TENORM Waste Processing and Disposal of Filter Cake – 14371

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ABSTRACT

Upon discovery of elevated concentrations of technologically enhanced naturally occurring radioactive material (TENORM) in filter cake at a water treatment plant, several steps were taken. First the affected materials were identified followed by a review of the current waste shipping process of filter cake. Then radiation surveys were performed and the TENORM was quantified for determination of disposal options. A process for transfer of filter cake material from roll-offs into dump trucks followed by transfer to rail cars in order to transport the materials to disposal site was developed to address the initial stockpile of materials. Later the waste handling process was changed to supersacks to reduce transportation costs. The approaches taken and basis for transportation and disposal options will be presented.

INTRODUCTION

Filter cake routinely produced at a water treatment facility alarmed a radiation monitor at the disposal facility, which initiated a series of steps that would ultimately lead to modified disposal of these materials. Upon notification of the radiation alarm, outgoing shipments of filter cake were suspended until additional information was collected. Analysis of the filter cake identified elevated levels of radium in the materials, which lead to classification as technologically enhanced naturally occurring radioactive material (TENORM). The existing disposal process for the filter cake materials was to collect them into roll-offs at the water treatment facility, drive them to a rail spur, dump the roll-offs into a loading bin and transfer the filter cake to a gondola rail car utilizing an excavator. Given the identified radiation levels now associated with the filter cake materials, this process needed to be revised to appropriately address handling, storage, transportation, and disposal.

Elevated concentrations of radium in the filter cake material analyzed after the initial alarm were generally in the range of 6 – 15 Bq/g (150 – 400 pCi/g) radium 226 (Ra-226) and 1 – 2 Bq/g (25 – 45 pCi/g) radium 228 (Ra-228). While these concentrations of TENORM do present a radiation hazard that was new for this facility, they are not significantly elevated to necessitate full radiological protection and controls.

A work plan was developed to address the revised process for transport and disposal of filter cake material. This included:

- material handling equipment;
- personnel monitoring methods;
- personnel training requirements;
- decontamination protocols;
- worker radiation awareness training;
- radiation monitoring;
- material transfer protocols; and
- documentation.

Disposal of the TENORM-containing filter cake was planned at a hazardous waste disposal site that also accepts low-activity radioactive material. A waste profile was prepared and accepted prior to disposal of these materials. Waste acceptance criteria (WAC) for the disposal site is 19 Bq/g (500 pCi/g) Ra-226 and Ra-228 (combined) for bulk loads.

METHODS

Transportation options considered for these materials included utilization of the existing roll-offs, intermodals, supersacks, and gondola rail cars. Given that the distance from the water treatment facility to the planned disposal site is more than 3,220 kilometers (2,000 miles), direct trucking options were eliminated due to costs (roll-offs). Intermodals were evaluated since they can be transported by rail; however, due to the additional equipment necessary for handling at the water treatment facility these were eliminated due to the additional costs. Supersacks could be utilized for transfer of the materials from the roll-offs and then consolidated into a gondola rail car for transportation. In this case, there would be additional costs with transferring material from roll-offs to supersacks and then loading the supersacks onto trucks for transportation. The selected method for transportation was to transfer material from the roll-offs into lined dump trucks, transport to a rail spur with a ramp for dumping into gondola rail cars.

Once transportation and disposal means and methods were selected a Material Handling Plan (work plan) was developed to provide step by step instruction and guidance for the field team performing the waste handling and loading activities. Key components of the work plan include:

- Material Handling Procedure
    - General TENORM Material Handling Guidance such as:
        - The handling or movement of TENORM materials shall be performed by properly qualified/trained individuals.
        - TENORM materials shall be properly packaged to ensure that there is no spread of contamination to individuals or the environment during transportation to designated storage areas on site.
        - TENORM materials shall be collected in approved containers inside facilities at designated locations.
        - Ensure all TENORM waste containers offered for transportation have been surveyed for radiation and contamination prior to release and that contamination limits on the external surfaces of the shipping container are not exceeded.
    - List of dust action levels
- Certified Health Physicist (CHP) Activities
    - Conduct TENORM Awareness Training
    - Perform airborne radiological monitoring
    - Perform or oversee TENORM radiation and contamination monitoring
    - Monitoring of respirable dust
- Applicable Radiological Procedures and Forms

Upon mobilization to the site, Radiation Awareness Training was provided for workers involved in the filter cake material waste handling and loading activities. The training contained the following elements:

