Knolls Laboratory Environmental Summary Report

September 2022

Prepared for the U. S. Department of Energy
by Fluor Marine Propulsion, LLC

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KNOLLS LABORATORY

ENVIRONMENTAL SUMMARY REPORT

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Prepared for the U.S. Department of Energy
By
Fluor Marine Propulsion, LLC
Knolls Laboratory
Niskayuna, New York
Document Number: KN-RES-ESH-EC-00341

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AOC	Areas of Concern
ASFP	Air State Facility Permit
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curies
CWA	Clean Water Act
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy – Office of Environmental Management
EMR	Environmental Monitoring Report
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FFCA	Federal Facility Compliance Act
FMP	Fluor Marine Propulsion, LLC
GAO	Government Accountability Office
HEPA	High Efficiency Particulate Air [filters]
hr(s)	hour(s)
LDA	Land Disposal Area
LLC	Limited Liability Corporation
KAPL	Knolls Atomic Power Laboratory
mgd	Million Gallons per Day
MTRU	Mixed Transuranic
MWMP	Mixed Waste Management Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NNL	Naval Nuclear Laboratory
NNPP	Naval Nuclear Propulsion Program
NOV	Notice of Violation
NPL	National Priorities List
NR	Office of Naval Reactors
NRC	U.S. Nuclear Regulatory Commission
NRLFO	Naval Reactors Laboratory Field Office
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PBS	Petroleum Bulk Storage
PCB(s)	Polychlorinated Biphenyl(s)
PWR	Pressurized Water Reactor
RCRA	Resource Conservation and Recovery Act
RML	Radioactive Materials Laboratory
SARA	Superfund Amendments and Reauthorization Act
SPDES	State Pollutant Discharge Elimination System
SPRU	Separations Process Research Unit
SPUD	Surface Penetrating Underground Detector
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
TSCA	Toxic Substances Control Act
USACOE	U.S. Army Corps of Engineers

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1.0 OVERVIEW AND CONCLUSIONS

The Knolls Atomic Power Laboratory (KAPL) - Knolls Laboratory (hereafter Knolls Laboratory), located in Niskayuna, New York, is a Government-owned, Contractor-operated facility. The Knolls Laboratory is owned by the U.S. Department of Energy (DOE) Office of Naval Reactors (NR) and currently operated by Flour Marine Propulsion, Limited Liability Corporation (FMP, a wholly owned subsidiary of Fluor Corporation). The Laboratory's mission is to conduct research and development in the design and operation of nuclear propulsion plants for U.S. Navy submarines and surface ships. General Electric operated the Knolls Laboratory under Government contract, from its inception in 1946 until 1993. In 1993, responsibility for operation of the Knolls Laboratory was transferred to KAPL, Inc., a subsidiary of the Martin Marietta Corporation. In 1995, KAPL, Inc. became a Lockheed Martin company, after the Martin Marietta and Lockheed corporations merged. The Bechtel Marine Propulsion Corporation (BMPC, a wholly owned subsidiary of Bechtel National, Inc.), operated Knolls Laboratory from February 2009 until October 2018, when BMPC was replaced by FMP. Also, in 2016, the Naval Nuclear Propulsion Program (NNPP) implemented the use of "Naval Nuclear Laboratory" (NNL) to refer to the collective operations of the four DOE sites that perform NNPP work and the personnel operating at the associated locations.

Knolls Laboratory is one of two single purpose laboratories operated by FMP and dedicated to the NNPP; the other is the Bettis Atomic Power Laboratory located in West Mifflin, Pennsylvania.

This report describes the environmental history of the Knolls Laboratory through 2021. A similar report describing the environmental history of the Kenneth A. Kesselring Site (hereafter, Kesselring Site) is issued separately.

The west side of the Knolls Laboratory contained an inactive, Cold War era facility known as the Separations Process Research Unit (SPRU), which operated between 1950-1953. At that time, Knolls Laboratory was operated as a general-purpose Laboratory for the Atomic Energy Commission (AEC) and SPRU made a valuable contribution by improving efficiency and decreasing the amount of radioactive waste associated with nuclear weapons production.

Following cessation of SPRU operations in 1953, partial cleaning of equipment and systems was performed, and the facility was placed in a stable long-term storage condition. Knolls Laboratory maintained an environmental monitoring program to confirm that the inactivated SPRU facility posed no threat to the health of site workers, the public, or the environment.

Consistent with the Federal Government's objective to clean up legacy sites that are no longer needed, funding was dedicated back in 1992 to support SPRU dismantlement and remediation. Knolls Laboratory turned over responsibility for the SPRU buildings and land areas to the DOE Office of Environmental Management (DOE-EM) in 2008, creating two separate entities on the DOE's property: Knolls Laboratory and SPRU. DOE-EM completed the majority of the SPRU dismantlement and remediation activities in 2019; however, DOE-EM still has some minor remediation work to complete and waste to disposition. The SPRU dismantlement and remediation activities have resulted in the removal of hazardous equipment and material from the Knolls Laboratory and restoration of the land for Knolls Laboratory use.

Separate information on the SPRU remediation project can also be found at the DOE-EM website *http://www.spru.energy.gov*.

Additionally, in 2019, NR and DOE-EM established an agreement for the decontamination and decommissioning (D&D), and environmental remediation of inactive environmental liabilities at NNL sites. In this endeavor, NR will capitalize on DOE-EM's core expertise in efficient, safe and cost effective remediation of environmental liabilities across the DOE laboratory complex. Recognizing that D&D and environmental remediation carry a high degree of uncertainty until comprehensive characterization and surveys more fully define the scope and cost, significant increases in productivity are expected by taking advantage of DOE-EM expertise in this area.

1.1 Background

For many years, Knolls Laboratory has performed environmental monitoring to demonstrate that the Knolls Laboratory is operated in accordance with environmental standards. The results of this monitoring have been published in annual Environmental Monitoring Reports (EMRs) provided to Federal, State, and local officials. These reports demonstrate that the Knolls Laboratory's monitoring practices meet, and are often more strict than, the requirements of applicable laws and regulations. The monitoring results confirm compliance with environmental standards, in many cases by a significant margin.

1.2 Purpose

While the annual EMR describes monitoring practices and results, it does not describe the nature and environmental aspects of the Knolls Laboratory's work and facilities, nor does it give a historical perspective of the Laboratory's operations. The purpose of this report is to provide this information as well as background information pertinent to understanding the environmental aspects of Laboratory operations.

1.3 Conclusions

Knolls Laboratory has had effective environmental control programs in place since operations at the Knolls Laboratory began in 1949. The objective has always been to meet or exceed the requirements of laws and regulations applicable at the time. The following conclusions may be drawn from this report and the results published in the annual EMR:

- Knolls Laboratory's performance in radioactivity control has established and maintained levels of control that are more stringent than applicable requirements (Sections 5.1 and 5.2). The following examples illustrate this point:
    - Radiation exposure to any member of the public due to Knolls Laboratory operations is too small to be measurable. The maximum possible annual radiation dose to any member of the public resulting from Knolls Laboratory operations can only be calculated using conservative assumptions of radioactivity release and human uptake. Such a calculation shows that the maximum dose is less than 0.1 millirem per year from current Knolls Laboratory operations and DOE-EM activities during 2021. This is about one-thirtieth of the radiation received from cosmic radiation sources during a one-way cross-country airplane flight from New York to Seattle. The calculations also show that if a person had lived continuously next to the Knolls Laboratory since Knolls Laboratory operations began in 1949, that person's total radiation exposure from operations at the Laboratory would be less than the same individual receives in four months from natural radiation sources (Section 7.0).

- There are no designated radioactive waste disposal sites at the Knolls Laboratory. There are, however, areas on Laboratory property where radioactivity releases and incidental radioactive material burial occurred in the early days of Laboratory operations. The total amount of radioactivity in the affected on-site areas is estimated to be approximately 0.5 curies (Ci). For perspective, 0.5 Ci is less than the amount of naturally occurring radioactivity in the top half-inch of soil covering an area the same size of a typical 18-hole golf course (170 acres) in the Schenectady region (Sections 5.1, 5.2, 6.0 and 7.1).

- Knolls Laboratory practices for handling chemical waste conform to established regulations. Knolls Laboratory meets or exceeds the stringent requirements for waste disposal that have been established by law since the late 1970's. In the past, however, chemical waste disposal was carried out in accordance with what were common industrial practices at the time. Past practices included burial of some chemicals at the Knolls Laboratory's former Land Disposal Area. The amount that was buried is estimated to be about 90 cubic feet per year through 1977, when such practices ceased. The land area involved was about 5% of the Laboratory area. Because of these practices, several chemical constituents are detectable in groundwater in the immediate vicinity of the historic chemical disposal areas, but pose no threat to public health or to the environment. The affected groundwater is limited in extent and is not migrating off-site. In addition, no detectable changes have been found in on-site stream samples or beyond the Laboratory's boundary in the Mohawk River water (Sections 5.0 and 7.0).

  - The U.S. Environmental Protection Agency (EPA), in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as "Superfund," conducted an evaluation of the areas containing radioactivity or chemical residues at the Knolls Laboratory. At the conclusion of this evaluation (called a Preliminary Assessment), the EPA concluded that the environmental significance of these areas was small, and therefore the Knolls Laboratory is not listed as a Superfund site on the National Priorities List (NPL). As a result, no CERCLA remedial action is anticipated. The Knolls Laboratory is continuing actions to preclude any impact on the environment from residual chemical or radioactive materials (Sections 5.1 and 9.0).

  - Subsequent to the EPA's CERCLA decision, all other work related to the historical chemical or waste disposal areas has been subject to the Resource Conservation and Recovery Act (RCRA) regulations administered by the New York State Department of Environmental Conservation (NYSDEC). The Knolls Laboratory manages hazardous waste associated with current operations in accordance with Title 6 of the New York Code, Rules and Regulations (NYCRR) Part 373 Hazardous Waste Management (RCRA) Permit issued by NYSDEC. This Permit also contains Corrective Action provisions that involve characterization and remediation, if necessary, of historical waste disposal areas. DOE-EM had a separate RCRA Corrective Action Only permit related to the SPRU project for characterization and remediation associated with the SPRU areas. DOE-EM is now operating under a Consent Order for the management of mixed transuranic waste that is currently in long-term storage. On-going characterization continues to confirm that historical chemical or waste disposal areas at Knolls Laboratory do not adversely affect human health or the quality of the environment (Sections 5.1 and 7.0).

