative of the overall site areas.

The reformatted data for use in the ARCON96 model are checked against the raw data to ensure that the parameter values and units have been properly converted and to ensure that the proper format has been developed.

NRC Request 2 – Meteorological Data

Provide an electronic copy of the meteorological data used to calculate the relative concentration (X/Q) values. Data should be provided either in the format specified in Appendix A to Section 2.7, "Meteorology and Air Quality," of NUREG-1555, "Environmental Standard Review Plan," or in the ARCON96 format described in NUREG/CR-6331, "Atmospheric Relative Concentrations in Building Wakes." Data may be provided in a compressed form, but a method to decompress the data should be provided. Invalid data should be designated by completely filling the field for that parameter with 9's.

Page 20 of Attachment A of the October 10, 2002 submittal states that when data using the delta-T method were not available, the sigma theta method was used instead. About how much sigma theta data were used? Was its use during certain periods of time and, if so, when? When estimating the stability category using the sigma theta data, were adjustments made in the selection to account for enhanced fluctuations in wind direction under light wind conditions? For example, a large sigma theta value at night more likely represents stable conditions with meander than the unstable conditions defined by some sigma theta tables.

Response

Electronic copies of the meteorological data used to calculate the X/Q values for DNPS and QCNPS are included on the enclosed CD-ROM. The following tables list the filenames for these data files. The data is provided in the ARCON96 format.

DNPS Meteorological Data				
Filename	Year of Data	Wind Speed and Direction Level		Stability Class (Delta Temperature Levels)
		Lower Level	Upper Level	
DRS95r1a.met	1995	35'	150'	150' – 35'
DRS96r1a.met	1996	35'	150'	150' – 35'
DRS97r1a.met	1997	35'	150'	150' – 35'
DRS98r1a.met	1998	35'	150'	150' – 35'
DRS99r1a.met	1999	35'	150'	150' – 35'
DRS95r1b.met	1995	35'	300'	300' – 35'
DRS96r1b.met	1996	35'	300'	300' – 35'
DRS97r1b.met	1997	35'	300'	300' – 35'
DRS98r1b.met	1998	35'	300'	300' – 35'
DRS99r1b.met	1999	35'	300'	300' – 35'

QCNPS Meteorological Data				
Filename	Year of Data	Wind Speed and Direction Level		Stability Class (Delta Temperature Levels)
		Lower Level	Upper Level	
QDC95r1a.met	1995	33'	196'	196' – 33'
QDC96r1a.met	1996	33'	196'	196' – 33'
QDC97r1a.met	1997	33'	196'	196' – 33'
QDC98r1a.met	1998	33'	196'	196' – 33'
QDC99r1a.met	1999	33'	196'	196' – 33'
QDC95r1b.met	1995	33'	296'	296' – 33'
QDC96r1b.met	1996	33'	296'	296' – 33'
QDC97r1b.met	1997	33'	296'	296' – 33'
QDC98r1b.met	1998	33'	296'	296' – 33'
QDC99r1b.met	1999	33'	296'	296' – 33'

The following table summarizes the periods when delta-T data was not available (i.e., delta-T losses) during the data collection period from 1995-1999. This information is provided for both DNPS and QCNPS.

Delta-T Losses from 1995-1999			
Site	Interval (feet)	Loss (Hours)	Loss (%)
DNPS	150-35	137	0.31
DNPS	300-35	195	0.44
QCNPS	196-33	297	0.68
QCNPS	296-33	385	0.88

This shows that during the period from 1995-1999, less than 1% of the delta-T data was lost. Therefore, very few hours of stability could have been computed using sigma-theta data. The recorded sigma-theta values were calculated directly from 1-second wind directions. Since Murray and Trettel (i.e., the supplier of the meteorological data) did not use sigma-theta data in their dispersion calculations, this parameter did not receive the same scrutiny as the delta-T data. Only sigma-theta values exceeding 40-50 degrees were investigated further. They were replaced either with a manual reading from strip charts or digital charts or with a value derived from 10 second digital recorder data by the Yamartino (1984) formula. No sigma theta data was utilized in the revised X/Q calculations.

NRC Request 3 – EAB and LPZ Relative Concentration Estimates

Provide a copy of the input joint frequency distribution(s) and other inputs and assumptions used in the PAVAN, fumigation, and main steam line break calculation.

Why are ground level exclusion area boundary (EAB) and low population zone (LPZ) X/Q values calculated for each accident individually for the 0 - 2 hour time period? What are the differences in the inputs and assumptions that result in the differences in the X/Q values?

Response

The PAVAN code was not used for the main steam line break (MSLB) assessment. The X/Q for the MSLB assessment is based on the more conservative X/Q model (i.e., stability class F and a wind speed of 1 meter per second) of Regulatory Guide 1.5 (i.e., Reference 3), which was used in past assessments.

