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September 24, 1981

A. A. F.
NUCLEAR PROJECTS

OCT 06 1981

Mr. Fred Leckie
Nuclear Containment Systems, Inc.
1225 Dublin Road
Columbus, Ohio 43215

Dear Mr. Leckie:

The subject of what conditions are applicable for laboratory methyl iodide tests is certainly not straightforward, as you indicated in your letter of July 1 (attached). Your letter has been referred to my office for resolution. With ANSI and ASTM standards, regulatory guides, and technical specifications, it can be a confusing area.

First, plant technical specifications are the over-riding controlling documents. If these technical specifications list specific conditions, perform the test under these conditions. If some conditions, but not all are specified, then the ASTM procedures in ASTM D3803-1979 "Standard Test Methods for Radioiodine Testing of Nuclear-Grade Gas Phase Adsorbents", should be invoked for the remainder of the conditions. If challenged, a technical case can easily be made for using the ASTM procedures.

Now, if the technical specifications refer to Regulatory Guide 1.52, Revision 2, March 1978, then page 6 of this document points you in the right direction. In Section C.6.b.(3), the reader is directed: "Representative samples of used activated carbon pass the laboratory tests given in Table 2." Table 2 (on page 7 of Regulatory Guide 1.52) refers to Table 5-1 of ANSI-N509-1976 for the test conditions (see the third column in Table 2), and also specifies the allowable penetration. As an example, for two inch systems outside containment with heaters, used carbon should be tested per test 5.b of ANSI-N509-1976, to a penetration of less than 1%, except 70% relative humidity is applicable, not 95%.

Now there are two minor variations. ANSI-N509-1980 has now been published, and does not number the tests. The applicable test (i.e., Test 5.b) is labeled as Methyl Iodine, 30°C, 95% R.H. Again, note that Regulatory Guide 1.52 says to perform the test at 70% relative humidity with a penetration of 1% (and this takes precedence over the 95% relative humidity and 3% penetration in ANSI-N509-1980). Also, N509-1976 refers to the RDT M16-1T for detailed procedures, whereas N509-1980 refers to ASTM D3803. The issuance of N509-1980 can be interpreted as allowing the utility an option. They can either literally invoke their technical specifications and use N509-1976. Or, since N509-1980 has been issued and is an update, they should be able to use N509-1980, with its temperature

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of 30°C instead of 80°C. Technically, the best way to go is to use N509-1980, since it is an update and refers to the latest industry approved test procedures (ASTM D3803). No field inspector should object, since the utility is increasing its safety margin by using the latest industry accepted guidance. Therefore, I will answer your specific question on testing when the specification refers only to Regulatory Guide 1.52: use the latest industry accepted guidance and test at 30°C, 70% relative humidity to a methyl iodide penetration of 1% with ANSI-N509-1980 and ASTM D3803 as the basis. (This, I repeat, is an update of the technical specification, which indicates to use N509-1976).

The second complication is a system with no air heaters. It does not follow to test at 70% relative humidity, and no column in Table 2 of Regulatory Guide 1.52 applies. Testing should be performed according to Test 5.b of ANSI-N509-1976, which is updated (again) by the test labeled Methyl Iodine 30°C, 95% relative humidity in ANSI-N509-1980 (with ASTM D3803 for detailed procedures). Acceptance criteria should be based on the accident analyses performed: if 90% credit was assumed in the accident analysis, the allowable penetration is 5%; if 70% credit was assumed in the accident analysis, the allowable penetration is 10%. Therefore, again to answer your specific question: For systems with no heaters test the used carbon at 30°C, 95% relative humidity and ASTM D3803 procedures, to a penetration based on that assumed in the accident analysis.

I hope this clears up your technical concerns. If you have further questions, please feel free to contact me at 301-492-8361.