  - DOE, using its authority under CERCLA, has pursued cleanup of radioactivity and the chemicals in the SPRU areas using the non-time critical removal action process and has completed all cleanup activities with the exception of a small area in the F-Yard.

- Knolls Laboratory's operations and environmental performance have always been subject to continuous oversight by resident NNPP representatives of the DOE (previously the AEC and then the Energy Research and Development Agency). Periodic in-depth reviews and inspections by NNPP headquarters personnel are also conducted (Section 8.0).

- In addition to Knolls Laboratory and NNPP reviews and inspections, various aspects of Knolls Laboratory and DOE-EM environmental programs continue to be periodically inspected by Federal and State agencies. Most recent inspections in 2011 – 2021 have found the Knolls Laboratory operations to comply with all substantive requirements (Section 8.0). There was one area of non-compliance identified by the EPA during 2010, regarding radionuclide National Emission Standard for Hazardous Air Pollutants (NESHAP), resulting from their investigation into the September 29, 2010, unplanned airborne release of radioactivity by SPRU (DOE-EM) during open-air demolition of Building H2. EPA and DOE signed a Compliance Order on Consent (Order) in March 2012. All short-term corrective actions specified in the Order were completed in May 2012. The EPA informed DOE on June 5, 2012, of EPA's conclusion that the Knolls Laboratory was back in compliance with the radionuclide NESHAP regulations. The remainder of the corrective actions specified in the Order were completed on February 28, 2013, and EPA issued a Consent Agreement and Final Order on May 28, 2014, which closed out the Order. This is further discussed in Section 8.0.

- The EPA also performed an extensive evaluation of Knolls Laboratory's operations and compliance with statutory and regulatory requirements during 1999 in multiple environmental areas, including waste disposal practices, pollution controls, operational procedures, and internal monitoring and external reporting; that is, a "Multi-Media Environmental Compliance Inspection". The EPA found no significant environmental impact from Knolls Laboratory operations.

  Following that evaluation, the EPA conducted Consolidated Multi-Media Environmental Compliance Inspections of the Knolls Laboratory in the years 2014, 2018 and 2020. These inspections, also known as a Multi-Media Screening Inspection, cover multiple EPA regulated areas usually by one or two EPA inspectors. The EPA results found Knolls Laboratory operations to comply with the regulations and the information provided by the EPA indicated no significant concerns (Section 8.0)

- The Government Accountability Office (GAO) (known as the General Accounting Office until 2004) reviewed Knolls Laboratory's environmental, health, and safety practices in 1991 and found that radioactive and hazardous materials are handled, stored, and disposed of in a safe manner and that employees, the public, and the environment are protected (Section 8.0).

In conclusion, in over seven decades of operation, there has been no significant impact from Knolls Laboratory operations on the environment or adverse effect on the community or the public. Knolls Laboratory has a well-defined environmental program in place to monitor current operations and address the results of past activities, which occurred when regulations and common industrial practices were less stringent.

2.0 THE KNOLLS LABORATORY

2.1 History

Construction of the Knolls Laboratory began in 1948 and operations began in 1949. The original mission of the Knolls Laboratory was to develop a chemical process for the separation of radionuclides from irradiated nuclear fuel, to develop the basic science of reactor design, and to develop an electric power station breeder reactor based on liquid metal coolant technology. The chemical process work, designated SPRU, was under the direction of the AEC's nuclear weapons program. The SPRU research project was completed in late 1953, although some minor support of chemical process work continued for several years. In 1950, the electric power station project was converted to a NNPP project using liquid sodium coolant technology. This was later supplemented by work on naval pressurized water reactor (PWR) plant technology.

By the late 1950s, the Knolls Laboratory was directing its attention to pressurized water technology, which had been established as technically superior to sodium technology for naval reactor application. Since the completion of SPRU related research in the mid-1950s, Knolls Laboratory has been dedicated to Naval nuclear propulsion research and development.

All Naval nuclear propulsion work has been, and remains, under the sole technical direction of the NNPP, operating initially as an element of the AEC and the Department of the Navy, and today as a DOE and Navy organization.

2.2 Significant Accomplishments

The technology developed at Knolls Laboratory is a critical element of the Nation's defense, making possible the extraordinary capabilities of U.S. nuclear-powered submarines and aircraft carriers that today comprise more than 40% of the Navy's major combatant fleet. Key achievements at the Knolls Laboratory include the development of the sodium-cooled reactor for the original Seawolf, the Nation's second nuclear-powered submarine; development of the dual PWR propulsion plant for the former submarine Triton; and development of the dual nuclear propulsion plant for the former guided missile cruiser Bainbridge and subsequent nuclear-powered cruisers. Knolls Laboratory has also developed advanced nuclear propulsion plants and long-lived reactor cores for modern nuclear powered ships including Los Angeles Class attack submarines and Ohio Class ballistic missile submarines. Work continues today on further advances in Naval nuclear propulsion technology, including the newest generation attack submarine, the Virginia Class, the next generation aircraft carrier, the Ford Class, and the next generation ballistic missile submarine the Columbia Class.

3.0 DESCRIPTION OF SITE

3.1 Site Location

The Knolls Laboratory is located in Schenectady County in the Town of Niskayuna, New York, on the south bank of the Mohawk River. The Laboratory consists of 170 acres of government-owned land, extending approximately 4,200 feet along the river. Most of the Laboratory property is located on a bluff about 100 feet high with a steep slope dropping off to a terrace about 15 to 20 feet above the river.

The Laboratory facilities are located in two principal areas (Figure 1). The larger area is at the top of the bluff on the northwesterly section of the property and is called the "Upper Level". The smaller area is located on the "Lower Level" terrace adjacent to the river. These two areas occupy about 60 acres (35%) of the property. The balance of the Laboratory property consists of woods and fields.

Figure 1 - Knolls Laboratory Reservation

The Knolls Laboratory is largely self-supporting and consists of offices, laboratory buildings, a warehouse, maintenance shops, a boiler house for centralized heating, and a river pumping station for cooling water. Water for domestic purposes and fire protection is supplied by the City of Schenectady and the Town of Niskayuna municipal water systems. A commercial utility company supplies natural gas and electrical power. A sanitary sewage pumping station transfers sanitary wastes to the Town of Niskayuna sanitary sewer system. The Laboratory roads and approximately 17 acres of parking lots are owned by the DOE and maintained by the Knolls Laboratory.

In 2007, the DOE purchased a residential house, located at the south side of the Knolls Laboratory along River Road. The property was first remediated to remove contaminants such as asbestos containing building materials and home heating oil from a cellar storage tank. The house was then demolished and the land returned to a "green grass" status in October 2010.

3.2 Land Use

The Knolls Laboratory is located in the northeastern part of Schenectady County. Schenectady County, together with the counties of Albany, Saratoga, and Rensselaer, form a larger metropolitan area called the Capital District, with a combined population of approximately 875,000 people. The section of the Town of Niskayuna in which the Knolls Laboratory is located is zoned as Research and Development - Industrial. On Knolls Laboratory's western border is the General Electric Global Research Center and to the east is the former Town of Niskayuna municipal landfill, which was converted to a community park after closing in 1994. To the south is a residential area, and to the north is the Mohawk River.

Land use plans have been developed for the Capital District and the Town of Niskayuna. These plans are based on the New York State Development Plan. Continued operation of the Knolls Laboratory is consistent with the planned future land uses for the area.

3.3 Geology and Seismology

The Knolls Laboratory is located in the northeastern sector of Schenectady County. This area lies across the western boundary of a lowland bounded on the north by the Adirondack Mountains, on the east by the Taconic Mountains, on the south by the Helderberg Escarpment of the Allegheny Plateau, and on the west by hills that lie between the Helderberg Escarpment and the Adirondack Mountains. The lowland has been deeply eroded and has considerable relief. In the vicinity of and within the Knolls Laboratory, wells and test borings show that surface deposits consist mainly of basal till overlying shale bedrock. The depth to the flat-lying bedrock is a function of the till thickness, generally ranging between 0 and 70 feet. The basal till deposits underlying the Laboratory are dense, tough, and compact as a result of being pressed down by the great weight of continental glaciers during the ice ages.

The area in which the Knolls Laboratory is located contains a number of faults but is only moderately active with respect to seismic events. Historic records of earthquakes that have occurred regionally date back about 300 years. No earthquake of intensity greater than about 5 on the Richter Scale (VII on the Modified Mercalli Scale – negligible damage to buildings of good design and construction) has been recorded within 100 miles of the Laboratory.

3.4 Hydrology

3.4.1 Surface Water Description

The major surface water in the vicinity of the Knolls Laboratory is the Mohawk River, serving as the main watercourse for the Mohawk River Drainage Basin. The reach of the Mohawk River formed by the movable dam at Scotia, New York (Lock 8) and the permanent dam at Vischer Ferry (Lock 7) is commonly referred to as the Niskayuna Pool. The pool is 10.7 miles long and at normal stages has a surface area of about 2 square miles. The Knolls Laboratory is located on the south bank of the Niskayuna pool about 1.7 miles upstream from the Vischer Ferry Dam. Surface water from the undeveloped sections of the Laboratory drains to the Mohawk by way of three small intermittent streams.

3.4.2 Groundwater Description

The groundwater conditions at the Knolls Laboratory have been extensively studied. The till and shale underlying the Laboratory have poor aquifer characteristics, with low porosities and permeabilities due to their high degree of consolidation and their small grain size. Neither the till nor the shale contains aquifers that would be suitable for either municipal or industrial water supply development. Overlying the till in the eastern portion of the site are silt and clay deposits and discontinuous deposits of sand and gravel associated with glacial meltwater. The sand and gravel deposits are capable of transmitting water, but their limited extent diminishes the potential for yielding useable water volumes. Water moves under the Knolls Laboratory towards the river at less than 5-10 feet per year. There are no known wells used for domestic consumption in the vicinity of the Laboratory, since area residences are all served by a municipal water system.

