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# ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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**This document was reviewed following the procedures described in WHC-CM-3-4 and is:**

**APPROVED FOR PUBLIC RELEASE**

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7. Abstract

Ion Exchange Modules (IXMs) are used at the 105-KE and 105-KW Fuel Storage Basins to control radionuclide concentrations in the water. A potential safety concern has been identified that relates to the production of hydrogen gas by radiolysis of the water trapped in the ion exchange media of spent IXMs. This document provides a procedure for sampling of the gasses in the head space of the IXM.

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## DISCLAIMER

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## 1.0 TEST ITEM DESCRIPTION

Ion-exchange modules (IXMs) are used at the 105-KE and 105-KW Fuel Storage Basins to control radionuclide concentrations in the basin water. The IXMs consist of six ion columns and the associated piping housed in a concrete block. The nominal dimensions of an IXM are 2.7 m long by 2.1 m wide by 2.5 m tall. The gross weight of an IXM is 19,050 Kg. During operation, basin water is pumped through the IXM and discharged back to the basin via the IXM's inlet and outlet ports. The six vent lines located on the top of the IXM are connected to a vent system.

The IXMs remove soluble (ionic) species of radionuclides such as $^{137}Cs$, $^{90}Sr$ and $^{239/240}Pu$ from the basin water. After a period of operation the IXM will contain a significant inventory of these radionuclides. A potential safety concern has been identified that relates to the production of hydrogen gas by radiolysis of the water trapped in the ion-exchange media. Over time, hydrogen gas may accumulate within ion column head spaces, internal piping and vent lines forming a flammable mixture of hydrogen, oxygen, and other gasses. The addition of an ignition source could then result in a deflagration or detonation of the flammable mixture.

The practice that was followed for spent IXMs in the past was to drain the IXM and then install caps on the inlet port, outlet port, and five of the six vent lines. A Nuc-Fil filter was installed on the sixth vent cap to provide ventilation. Prior to shipment to the Central Waste Complex for burial, the openings in the IXM for the inlet, outlet, and vent lines are sealed with grout. A plastic pipe was used to surround and protect the vent line with the NUC-FIL filter when that opening was grouted. There are three IXMs at the 100-K Basins that are configured in this manner. These are KW No. 14, KE No. 11, and KE No. E94-02. A fourth IXM, KE E94-03, has been capped as described but has not been grouted.

The current practice for handling spent IXMs has been modified to accommodate the hydrogen generation issue. When the IXM is removed from service it is drained and the outlet port is capped. A Nuc-Fil filter is installed on the inlet port and all six of the vent lines to provide additional ventilation and prevent the accumulation of hydrogen gas. A valve and sample port is attached to one of the vent lines to facilitate future sampling activities. IXMs configured in this manner are not grouted. There are three IXMs, E94-06, E94-07, and E94-08 in storage at KE Basin that are configured in this manner.

## 2.0 GENERAL DESCRIPTION

There are several documents that have been prepared to support sampling of the IXMs at K Basin. These include a Data Quality Objectives document

(DQO), a Sampling and Analysis Plan (SAP), a risk assessment document, a jobs hazards analysis (JHA), and a radiation work permit (RWP). This sampling procedure is intended to be a working document that can be read and understood by all personnel involved in the actual sampling activities. Many areas that are covered in great detail in the other documents will be addressed only briefly in the sampling procedure. The main focus of this procedure will be the sampling procedure steps.

### 2.1 TEST OBJECTIVES

The objectives of the test are to (1) obtain the best representative gas sample from an IXM; and (2) identify constituent gases and determine their concentration in the sample.

### 2.2 TEST METHOD

The test method consists of attaching a sampling adapter and a sampling device to the vent line on the IXM to be sampled. A small amount of gas will be withdrawn from the IXM into an evacuated cylinder. The cylinder will then be transported to a onsite laboratory for analysis. The number of samples taken, field blanks, and the IXM, has been determined by the (DQO).

### 2.3 TEST SCOPE

The procedure is limited to sampling activities involving those IXMs currently in storage at the 100-K Basins.

