Environmental Protection Note 32

Evaluation and Determination of the Management of the Tritiated Water at the Booster Neutrino Beam at MI12

June 5, 2017

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Introduction

The ESH&Q Section recently took a close look at the details of how tritiated water in the Booster Neutrino Berm (BNB) sump system at MI12 was being managed. It was unclear if a review of the management options performed in the past to ensure that the water was being handled in the safest and most environmental conscious and cost effective manner considered budgetary impacts if operations resulted in sustained increases in tritium concentrations. Environmental and Radiation protection experts of the ESH&Q Section reviewed the current process, applicable regulations, and safety, radiological, and environmental impacts. The following documents the history of the tritiated water management at BNB, the details of this review and determination for a path forward.

Background

Tritiated water is created as a result of the accelerator operations that occur at MI12. This water is collected into two different systems: the sump system and condensate from the dehumidification system. Currently, the water generated from both the sump and the dehumidification system were collected and managed as Low Level Radioactive Waste (LLRW). The water is collected in drums, transported to Site 40, and solidified prior to disposal. The amount of water managed by this method is approximately 8,000-10,000 gallons of sump water and approximately 3,000 gallons of condensate annually. The management of this water as LLRW has cost the lab approximately $160,000 each year.

Fermilab's solidified sump and dehumidification water is disposed of at a LLRW landfill located in Clive, Utah. A shipment consists of 80 drums; processing the 80 drums is very labor intensive and utilizes an abundance of resources. Approximately 72 man hours for each shipment and over $10,500 of materials are expended. These materials include drums, absorbent, labels, banding material, pallets and blocking and bracing material. Transportation and disposal costs are an additional $21,000. Fermilab has shipped, on average, three shipments of absorbed water per fiscal year for the past five fiscal years.

Regulatory Review

The following regulations for target chase water generated at BNB were reviewed for applicability as a part of this determination. The list includes specific regulations, descriptions, and notes or interpretations made during their review.

Title 35 of the Illinois Administrative Code:

- 201.123 – Burden of Persuasion Regarding Exceptions
    - This regulation states that it is Fermilab's responsibility to prove that the target chase water is condensate water
- 201.146 – Exemptions from State Permit Requirements
    - Quoted from Section 201.146. "Construction or operating permits, pursuant to Sections 201.142, 201.143 and 201.144 of this Part, are not required for the classes of equipment and activities listed below in this Section. The permitting exemptions in this Section do not relieve the owner or operator of any source from any obligation to comply with any other applicable requirements, including the obligation to obtain a permit pursuant to Sections 9.1(d) and 39.5 of the Act, sections 165, 173 and 502 of the Clean Air Act or any other applicable permit or registration requirements."
    - 201.146 b) - Air conditioning or ventilating equipment not designed to remove air contaminants generated by or released from associated equipment
        - The MI-12 BNB Target Chase system is not a system that removes contaminates from the air. The Target Chase system is a dehumidifying system that only removes condensate water from the air in the target chase.
- 807.104 Solid Waste Definitions; "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking or placing of any waste into or on any land or water or into any well so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater. As used in this Part, "disposal" includes methods of storage or treatment in which there is no certain plan to remove wastes or waste residues from the storage or treatment unit to another unit for ultimate disposal. "Treatment" means any method, technique or process designed to change the physical, chemical or biological character or composition of any waste so as to neutralize such waste or so as to render such waste safer for transport, amenable for storage or reduced in volume
    - Solid Waste Definitions: The target chase water is not a solid waste as the target chase water is a condensate water and condensate water falls under an exemption.
- 807.201 Development Permits

- Requirement for obtaining a permit. This requirement does not apply as the condensate water falls under an exemption.

- 807.202 Operating Permits
  - Requirements for an operating permit. This requirement does not apply as the condensate water falls under an exemption.
- 807.205 Applications for Permit
  - Requirements for applying for a permit. This requirement does not apply as the condensate water falls under an exemption.
- 808.245 c) 1) Classifications of Waste
  - Definition that determines that condensate water would be a special waste if it did not fall under an exemption.
- 810 Solid Waste Disposal
- 810.103 – Definitions "Disposal"
  - Definition that would constitute evaporation as disposal. This requirement does not apply as the condensate water falls under an exemption.

