



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION IV  
611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TEXAS 76011-4005**

July 24, 2006

U.S. Department of the Interior  
U.S. Geological Survey  
ATTN: Darrell Liles  
Radiation Safety Officer  
P.O. Box 25046, MS-974  
Denver Federal Center, Bldg. 15  
Denver, Colorado 80225

SUBJECT: NRC INSPECTION REPORT 030-03728/06-001

Dear Mr. Liles:

This refers to the reactive inspection conducted on June 29, 2006, at your radiochemistry laboratory located at the Denver Federal Center in Denver, Colorado. The purpose of the inspection was to conduct a follow up review of an incident involving a leaking tank that was reported to the NRC on June 23, 2006.

This inspection was an examination of activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Within these areas, the inspection consisted of selected examination of procedures and representative records, observations of activities, and interviews with personnel. The enclosed report presents the results of that inspection. No violations were identified, and no response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

Should you have any questions concerning this inspection, please contact the undersigned at (817) 860-8143 or Mr. Robert J. Evans, Senior Health Physicist, at (817) 860-8234.

Sincerely,

**/RA/**

Vivian H. Campbell, Chief  
Nuclear Materials Inspection Branch

Docket No.: 030-03728  
License No.: 05-01399-08

Enclosure:  
NRC Inspection Report  
030-03728/06-001

cc w/enclosure:  
Robert Duraski  
U.S. Environmental Protection Agency  
Region 8  
999 18<sup>th</sup> Street  
Denver, CO 80202

Steve Tarlton  
Radiation Program Control Director  
Colorado Department of Public Health  
and Environment  
Hazardous Materials and Waste  
Management Division  
4300 Cherry Creek Drive South, B-2  
Denver, CO 80246-1530

bcc w/enclosure (via ADAMS e-mail distribution):

LDWert

DBSpitzberg

WAMaier

VHCampbell

ADGaines

CHBassett

RJEvans

KEGardin

NMLB File

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**ENCLOSURE**

U.S. NUCLEAR REGULATORY COMMISSION  
REGION IV

Docket No:	030-03728
License No:	05-01399-08
Report No:	030-03728/06-001
Licensee:	U.S. Department of the Interior U.S. Geological Survey
Facility:	High Level Radiochemistry Laboratory
Location:	Denver Federal Center
Date:	June 29, 2006
Inspectors:	Robert J. Evans, P.E., C.H.P., Senior Health Physicist Fuel Cycle & Decommissioning Branch  Craig H. Bassett, Inspector Office of Nuclear Reactor Regulation Division of Policy & Rulemaking Research and Test Reactors Branch B
Approved By:	Vivian H. Campbell, Chief Nuclear Materials Inspection Branch
Attachment:	Supplemental Inspection Information

## **EXECUTIVE SUMMARY**

U.S. Department of the Interior  
NRC Inspection Report 030-03728/06-001

This inspection was a reactive, announced inspection of an incident that was reported to the NRC on June 23, 2006. The purposes of the inspection were to identify the sequence of events leading up to the incident, determine the causes of the incident, review the licensee's short and long term corrective actions taken or proposed in response to the incident, and to determine the regulatory significance of the incident.

### **Event Chronology**

- The licensee concluded in early June 2006 that a 3000-gallon underground storage tank was leaking. The licensee collected tank water samples and quantified the amount of water and radioactive material that had leaked from the tank. As a courtesy, the licensee notified the NRC of the leak on June 23, 2006 (Section 1.2.a).

### **Causes of the Event**

- The cause of the leak was suspected to be galvanic corrosion of the bottom tank liner. The causes of the water loss from the tank were most likely a combination of liner leakage and, to a lesser extent, cleanup pump seal leakage into the liner gap (Section 1.2.b).

### **Corrective Actions Taken**

- Immediate corrective actions taken in response to the leaking tank included repair of the liner and increased tank sampling and monitoring. Longer term corrective actions were being considered by the licensee in consultation with its Radiation Safety Committee and U.S. Geological Survey management (Section 1.2.c).

### **Regulatory Significance**

- The concentration of cobalt-60 in fluid released to the subsurface was a small fraction of the NRC's effluent concentration limit. The total quantity of radioactive material released was a small fraction of the NRC's reporting limit. The licensee believes that the contamination is not likely to migrate into the groundwater, in part, because of the mobility of cobalt-60. Accordingly, the leak was not a significant health and safety hazard to members of the public (Section 1.2.d).

## **Report Details**

### **Program Overview**

The licensee possesses byproduct radioactive material under an NRC broadscope license for use in research and development activities. The licensee possesses and stores some of its licensed material in the radiochemistry laboratory. This laboratory is also used for initial handling and processing of components irradiated in an adjacent research and test reactor. Located within the laboratory room is a 3000-gallon, below-grade storage tank. The licensee issued Radioisotope Utilization Permit No. 22, which specifically authorizes the possession and storage of reactor activated metal components in the tank under the broadscope license.