## 3.0 TEST CONDITION LIMITS

### 3.1 ADMINISTRATIVE

Prior to executing this test procedure, all other required documentation must have been prepared, reviewed, and approved. In addition to normal approvals, all required documents will be reviewed and approved by K Basin management.

Scheduling of sampling activities at the K Basins and support from the Operations and Facility Health Physics organizations will be coordinated by the 100-K Area JCS (job control system).

### 3.2 OPERATIONAL

Sampling activities will be coordinated with K Basin Operations so that personnel not directly associated with the sampling will be excluded from the immediate area of the IXMs during execution of the sampling procedure. Sampling activities will be scheduled so that the impact on routine operations and maintenance activities will be minimized.

### 3.3 ENVIRONMENTAL

The concentration of the gasses in the IXM void spaces can be affected by a change in atmospheric pressure. Sampling activities will only be conducted during a period of constant atmospheric pressure (an equilibrium condition) or when the atmospheric pressure is dropping. Sampling activities will not be performed during a period of rising atmospheric pressure. Information on atmospheric pressure trends will be obtained from the Hanford Weather Station and the determination of acceptable conditions will be made by the test director based on this information.

### 3.4 EMERGENCY AWARENESS

Personnel involved with the sampling of the IXM will be trained in any facility emergency training. Emergencies will warrant the following actions: (1) stop sampling; (2) put the sampling apparatus in a safe position; and (3) follow emergency procedures.

## 4.0 INSTRUMENTS AND CALIBRATION

The instruments used in the sampling procedure are a vacuum gauge and a thermocouple reader. The calibration of these gauges will be certified by the Westinghouse Hanford Company (WHC) Physical and Electrical Standards Laboratory. A calibration sticker providing the last calibration date and calibration due date will be affixed to the instrumentation.

# 5.0 FACILITIES, EQUIPMENT, AND MATERIALS

## 5.1 FACILITIES

All sampling activities will be conducted at the 100-K Basins. This area has the necessary facilities (change rooms, rest rooms, lunch room) required to support the activity.

The HEPA filter and tritium trip samples will be transported to the 222-S Laboratory to obtain radiological release. The sample cylinders will be sent to the 326 Laboratory (Pacific Northwest Laboratory) for analysis.

## 5.2 EQUIPMENT

- IXM Sample port connector
- Sampling apparatus
  - Bellows type valves (1)
  - Vacuum gauge (calibrated)
  - HEPA filters (efficiency tested)
  - Silcia gel sorbent tube
- 9 Silica gel sorbent tubes with protective caps
- Vacuum source (6 L summa canister)
- Sample collection device (evacuated)
  - Protective caps
  - Trip blank (1)
  - Spiked blank (evacuated and spiked at site)
  - Sample cylinders
  - Sample cylinder (vacuum test)
- Temperature measurement device (calibrated) type "K", 1 decimal point
- Sparkless tools (beryllium-copper)
  - 9/16 in. Combination wrench
  - 1/2 in. Combination wrench
  - Pliers
  - Blade screwdriver
- 1/4 in. TFE tape, roll
- Clamp 2.25 in. dia

- Plastic bags
- Custody locker
- Lecture bottle of Argon (15 L gas volume) with regulator
- Gas dam assembly
  - 4 in. x 10 in. dia. thin walled plastic tubing
  - Plumbers Putty with MSDS
- Log sheet and clip board with sample numbers and table for requested data during sampling process.
- Copy of Approved Gas Sampling Procedure.

### 5.3 REAGENTS

Plumbers Putty (MSDS# 14489)

Not classified as hazardous in accordance with OSHA 1910.1200

## 6.0 SAFETY

The safety hazards include potential exposure to high radiation levels, flammable gases, falls, trips and back strains. Applicable work package instruction and Radiation Work Permits (RWPs) are to be used in preforming this procedure.

