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Brookhaven Medical Research Reactor

Facility Environmental Monitoring Report

Calendar Year 2002

BROOKHAVEN
NATIONAL LABORATORY

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Summary of Results

Although the BMRR was shut down in December 2000, BNL has maintained the semi-annual periodic emissions monitoring program to verify that radionuclide emissions are diminishing as anticipated. Emissions monitoring during 2002 confirmed that no radionuclides were emitted from the BMRR facility.

Analyses of groundwater samples collected from BMRR monitoring wells during CY 2002 indicate that engineered and operational controls have been effective in protecting groundwater quality. Monitoring results indicate that tritium concentrations continue to be well below the 20,000 pCi/L drinking water standard.

Water discharges from the BMRR were permanently discontinued in June 2001, and a permit modification request was submitted to NYSDEC to remove this discharge from BNL's SPDES permit. These changes were approved by NYSDEC, and a revised SPDES permit was received in February 2002.

Background

The Brookhaven Medical Research Reactor (BMRR) is a 3 MW light water reactor that was used for biomedical research. Research operations at the BMRR stopped in December 2000, and BNL is preparing plans to permanently decommission the facility.[1]

Comment [KR1]: We need to say whether the fuel removal occurred in 2002 as scheduled, and if all primary cooling water was drained.

The BMRR's primary cooling water system consists of a recirculation piping system that contains 2,550 gallons of highly tritiated water. Unlike the High Flux Beam Reactor (HFBR), the BMRR does not have a spent fuel storage canal or pressurized embedded piping systems that contain radioactive liquids. Historically, fuel elements that required storage were either stored within the reactor vessel or were transferred to the HFBR spent fuel canal. The primary system's piping is fully exposed within the containment structure and is accessible for routine visual inspections. When the BMRR was operational, excess heat was transferred by means of heat exchangers with once-through (secondary) cooling water that was obtained from former Process Well 105 or the BNL Chilled Water System. This secondary water was discharged to recharge basin HP (SPDES Outfall 004) located 800 feet to the south of the Medical Department complex. These discharges were monitored as part of the State Pollutant Discharge Elimination System (SPDES) program.

To cool the neutron reflector surrounding the core of the BMRR reactor vessel, air from the interior of the containment building was used. When air was drawn through the reflector, it was exposed to a neutron field that caused the argon component of the air to become radioactive. This radioactive form is known as argon-41, which is a chemically

[1] All spent fuel has been removed from the BMRR, and the primary cooling water system is scheduled to be drained by the end of CY 2003.

inert gas with a half-life of only 1.8 hours. After passing through the reflector, air was routed through a roughing filter and a high efficiency particulate air (HEPA) filter to remove any particulate matter, then finally through a charcoal filter to remove radioiodines produced by the fissioning of fuel. Following filtration, the air was exhausted to a 150-foot stack adjacent to the reactor containment building. Although the facility is inactive, a real-time monitor continues to track potential remnant argon-41 air emissions, while passive filter media are used to collect and quantify radioiodines and particulates.

In 1997, tritium was detected in wells installed directly downgradient (within 30 feet) of the BMRR. The maximum tritium concentration during 1998 was 11,800 pCi/L, almost one-half of the drinking water standard of 20,000 pCi/L. The tritium is believed to have originated from the historical discharge of small amounts of BMRR primary cooling water to a basement floor drain and sump system that may have leaked. Although the last discharge of primary cooling water to the floor drain system occurred in 1987, the floor drains continued to be used for secondary (nonradioactive) cooling water until 1997. The infiltration of this water may have promoted the movement of residual tritium from the soils surrounding the floor drain piping system to the groundwater. The floor drains were permanently sealed in 1998 to prevent any accidental future releases to the underlying soils.

Environmental Monitoring Program

The environmental monitoring program for the BMRR is described in the BNL Environmental Monitoring Plan (BNL, 2000 and 2002). The BMRR monitoring results and recommendations are summarized below.