3.4.3 River Water Use

Along with its role as a navigable waterway and recreational resource, the Mohawk River supplies water for domestic and industrial purposes. The Knolls Laboratory uses Mohawk River water in single-pass heat exchangers at an average rate of about 1.6 million gallons per day (mgd), with a maximum system capacity of approximately 5 mgd. These heat exchangers have no association with radioactivity, and the associated test equipment is monitored to preclude the potential for chemicals in the test equipment from affecting the river water.

The Latham Water District is the nearest downstream user of Mohawk River water as a potable supply. The other major sources of potable water in northeastern Schenectady County and southern Saratoga County are from wells located in gravel deposits adjacent to the Mohawk River. The gravel deposits are recharged, in part, from the river as water is withdrawn.

4.0 DESCRIPTION OF OPERATIONS

4.1 Past Operations

During the early years of operation of the Knolls Laboratory, research was conducted on several new technologies, but was focused primarily in two areas: SPRU and, beginning in 1950, Naval nuclear propulsion plant development.

The SPRU work was conducted under the direction of the AEC's nuclear weapons program. The function of SPRU was to develop and refine a process for the extraction of useful radionuclides from irradiated nuclear fuel. The work was done on a limited scale; SPRU was never a production plant. Test quantities of fuel were dissolved in acids and treated with various chemicals to separate the radionuclides. The process included extraction, packaging, and shipment of the resultant wastes. The SPRU processes were developed for use at the AEC's Hanford Site in Washington State and Savannah River Plant in South Carolina.

SPRU work occupied several buildings on the Upper Level of the Knolls Laboratory. A rail siding on the Lower Level was used for packaging and shipping of radioactive materials. Most of the radioactivity from SPRU was processed in Building H2 located on the Upper Level. An area on the Upper Level was also used in the early 1950s to store drums of radioactive waste awaiting shipment off-site for disposal. Areas of former SPRU activities on the Upper and Lower Levels are shown in Figure 2.

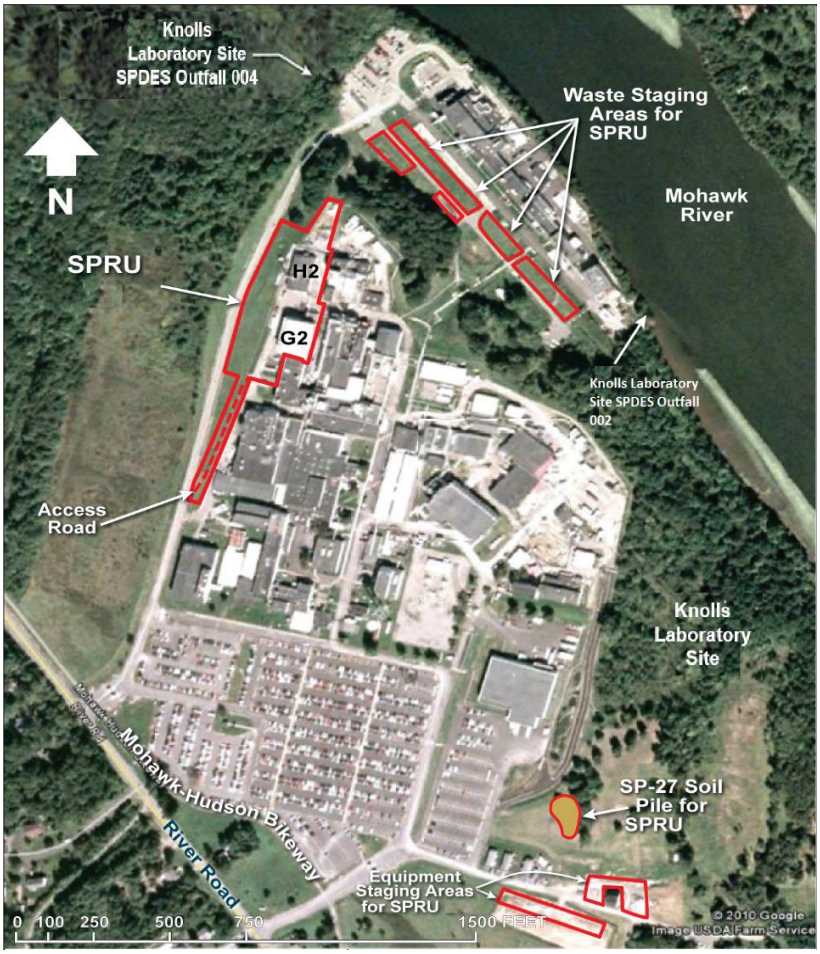

Figure 2 - Former DOE-EM SPRU Areas

Separations research work at the Knolls Laboratory was completed in late 1953, although some minor chemistry process support continued for several years. During the next several years, substantial effort was devoted to disposing of the waste products generated by the SPRU program and conversion of some of the space in the SPRU facilities for use in support of on-going programs. By the mid-1960s, most of the liquid and solid products and wastes in the SPRU systems were removed. Additional radioactive materials remaining in the systems were removed in 1977.

4.2 Present Operations

Since the mid-1950s, Knolls Laboratory's work has continued to be exclusively engaged in the development of nuclear propulsion plants for the U.S. Navy. Much of the work at the Knolls Laboratory is conducted in office and computer spaces, employing scientists and engineers in propulsion plant design, operator training development, and procedure preparation activities. Physical work involving the development of improved materials and components for Naval nuclear propulsion plants is conducted in several Knolls Laboratory facilities described below.

Chemical Laboratories

The chemical laboratories consist of several individual laboratories for mass spectrometry, corrosion testing, chemical analysis, radiochemistry, and other related analytical and developmental functions. Most of the chemical laboratory work involves non-radioactive materials and is confined to appropriate containment areas, such as laboratory benches and hoods. For radioactive work, containment areas are provided with filtered and monitored ventilation exhaust systems and controlled drainage systems that convey liquids to collection tanks for absorption for disposal as solid waste. Hazardous and non-hazardous chemical waste is collected for proper off-site disposal. Non-hazardous analytical waste and wash water drain to the sanitary wastewater system (see Section 5.1.2).

Fluids and Corrosion Testing Laboratories

These facilities are used to test power plant components. Both high and low pressure and temperature facilities are operated to support materials and equipment development work. Hazardous chemical waste is collected for proper off-site disposal.

Metallurgical Laboratories

These laboratories are operated to provide services related to the development, fabrication, testing, and inspection of materials for use in Naval reactors. Similar to the other laboratories, most of the work is on non-radioactive materials. Radioactive work is confined to containments serviced by filtered and monitored ventilation systems and controlled drainage systems that convey liquids to collection tanks for absorption for disposal as solid waste.

Radioactive Materials Laboratory

The Radioactive Materials Laboratory (RML) consists of shielded cells and support facilities for the physical, chemical, and metallurgical testing of highly radioactive material specimens. The quantities of such materials handled on-site are small; however, the level of radioactivity in the RML requires the use of the shielded cells. The facility is designed to assure complete containment of the radioactivity within sealed and shielded cells equipped with exhaust air filters. In addition, the facility has comprehensive radiation monitors to verify the integrity of the shielded containment rooms and the effectiveness of the air handling systems. Due to the small volumes generated, RML radioactive liquids are collected and absorbed for shipment to an off-site disposal facility. The controlled drainage system that conveyed liquids to collections tanks for processing is no longer used.

Machine Shops

Machine shop facilities are used to perform machining operations such as turning, milling, grinding, and drilling on a variety of non-radioactive metal products used in research at the Laboratory.

Storage Vaults

Materials for use in reactor development are stored in vaults with special safety and security provisions. Only a small amount of such material is kept at the Knolls Laboratory. The storage vaults are serviced by a filtered exhaust system. Personnel involved in the handling of these materials are specially trained in nuclear and radiological safety and security.

Other Facilities

In addition to the technical facilities described above, there are a number of support facilities necessary to sustain Laboratory operations. These facilities include office buildings that house the scientists, engineers, and support staff; a library; a computing center; and the following service facilities:

Boiler House

A boiler house at the Lower Level was placed in operation in 2002. The boiler house has three boilers that burn natural gas as their primary fuel, with a total steam capacity of 100,000 pounds per hour (hr). As an emergency backup fuel supply, ultra-low sulfur No. 2 fuel oil is stored in one above ground storage tank near the boiler house. Three exhaust stacks dissipate the combustion products from the boilers. Auxiliary support facilities for the boilers include feed water treatment components such as a water softener and dealkalizer and a neutralization system for boiler blow down water. The boiler house air emissions are controlled in accordance with a New York State air emissions permit. Wastewater discharged from the neutralization system complies with the State discharge permit requirements.

Demineralized Water Production Facilities

Demineralized water is produced at the Knolls Laboratory by passing city water through columns of activated carbon and ion exchange resins to obtain the desired purity of water to support operations at the Laboratory. A commercial vendor regenerates these columns off-site.

Cooling Towers

There are four small evaporative cooling towers in operation at the Knolls Laboratory that dissipate the heat generated by computer air conditioning systems and other operations.

During operation, continuous blow down of the cooling tower water at a rate of a few gallons per minute is used to control the concentration of soluble minerals that are naturally present in the supply water and cooling tower treatment chemicals. The small quantity of blow down water is directed into the Laboratory stormwater drainage system, which discharges to the Mohawk River through an outfall monitored to confirm compliance with State discharge permit requirements.

Hazardous and Mixed Waste Management Facilities

The Knolls Laboratory operates a hazardous waste management facility in accordance with the provisions of its RCRA Permit issued by NYSDEC. This facility is used for temporary storage of waste prior to shipment to permitted off-site treatment and disposal facilities. The facility is designed to contain any potential spill. Mixed waste management facilities are also operated under the same Permit, and are used for storage of waste containing both chemically hazardous and radioactive constituents. These facilities are also designed to contain any spill. The amount of waste stored in the above facilities is limited as specified in the Permit. The facilities' construction and operation comply with applicable Federal and State regulations.

Radioactive Waste Treatment Facilities

Radioactive waste treatment facilities collect, process, package, and ship solid and liquid radioactive waste. Liquid waste from Knolls Laboratory operations is absorbed into a solid material prior to shipment as solid waste. As with all Knolls Laboratory facilities handling radioactive materials, the processing facilities for liquid and solid wastes are serviced by filtered and monitored exhaust systems. See Section 5.1 for a complete description.