The PAVAN input files used to determine the EAB and LPZ X/Q values for the fuel handling accident (i.e., reactor building stack release) are included on the enclosed CD-ROM. The following tables list the filenames for the PAVAN input files. These input files contain the joint frequency distributions determined from the hourly meteorology data used in the ARCON96 calculations.

DNPS PAVAN Input Files			
Filename	**Source**	**Receptor(s)**	**Building Area**
1DRS.inp	Unit 2 and 3 MSIV	EAB and LPZ	Reactor Building
2DRS.inp	Station Chimney	EAB and LPZ	
3DRS.inp	Station Chimney	Control Room Intake (81 m)	
4DRS.inp	Unit 2 and 3 Reactor Building Vent Exhaust Stack	EAB and LPZ	
5DRS.inp	Station Chimney	Control Room Intake (75 and 100 m)	
6DRS.inp	Station Chimney	Control Room Intake (150 and 200 m)	
7DRS.inp	Station Chimney	Control Room Intake (400 and 600 m)	
8DRS.inp	Station Chimney	Control Room Intake (800 and 1000 m)	
9DRS.inp	Station Chimney	Control Room Intake (1500 and 2000 m)	
10DRS.inp	Station Chimney	Control Room Intake (300 and 350 m)	
11DRS.inp	Station Chimney	Control Room Intake (375 and 425 m)	
12DRS.inp	Station Chimney	Control Room Intake (450 and 1800 m)	
13DRS.inp	Station Chimney	Control Room Intake (1900 and 2200 m)	
14DRS.inp	Station Chimney	Control Room Intake (2500 and 3000 m)	

QCNPS PAVAN Input Files			
Filename	**Source**	**Receptor(s)**	**Building Area**
1QDC.inp	Unit 1 and 2 MSIV	EAB and LPZ	Reactor Building
2QDC.inp	Station Chimney	EAB and LPZ	
3QDC.inp	Station Chimney	Control Room Intake (127 m)	
4QDC.inp	Unit 1 and 2 Reactor Building Vent Exhaust Stack	EAB and LPZ	
5QDC.inp	Station Chimney	Control Room Intake (75 and 100 m)	
6QDC.inp	Station Chimney	Control Room Intake (150 and 200 m)	
7QDC.inp	Station Chimney	Control Room Intake (400 and 600 m)	
8QDC.inp	Station Chimney	Control Room Intake (800 and 1000 m)	
9QDC.inp	Station Chimney	Control Room Intake (1500 and 2000 m)	
10QDC.inp	Station Chimney	Control Room Intake (300 and 350 m)	
11QDC.inp	Station Chimney	Control Room Intake (375 and 425 m)	
12QDC.inp	Station Chimney	Control Room Intake (450 and 1800 m)	
13QDC.inp	Station Chimney	Control Room Intake (1900 and 2200 m)	
14QDC.inp	Station Chimney	Control Room Intake (2500 and 3000 m)	

The X/Q values for the loss-of-coolant accident and control rod drop accident are based on releases from the turbine area and are based on methodology similar to, but not identical to, that used in the PAVAN code. The fuel handling accident (FHA) X/Q was determined using the PAVAN code and assumes a release from the reactor building stack. The difference between these two release points is small, so the differences in X/Q values are negligible.

NRC Request 4 – Control Room Relative Concentration Estimates

What specific inputs were used in each of the ARCON96 calculations? Was any stack flow or buoyancy assumed? Are all directions input into the calculations, including wind direction, based upon true north?

If more than one release scenario to the environment could occur for a postulated design basis accident (e.g., due to lose of offsite power or single failure) were the limiting atmospheric dispersion factors used in the dose calculations?

What release/receptor location pairs are assumed to be the most limiting for each of the design basis accidents?

Figures 1a and 1b of Attachment A to the October 10, 2002 submittal cites the main steam line break release pathway as a steam cloud. From where is this cloud postulated to originate when released to the environment? Were X/Q values calculated for the control room dose assessment and, if so, what are the values and how were they calculated?

Response

Electronic data files used in the ARCON96 calculations for main steam isolation valve (MSIV) leakage and the FHA are provided on the enclosed CD-ROM. The following tables list the filenames for the ARCON96 input files.