- Description of radiation, radioactive material, and radioactive contamination
- Units to measure radiation, radioactivity, and contamination
- Identification of sources of natural and manmade radiation
- Identification of possible health effects of radiation
- Fundamental principles of radiation safety (time, distance, shielding)
- Perspective of radiation doses to health risks encountered in industry and life

Five dump trucks were loaded each day with TENORM-containing filter cake material for five days for a total of 25 trucks. Approximately five dump truck loads of material were placed into a gondola car for a total of five gondolas. In general, material from multiple roll-off containers were loaded into a single dump truck and approximately 31 roll-offs were processed during the waste handling campaign as follows:

- Dump trucks were lined and loaded with approximately 18,144 kilograms (20 tons) each of TENORM-containing filter cake. Loading was accomplished utilized a medium sized excavator with a grade bucket (smooth edge) to move material from roll-offs into the dump trucks.
- Residual material and remaining liner materials from emptied roll-offs were cleaned using shovels/brooms into a skid steer bucket to facilitate transfer to another full roll-off for future shipment.
- Prior to departure the trucks were tarped and radiologically surveyed. Waste manifests were generated at the facility and given to the driver.
- Trucks departed the water treatment facility and transported their material to the transload facility. Upon arrival at the transload, trucks were weighed and transferred their material into lined gondola train cars. Approximately five truckloads of material were loaded into a single gondola train car.

The total radioactivity was calculated for each gondola and the gondola departed the transload facility for eventual disposition at the waste disposal site.

DISCUSSION

Overall, the backlog of TENORM-containing filter cake waste was handled, transferred and transported from the water treatment facility during the planned five days. This included 25 dump truck loads transloaded into 5 gondola rail cars. This process was performed for this initial backlog of TENORM-containing filter cake to alleviate storage constrains at the facility while alternate approaches could be evaluated. During the handling, transferring, and transporting TENORM-containing filter cake, several minor issues were encountered, including standing liquids and decontamination.

Standing Liquids

Due to the “dry” appearance of the filter cake material it was not expected that liquid/water issues would be encountered at any point during the waste handling and transporting activities. However, during the course of the week, upon arrival at the transload facility, four dump trucks presented with free standing liquids in the truck beds (Figure 1). Initially, the cause of the free standing liquids was thought to be due to infiltration of rain water into the dump truck, but then it

reoccurred on a day without rain. The filter cake material was determined to be thixotropic and releases water during transportation due to the vibrations.