Monitoring Results

Air Monitoring

Since the BMRR was shut down in December 2000, BNL has maintained semiannual monitoring of argon-41 emissions; passive filter media are used to collect and quantify radioiodines and particulates. Periodic monitoring was implemented at the BMRR facility in accordance with NESHAP requirements to confirm that the air concentrations for radionuclides remained below detection levels. When BMRR was operational, it was a major point source of airborne radioactive emissions released from the BNL site, with argon-41 consistently contributing the largest fraction of all radionuclide activity released. Following the termination of reactor operations, the probability for particulates, radioiodines, and argon-41 emissions has been very low. Historically, argon-41 was the only radionuclide that had the potential to contribute a small fraction of dose to members of the public. As anticipated, monitoring of BMRR emissions during 2002 did not detect any reactor-derived radionuclides.

Groundwater Monitoring

Samples collected from four groundwater monitoring wells are used to verify that the engineered and administrative controls described above are effective in preventing additional impacts to groundwater quality (Figure 1).

Monitoring results for sampling conducted during 2002 indicate that tritium concentrations continued to be well below the drinking water standard of 20,000 pCi/L. Detectable levels of tritium were observed in all three downgradient wells, with the maximum value of 4,680 pCi/L in Well 084-27 (Table 1 and Figure 2). Note that groundwater monitoring conducted during 1997 though 2001 did not detect any other reactor-related radionuclides. Therefore monitoring for 2002 focused on tracking tritium concentrations in the groundwater.

SPDES Monitoring

As noted above, once-through cooling water was used to cool the BMRR. Discharges from this system were release to Outfall 004 (Figure 3), and monitored in accordance with the SPDES permit. Water discharges from the BMRR were permanently discontinued in June 2001, and a permit modification request was submitted to NYSDEC to remove this discharge from BNL's SPDES permit. These changes were approved by NYSDEC, and a revised SPDES permit was received in February 2002.

Future Monitoring Actions

The following actions are recommended for the CY 2003 monitoring period:

- Continue to sample the monitoring wells on a semiannual basis. Analyze samples for tritium.
- Request DOE approval to discontinue air monitoring because the BMRR fuel was removed, and the source of Ar-41 emissions no longer exists.

References

BNL. 2000. *Brookhaven National Laboratory Environmental Monitoring Plan 2000*. BNL-52584. Brookhaven National Laboratory, Upton, NY. March 2000.

BNL. 2002. *Brookhaven National Laboratory Environmental Monitoring Plan CY2002 Update.* BNL-52584 (Update). Brookhaven National Laboratory, Upton, NY. January 2002.

Table 1. Groundwater Tritium Results Near the BMRR, CY 2002.

Well	Location	Collection Date	Tritium Result	Tritium MDL
			----------pCi/L----------	
84-28	Upgradient of BMRR	03-19-02	<362	362
		09-09-02	<296	296
84-12	Downgradient of BMRR	03-19-02	437 +/- 290	362
		09-09-02	<296	296
84-13	Downgradient of BMRR	03-19-02	583 +/- 299	362
		09-09-02	837 +/- 232	296
84-27	Downgradient of BMRR	03-19-02	4,610 +/- 420	362
		09-09-02	4,680 +/- 372	296
Drinking Water Standard			20,000	

Notes:
MDL = Minimum Detection Limit
"<" preceding a value (e.g., <362) indicates that the measured value was less than the stated MDL.

Figure 1. BMRR Area Groundwater Monitoring Wells.