Petroleum Storage Tanks

There are two separate dual compartment above ground tank systems at the Knolls Laboratory that have integral secondary containment systems with leak detection capabilities. One of the dual tank systems consists of a 10,000 gallon No. 2 fuel oil tank for the backup fuel oil supply for the Knolls Laboratory's Boiler House, and a 2,000 gallon diesel tank to fuel a backup power generator. The other contains a 2,000 gallon gasoline storage tank and a 1,000 gallon diesel fuel tank, both of which are used for fueling Laboratory vehicles and equipment.

In addition, there are assorted diesel fuel storage tanks that range from 50 to approximately 1,600 gallons, which all have integral secondary containment systems. Knolls Laboratory storage tanks are registered with NYSDEC, comply with applicable petroleum bulk storage (PBS) regulations, and are covered within the site's Spill Prevention Control and Countermeasure Plan.

SPRU Remediation

From 2007 through 2018, DOE-EM performed remediation, demolition and disposal of the Cold War era facilities and impacted soil from legacy operations associated with SPRU at the Knolls Laboratory. Following DOE-EM's efforts at the Knolls Laboratory to remove the SPRU facilities, the NNPP established a partnership with DOE-EM in 2019 to remove the NNPP's legacy facilities at the Knolls Laboratory. The NNPP maintains a cradle-to-grave responsibility for its actions, and consistent with this philosophy, the NNPP is dedicating funding to support remediation and demolition of these facilities.

In 2021, DOE-EM removed all construction materials from the F-Yard, which was adjacent to the former H2 Building on the SPRU site. Storage of mixed transuranic (MTRU) waste from the DOE-EM SPRU project that is awaiting final shipment for disposal remains in a DOE-EM controlled shielded area at the lower level area under a consent agreement with the NYSDEC. As shown in Figure 3, approximately 28.8 Ci of mixed fission product and transuranic waste are

stored in weatherproof storage containers, which are inspected and maintained in accordance with the consent agreement.

Additionally pursuant to the 2019 agreement between NR and DOE-EM, regarding the remediation of inactive environmental liabilities at NNL Sites, in 2021 DOE-EM performed characterization sampling at the Knolls Laboratory in support of planned D&D activities and/or remediation work. The characterization effort at the Knolls Laboratory was conducted of soil and groundwater at the Q-Complex.

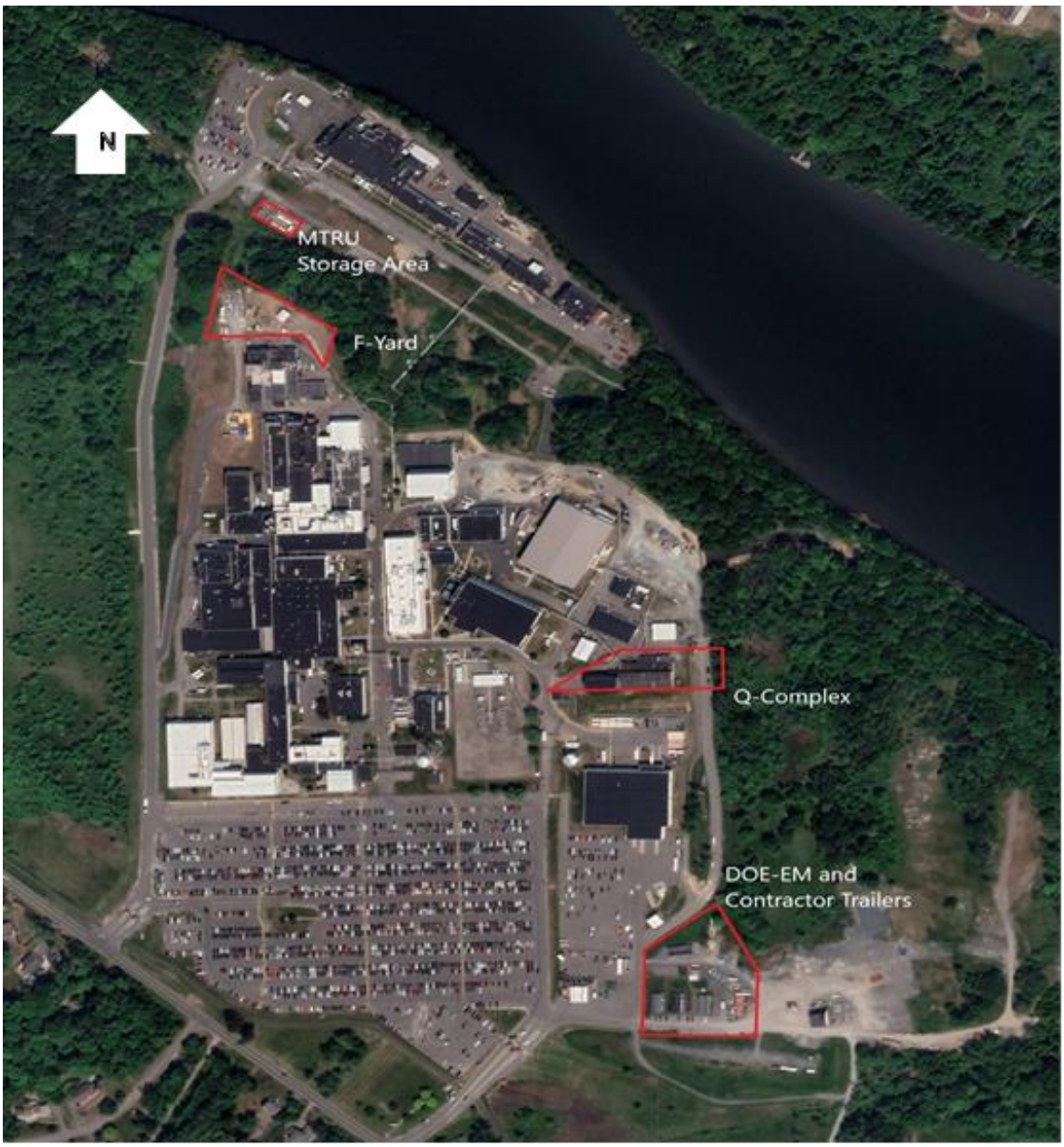

Figure 3 - DOE-EM Land Areas at the Knolls Laboratory

5.0 WASTE GENERATION AND CONTROLS

The Knolls Laboratory is not, and has never been, a manufacturing facility. Consequently, the total quantities of chemical and radioactive materials handled on the Knolls Laboratory have been small. During the past five years, the quantity of routine chemically hazardous waste shipped off-site from the Knolls Laboratory averaged about 5.0 tons per year. This waste consists of solvents, cleaning solutions, analytical waste, unused or expired products and reagents, out-of-service equipment from research and development activities, and material and debris from routine building and equipment maintenance.

During the past five years, the Knolls Laboratory also shipped an average of 4.2 tons of mixed waste annually. Mixed waste contains both chemically hazardous and radioactive constituents. Small amounts of mixed waste, which may also contain polychlorinated biphenyls (PCBs), are generated by research and development activities and facility inactivation and remediation projects.

Occasionally, when sufficient quantities are accumulated, lead scrap metal and lead acid batteries are shipped for reclamation. Other hazardous material recycling efforts include scrap metal, computers and computer peripherals, refrigerants, used oil, batteries, fluorescent lamps, light bulbs, liquid mercury, and mercury compounds. Previously implemented waste reduction efforts have included better segregation of hazardous and non-hazardous waste streams, installation of digital photo processing equipment, substitution of natural gas for fuel oil at the boiler house, installation of a new water treatment system in the boiler house, and substitution of non-hazardous paints and solvents where feasible. Non-hazardous, non-chemical solid waste is also recycled as practical.

The amount of radioactive materials managed at the Laboratory is also small and consists of irradiated test specimens, special nuclear materials, and a number of components with small amounts of radioactivity on their surfaces. The amount of low-level radioactive solid waste material generated by current Laboratory operations has averaged about 347 cubic yards per year over the past five years. By volume, this is equal to the yearly amount of ordinary trash generated by about 15 average households. A significant portion of this radioactive waste has been generated by the Knolls Laboratory's efforts to dispose of residual radioactivity within and adjacent to buildings used for work involving radioactive materials.

A discussion of current and past waste management operations follows.

5.1 Current Waste Management Programs

5.1.1 Radioactive Waste Management

The Knolls Laboratory has maintained a radioactive waste control and minimization program for many years. Liquid, solid, and gaseous radioactive wastes are generated and controlled in Knolls Laboratory operations. The generation processes and the minimization program are described below.

Radioactive Liquid Waste

Regulations applicable to commercial nuclear industries in the U.S. permit discharge of liquids containing low levels of radionuclides if they meet concentration standards established by the Nuclear Regulatory Commission (NRC). DOE regulations also permit similar discharges of these

liquids. Knolls Laboratory has operated to a far more rigid standard for over four decades. At the Knolls Laboratory, water from current Laboratory operations that contains radioactivity is collected. Until 2006, the water was processed to remove the radioactivity prior to reuse in appropriate Laboratory operations. The reuse processing systems included collection tanks, particulate filters, activated carbon columns to remove organics, and/or mixed-bed exchange columns to remove inorganics. The water was reused in operations involving radioactivity to the maximum extent practicable.

Because of the amount of water from current Laboratory operations that contains radioactivity is very small, it is now collected, absorbed, and packaged for shipment to an approved radioactive solid waste disposal site.

Until October 2010, water from prior Laboratory operations and SPRU D&D activities that could not be reused or absorbed for disposal was processed to remove radioactivity and discharged. This water was sampled prior to discharge to ensure that radioactivity had been removed to the lowest practicable level. In all cases, this level was far lower than any applicable standard. For example, during 2010, the annual average outfall radioactivity concentrations released to the Mohawk River were over 100 times lower than NRC limits for unrestricted use, and were small fractions of the concentrations permitted by the EPA for drinking water. Since October 2010, water from SPRU D&D activities was shipped by DOE-EM to an out-of-state disposal facility.

Radioactive Solid Waste

Solid radioactive wastes are generated at the Knolls Laboratory as a result of operations and facility dismantlement. Included in this waste are such radioactive items as process system and ventilation filters, metal scrap, test specimens, contaminated components, pieces of insulation, rags, sheet plastic, paper, sampling planchets, filter papers, swipes, towels resulting from radiochemistry and radiation monitoring operations, and until recently expended activated charcoal and resin. Also included is solidified or absorbed liquid waste and waste from the disposal and cleanup of old facilities no longer needed at the Laboratory.

