



Overview of NUCON Tracer Gas Testing Program Per ASTM E741 and US Nuclear Regulatory Commission Generic Letter 2003-01: "Control room Habitability"

1 Background

- 1.1 The United States Nuclear Regulatory Commission (USNRC) has published "NRC Generic Letter 2003-01: Control Room Habitability." This document applies to all operating PWRs and BWRs.
- 1.2 Holders of operating licenses are advised that there are concerns about control room habitability. Utilities are required address the issues raised in the GL. Operators are required to evaluate their Control Room Envelope (CRE) for compliance with applicable design and licensing requirements.
- 1.3 CRE integrity testing is being done using ASTM E741-2000; "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution.
- 1.4 NUCON has instrumentation and personnel qualified to perform ASTM E741 CRE testing.

2 Methodology

- 2.1 A walk-down of the CR system may be performed prior to development of a final test plan and site specific procedures. The main purpose for this walk-down will be to identify tracer gas injection and sample points in order to test the different modes and to ascertain if supplemental mixing fans will be needed in the CR proper to insure uniformity of tracer gas concentration in the envelope. Any vulnerability found will also be noted and discussed with plant personnel.
- 2.2 The testing methodology of ASTM E741-2000, "Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution" will be used to measure the control room air in-leakage.
- 2.3 The constant injection technique described in this method will be used for the operational modes that use outside air to pressurize the CR envelope. In addition, the testing methodology of ASTM E2029-1999, "Volumetric and Mass Flow Rate Measurement in a Duct Using Tracer Gas Dilution" will be used to measure outside airflows. Sulfur hexafluoride (SF₆) will be used as the tracer gas.

NUCON test procedures 12-365 "Airflow Measurement Using Tracer Gas Technique" and 12-366 "Envelope Leakage Testing and Characterization Using the Constant Injection Test Method" show how NUCON implements these ASTM methods are attached. The first step in testing is to assure that the CR envelope can be treated as a single zone (so called spatial testing performed during envelope characterization tests). A constant injection leak test method is used in conjunction with the duct flow method to measure the total in-leakage to the CR envelope while measuring the outside airflow at the same time during testing in the pressurization modes.



Overview of NUCON Tracer Gas Testing Program Per ASTM E741 and US Nuclear Regulatory Commission Generic Letter 2003-01: "Control room Habitability"

The difference between the total envelope leakage flow and the outside airflow is then a measure of the unknown in-leakage to the system. The main advantage of the constant injection method is that it provides a measure of the total in-leakage flow rate without having to know the control room volume. Its uncertainty can be reduced by injecting the tracer gas into the outside air pressurization flow and measuring it at the same time the total leak flow is measured in the control room return by measuring its concentration.

- 2.4 The E741 testing methodology provides a comprehensive measurement of the integrity of the control room envelope. Supplementing this information with the differential pressure of the control room with respect to adjacent areas along with static duct pressure measured during operation in the different modes along with a knowledge of the CR HVAC system and other HVAC systems adjacent or associated with the CR (gained from a review of plant drawings, a system walk-down and discussions with plant personnel) will allow any unknown in-leakage found to be noted as filtered or unfiltered in-leakage.

3 Satisfaction of NRC Generic Letter 2003-01 (12 June 2003)

- 3.1 The E741 test method meets the requirements of "... reliable, comprehensive surveillance testing to verify CRE habitability..." as mentioned in point (2) of the purpose of the proposed letter. Further more the proposed letter states, "...the E741 test measures the total CRE in-leakage from all sources. It is well suited for assessing the integrity of positive-pressure or neutral-pressure CREs.
- 3.2 The test basically involves homogeneously dispersing a nontoxic tracer gas throughout the CRE and measuring the dilution of tracer gas caused by the in-leakage.
- 3.2.1.1 (a). "That the most limiting unfiltered in-leakage into your CRE (and the filtered in-leakage if applicable) is no greater than the value assumed in your design basis radiological analysis for CRE habitability. Describe how and when you performed the analyses, tests, and measurements for this confirmation."
- 3.2.1.2 (b). "That the most limiting unfiltered in-leakage into your CRE (and filtered in-leakage if applicable) is incorporated into your fire and hazardous chemical assessment, and the CRE integrity preserves the reactor control capability from either the CRE or the alternate shutdown panel in event of fire. Both of these questions will be answered by the test results from the proposed tests as will be contained in the final report.

