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Clinton Power Station, Unit 1
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Subject: Control Room Envelope Unfiltered Air Inleakage Test Results in Response to Generic Letter 2003-01, "Control Room Habitability"

References: (1) NRC Generic Letter 2003-01, "Control Room Habitability," dated June 12, 2003

(2) Letter from Michael P. Gallagher (Exelon/AmerGen) to USNRC, dated August 11, 2003, "Exelon/AmerGen 60-Day Response To NRC Generic Letter 2003-01, 'Control Room Habitability'"

(3) Letter from Michael P. Gallagher (Exelon/AmerGen) to USNRC, dated December 9, 2003, "Exelon/AmerGen 180-Day Response To NRC Generic Letter 2003-01, 'Control Room Habitability'"

(4) Letter from Michael P. Gallagher (Exelon/AmerGen) to USNRC, dated March 19, 2004, "Generic Letter 2003-01, 'Control Room Habitability,' Integrated Control Room Envelope Unfiltered Inleakage Test Schedules"

This letter provides the results of the integrated Control Room Envelope (CRE) inleakage testing performed at Clinton Power Station (CPS) during November 14-16, 2004.

Generic Letter 2003-01, "Control Room Habitability," (Reference 1) requested that licensees provide confirmation that: 1) the control room meets the applicable habitability regulatory requirements (e.g., General Design Criteria 1, 3, 4, 5, and 19), and 2) the Control Room Habitability Systems (CRHSs) are designed, constructed, configured, operated, and maintained in accordance with the design and licensing bases.

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References 2 and 3 provided the Exelon/AmerGen 60-day and 180-day responses to NRC Generic Letter 2003-01, "Control Room Habitability." These responses included the commitment for CPS to perform integrated CRE testing utilizing the American Society for Testing and Materials (ASTM) Standard E741-00, "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution." Reference 4 provided the planned schedule for performance of the testing at CPS, and committed to provide a complete response to the Generic Letter requested information, based on test results, within 90 days of completion of the test.

The measured filtered and unfiltered inleakage test values are bounded by the values assumed in the design basis accident radiological analyses for control room habitability. The following provides a description of the testing performed and the results.

CRE Inleakage Testing

Reference 1 requested that licensees confirm the most limiting inleakage into the CRE is less than the values assumed for design basis analyses. Reference 1 refers to ASTM E741-00, "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution," as an example of an acceptable test methodology.

Exelon/AmerGen contracted NCS Corporation (NCS) and Lagus Applied Technologies (LAT) to perform the CRE inleakage testing at CPS. The testing was performed in accordance with NCS/LAT Procedure 1204A, Revision 5, "Constant Injection Tracer Ventilation Test," which is based on the ASTM E741-00 methodology. The tracer gas testing was completed on November 16, 2004.

Test Configurations

The inleakage test is comprehensive if it quantifies all of the inleakage associated with the control room envelope (CRE) for all system modes of operation. The CPS Control Room (VC) Heating, Ventilating, and Air Conditioning (HVAC) System is safety related and active components are designed with redundancy to meet single active failure criteria.

The CRHSs serving the CRE consist of two redundant VC systems with supply air handling units (supply fans, cooling/heating units), recirculation air filter units, return air fans and makeup air filter units. The VC system is safety-related and active components are designed with redundancy to meet single active failure criteria. The VC system equipment is located within a seismic Category I control building structure. The VC system's redundant trains are physically separated. The two trains share common supply and return ducts inside the CRE. Normal operation alignment of the VC system is with one supply subsystem train operating, recirculation air filter in bypass mode, return air fan running, and the second subsystem train in standby.