Solid radioactive wastes are packaged and shipped in accordance with the requirements of the U.S. Department of Transportation. These wastes are disposed of in land disposal sites operated by the DOE or licensed disposal sites. All such sites are outside of New York State.

On occasion, material containing hazardous constituents and small amounts of radioactivity may require disposition; this type of material is defined as mixed waste. Mixed waste was managed until July 2012 in accordance with both the Knolls Laboratory Mixed Waste Management Plan (MWMP) and its RCRA Permit administered by NYSDEC. On July 30, 2012, the elements of the Knolls MWMP were integrated into the Knolls Laboratory's RCRA Permit. Specific types of mixed waste are disposed of at commercial disposal sites licensed to receive those types of waste.

Materials containing PCBs and radioactivity are controlled and disposed of in accordance with the requirements of the Toxic Substances Control Act (TSCA). Most of these materials are bulk products, such as painted metal, and are disposed of off-site in the same DOE land disposal sites as other solid radioactive waste.

Radioactive Airborne Effluents

Exhaust systems that service radiological work facilities are designed and operated to ensure the control of potential sources of airborne radioactivity. All systems include high efficiency filters for

the removal of particulate radioactivity from the exhaust air. In addition, specific systems are also provided for the collection of any potential radioactive iodine emissions, although such emissions would be limited and rare.

The exhaust systems are tested periodically to ensure that design flow rates are maintained and that the filtration media provide the proper collection efficiency. All high efficiency particulate air (HEPA) filters are tested upon installation and periodically thereafter. The testing is performed using 0.7-micron diameter dioctylphthalate smoke particles. In accordance with Federal standards, the installation must exhibit an overall collection efficiency of 99.95% or higher to be accepted.

In addition, controlled exhaust systems from major radiological facilities are continuously sampled for radioactivity. Systems servicing major radiological facilities may also be provided with continuous monitoring equipment with alarm capability. Air monitoring results are reported annually to Federal and State agencies.

In recent years, releases have averaged less than one curie per year, consisting mainly of inert gases. The annual average dose to the maximally exposed off-site individual from both Knolls Laboratory and DOE-EM airborne emissions has been less than 1% of the EPA standard over the past several years.

Radioactive Waste Minimization

Knolls Laboratory has maintained a radioactive waste minimization program for many years. The program includes work to identify and eliminate sources of waste generation and identify means to concentrate wastes to the minimum practicable volumes. The Knolls Laboratory has maintained an essentially constant generation rate for radioactive wastes from current operations during the past five years, averaging about 347 cubic yards per year. This is less than one percent of the low-level radioactive waste generated by all DOE sites. The volume of radioactive waste generated by DOE-EM during the SPRU remediation project is discussed below.

In addition, the Knolls Laboratory ships slightly radioactive metal to an out-of-state licensed facility for recycling. The recycled metal generated is then sent to other sites for controlled reuse as radiation shielding. Over the past five years, the Knolls Laboratory only made two shipments totaling 10.5 tons of radiologically contaminated metal for recycling. This metal was primarily generated by inactivation of facilities and equipment.

Remediation Programs for Radioactivity

In 1977, Knolls Laboratory established a program to deactivate and minimize the number of facilities and areas requiring radiological controls, although some remedial actions had already occurred by that time. This program is continuing and to date has accomplished the following:

- Released for unrestricted use, over 47,300 square feet of Knolls Laboratory floor space, including nineteen complete chemistry laboratory units.

- Released for unrestricted use or for future construction, over 244,776 square feet of Knolls land area.

- Decontaminated and partially removed eighteen Knolls Laboratory structures totaling over 20,800 square feet of floor area.

- Removed over 3,000 cubic yards of soil from the Knolls Laboratory land area containing radioactive residues from past Laboratory operations.

Future Knolls Laboratory activities will include removal of various additional systems and structures once used for the management of radioactive materials. Examples include old ventilation ductwork, tanks, and piping.

The deactivation program has concentrated on removing structures and not soil; however, some soil has been removed incidental to the removal of structures. The areas with residual soil radioactivity (Section 5.2) are monitored to assure that there is no potential for radiation exposure to workers or the public, and the radioactivity is remaining in place. As the radionuclides in question are primarily cesium-137 with some strontium-90, which decay with a half-life of about thirty years, the concentrations will naturally decline. If the Knolls Laboratory was ever decommissioned as a Federal Laboratory, actions would be taken to release all facilities and land for unrestricted use, in accordance with all applicable requirements.

SPRU Project

The SPRU buildings and related land areas were included in the SPRU Project's remediation program. The DOE commenced planning and preparation for the future disposition of the SPRU facilities over two decades ago. In 2000, the DOE commenced the characterization of the existing SPRU facilities and related areas as the first phase of the long-term SPRU remediation program. The characterization included collecting and analyzing environmental samples, soil, and groundwater from SPRU areas.

In 2004, the DOE dismantled and removed a 1,000 square foot concrete structure, known as K-6, which had been used in the 1950s for storage of SPRU radioactive waste. In 2006, the DOE dismantled and removed a concrete structure, known as K-5, consisting of two basins in which liquid waste containing low levels of radioactivity was collected after processing and sampled before release. Also in 2006, the DOE dismantled and removed a small evaporative cooling tower, known as H-1, which had once provided cooling to SPRU processes during SPRU operation.

Subsequent to public meetings to obtain public comment on future dismantlement and SPRU cleanup options and consistent with overall community desires, the SPRU Project placed contracts for dismantlement of SPRU related buildings and removal of soil containing SPRU related radioactivity over the next several years.

From 2008 through 2010, the majority of the contaminated soil areas at the Lower Level and North Field were remediated. Approximately 20,000 cubic yards of soil were shipped to an off-site disposal facility. The D&D activities on Buildings G2 and H2 started in 2009, but were suspended in September 2010 after an unplanned release of airborne radioactivity during an open-air demolition of Building H2.

Enclosures with HEPA-filtered ventilation were installed over Buildings G2 and H2 in September 2012 and February 2013, respectively. D&D work for Buildings G2 and H2 occurred under these enclosures.

In 2016, DOE-EM completed decontamination of the G2 building, removed the HEPA ventilation system, and began open-air demolition of the G2 building. During that year, 595 shipments

encompassing approximately 337,095 gallons of water (containing ~0.33 Ci) and 522 shipments totaling approximately 5,099 cubic yards of solid low-level radioactive waste (containing ~14.9 Ci) were made by authorized common carriers to disposal sites located outside New York State.

The G2 excavation was backfilled in November 2017, and work continued on the dismantlement of Building H2. During 2017, 599,477 gallons of water (containing ~0.01 Ci) and 1,319 shipments totaling approximately 22,420 cubic yards of solid low-level radioactive waste (containing ~7.46 Ci) were shipped from SPRU for treatment and/or disposal.

In 2018, the work scope also included maintenance of contamination controls and shipments of waste. This work culminated in the completion of the building demolition and site remediation activities. Site restoration began in October 2018. During 2018, 284,120 gallons of water (containing ~0.005 Ci) was shipped from SPRU for disposal. In addition, 1,810 shipments totaling approximately 25,929 cubic yards of solid low-level radioactive waste (containing ~5.38 Ci) were shipped for disposal.

DOE-EM completed remediation and restoration of the SPRU areas (shown on Figure 2) in 2019. DOE-EM made one shipment of radioactive waste in 2019 that was generated and packaged during remediation in 2018. This shipment consisted of approximately 15 cubic yards of solid low-level radioactive waste containing approximately 0.0002 Ci of radioactivity.

Operations during 2020 at SPRU and other DOE-EM activity work sites did not result in the generation of radioactive materials and wastes. SPRU operations in 2020 consisted of finalizing closure reports and demobilizing from the site. However, in 2021 DOE-EM removed all construction materials from the F-Yard, which was adjacent to the former H2 Building on the SPRU site. This activity resulted in 410 cubic meters of low-level radioactive waste being shipped for disposal. DOE-EM also maintained and inspected the mixed transuranic waste storage area, which includes wastes from the SPRU project that are pending offsite disposition.

5.1.2 Non-Radioactive Waste Management

Knolls Laboratory operations produce a variety of industrial waste products including sanitary sewage, once-through non-contact cooling water, chemical wastes, boiler exhaust gases, and other such products typical of a large laboratory facility. All such waste products are controlled in accordance with various permits as required by Federal and State regulations. In addition, Knolls Laboratory has a hazardous waste minimization program. Each area is discussed below.

Non-Radioactive Liquid Wastes

Sanitary sewage from restroom, cafeteria, and janitorial activities; a small quantity of non-hazardous laboratory waste; and a small quantity of non-hazardous process waste water are discharged to the Town of Niskayuna sewer system and subsequently treated in the Niskayuna sewage treatment plant. These discharges are in accordance with a Users' Agreement with the Town.

Once-through, non-contact cooling water consisting of river water and/or city water used to cool Knolls Laboratory test equipment is discharged to the Mohawk River in accordance with the Laboratory's Clean Water Act (CWA) discharge permit issued by New York State. Likewise, stormwater runoff from the Laboratory is discharged to the Mohawk River in accordance with the New York State permit.

The small quantity of process and analytical waste liquid from Laboratory operations is controlled by several methods depending on the volume and nature of the waste. Methods used to ensure safe disposal include:

- Employee training in waste management requirements;
- Local collection and possible treatment of non-hazardous waste;
- Collection and transfer of wastes that contain hazardous materials or unusable mixtures of oils and liquids to a permitted subcontractor for reclamation, incineration, or treatment at a permitted facility; and
- Careful monitoring and control of chemical constituents to ensure that concentrations in effluent water comply with applicable standards.

Chemical wastes, defined either as hazardous in accordance with RCRA and/or as PCB waste in accordance with TSCA, are managed compliant with the RCRA hazardous waste management program administered by New York State and/or the TCSA PCB waste program administered by the EPA, as applicable.

In the case of storage tanks and electrical transformers containing environmentally hazardous materials, such as petroleum products, precautionary measures are taken to prevent or retain any leakage. These measures include periodic inspections, use of revetments or stone-filled trenches with berms, sealing of drains, and inclusion of liquid level gages and/or alarms in selected storage tanks. As of 1992, all buried petroleum storage tanks had been removed from the Knolls Laboratory. As of 1999, the Laboratory completed a program to replace all PCB electrical transformers with PCB-free equivalents.