The following directive for managing sump water containing > 1900 pCi/ml of tritium generated at BNB was reviewed as a part of this determination.

- DOE Order 458.1;
  - DOE O458.1 implements the Derived Concentration Standard (DCS) value of 1,900 pCi/ml for tritium along with the tabulated values therein of other radionuclides as the applicable standard for surface water discharges. Therefore, any water exceeding 1,900 pCi/ml of tritium may not be discharged to surface waters.

Radiological Review

Air emissions are governed by the IEPA/USEPA regulations applicable to the site, including 40 CFR 61 Subpart H (National Emission Standards for Hazardous Air Pollutants [NESHAP]). The NESHAP rule allows for an annual dose of 100 micro-rem to the Maximally Exposed Offsite Individual (MEOI) from all Fermilab radioactive air emissions combined. This is the Laboratory's annual budget for radioactive air emissions. The primary public dose limits include consideration of exposure modes from all Fermilab activities. Doses due to airborne radionuclide releases under 40 CFR 61 Subpart H (NESHAP), using the required code CAP88, conservatively apply to the MEOI. The Derived Concentration Standards (DCSs,

DOE-STD-1196-2011) for the general population for airborne radionuclides commonly encountered at Fermilab are given in Table 3-2 of the Fermilab Radiological Control Manual (FRCM).

- MI-12 BNB Target Chase Condensate

Assuming conservatively that the concentration of tritium in the air condensate from BNB is less than 200,000 pCi/ml, and that it is estimated that an average of 56, 55-gallon drums are generated each year, the results show that the annual MEOI dose from the condensate evaporation would be 0.06% of the laboratory budget. Therefore, the evaporation of BNB dehumidifiers' condensate will have a very small contribution to Fermilab's radioactive air emissions budget.

- Evaporation Water from the BNB Decay Pipe Berm Sump-Wells 1 to 6

Reviewing the RAF analysis reports of the 1,000-gallon tank samples from January 2013 through August 2016, showed that none had a Na-22 concentrations larger than 1 pCi/ml, or tritiated water concentrations greater than 10,000 pCi/ml. the results showed that the annual MEOI dose from Na-22 would be 0.2% of the Laboratory's budget. The dose from tritium evaporation, assuming a tank concentration of 10,000 pCi/ml, would be 0.03% of the Laboratory's budget. It is estimated that evaporating the average 400 55-gallon drums in a year of BNB sump discharges, at the above maximum concentrations will contribute 0.2% due to Na-22 and 0.03% due to tritium, to the Laboratory's annual air emissions budget.

Determination

In an attempt to reduce costs and minimize waste generation, a review was conducted on the management of the tritiated water that is produced at BNB at MI12. As the review was underway, it was apparent that past decisions to manage the tritiated water as a LLRW were made as a matter of conservatism. It did not include an evaluation of alternative options if concentrations >1900 pCi/ml were sustained. Alternative options have been reviewed for both the condensate and sump water as they result from two different generation streams. The following is the determination that was made for each:

- MI12 condensate

After a review of the processes that generates the condensate water, and the regulations that apply, the determination was made to manage the condensate water as an air emission through the evaporator. The condensate water is a result of the dehumidification system associated with BNB and is generated as a part of routine operations. The dehumidification system condenses the moisture in the air, generating the condensate. The evaporator would allow this condensate to return to its original form near the point of generation and be managed as an air emission.

- The sump water

After reviewing the water collection systems at MI12, and the regulations that apply, the determination is to continue to manage the tritiated sump water that contains > 1900 pCi/ml as a LLRW as a matter of normal practice.

Sump water that contains tritium in concentrations < 1900 pCi/ml will be allowed to enter the surface waters and monitored in compliance with the NPDES permit and Fermilab Environmental Monitoring Program.