## 7.0 MAINTENANCE AND FAILURES

To insure the validity of the samples the sampling procedure must be completed without interruption. An extra vacuum source will be available if loss of system integrity causes the loss of the vacuum source. Extra silica sorbent tubes will be available as a replacement in case excessive water in the system saturates the in-line sorbent. The sample connector will be covered with a cover gas during sampling to ensure confidence in the connector seal with the IXM vent tube.

## 8.0 TEST DATA

The data generated by the sampling will consist of the identification and concentration of the constituent gasses in the IXM. The specific gasses to be identified will consist of hydrogen and others as specified by the Sampling Analysis Plan. After analysis is complete, the onsite laboratory will report the results to the test director. The test director will evaluate the results and report them along with comments and observations to all interested parties via internal memo. The test director will record the results in a controlled logbook which will serve as the record copy of the results.

## 9.0 PERSONNEL REQUIREMENTS

Sampling activities at the 100-K Basins will require the coordinated effort of several personnel.

- Facility Health Physics will issue dosimetry and provide continuous coverage during sampling activities.
- Operations will provide access to the 100-K Basins and provide operations escort while in the basin area.
- All steps in the sampling procedure will be performed by personnel assigned to the Field Analytical Services organization who will work under the direction of the test director.
- Sampling will be performed by personnel who have been qualified by written or oral exam and demonstration of performing sampling procedure on a known standard that is a mock-up of the actual IXM.

## 10.0 QUALITY CONTROL

Due to the nature of the sampling activity, ALARA conditions, and the hazards associated will sampling potentially flammable gasses, witnessing the sampling, if required, will be done from the mezzanine overlooking the transfer area.

Quality control of the sampling operation will be governed by the DQO. QC personnel shall check the vacuum gauge for current calibration stickers, prior to sampling.

A gas dam will be placed around the sample point. It will consist of a thin walled ~4 in. high x ~10 in. dia. plastic tube temporarily sealed to the IXM with plumbers putty. The gas dam will allow the filling of the sample

cavity with an inert gas, argon, prior to sampling. The analytical results will report the argon concentration in the sample vessel thus giving a quantitative measure of the efficiency of the IXM and sample connector gas seal at the interface and the verification of filling the sample cylinder with sample gas.

## 11.0 PROCEDURE STEPS

### 11.1 PRE-JOB MEETING AND SAMPLING PREPARATION

1. Identify the Operations Person-In-Charge (PIC).

   NOTE: It is important that the sample technician and the PIC completely understand the job and resolve any questions prior to entering the basin.

2. Identify and follow the applicable Work Package and Radiation Work Permits (RWPs) for the sample collection.

3. Discuss with the PIC the route that will be used to position the sampling equipment.

4. Ensure that the operators and the radiation monitors understand the sampling operation. If needed, set up a dry sampling demonstration to familiarize the personnel with the procedural steps.

5. Discuss the possible emergency scenarios that would warrant the stopping of sampling and how to respond in a safe manner.

6. Collect, assemble, and test the sampling equipment.

### 11.2 VACUUM TEST OF THE SAMPLING SYSTEM

See Figure 1.
NOTE: The vacuum test should be preformed prior to entering the basin.