Non-Radioactive Solid Waste

Non-hazardous demolition debris and other similar materials, as well as sanitary wastes such as cafeteria waste, are disposed of in a municipal landfill or other permitted disposal facility. Newspaper, office paper, magazines, corrugated cardboard, tin cans, glass, printer toner cartridges, wood, asphalt, concrete, metals, computers, oil, drums, fluorescent lamps, light bulbs, batteries, and some types of plastic are recycled. The Knolls Laboratory recycled approximately 4,473 tons of materials during the last five years (2017 – 2021).

Chemically hazardous solid waste is controlled and disposed of in accordance with the requirements of RCRA and TSCA. The controls provided for PCBs are in accordance with the requirements of TSCA and applicable State hazardous waste requirements. Most metal waste is accumulated and sent to a scrap reclaimer. Asbestos waste is packaged and transported to an approved asbestos waste disposal facility.

Non-Radioactive Airborne Effluents

The Knolls Laboratory had four residual oil fired boilers primarily used for heating purposes with the capability of using the units for testing purposes. During 1990, the need for using the heating boilers for testing was eliminated by the addition of two natural-gas fired industrial hot water heaters to the Laboratory's test facilities. In 1995, the old boiler house was converted from burning residual fuel oil to burning natural gas as its primary fuel with distillate oil as a backup fuel source. A new boiler house with three boilers began operation in 2002, replacing the old boiler house. The new boilers

also burn natural gas as their primary fuel, but have the ability to burn ultra-low sulfur No. 2 fuel oil as a backup. These boilers have elevated exhaust stacks approximately fifty feet above ground level. The boilers provide steam primarily for heating and are therefore in maximum use during the colder months. In 2009, New York State issued the Knolls Laboratory a consolidated Air State Facility Permit that combined all the air permits held by the Laboratory into one document. The heating boilers and two natural gas-fired industrial water heaters are operated in accordance with this air emissions permit and applicable EPA requirements.

Non-Radioactive Waste Minimization

Knolls Laboratory has long recognized the need to minimize the generation of hazardous waste. In accordance with RCRA, Knolls Laboratory prepared a hazardous waste minimization plan. In 1991, Knolls Laboratory submitted this plan to NYSDEC, as required by State law; the plan was updated annually. The plan detailed actions to identify and minimize waste producing operations, compared minimization efforts year to year to demonstrate progress, and established waste minimization goals. This was accomplished by establishment of strict procurement procedures, substitution of non-hazardous materials where practical, and other similar measures. In 2000, the amount of hazardous waste generated annually by the Knolls Laboratory had been reduced to a level that no longer required waste minimization plans to be submitted to the State. In 2016, NYSDEC directed the Knolls Laboratory to resume submitting the plan annually starting with the waste generated in 2015. The plan details actions to identify and minimize waste producing operations, compare minimization efforts year to year to demonstrate progress, and establish waste minimization goals. This is accomplished by establishment of strict procurement procedures, substitution of non-hazardous materials where practical, and other similar measures.

Actions taken by the Knolls Laboratory during the period 2017 - 2021 include:

- Recycling approximately 29 tons of lead acid batteries;
- Recycling approximately 9 tons of used lubricating oils;
- Recycling approximately 2,742 tons of concrete and asphalt; and
- Recycling approximately 1,145 tons of scrap metal, including lead.

Employees are trained to understand the environmental hazards associated with the potentially hazardous materials used in their work and to follow the proper controls when handling and disposing of these materials.

Knolls Laboratory stresses environmentally sound management of the waste products by the vendors selected for disposal or recovery. Knolls Laboratory requires that vendor practices conform to all applicable regulations and, where practicable, use advanced disposal technology for Knolls Laboratory wastes.

Knolls Laboratory continues to evaluate improvements in areas such as chemical purchases and operations to identify ways to reduce the generation of hazardous wastes.

Remediation Programs

CERCLA requires all Federal facilities to identify environmentally harmful waste disposal areas that require prompt remedial action in accordance with a National ranking system. The EPA, in consultation with the States, is responsible to review and independently rank the site to determine the need for further action. Facilities with high rankings are considered for placement on the NPL (Superfund) for cleanup, in accordance with direction from the EPA. Otherwise, sites are addressed in accordance with relevant State requirements.

In 1994, the EPA determined that the Knolls Laboratory did not qualify for inclusion on the Superfund, and no remedial action was warranted under CERCLA. Subsequent characterization work related to the disposal areas is being conducted under the RCRA authority of New York State. Additional detail is provided in Section 9.

The disposal areas, discussed in Section 5.2, were the prime focus of the CERCLA review. Existing sampling information, discussed in Section 5.2 and in Knolls Laboratory's annual EMR, indicates there is no adverse effect on environmental quality. Knolls Laboratory will continue to perform environmental monitoring of these areas.

Beginning in 2002, environmental characterization of Knolls Laboratory historical waste disposal areas has been performed in accordance with the Knolls Laboratory RCRA Permit issued by NYSDEC. All fieldwork and environmental data have been subject to review by NYSDEC. Although the data show small amounts of chemicals detected in the environment because of past Knolls Laboratory's waste handling and disposal practices, there is no threat to human health or the environment that warrants immediate remediation. Characterization and remediation of historical isolated chemical releases to the environment elsewhere at the Knolls Laboratory continues to be addressed in accordance with the RCRA Permit. Any RCRA remediation plans will require approval by NYSDEC. Additional information is provided in Section 9.

The Knolls Laboratory's CERCLA review also addressed areas where there was potential for migration of radioactivity remaining from past operations. Section 5.2 discusses this in detail and discusses Knolls Laboratory's on-going remediation program. As required by CERCLA, Knolls Laboratory will incorporate New York State direction into this program as appropriate.

Apart from the CERCLA and RCRA programs, Knolls Laboratory formally closed the Knolls Laboratory landfill in 1993 in accordance with NYSDEC solid waste regulations. The closure plan was approved by New York State. Closure included installation of a clay cap to preclude rainwater infiltration, installation of a topsoil cover, and seeding and landscaping to control subsequent erosion. Groundwater monitoring will be continued in accordance with New York State landfill closure regulations. The Knolls Laboratory also voluntarily remediated a former on-site firearms practice range in 1997.

Although not required at the time by any rule or regulation, the Knolls Laboratory stopped the use of asbestos insulation products in 1976, and in 1989 initiated an ongoing program to reduce the amount of accessible asbestos insulation on site.

5.2 Past Waste Management Practices

Radioactive waste management practices have evolved over the years consistent with advances in technology and changes in regulatory requirements. The Knolls Laboratory has always maintained an environmental program substantially more strict than the rules in effect at the time. For example, in 1964, the Knolls Laboratory took unilateral action to significantly reduce discharges of radioactivity to the Mohawk River. In 1977, the Knolls Laboratory implemented an advanced water-processing and reuse program to reduce even more the minute amount of radioactivity being released to the Mohawk River. None of these actions was required by law or regulation. They were done because they had become feasible and were consistent with the conservative engineering approach followed by Knolls Laboratory of minimizing releases of radioactivity to levels as low as possible.

Non-radioactive waste management practices evolved in a similar manner. Land burial of chemicals on-site was conducted in the early years. On-site burial of such materials was stopped in 1977. The Knolls Laboratory's current practices incorporate all of the strict controls required by current Federal and State regulations. Each of these areas is discussed below.

5.2.1 Past Radioactive Waste Management

The Knolls Laboratory has always been involved in handling radioactive materials and has always had a radioactive waste management program.

Liquid radioactive wastes associated with SPRU and other work in the 1950's and 1960's at the Knolls Laboratory were categorized using the then current terminology as either low radioactivity level (less than 0.05 microcuries of radioactivity per milliliter) or high radioactivity level (0.05 microcuries or more per milliliter). Solid wastes were categorized as low radiation level (less than 200 millirem/hr on the surface), intermediate radiation level (200 millirem/hr to 25 rem/hr), and high radiation level (above 25 rem/hr).

Disposal practices appropriate to each of these categories and waste streams were developed and implemented. Requirements for treatment and disposal of these wastes were provided for in the design of the operating facilities. For example, retention tanks and evaporators for liquid waste, surface and subsurface facilities for temporary storage of solid waste, and air cleaning systems (high efficiency filters, activated carbon filters, etc.) were incorporated in the initial design of the facilities. The following is a description of the practices employed in management of these materials.

Radioactive Liquid Waste

High radioactivity level liquid wastes were normally solidified by evaporation. The radioactive sludge resulting from these processes was disposed of off-site as solid waste. Occasionally, some liquids were solidified with absorbents and disposed of off-site in this form.

Low radioactivity level liquid wastes were managed by a variety of methods. In 1948, during the initial construction of the Knolls Laboratory, a study of the hydraulics and hydrology of the Mohawk River was begun to determine the suitability of releases of low concentrations of radioactivity to the river. The U.S. Geological Survey performed this study in cooperation with the AEC. Representatives of the New York State Department of Public Works and Department of Public Health also participated in the study. The Knolls Laboratory also initiated a preoperational monitoring program during the construction of the Laboratory to determine background concentrations in the river due to naturally occurring radioactivity and fallout from nuclear weapons

tests. Effluent water containing concentrations of radioactivity below then-existing concentration limits for discharge was first released from the Knolls Laboratory in 1950, shortly after operations began.

In response to contacts made by the AEC with State and local agencies in 1951, the Mohawk River Advisory Committee was established in 1952. The functions of the committee were to provide advice and counsel regarding the release of radioactivity to surface streams (including the Mohawk River) and to provide liaison to ensure that State and local officials interested in these matters were kept informed. Membership of the committee consisted of representatives of the New York State Department of Health and the City of Schenectady. The Committee periodically reviewed the Knolls Laboratory waste management program, concurred with program changes, and participated in the establishment of limits for radioactivity in Knolls Laboratory effluent water.

In 1955, the Mohawk River Advisory Committee concurred with the use of the dilution potential of the river to reduce the concentration of radioactivity in effluent water and to increase discharge limits for the Knolls Laboratory. This was based on data obtained from the hydraulic and hydrology study of the Mohawk River conducted by the U.S. Geological Survey and the results of environmental monitoring.