The VC makeup air filter units provide filtered outside air supply to the CRE during high radiation (Hi-Rad) accident conditions to maintain control room habitability. There are two 100% seismic Category I makeup air filter units consisting of a moisture separator, prefilter, electric heating coil, high efficiency particulate air (HEPA) filter, carbon adsorber, and a downstream HEPA filter. The two 100% redundant recirculation air filter units consist of a prefilter and carbon adsorber. In the Hi-Rad mode, the control room outside air intake, the makeup air filter units and recirculation air filter units are aligned, so that all outside air must pass through both charcoal filter trains before it enters the CRE. The two makeup air filter trains and supply/return trains have separate ductwork outside the CRE, while the portion of the supply and return ductwork inside the CRE is common to both trains. The VC system is designed to remain operable during normal, shutdown, and accident conditions.

The tracer gas inleakage test was performed in the Hi-Rad mode of operation for accident conditions, with each individual train in operation. The flow path for the Hi-Rad mode is similar to the normal mode, except the outside makeup air is filtered by the makeup filter unit, and the return air and outside makeup air mixture is filtered by the recirculation carbon filter. The ductwork and flow paths for the make up filter unit and recirculation filter unit remain separate outside the CRE during Hi-Rad mode of operation. Thus, testing each train separately in the Hi-Rad mode provided independent testing of the train specific ductwork to assure all flow paths are tested.

Inleakage testing was not done for the toxic gas isolation mode, since CPS does not presently have a toxic gas protection concern.

The HVAC systems for areas adjacent to the CRE were maintained in the most conservative mode of operation during the test. The areas adjacent to the CRE are maintained by the non-safety related Auxiliary Building (VA) HVAC system and the safety-related Switchgear Heat Removal (VX) HVAC system. Both systems are designed to maintain the associated areas at atmospheric pressure, and there is no specific positive or negative pressure requirement. However, based on actual operating conditions the VA system tends to maintain areas adjacent to the CRE at a slightly positive pressure compared to atmosphere (i.e., loss of VA during accident/loss of offsite power (LOOP) condition would result in atmospheric pressure in these areas). Therefore, maintaining the VA system in operation during tracer gas testing was considered to be conservative, since a positive pressure in the adjacent area would affect inleakage adversely. Since the safety-related VX system would be operating during an accident condition and it maintains atmospheric pressure in the areas served by it, there is no impact of this system during tracer gas testing.

Test Methods

Testing was performed with the system aligned as described above using NCS/LAT Procedure 1204A, Revision 5, "Constant Injection Tracer Ventilation Test," which is based on the ASTM E741-00 methodology.

On site calibration of the two AUTOTRAC™ Automated Gas Chromatographs using certified calibration standards was performed daily prior to the initiation of each test to ensure that instrument drift and any sensitivity variations would be minimized. Calibrations were performed in accordance with NCS/LAT Procedure 1308, Revision 2, "Field Calibration of AUTOTRAC™ Automated SF6 Gas Chromatograph."

Makeup flow rates from the filter unit were measured by a tracer gas dilution technique using NCS/LAT Procedure 1215, Revision 5, "Tracer Gas Flowrate Determination Test." Measurement of the filtered makeup flow rate in combination with a measured tracer gas concentration value allows calculation of the amount of air inleakage to the CRE.

No mixing fans were used in the Main Control Room (MCR) during the testing. Within the OSC, located adjacent to the MCR and within the CRE, a number of fans were positioned to assist with tracer gas mixing. Three circulating fans were located at the entrance to the Technical Support Center (TSC), also located adjacent to the MCR and within the CRE, and routed air from the Operations Support Center (OSC) to the TSC. Circulating fans were also located in the northwest, southwest and southeast corners of the OSC.

The doors to the TMI Panel Room from the adjoining space with the CRE were left open during the testing and a blower was connected to a flexible duct that was routed into this room. Air from the OSC was delivered into the TMI Panel Room using this blower/flexible duct combination.

Differential pressures between the MCR and various surrounding areas were measured in accordance with NCS/LAT Procedure 1302, Revision 2, "Measurement of Control Room Differential Pressures," using two calibrated digital barometers. Initially, both barometers were placed next to each other in the MCR and the units were "zeroed." One unit was then moved to the various locations and the pressure values noted at timed intervals. The indicated pressure values of the unit that remained in the MCR were also recorded at the same timed intervals. The mobile unit was then returned to the MCR and both readings were recorded. This allowed a correction to be made for drift between the responses of the two units. Differential pressure calculations included corrections for drift and elevations.