The tank was constructed in the 1960's for use as a gamma irradiator. The rectangular shaped tank is 6 foot by 6 foot by 12 feet deep. The tank remained empty until about 1987. At that time, the licensee elected to use the tank for storage of large, irradiated components. The concrete tank was not leak-tight, and the tank was lined with a 0.1-inch stainless steel liner. Following liner installation, the tank was filled with water that provided radiation shielding. At the time of this inspection, the licensee was storing a rotary specimen rack and two ion chambers contaminated with cobalt-60 in the tank. The licensee also was storing a cadmium terminus in the tank that contained a small amount of cadmium-109.

Tank water consisted of de-ionized water that was maintained by a cleanup subsystem. The cleanup subsystem included a recirculation pump, a 10-micron filter, and a mixed bed ion exchanger. Tank water is maintained clean, in part, because the water is used as makeup water for research reactor operations. De-ionized water is added to refill the tank on an as-needed basis.

### **1 Inspection of Material Licensees Involved in an Incident or Bankruptcy Filing (87103)**

#### **1.1 Inspection Scope**

On June 23, 2006, the licensee reported to the NRC's Region IV office that it had detected leakage from the below-grade storage tank. The purposes of this inspection were to identify the sequence of events leading up to the incident, determine the causes of the incident, review the licensee's short and long term corrective actions taken or proposed in response to the incident, and to determine the regulatory significance of the incident.

#### **1.2 Observations and Findings**

##### **a. Event Chronology**

During mid-May 2006, the licensee noticed that the tank level was decreasing. At first, the licensee was uncertain if the tank was actually leaking or if the tank had not been refilled following removal of water for reactor operations. During early June 2006, the licensee concluded that the tank was actually leaking water. At that time, the licensee

elected to clean the tank, wire brush corroded spots, and then apply an epoxy seal to patch the liner holes.

The tank floor was cleaned on June 6, 2006. The next day, underwater patching material was applied to three locations. With the use of an underwater camera, the licensee located additional suspect liner defects. At the time of the inspection, the licensee had applied 28 individual patches. The licensee successfully lowered the leakage rate from a conservative estimate of 13.8 gallons per day to about 2 gallons per day. The licensee plans to continue searching for possible leakage pathways to further reduce the daily leak rate.

The licensee quantified the amount of water that had leaked from the tank. Based on the observed water level changes, the licensee conservatively estimated that 575 gallons of liquid had leaked from the tank since May 2006.

The inspectors discussed with the licensee the potential for siphon draining and evaporation of water from the tank. The inspectors confirmed that there were no siphon pathways for draining the tank. During the inspection, the licensee was in the process of trying to calculate a potential evaporation loss rate, but the leakage rate (2 gallons per day) was most likely much greater than the evaporation rate.

The inspectors reviewed the licensee's radiation protection program to ensure that contamination had not migrated into the radioisotope laboratory. Monthly swipe samples were conducted to monitor for removable contamination. The most recent sample results (June 27, 2006) for the radioisotope laboratory were less than the minimum detectable activity of the counting equipment. The licensee did not collect air samples in the laboratory because all work involving loose radioactive material was required to be conducted within ventilation hoods. Finally, the licensee has an internal policy that prohibits the release of liquid effluents to the environment, including sewer releases. In summary, the leaking tank has not resulted in the contamination of the radioisotope laboratory.

b. Causes of the Event

The inspectors concluded that the causes of the water loss was most likely liner leakage combined with some cleanup pump seal leakage into the gap between the stainless steel liner and the concrete wall. At about the same time the licensee identified the tank liner leak, the licensee noted that the cleanup pump was also leaking. Some of this pump leakage was entering the liner gap area.

The licensee believes that the cause of the tank leakage was galvanic corrosion of the liner. The licensee suspected that galvanic corrosion occurred due to small metal items (screws, nuts, washers) being in contact with the tank liner for extended periods of time. Further, the corrosion appeared only at the bottom of the tank and in random locations not associated with liner seams or welds. The licensee noted that aluminum components in the tank did not appear to be causing deterioration of the liner.

c. Corrective Actions Taken

Short term corrective actions taken by the licensee included repairing the liner, sampling the tank, quantifying the amount of material released, and sampling the nearby environmental groundwater monitoring well. In addition, the licensee installed plastic sheeting to temporarily redirect cleanup pump leakage back into the tank. The licensee plans to replace the pump in the near future.

Between June 9 and June 26, 2006, the licensee collected four water samples from the tank. The licensee previously sampled the tank water for gross alpha and beta radioactivity from April 1989 until June 2001. The licensee elected to discontinue sampling during 2001, in part, because of low sample results.

The licensee conducted gamma spectroscopy analyses of the four water samples using its high purity germanium detector. Cobalt-60 was identified in the samples in small concentrations. The sample results ranged from  $3.58 \text{ E-}7$  microcuries per milliliter ( $\mu\text{Ci/ml}$ ) immediately after tank cleaning operations to  $1.35 \text{ E-}7 \mu\text{Ci/ml}$ , the last of the four samples. For comparison, the NRC's effluent concentration limit, specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for cobalt-60 is  $3.0 \text{ E-}6 \mu\text{Ci/ml}$ . The highest sample result ( $3.58 \text{ E-}7 \mu\text{Ci/ml}$ ) was 12-percent of the effluent concentration limit.