The dilution potential of the river was used until 1964. During that period, it was confirmed that the river flow would readily disperse the radioactivity. Radioactivity levels in river water were usually non-detectable. However, not all of the radioactivity that was released was dispersed and carried away. Over several years, river bottom sediment samples taken by the Knolls Laboratory showed an increase in radioactivity, primarily cesium-137. At first, it was seen immediately adjacent to the Laboratory outfall; while later, lower concentrations were found several miles downstream. To prevent further buildup, the practice of relying on river dilution was stopped in early 1964. Initially, most liquids were processed by evaporation or ion exchange, and the resultant resins and sludge were disposed of off-site as solid waste; only liquids, which themselves met drinking water radioactivity limits without river dilution, were released without further processing. Since 1978, a majority of all liquids associated with radiological work have been processed to remove radioactivity or absorbed for shipment off-site, regardless of whether or not they already met drinking water limits. Since that time, the total radioactivity released to the Mohawk River in all Knolls Laboratory effluent water has been substantially below any applicable limits.

Knolls Laboratory has performed comprehensive environmental monitoring of the Mohawk River since 1948, before operations at the Laboratory began. Water, fish, and sediment samples have been evaluated for the effects of Laboratory operations. Where necessary, environmental monitoring has resulted in changes being made in radioactivity management practices, such as the change made in 1964. In 1978, a particularly thorough biological survey of the river was made to determine whether there was any discernible effect from past discharge practices on the aquatic life in the river. In 1980, the results were published in KAPL-ES-80-1, Mohawk River Biological Survey, which concluded there was no detectable radioactivity of Knolls Laboratory origin in any biological sample.

During 1992, an extensive sampling program was performed to update information on the quantity and distribution of radioactivity in the river sediment attributable to Knolls Laboratory operations and to determine any effect on the environment from this residual radioactivity. Over 2,000 biological, sediment, and water samples were analyzed. In 1995, the results were published in KAPL-4808, Mohawk River Survey Report. Similar to the 1980 report, the 1995 report concluded there was no detectable radioactivity of Knolls Laboratory origin in any biological sample. The results continued to demonstrate that the residual radioactivity in the sediment is not being taken up in the food chain.

The sediment sampling results showed that the residual radioactivity is distributed in a manner similar to that shown in previous studies except the radioactivity is now deeper in the sediment. The total radioactivity of Knolls Laboratory origin present in the sediment is less than 10% of the naturally occurring radioactivity found in sediment in the same region.

During 2002, another extensive sampling program was performed to obtain current data to compare with results from the two previous river surveys. Over 900 biological, sediment, and water samples were analyzed. NYSDEC participated in the survey. The results were published in 2005 via KAPL-4850, Mohawk River Survey Report. The 2002 survey results confirmed the findings of the 1980 and 1995 reports, concluding that the residual radioactivity in the sediment is not being taken up in the food chain or detectable in water samples and has no adverse effect on human health or the environment.

During 2019, another sampling program was performed by DOE-EM to obtain current data to compare with results from the previous river surveys. A smaller sampling plan that required 15 sediment samples were analyzed. NYSDEC observed select core sectioning and obtained split samples for comparison analysis. The 2019 survey results confirmed the findings of the 1980,1995, and 2005 reports, concluding that the residual radioactivity in the sediment has not migrated further downstream, but remains within several hundred feet of the outfall with minimal impact on human health and the environment (i.e., water, sediment, and biological quality).

Since Knolls Laboratory operations began in 1949, about 153 Ci of Knolls Laboratory-produced radioactivity have been released to the Mohawk River, about 150 Ci of which were released prior to 1964. The most radioactivity released in any one year was about 37 Ci in 1963, compared to the Mohawk River Advisory Committee limit of 40 Ci per year. (The reported 3 Ci discharged since 1964 is actually a conservative estimate; i.e., in some cases, a radionuclide is assumed to be present at the detection limit and included in the total when in fact the actual measurement indicated it was less than the detection limit.)

At present, there is less than 1 Ci of radioactivity in the river sediments in the vicinity of the Laboratory. Radioactivity produced by the Knolls Laboratory consists primarily of cesium-137, but includes traces of other radionuclides such as strontium-90, americium-241, uranium, and plutonium. The average concentration of cesium-137 in sediment between the Knolls Laboratory and the downstream Lock 7 dam is less than 3 picocuries per gram. The concentrations decrease with distance down the river. The concentration of naturally occurring radionuclides, such as potassium-40, present in the same sediment is about 30 picocuries per gram. During the 2002 sampling program, the highest cesium-137 concentration (670 picocuries per gram) found was in the immediate vicinity of the discharge location. As noted above, the cesium-137 in the sediment poses no risk to the population. The concentration will gradually decline consistent with the thirty-year half-life of the isotope.

Mohawk River sediment analysis performed by NYSDEC in 1989 confirmed previous radionuclide concentration levels reported in the annual Knolls Laboratory EMR. The State confirmed that sediments in the river contain only low levels of radioactivity, in most cases at levels no greater than those found in New York State soils. The sampling showed the levels of radioactivity attributable to Knolls Laboratory operations are low and not of a health or environmental concern.

Periodic environmental monitoring continues to this day, with the results reported in the Laboratory's annual EMR. The conclusions remain unchanged. Fish and water samples taken in the Mohawk River, both upstream and downstream of the Knolls Laboratory, show only naturally occurring radionuclides (e.g., potassium-40) and radionuclides from atmospheric weapons testing,

but no radionuclides attributable to Laboratory operations. The residual radioactivity from Laboratory operations remaining in the sediment has resulted in no significant impact on the environment and poses no health risk to the public.

Radioactive Solid Waste

Prior to shipment off-site for disposal at a designated radioactive waste disposal site, solid radioactive wastes were characterized and managed during the 1950's and 1960's as follows:

Low Radiation Level - (Radiation levels less than 200 millirem/hr at the surface of each container). This type of waste consisted of items such as paper and cloth wipes, protective clothing, some air filters, wood, and floor sweepings. The waste was collected in waste cans, baled if compressible, packaged in boxes or drums, and transported by rail for disposal. The low-level waste handling building on the Lower Level was equipped with a hydraulic baler and controlled exhaust system with an absolute filter and a stack. The processed wastes were stored in monitored areas at the Lower Level of the Laboratory prior to shipment.

Intermediate Radiation Level - (Radiation levels from 200 millirem/hr to 25 rem/hr at the surface of each container). This included such solid wastes as laboratory equipment and solidified sludge from the RML and the liquid waste processing facilities. The waste was packaged in containers using remote handling equipment. The containers were then stored in one of five shielded storage structures until radioactive decay reduced the radiation from the container to a level that permitted efficient and economical off-site shipment by rail. During their use, three structures became contaminated with small amounts of residual radioactivity. All residual radioactivity associated with these structures has been removed and disposed of as radioactive waste.

High Radiation Level - (Radiation levels greater than 25 rem/hr at the surface of each container). This included such waste as irradiated reactor material samples, mixed fission products, and corrosion products. This waste was generated in the RML shielded cells. It was placed in containers while in the cells, removed from the cells, transported to a shielded underground storage structure located on the Upper Level, and stored until sufficient wastes accumulated for an economical shipment. Periodically, waste containers were removed from the storage structure and shipped off-site for disposal. In 1984, the storage structure and all associated residual radioactivity were removed from the Laboratory and disposed of as radioactive waste.

Radioactive Airborne Effluents

During the 1950's and 1960's ventilation air from radiological facilities was discharged to the atmosphere through elevated exhaust stacks. Prior to release, the air was passed through cleaning systems and monitored to ensure compliance with existing radiation protection guides. The air cleaning systems included glass wool and high efficiency particulate filters, cyclone separators, electrostatic precipitators, and caustic scrubbers as appropriate for the process being served.

Monitoring of exhaust air was accomplished through the collection and analysis of samples of the effluent. The sampling technique used was dependent on the physical and chemical nature of the radioactivity and included sampling with filter papers, caustic scrubbers, and gas chambers. Since airborne material may deposit on surfaces, vegetation as well as air was monitored at various distances and directions from the exhaust stacks.

Overall, an estimated 2,530 Ci of Laboratory-produced radioactivity have been released to the atmosphere during the years of operation since 1949. Over 95% of the total radioactivity emissions to date were associated with SPRU operations in the period from 1951 through 1954. The completion of SPRU operations resulted in reducing radioactivity emissions to less than one percent of previous levels. Over 95% of the radioactivity consisted of the inert gas krypton-85. This inert gas does not deposit on surfaces and readily disperses in the atmosphere. Smaller amounts, approximately 90 Ci, of other beta-gamma emitting fission products and trace quantities of alpha emitting particulates comprised the remaining amount of the airborne radioactivity released. In recent years, releases have averaged less than one curie per year, again consisting mainly of krypton-85.

For perspective, the total amount of radioactivity released to the atmosphere since the start of operations at the Knolls Laboratory corresponds to a small fraction of that permitted by Federal regulations. During the period of largest discharges (1951-1954), the radioactivity released corresponded to less than 10% of the amount permitted by Government standards. Subsequent monitoring has indicated no detectable residual radioactivity as a result of the release of radioactivity into the atmosphere.

Because the radiation exposure to people off-site is too small to be measured, Knolls Laboratory has employed calculation techniques that conservatively estimate potential exposures. These techniques consider breathing the air and eating regional animal and vegetable food. It is conservatively estimated, using the EPA approved computer model CAP88-PC Version 4.0, that the total accumulated radiation exposure to a member of the public living continuously next to the Knolls Laboratory during the entire time the facility has been operating would not exceed 25 millirem due to airborne radioactive effluents. This is about the exposure an average person receives in one month due to naturally occurring radiation sources. The updated version of CAP88 results in a lower calculation of dose due to airborne radioactive effluents than reported previously. This is due to more current dose conversion factors and updated modeling.