Each VC train's test was performed similarly using a concentration buildup/steady state tracer gas test method in accordance with NCS/LAT Procedure 1204A, Revision 5, "Constant Injection Tracer Ventilation Test." The tracer gas was continuously injected into the VC system air stream at a constant rate and dispersed throughout the CRE. After allowing a sufficient period of time for concentration equilibrium to occur, in accordance with ASTM E741-00 requirements, tracer gas samples were obtained for analysis.

<u>Results</u>

The following tabulates the results of the above testing and associated acceptance criteria:

Test	VC System Mode	Train In Service	Outside Air Makeup Flow (SCFM)*	Existing Design Basis Assumption for Maximum Filtered/Unfiltered CRE Inleakage (CFM)		Measured Test Filtered/Unfiltered CRE Inleakage (SCFM)*	
				Filtered	Unfiltered	Filtered	Unfiltered
1	Radiation/ Pressurization	A	2849 ± 126	650	10	198 ± 214	0
2	Radiation/ Pressurization	B	2795 ± 84	650	10	310 ± 157	0

* Referenced to 70 degrees F and 14.7 psia.

Each inleakage value given above is the total inleakage, including "filtered inleakage" (occurring upstream of the recirculation carbon filter) and the "unfiltered inleakage" (occurring downstream of the recirculation carbon filter). Based on the CPS CRHS design, the unfiltered inleakage can occur only at the duct/components downstream of the recirculation carbon filter, or at the CRE boundary. The VC system duct and components downstream of the recirculation carbon filter are pressurized except for a small air-tight portion between the recirculation carbon filter unit (which is constructed per American National Standards Institute (ANSI) N509, "Nuclear Power

Plant Air Cleaning Units and Components," leak tight design requirements) and the supply fan inlet, where no inleakage was identified based on tracer gas concentration measurements across this portion. All areas of the CRE were confirmed to be pressurized with respect to adjacent areas, which indicates that there is no inleakage at the CRE boundary. This implies that the inleakage measured by the test is all "filtered inleakage" occurring upstream of the recirculation carbon filter, and the unfiltered inleakage is essentially zero.

Measurement of the differential pressure verified that the MCR is maintained at a positive pressure of at least 0.125 inches water gauge relative to areas adjacent to the CRE during Hi-Rad mode of VC operation.

Operability of the CRE

The VC system is designed to ensure habitability after any of the design basis radiological accidents assuming filtered inleakage is no more than 650 cfm, and unfiltered inleakage is no more than 10 cfm. Based on the test results above, the filtered and unfiltered inleakage values into the CRE are less than the values assumed in the control room habitability radiological dose analysis. These test results show that the CPS control room integrity is within the current design assumptions.

The CPS design basis accident analysis control room operator dose, with an assumed CRE filtered inleakage rate of 650 cfm and unfiltered inleakage rate of 10 cfm, remains within the 10 CFR 50, Appendix A, GDC 19 limits of 5 rem whole body and 30 rem thyroid. Therefore, CPS has demonstrated that the most limiting filtered and unfiltered inleakage into the CRE is bounded by the value assumed in the design basis radiological analyses for control room habitability. Additionally, CPS has submitted a License Amendment Request (LAR), dated April 3, 2003, to incorporate Alternative Source Term (AST) methodology into the CPS design and licensing basis in accordance with 10 CFR 50.67. The design basis radiological analyses supporting this LAR demonstrate that significantly higher unfiltered inleakage rates remain within the regulatory limits for control room operator dose.

The above information completes the CPS response to Generic Letter 2003-01, "Control Room Habitability," requested information Item 1(a).

No new regulatory commitments are established by this submittal. If you have any questions or require additional information, please contact Mr. David J. Distel at (610) 765-5517.

Respectfully,

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Clinton Power Station

cc: Regional Administrator, NRC Region III
NRC Project Manager, NRR – Clinton Power Station
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