The licensee quantified the amount of radioactive material released from the tank based on the estimated volume of material leaked (575 gallons) and the highest water sample result ( $3.58 \text{ E-}7 \mu\text{Ci/ml}$ ). The total amount of radioactive material that could have leaked from the tank was conservatively estimated to be 0.78 microcuries.

The licensee has a groundwater monitoring well that is sampled biannually for tritium releases from the research reactor. The four previous sample results indicated that tritium concentrations were less than the minimum detectable activity level of the laboratory sampling equipment. The licensee sampled the monitoring well in early June 2006 as part of the routine sampling program. This sample was submitted to a third-party laboratory, and the results were not available during the inspection. The licensee requested that the laboratory conduct additional analysis of the sample for gross beta and gross alpha concentrations.

The licensee also collected a special groundwater sample from the monitoring well on June 26, 2006. The licensee analyzed the sample using gamma spectroscopy. No licensed radioactive material was identified by the licensee in the well sample.

The local groundwater was about 24-25 feet below the ground surface and about 12-13 feet below the bottom of the tank. The licensee suspects that the cobalt-60 will not enter the groundwater, in part, because of the mobility of the cobalt-60. The licensee's internal review, which included a recent geologist's report, concluded that there was a "high probability that introduced cobalt-60 will be strongly retained in the immediate vicinity of the reactor [and radioisotope laboratory]." In summary, the licensee believes that any cobalt-60 released from the tank will remain in the vicinity of the tank and will not be detected in the monitoring well.



At the time of the inspection, the licensee had not finalized its long-term corrective actions. One corrective action being considered was the installation of a second monitoring well in the vicinity of the tank. The proposed location would allow the licensee to directly monitor for tank leakage. Other corrective actions being considered include: (1) revising the byproduct materials license to clarify the use of the tank for storage versus research and development activities, (2) repairing or permanently discontinuing the use of the tank, and/or (3) installing a tank leak detection system. These decisions will be made by the licensee's representatives in consultation with its Radiation Safety Committee and licensee management.

d. Regulatory Significance

The tank is not specifically mentioned in the license application; therefore, there are no procedure, monitoring or parameter limitations specified in the license. However, the licensee has implemented short term corrective actions which include weekly tank sampling, weekly monitor well sampling, and daily water level measurement (during days that the building is occupied). The licensee plans to continue collecting these additional samples until enough samples are accumulated to indicate that no negative trend exists.

The highest tank water sample result ( $3.58 \text{ E-7 } \mu\text{Ci/ml}$ ) was only 12-percent of the cobalt-60 effluent concentration limit; therefore, the concentration of fluid being released did not exceed the regulatory limit for liquid releases to the environment.

Regulation 10 CFR 20.2201(a)(ii) specifies that a 30-day report is required if the amount of lost, stolen, or missing cobalt-60 exceeds 10 microcuries. The amount of lost cobalt-60 was conservatively estimated to be 0.78 microcuries, or 7.8-percent of the reporting limit. At the time of this inspection, the amount of radioactive material that had leaked from the tank had not exceeded the reporting limit. Therefore, the leak was not reportable to the NRC.

1.3 Conclusions

The licensee concluded in early June 2006 that a 3000-gallon underground storage tank was leaking. The licensee collected tank water samples and quantified the amount of water and radioactive material that had leaked from the tank. As a courtesy, the licensee notified the NRC of leak on June 23, 2006.

The cause of the leak was suspected to be galvanic corrosion of the bottom tank liner. The causes of the water loss from the tank were most likely a combination of liner leakage and, to a lesser extent, cleanup pump seal leakage into the liner gap.

Immediate corrective actions taken in response to the leaking tank included repair of the liner and increased tank sampling and monitoring. Longer term corrective actions were being considered by the licensee in consultation with its Radiation Safety Committee and U.S. Geological Survey management.

The concentration of cobalt-60 in fluid released to the subsurface was a small fraction of the NRC's effluent concentration limit. The total quantity of radioactive material

released was a small fraction of the NRC's reporting limit. The licensee believes that the contamination is not likely to migrate into the groundwater. Accordingly, the leak was not a significant health and safety hazard to members of the public.

## **2 Exit Meeting Summary**

The inspectors presented the inspection results to members of licensee management at the exit meeting on June 29, 2006. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

## **ATTACHMENT**

### **PARTIAL LIST OF PERSONS CONTACTED**

#### **Licensee**

T. Debey, Radiation Safety Committee Chairman  
D. Liles, Radiation Safety Officer

### **INSPECTION PROCEDURES USED**

87103 Inspection of Materials Licensees Involved in an Incident or Bankruptcy Filing

### **ITEMS OPENED AND CLOSED**

#### **Opened**

None

#### **Closed**

None

#### **Discussed**

None

### **LIST OF ACRONYMS**

μCi/ml                      microcuries per milliliter