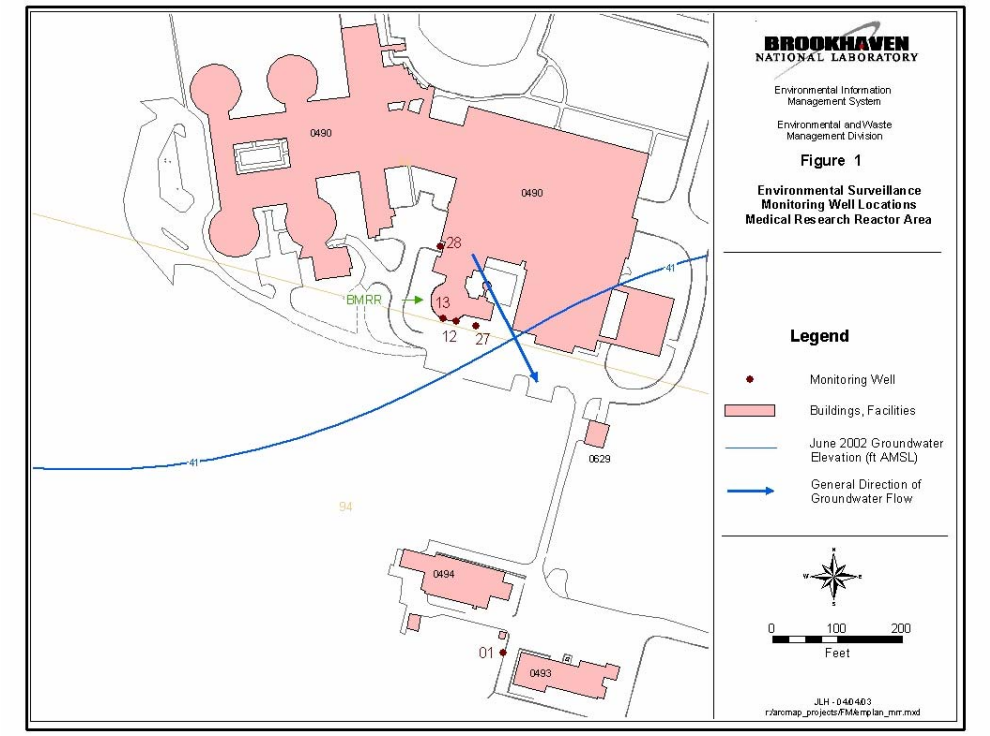

Figure 2. Tritium Concentrations at the BMRR 1997–2002.

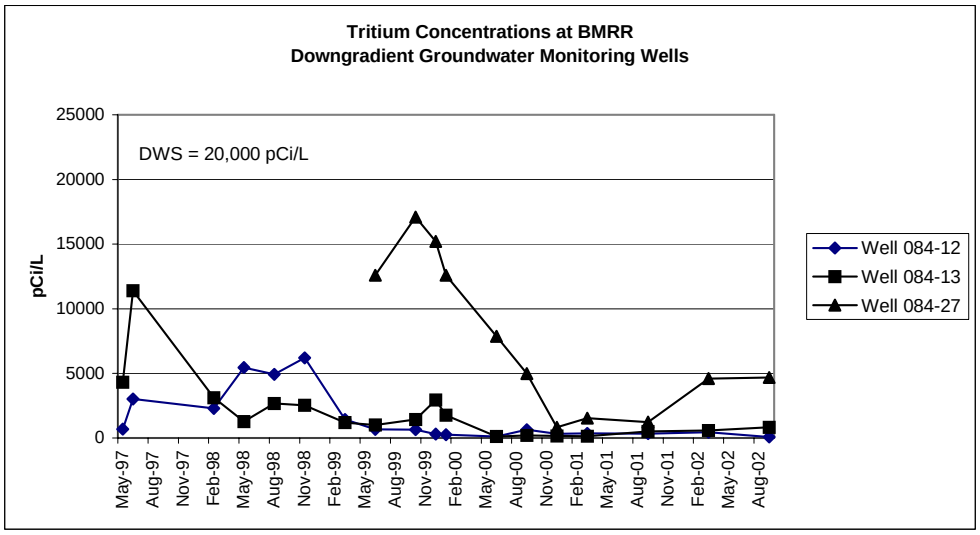

Figure 3. **Location of SPDES-Permitted Outfalls.**