1. Attach sample cylinder for vacuum test.

2. Close all bellows valves.

3. Record system internal pressure.

4. Open valve 3.

5. Close valve 3 when internal vacuum exceeds 15 in. Hg.

6. Record system internal pressure.

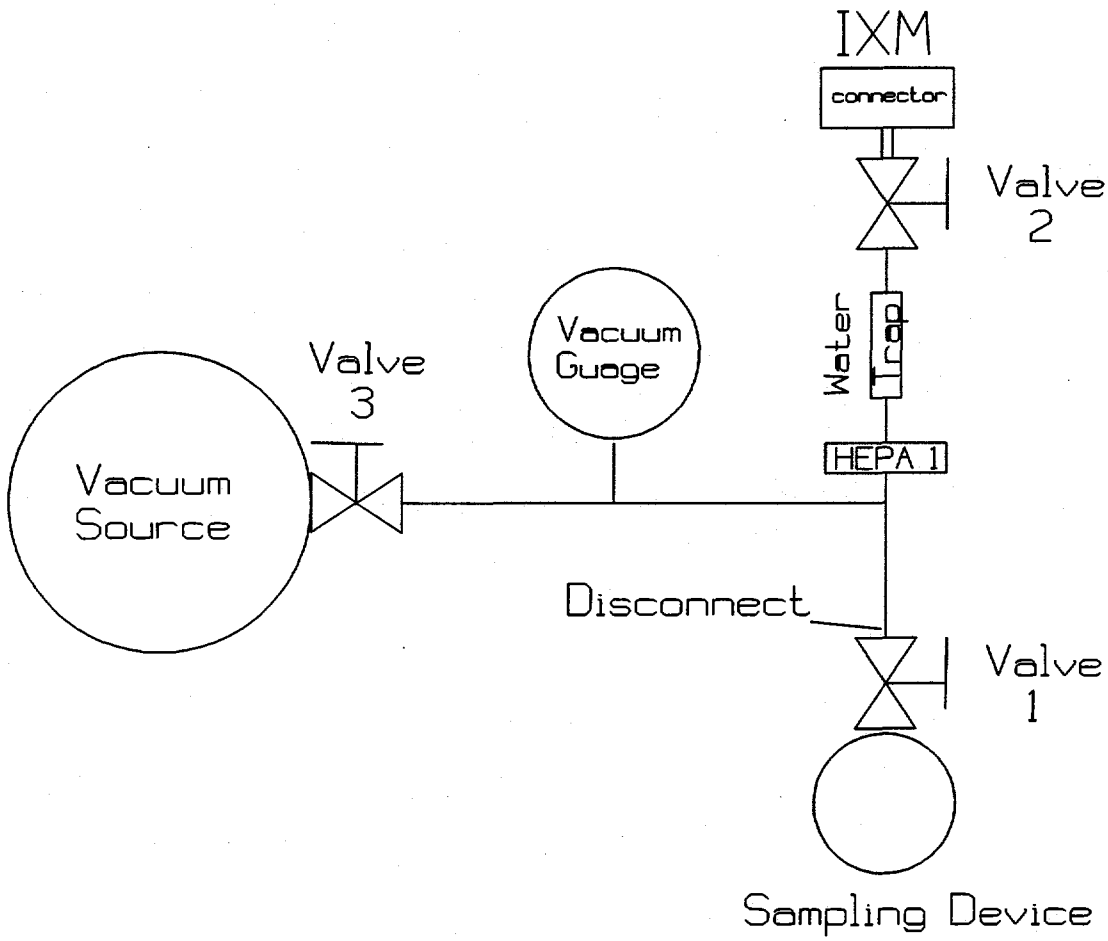


Figure 1. Device to Be Used for the Sampling of the Headspace Gas in the Ion-Exchange Modules Located in the K-Basin.

7. Monitor the vacuum drop within system. If the rate at which the vacuum leaks from the system exceeds 1 in. Hg per 1 minute.

   a. Check all fittings .

   b. Repeat leak test at step 11.2.2.

8. Open valve 1. If the rate at which the vacuum leaks from the system exceeds 1 in. Hg per 1 minute.

   a. check all fittings.

   b. repeat leak test at step 11.2.2.

9. Close valve 1.

10. Open valve 2 (bring internal pressure to atmosphere).

## 11.3 PRIOR TO ENTERING THE BASIN

1. Verify and note unique identification for each sample cylinder.

2. Assemble the sampling apparatus using the vacuum source and first sampling cylinder.

3. Check thermocouple reader for apparent correct operation.

## 11.4 ENTERING THE BASIN AND ATTACHING SAMPLING EQUIPMENT

Figure 2 Illustrates the sampling assembly.