4 Set-up and Logistic Requirements

- 4.1 The equipment needed to perform the test is shipped to your site to arrive no later than the middle of the week before testing begins. Injection and sample points need to be identified during a pre-test walk-down. The information gathered during this walk-down will also provide the information needed for site-specific test procedures based on NUCON procedures.



Overview of NUCON Tracer Gas Testing Program Per ASTM E741 and US Nuclear Regulatory Commission Generic Letter 2003-01: "Control room Habitability"

5 Summary of Testing and Related Activities

5.1 A site briefing and walk-down may be necessary to develop site-specific tests procedures and to identify locations for tracer gas injection and sample points.

5.2 Prior to Testing:

- 5.2.1 Prepare site-specific test procedures.
- 5.2.2 Provide a Quality Assurance Plan.
- 5.2.3 Provide personnel Qualification, Security Data and Exposure History.
- 5.2.4 Pre-test Plant Staff Briefing & "Walk-down" (Optional).

5.3 Testing:

NUCON will send personnel and calibrated instrumentation to site to perform the subject testing. In general, Site Testing activities breakdown as follows:

5.3.1 Day One:

5.3.1.1 Site-specific Training and Badging & Equipment Set-up.

5.3.2 Day Two: (2nd Shift)

- 5.3.2.1 Characterize the CRE and measure outside airflows.
- 5.3.2.2 Establishing "target" SF₆ concentration and taking multiple samples at various locations around the CRE to confirm spatial uniformity.
- 5.3.2.3 Measure outside airflows on Train A and Train B using tracer gas.
- 5.3.2.4 Confirm "positive pressure" of the CRE to adjacent areas.

5.3.3 Day Three: (2nd Shift)

5.3.3.1 Tracer Gas Test Alignment No. 1

5.3.4 Day Four: (2nd Shift)

5.3.4.1 Tracer Gas Test Alignment No. 2

5.3.5 Day Five: If needed (2nd Shift)

5.3.5.1 Tracer Gas Test Alignment No. 3

5.3.6 Day Six: If needed (2nd Shift)

5.3.6.1 Additional Tracer Gas Leak Testing/ Brief site personnel (briefing) and present results of testing.

5.4 Post-Testing:

5.4.1 Prepare a Certified Test Report.

- 5.4.1.1 Submit "Draft" report (draft report for client review).
- 5.4.1.2 Submit "Final" report.



Overview of NUCON Tracer Gas Testing Program Per ASTM E741 and US Nuclear Regulatory Commission Generic Letter 2003-01: "Control room Habitability"

6 Deliverable Reports and Documentation

6.1 Principal Deliverables:

- 6.1.1 Pre-test "walk-down" and Plant Staff briefing (Optional).
- 6.1.2 Site walk-down report (Optional).
- 6.1.3 Site Specific Testing Procedures (By separate arrangement).
- 6.1.4 Tracer Gas Testing, including Post-test data/briefing of site personnel.

6.2 Certified Test Report

- 6.2.1 Draft Report
- 6.2.2 Final Report

6.3 Support Documentation:

- 6.3.1 Calibration Certificates for all Test Equipment
- 6.3.2 Quality Assurance Program Manual
- 6.3.3 Quality Plan
- 6.3.4 Personnel Qualifications (Individual Qualifications, Security & HP Data)
- 6.3.5 Charcoal Impact Statement; Effect of SF₆
- 6.3.6 Miscellaneous project related documentation and correspondence.

If you would like to discuss CRE testing please contact us: (614-846-5710)

- Curt Graves (curt.graves@nucon-int.com) x-115
- Eric Banks (eric.banks@nucon-int.com) x-126
- Clint Summers (clint.summers@nucon-int.com) x-159
- Joe Enneking (joe.enneking@nucon-int.com) x-111
- Bob Sommer (bob.sommer@nucon-int.com) x-125