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NRP-RGC-83-1

January 13, 1983

Mr. Caudle Julian
Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Docket No. 50-297

Dear Mr. Julian:

By letter dated 21 April 1982, Subject: Report Nos. 50-297/82-01 and 50-111/82-02, we were informed of the results of the PULSTAR inspection that occurred on 15 - 19 March, 1982. In the supporting section entitled "Details", Section 13, Radiation Control (third paragraph), the inspector acknowledged the procedures that are followed in the calibration of the stack monitor system as fulfilling the requirements of our Technical Specifications. However, he did suggest that "it is good practice to periodically perform a direct calibration by observing the monitor response to a known concentration of radioactive gas". In the following paragraphs, this suggestion is discussed.

For the purpose of this discussion, our Stack Gas Monitor System will be used as an example of the operating system. This monitor is the one used to estimate the Ar-41 average concentration released during the reporting period. The Stack Gas Monitor System includes:

1. G.M. detector in a special shield
2. Pre-amplifier
3. Cabling
4. Electronics Log Ratemeter including amplifier
5. Read-out meter having log system from 10 to 10^6 (5 decades,
6. Recorder, log scale to complement the read-out meter

When the Stack Gas Monitor System is operating correctly and is in calibration, the following facts are known:

1. The activity of the radiation source, either sealed source or gaseous source, used in the calibration procedure.
2. The G.M. detector sensitivity to Ar-41.
3. The air flow in the exhaust system.
4. All electronic components are properly adjusted to the manufacturer's specifications.
5. The System responds to a radiation source.
6. The recorder has been separately calibrated according to the manufacturer's specifications.

7. Auxiliary Ortec counting equipment does not electrically load the system.
8. The system read-out meter, the recorder, and the Ortec counting equipment are in agreement at all test points.

The calibration procedures used at NCSU require at least two (2) sealed sources of known activity (Ba-133 and Cs-137) as the known radiation input (Item 1 above). Items 4-8, inclusive, are individually checked, adjusted as necessary, and verified. A pulse generated by a calibrated pulse generator is applied to the system input in place of the detector and the system operation and stability are confirmed on all ranges before using the radiation sources. Finally, the radiation sources, individually and decayed to the day of the test, are used. The three data outputs - read-out meter, the recorder, and the Ortec equipment - must be in agreement. Further, the output data must agree within 10% of the input data for the calibration to be accepted.

Independently, a detector shield very closely approximating the system operational shield has been constructed for the purpose of verifying the detector sensitivity. Item 2 above. The procedure for this determination includes:

1. Determining the activity of Ar-41 made by irradiation of air in a vial in the PULSTAR and actually transferred to the Test Shield.
2. Using Ortec counting equipment, record three (3), two (2)-minute counts.
3. Repeat 2 above for 4 or 5 sets of counts.
4. Compute all net counts to a common time; say, the time activity is transferred to the Test Chamber.
5. Knowing the activity transferred to the Test Chamber and the volume of the Test Chamber, compute the concentration in μCi/ml.
6. Divide the net counts, corrected (Step 4 above), by the concentration. The average of these values is the sensitivity of the G.M. detector.
7. A set of counts taken about two hours apart will permit a determination of the half-life of the activity. A significant deviation from $T_{1/2}$ = 1.83 hours is reason to question the validity of the test.

Attention is invited to the fact that as outlined above the sensitivity has been determined while the radioactivity is in a "static" or non-flowing status. Further, the above procedures are not dependent upon knowing the flow rate of the exhaust from the reactor bay.

A calibration procedure using the operating system (Direct Calibration) could satisfy either of two (2) objectives, namely:

1. Is the output data in agreement with the input data. Note: the sensitivity of the detector must be known.
2. The determination of the G.M. detector sensitivity to Ar-41.

Either of the above two procedures requires reasonably accurate knowledge of the activity input rate and the exhaust air flow rate. It should be noted that

in these procedures the radioactive effluent is flowing (dynamic) throughout the exhaust system (10^4 cfm) and through the System monitor (10 cfm) where it resides within the detector shield a finite time.

The procedures used at NCSU do not require the activity input rate as a gas flow, but rather as a disintegration rate, and the exhaust air flow rate is not involved in any calculation.

Comparing the "Direct Calibration" procedure with that used at NCSU and referring to the eight (8) facts known about a properly operating system stated above, it is noted that:

1. Points 4 through 8 are common to both the "Direct" and "NCSU" procedures.
2. Point 1 differs only in that the "Direct" procedure requires reasonably accurate knowledge of the activity flow rate; whereas, the "NCSU" procedures depend upon certified sealed sources and their disintegration rate. Note that an "activity flow rate" requires more test equipment; hence, a potential for problems.
3. Point 3, exhaust air flow rate is required by "Direct Calibration" procedures, but not by the "NCSU" procedures.

These three points of comparison indicate that the "NCSU" procedure is, at least, as acceptable as the "Direct Calibration", if not a preferred procedure. Therefore, we prefer to continue to use our established procedure, and respectfully request your concurrence with this position in the light of the information presented in this letter.

Very truly yours,

Robert G. Cockrell

Robert G. Cockrell
Director,
Nuclear Reactor Program

RDC:
RGC:lsh

cc: Dr. Paul J. Turinsky
Mr. Thomas C. Bray
Mr. Robert D. Cross