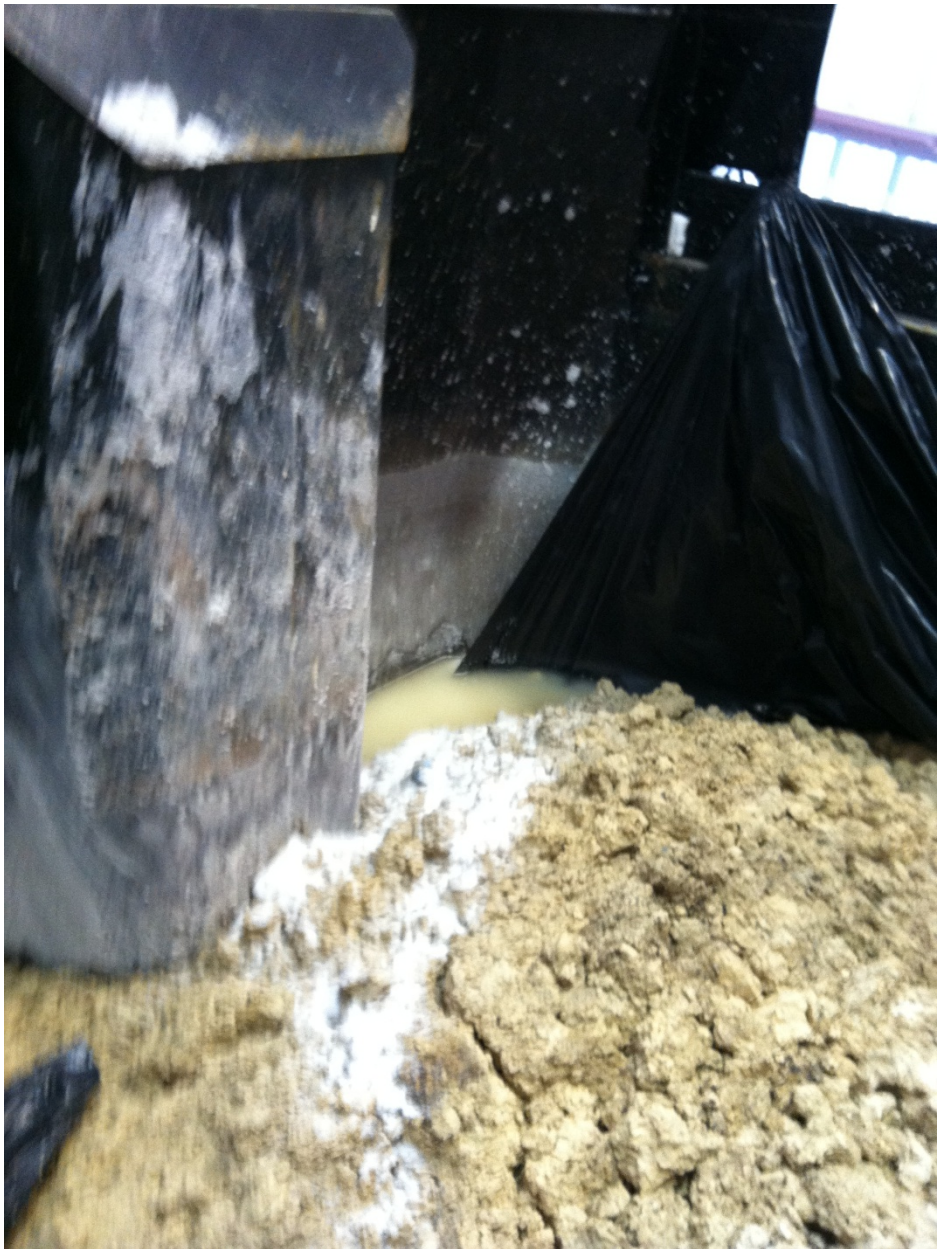

Figure 1 Picture of Standing Liquids upon Truck Arrival at the Transload Facility

In order to remedy this situation, water absorbent materials were added to outgoing dump truck shipments. Approximately 90 – 109 kilograms (200-240 pounds) of absorbent pellets were added into each dump truck before and during filter cake material loading (Figure 2). Additional precautions were taken to ensure the truck bed liner was properly installed and in place during the material loading process. This approach addressed the issue and resolved the concerns. The

waste profile for the disposal site was modified slightly to accommodate any potential accumulation of free standing liquids formed in a gondola car during the rail transportation.

