

ORNL/LTR-2014/358

September 30, 2014

To: Terry A. Todd

From: Robert T. Jubin

**Subject: Completion of the ORNL Fuel Cycle Research and Development (FCR&D) Level 4 Milestone – Sigma Team – Off-Gas – ORNL – FT-14OR031202, MS# M4FT-14OR03120217, “Initiate very low iodine concentration adsorption tests,” due September 30, 2014**

This letter documents the completion of the FCR&D Level 4 milestone for the Sigma Team – Off-gas – ORNL work package (FT-14OR031202), “Initiate very low iodine concentration adsorption tests,” M4FT-14OR03120217, due September 30, 2014.

The objective of this effort was to design and install a system to allow the testing of sorbent materials under simulated vessel off-gas (VOG) conditions. The test system consisted of a gas supply system that allows the mixing of dry air, humidified air, and low levels of iodine. The iodine is supplied by a KIN-TEK Flexstream Gas Standards Generator. The sorbents are placed in three separate glass sorbent housings. The first housing is a thin bed, subdivided into four quadrants. The second housing holds a deep bed, followed by a third housing that holds a second thin bed. The first thin bed will allow periodic samples to be taken to examine the effect of time-on-line on sorbent performance. The second bed (deep bed) will allow a determination of the DF for the sorbent over time by the analysis of the third thin bed, which will be replaced at intervals during the multi-month test period. This system was been installed in the south hood of laboratory 38 in Building 4505, and the necessary safety documentation has been revised to reflect the addition of the KIN-TEK iodine generator. Figure 1 shows the installation of the iodine generator and oven used to maintain the sorbent at temperature.

### **Primary test conditions**

Iodine concentration: 1 to 20 ppb (Target is 10 ppb)

Moist air: 0 to 10°C dew point

Test series 1: Reduced AgZ and elemental iodine – permeation tube iodine generator

Test series 2: Reduced AgZ and organic iodide from gas cylinder

Test series 3: Ag Aerogel and elemental iodine – permeation tube iodine generator

Test series 4: Reduced AgZ and elemental iodine – permeation tube iodine generator  
with TBP / diluent vapor added to gas stream

### Configuration of the three sorbent beds in sequence

- 1) The first bed is a thin bed (approximately one to two pellets deep). The bed will be divided into four quadrants. The quadrants will allow periodic sampling over the 2 to 4 month test period.
- 2) The second bed will be approximately 4 in. in length and contain two layers separated by quartz wool. This bed will remain online during the entire duration of the test and will be sampled at the end and analyzed by neutron activation. The media in the first layer will be 1 in. deep. The second layer will have a media depth of 3 in.
- 3) The third and final bed is thin bed (approximately ½ in. deep) to serve as a backup bed that will be removed every 2 weeks for iodine analysis by neutron activation to identify when breakthrough occurred.

### Bed 1 Sample schedule:

Cumulative time on line / Sampling schedule				
Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	Time increment
1 week / <b>Pull at end of time increment and replace with fresh sample</b>	1 week	1 week	1 week	1 week
3 weeks	4 weeks/ <b>Pull at end of time increment and replace with fresh sample</b>	4 weeks	4 weeks	3 weeks
7 weeks	4 weeks	8 weeks/ <b>Pull at end of time increment and replace with fresh sample</b>	8 weeks	4 weeks
15 weeks/ <b>Pull at end of time increment</b>	12 weeks/ <b>Pull at end of time increment</b>	8 weeks / <b>Pull at end of time increment</b>	16 weeks/ <b>Pull at end of time increment</b>	8 weeks

### Bed 2 sample schedule:

At the end of the test series, collect samples of both layers in Bed 2 for neutron activation analysis (NAA).

### Bed 3 sample schedule:

Replace every 2 weeks with fresh material of same type as in Beds 1 and 2. Determine iodine loading by NAA.



**Figure 1. Vessel off-gas sorbent test system as installed.**

Testing with this system was initiated on 30 September 2014.

If you have any questions, please contact me at (865) 574-4934.

cc: C. V. Bates (INL)  
S. H Bruffey  
B. B. Spencer  
J. F. Walker, Jr.  
M. C. Vance