Sincerely,

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William Gambill, Chief
 Effluent Treatment Systems Branch
 Office of Nuclear Reactor Regulation

Attachment: As Stated

- bcc: W. Kreger
- R. Bangart
- L. Higgenbotham
- C. Willis
- R. Houston
- B. Snyder
- L. Barrett
- R. Bellamy
- M. Weinstein

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ATTACHMENT 4

PHOTOCOPY OF PAGE 63
FROM
"NUCLEAR AIR CLEANING HANDBOOK" (ERDA 76-21)

tion will depend on the degree of fuel burnup) will exist in the form of heat-generating radioiodine and will contribute to fission product decay heating of the carbon, which, if adequate cooling airflow is not maintained, may cause desorption of trapped iodine or ignition of carbon in the beds. Of these two possibilities, desorption of iodine is the more serious for two reasons; first because it would constitute a loss of containment for radioiodine, and secondly because bed temperatures will never reach the ignition point if sufficient airflow to prevent desorption of trapped iodine is maintained. Sufficient airflow is necessary to keep bed temperatures below 230°F, probably on the order of 6 to 10 fpm. An MPL of 2.5 mg total iodine (including inert and radioactive isotopes as both elemental iodine and organic compounds) per gram of carbon is considered adequate to prevent significant fission product decay heating provided a minimum airflow of 6 to 10 fpm under accident conditions is maintained.³³

To determine the minimum quantity of carbon required in a specific system, the quantity of inert and radioactive iodine that may be trapped in the adsorbers must be estimated. Using the MPL of 2.5 mg total I/mg C and the assumptions on iodine distribution noted previously, the minimum quantity of carbon in the system can be estimated from the equation

$$C = 0.22 Q \quad (3.1)$$

where

C = minimum quantity of carbon required, lb;

Q = potential iodine inventory that could be released, g.

Using this equation, a 1000-MW(e) reactor with a potential iodine inventory of 15,000 g would require a minimum of 3300 lb of carbon to provide adequate protection against desorption and ignition under accident conditions. This amount is more than adequate to meet the requirements for efficiency and retention under normal conditions.

System airflow is a function of the quantity of carbon in the system and of gas residence time. Although the minimum gas residence time of 0.20 sec is required for effective sorption of organic radioiodine compounds, a minimum of 0.25 sec is recommended for design purposes. This provides the conservatism necessary to account for adsorbent bed thinning due to the nearly unavoidable warpage and

camber of screens used to hold the adsorbent in modular cell and PSU adsorbers. Gas residence time can be increased by increasing bed depth or, for a fixed bed depth, by decreasing airflow velocity (i.e., by underrating). Increasing bed depth over the 2-in. minimum employed in both PSU and modular cell adsorber designs and recommended in Regulatory Guide 1.52³³ has the advantage of increasing system reliability by increasing holding capacity. It has the disadvantages of higher cost and, in activated carbon systems, of slightly decreasing ignition temperature.⁴¹ Ignition temperature also decreases with aging of the carbon, particularly in continuously on-line systems. Minimum operational airflow capacity can be determined from the equation

$$C = \frac{Ntn(A-b)}{28.8 ST} \quad (3.2)$$

where

C = minimum system design airflow, cfm;

N = number of cells or adsorber assemblies in the bank ($N = 1$ for a PSU);

n = number of beds per adsorber assembly ($n = 2$ for IES CS-8 type II cells);

t = bed thickness, in. ($t = 2$ for IES CS-8 type II cells);

A = total area of all bed screens of one cell or of a PSU, in.²;

b = total unperforated area of screens having total area A , in.²;

S = number of screens per cell or PSU adsorber;

T = minimum gas residence time required for effective sorption, sec.

For IES CS-8 type II cells and gas residence time of 0.25 sec, Eq. (3.2) reduces to

$$C_{II} = 333 N \quad (3.3)$$

For an installation of modular cell adsorbers, gas residence time can also be increased by providing two banks in series. This not only increases holding capacity and system reliability but avoids the decrease in carbon ignition temperature (since each bed is only 2 in. thick) and provides series redundancy. Because the first bank serves as a guard bed, most of the aging, weathering, and poisoning of the adsorbent would take place in the first bank, and service life of the second bank should be greatly extended. All these advantages are gained at increased investment costs, building space charge (because of the greater space required), and operation costs (because of the greater power requirements