1. Enter the basin following the procedures for entry.

2. Attach electrical bonding.

3. Place IXM connector on IXM vent and secure.

4. Ensure all valves are in the OFF position (CW).

5. Place gas dam around sample port of IXM connector.

6. Attach the sampling equipment to the vent connector.

7. Ensure all fittings are tight at vacuum source and sample cylinder.

8. Fill gas dam with argon cover gas setting flow regulator for gentle flow rate.

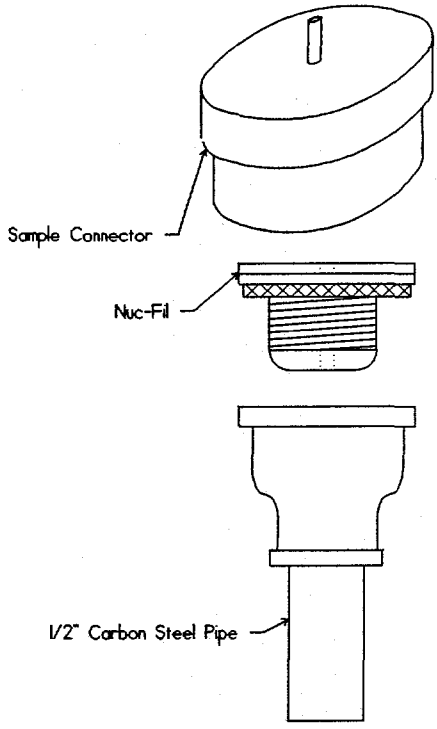


Figure 2
Connector/Nuc-Fil Assembly

## 11.5 SAMPLE COLLECTION

Refer to Figure 1.

1. Open valve 3. Wait until vacuum pressure stabilizes and record pressure reading.

2. Close valve 3.

3. Open valve 2.

4. Wait until pressure stabilizes to apparent atmospheric pressure and log pressure reading, approximately 60 seconds.

5. Open valve 1.

6. Wait until pressure stabilizes to apparent atmospheric pressure and log pressure reading, approximately 60 seconds.

7. Close all valves 1 and 2.

8. Ensure valve 3 is closed.

9. Record air temperature of K-Basin near sample point.

10. Remove exposed sample cylinder.

11. Check tritium traps for saturation; continue sampling if apparently dry.

    If saturated, replace with new sorbent tube. Identify saturated sorbent with unique number. Package for shipment to laboratory for analysis.

    Note: Because of the internal volumes of the vent lines within the IXM any backflush of outside air will dilute the sample collected. Valve 2 should remain closed at this time.

    If all sample cylinders have been exposed move ahead to Section 11.8.

**11.6 Continuing the Sampling Process.**

1. Attach next sample cylinder to sampling apparatus.

2. Repeat sampling steps at 11.5.1.

**11.7 SYSTEM SHUT DOWN**

In the event of sampling system problems:

1. Do as many of the following steps as safely as possible:

    a. Shut off all bellows valves.

    b. Shut off Argon cover gas supply.

    c. Remove sampling apparatus from sample connector.

d. Remove sampling connector from NucFil.

e. Remove any equipment from the IXM to a sagging area.

In the event of a facility emergency:

1. Stop sampling.

2. Follow facility emergency procedures.

## 11.8 COMPLETING SAMPLING PROCESS

1. Place protective cap over open ends of sample line.

2. Move equipment to area where system can be disassembled.

3. Remove vacuum gauge and sample lines, disconnecting at HEPA 1.

4. Disassemble HEPA holders in the Surface Contaminated Area (SCA) and bag HEPA 1 for transport to the radiological laboratory for analysis.

5. Bag HEPA holder for decontamination.

6. Remove IXM connector and valve 2 from IXM and bag for decontamination.

7. Remove all equipment from K-Basin and exit following K-Basin Health Physics protocol for exiting the basin.

# 12.0 DISPOSITION OF TEST ITEM

After the sampling procedure is completed the IXM will be left in its original configuration. The sample apparatus will be radiologically released and used in future sampling activities. Those components that cannot be released will stored in the K Basin area and reused if possible or disposed of a rad waste.

## 13.0 REFERENCES

WHC, 1994, *WHC K-Basin ALARA Program*, WHC-IP-1028, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-1-6, Radiological Control Manual, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-3, Industrial Safety Manual, Westinghouse Hanford Company, Richland, Washington.