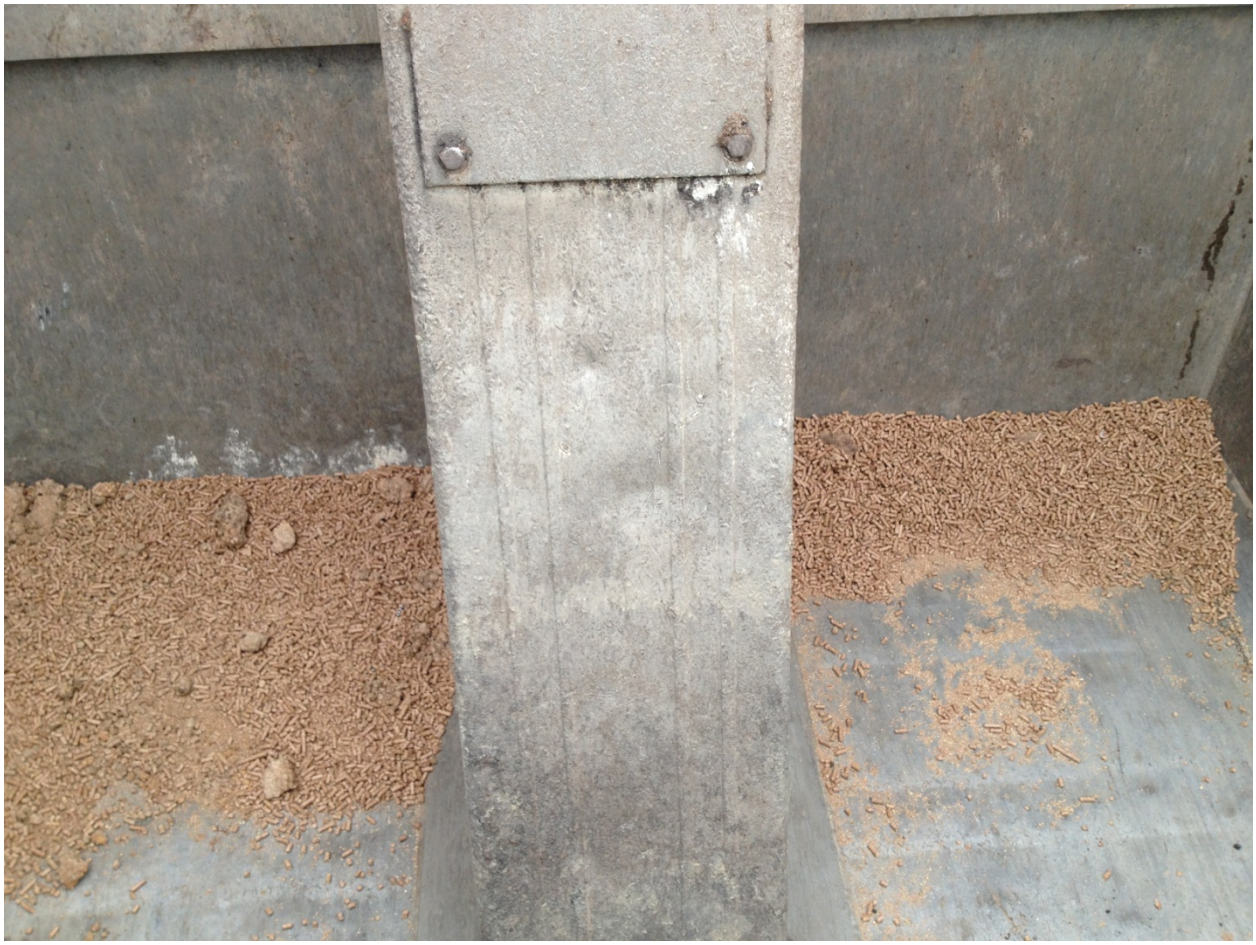

Figure 2 Picture of PIG Pellets Placed into Dump Truck Prior to Liner Installation

Decontamination

After surveying emptied roll-off containers with portable radiation instrumentation it was determined that additional decontamination methods would be necessary in order for the majority of the roll-off containers, excluding relatively new containers with a fresh coat of paint, to meet free release criteria. The protocol established was to pressure wash all roll-offs followed by a radiological survey for free release. A decontamination area was designated and a decontamination pad was constructed suitable for pressure washing roll-off containers. Following pressure washing of the roll-off containers, all bins were able to meet radiological free release criteria.

Field Measurements

Qualified staff provided observations and measurements during the waste loading process including general area surveys, radiological release surveys, radiological air monitoring, and dust air monitoring. General area radiation dose rate surveys were performed at least twice daily in the waste loading areas. Surveys were within expected ranges, typically between 0.1 – 0.6 microsievert per hour (uSv/h) (10 – 60 microrem per hour [urem/h]). Measurements recorded at the roll off bins containing filter cake material were in the 0.3 – 3 uSv/h (30 to 300 urem/h) range.

Release surveys were performed on empty roll-off containers, hand tools (e.g. shovels, scraper, broom, etc.), excavator bucket and tracks, and the Skid Steer bucket and tracks following pressure wash in the decontamination area. Scan/direct measurement surveys using an alpha/beta probe and smears surveys were performed.

TENORM particulate airborne radiological monitoring was performed during the waste transfer activities. Lapel BZ air monitors with a filter were utilized daily. Results of the airborne radioactivity measurements indicate that the waste handling activities did not generate significant airborne particulate matter. Given the nature of the filter cake material, it was not expected that airborne particulate matter would be generated during waste transfer process; however, the airborne monitoring was provided to document the actual conditions encountered and to establish a baseline for these activities.

Air monitoring for respirable dusts was conducted using a MIE Personal DataRAM PDR-1000. The dust monitor was positioned daily in a “downwind” location with a high potential for airborne dust, if present. Results were compared to the Action Levels listed in the MHP and were typically within expected ranges.

CONCLUSIONS

Approximately 450,000 kilograms (992,200 pounds) of TENORM-containing filter cake were loaded into lined dump trucks and transported to a transload facility. From the transload facility, materials were loaded into lined gondola train cars and departed for final disposition. Roll-off bins were emptied, cleaned, decontaminated, and surveyed for radiological free release. Similarly, equipment and tools that were used during waste transfer activities were cleaned, decontaminated, and surveyed for radiological free release.

Radiological observations and measurements during the waste load out process indicate that the accumulation of TENORM-containing filter cake material in roll off bins and transfer to lined dump trucks is not causing worker exposure to hazardous levels of radioactivity that would warrant additional radiological controls. Measurements recorded at the roll off bins containing filter cake material were in the 0.3 – 3 uSv/h (30 to 300 urem/h)r range.

Since the initial handling and transporting campaign, additional options have been utilized and are continuously being evaluated including utilizing roll-offs with a different rail spur, intermodals, or utilization of supersacks during generation of filter cake. Key factors influencing method selection include safety, minimizing container contamination, transportation regulations, cost, and maintaining worker exposures as-low-as-reasonably-achievable.