DNPS ARCON96 Input Files			
Filename	**Source**	**Receptor**	**Building Area**
1DRS.RSF	Unit 2 MSIV	Control Room Intake	Reactor Building
2DRS.RSF	Unit 3 MSIV	Control Room Intake	Reactor Building
3DRS.RSF	Station Chimney	Control Room Intake	Turbine Building
4DRS.RSF	Unit 2 and 3 Reactor Building Vent Exhaust Stack	Control Room Intake	Reactor Building

QCNPS ARCON96 Input Files			
Filename	**Source**	**Receptor**	**Building Area**
1QDC.RSF	Unit 1 MSIV	Control Room Intake	Turbine Building
2QDC.RSF	Unit 1 MSIV	Control Room Intake	Reactor Building
3QDC.RSF	Unit 2 MSIV	Control Room Intake	Turbine Building
4QDC.RSF	Unit 2 MSIV	Control Room Intake	Reactor Building
5QDC.RSF	Station Chimney	Control Room Intake	Turbine Building
6QDC.RSF	Unit 1 and 2 Reactor Building Vent Exhaust Stack	Control Room Intake	Turbine Building
7QDC.RSF	Unit 1 and 2 Reactor Building Vent Exhaust Stack	Control Room Intake	Reactor Building

No credit was taken for momentum or buoyant plume rise. All directions input into the calculations are reckoned from true north.

Only one release scenario was considered for each of the design basis accidents.

Figures 1a and 1b in Attachment A of Reference 2 identify the release location for each of the design basis accidents. The DNPS and QCNPS control rooms have only a single receptor location.

Figures 1a and 1b in Attachment A of Reference 2 cites the main steam line break release pathway as a steam cloud. New X/Q values were not calculated for the control room dose assessment. Rather, the X/Q model for the MSLB accident is that which has been used for previous MSLB assessments. The model assumes that the steam and water released in a

MSLB expands to a hemispheric volume at atmospheric pressure. This hemisphere then moves past the control room intake at a speed of one meter per second. This steam cloud is assumed to stay at the level of the intake during its passage.

References

1. U. S. Nuclear Regulatory Commission Safety Guide 23, "Onsite Meteorological Programs," February 17, 1972

2. Letter from K. R. Jury (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, "Request for License Amendments Related to Application of Alternative Source Term," dated October 10, 2002

3. U. S. Nuclear Regulatory Commission Regulatory Guide 1.5, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors," March 1971

ATTACHMENT 5
Revised Response to Request for Additional Information Dated October 31, 2003

NRC Request 1

Standard Review Plan 2.3.3, "Onsite Meteorological Measurements Programs," states that meteorological data used in relative concentration (X/Q) calculations should be checked for appropriateness of heights of measurements of wind direction, wind speed, and atmospheric stability. For example, generally, ground level X/Q values should be based upon the lower level wind data and delta-T measurements between the middle and lower levels and X/Q values for postulated elevated releases should be based upon upper level wind measurements and delta-T measurements between the upper and lower levels. During the September 25, 2003 telecom, Exelon personnel provided some information indicating that delta-T measurements at the Dresden and Quad Cities sites were very similar between the middle and lower levels, and the upper and lower levels for the limiting conditions. Following the telecom, staff examined several years of effluent release report meteorological data for the sites, but did not reach the same conclusion as that expressed by the licensee. Therefore, please provide 1995 through 1999 hourly wind data for the lower and middle measurement levels and delta-T measurements between the middle and lower levels to facilitate staff confirmation that the X/Q values used in the dose assessment are adequate.

Response

During a telephone call between Exelon Generation Company, LLC (EGC) and the NRC on May 26, 2004, EGC confirmed that there were errors in the meteorological data files previously submitted to the NRC. The errors in the meteorological data files have been corrected, and the atmospheric dispersion factors (X/Q) have been recalculated with the changes described in Attachment 1. As stated in the response to NRC Request 2 – Meteorological Data in Attachment 4, electronic copies of the meteorological data used to calculate the X/Q values for Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) are included on the enclosed CD-ROM.

For the revised X/Q calculations, narrow interval delta-T values were used for ground level releases, and wide interval delta-T values were used for releases from the station chimney.

NRC Request 2

What are the distances between the chimneys and control room air intakes at the Dresden and Quad Cities sites and height of wind data used in the elevated release control room X/Q calculations? This information did not appear to be on the compact disk providing other data.

Response

Attachments 2 and 3 provide the X/Q summaries for DNPS and QCNPS, respectively. These tables summarize the parameters used in the X/Q calculations. Additionally, Attachment 4 (i.e., response to NRC Request 2) provides the height for the delta-T measurements and wind instruments.

NRC Request 3

What are the inputs, including height of wind measurements and offsite terrain heights, for the exclusion area boundary and low population zone relative concentration estimates from postulated elevated releases? Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Consequence Assessments at Nuclear Power Plants," states that "... the maximum terrain height above plant grade between the release point and the point for which the calculation is made ..." is an input to the elevated release calculations. This information did not appear to be on the compact disk providing other data.

Response

The wind data used in the determination of X/Qs for elevated releases with respect to the EAB and LPZ are those from the upper elevation of the meteorological monitoring tower (i.e., 300 feet at DNPS and 296 feet at QCNPS). A terrain height factor of 1 was used in the calculations since the terrain surrounding each station is essentially flat. No terrain difference is specified between plant grade and EAB and LPZ receptors.