5.2.2 Residual Radioactivity in Soil

The Knolls Laboratory has no designated radioactive waste disposal sites. However, historical waste management operations described above and the operation of SPRU resulted in some soil adjacent to these facilities becoming contaminated with radioactive residues. Some incidental low-level radioactive materials have also been found in land area disposal sites. The radionuclides involved consist primarily of cesium-137, with a very small amount of strontium-90 and even smaller amounts of plutonium and uranium in isolated spots. In addition, based on investigation work performed initially in 2000 under the Knolls Laboratory RCRA Permit Corrective Action provisions, and subsequently under the SPRU Permit, chemical contamination was found to be commingled with radioactivity. All chemical investigation and remediation work has been conducted in accordance with work plans approved by NYSDEC. Each of the affected areas is discussed below.

SPRU

Work on this project was done in the buildings shown in Figure 2. During construction of the radioactive waste treatment facility for this project (Building H2), standard construction practices called for a gravel drain around the base of the building to collect groundwater near the structure. This groundwater drained through an underground pipe to a concrete pit on the hillside west of the building. This water was originally discharged to the storm water drainage system. In 1953, the water was found to contain very low levels of radioactivity, indicating release of radioactivity from the systems in the building to the soil around the foundation.

Until 1963, this water was released to the Mohawk River because it met the previously described criteria for release. In late 1963, the Knolls Laboratory began processing all of this water as necessary before release to reduce the radioactivity to levels permitted for drinking water without the dilution afforded by the river. In the early 1970s, the Knolls Laboratory began more extensive processing of this water to remove all but minute traces of radioactivity before release. This practice continued until October 2010. Since October 2010, the water had been collected and shipped to an off-site disposal facility by SPRU. Prior to SPRU D&D work, actions were also taken to reduce the source of groundwater near the foundation, including covering the ground surface surrounding the building and diverting surface storm water. The SPRU D&D project took additional measures to reduce the source of groundwater flow, including controlling surface run-off and installation of French drains.

Occasionally, since 1993, the amount of drainage collected exceeded the capacity of the collection system. This mostly occurred during rare torrential summer thunderstorms, and resulted in a small amount of unprocessed water being discharged to the Mohawk River via the Laboratory's storm drains. In all cases, representative samples of the discharged water were analyzed to determine the amount of radioactivity released. The amount released was well within allowable regulatory standards and was included in the reported total amount of radioactivity released in that year. Prior to 2003, the cause of the overflow was determined to be a nearby storm sewer pipe that leaked rainwater to the groundwater during exceptionally heavy rainfall. The leaking pipe was repaired in 2005. In 2008, two overflow events occurred, one caused by a break in an underground fire main and one as a result of a greater than 100-year rain event. More recently in October 2010, an overflow event occurred as a result of an electrical malfunction to the sump pumps. Corrective actions were taken, including placing an overflow tank on the sump overflow outlet line and significantly increasing pumping capacity.

Additionally, all portions of the SPRU complex have been removed from the Knolls Laboratory along with the soil immediately adjacent to the structures. All of the removed radioactive materials have been sent off-site for disposal at an approved radioactive waste disposal site. Measurements of the groundwater from environmental monitoring wells in the area of Buildings H2 and G2 have shown extremely low but detectable levels of radioactivity picked up from the soil. The highest measurement was less than one-tenth of the NRC limit for the unrestricted release of water to the environment, and is therefore of no environmental concern.

Lower Level Area

Parts of the Lower Level area were used historically to store, process, or package wastes for off-site shipment. These operations involved the following areas and facilities:

- Two concrete structures for solid waste storage (both structures have been removed);

- Storage areas adjacent to the railroad siding;
- Two concrete basins in which liquid waste containing low levels of radioactivity was collected after processing and sampled before release (this structure has been removed);
- Sand filter beds housed in a concrete structure used to filter wastewater from an anti-contamination clothing laundry (operated until 1959) prior to final processing of the water; and;
- A facility for the baling of solid waste.

As a result of operations, radioactivity was deposited on the surfaces of the above structures and in some adjacent soil areas. In the early 1960s, soil from the Lower Level area was used as fill for enlargement of the Lower Level parking lot. The majority of the contaminated soil at the Lower Level, including the parking lot area, has been removed as part of the SPRU remediation project.

Some measurements of the groundwater from environmental monitoring wells at the Lower Level have shown very low but detectable levels of radioactivity picked up from the soil; other such measurements show no detectable radioactivity of Knolls Laboratory origin. The highest measurement was less than the NRC limit for the unrestricted release of water to the environment and is therefore of no environmental concern.

Small amounts of the groundwater containing very low-level residual radioactivity are also released in the Laboratory drainage water. The amount released is well within allowable regulatory standards and is included in the reported amount of total radioactivity released.

During the course of the SPRU remediation project, chemically contaminated soils were removed and confirmation sample data was generated in accordance with a NYSDEC approved work plan. The resultant remediation report, including a no further action recommendation, was approved by NYSDEC in December 2011.

Drum Staging and Land Disposal Areas

During the 1950s, containers of radioactive waste awaiting shipment off-site for disposal were assembled in the Land Disposal Area (LDA) (see Figure 4). The handling and storage of these drums resulted in the deposition of some radioactivity in this area. Subsequent activities in this area, including movement of top soil to accommodate road building and other construction, resulted in distributing the radioactivity to areas near the Drum Staging Area. All affected areas are shown in Figure 4. In the mid-1960s and again in 1977-78, contaminated soil was removed from this area and shipped off-site for disposal. Overall, about 1,000 cubic yards of soil were disposed of in this manner.

During 2009 and 2010, the majority of the soil contamination remaining in the Drum Staging Area was removed as part of the SPRU remediation project. As reported in the 2005 and 2008 Environmental Summary Reports, based on survey data, Knolls Laboratory estimated that there were about 0.4 Ci of radioactivity in the LDA. The former Drum Staging Area is near the original Laboratory landfill, now closed, and is near areas where chemical wastes were known to have been buried (see Section 5.2.3). In 1986, a review was made to assess whether radioactive wastes may have been disposed of in the original landfill or in the chemical disposal areas. An initial indication

that small amounts of radioactive material may have been buried came from the knowledge that there is measurable low-level radioactivity in some parts of these areas and from the recollections of some of the Knolls Laboratory's early employees. After searching records, analyzing samples of soil and groundwater from the area, and reviewing surface radiation measurements, no evidence of such a specifically designated practice could be found. Knolls Laboratory rules have always prohibited burial of radioactive wastes on-site. A few low-level radioactive materials were found while excavating the areas during 2010. However, there was no evidence of any significant burials of radioactive materials.

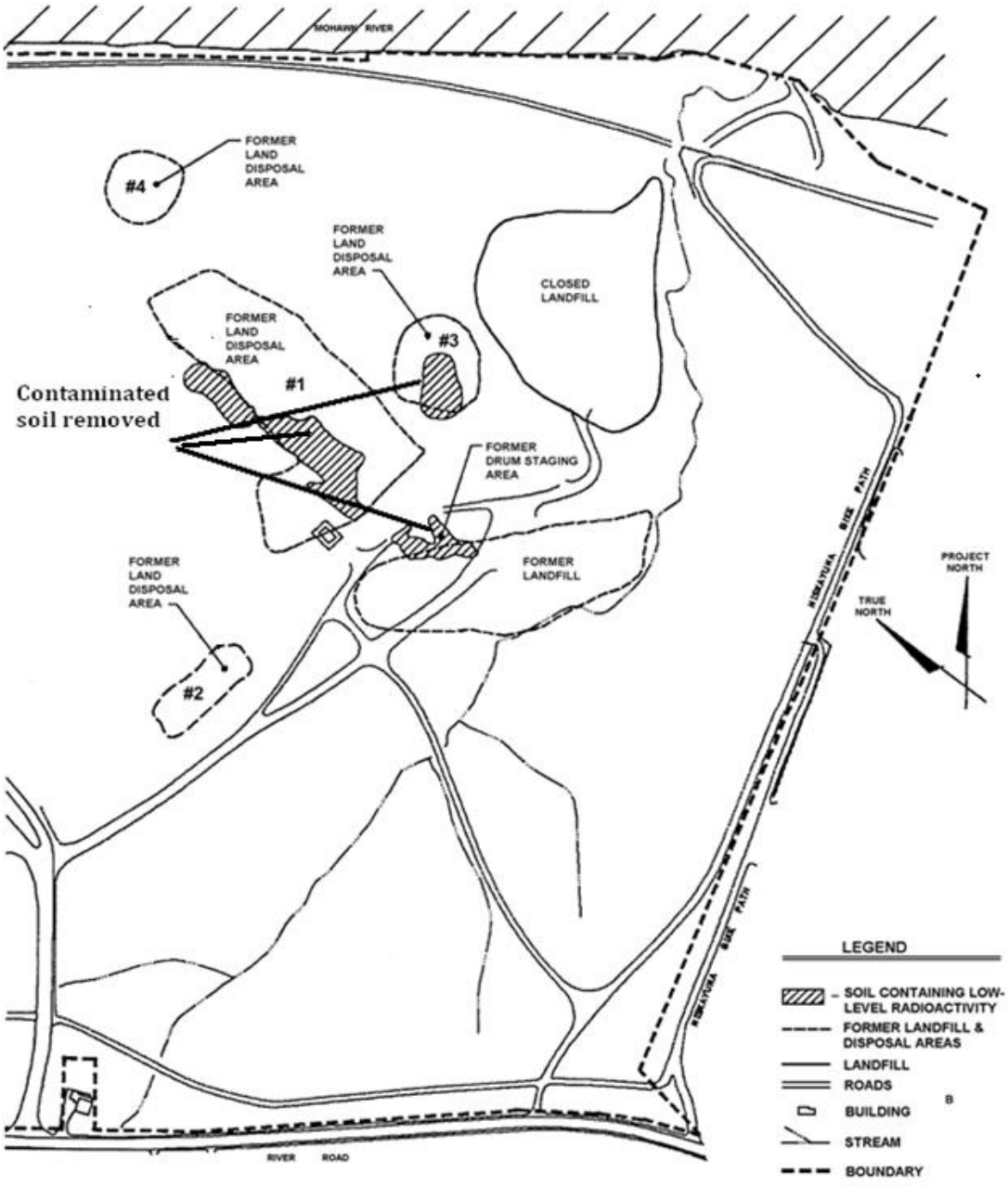

Figure 4 – Knolls Laboratory Land Disposal Areas

Therefore, Knolls Laboratory is confident that, while there was some soil contamination and low-level radioactive materials found resulting from operations as discussed above, no radioactive waste was ever specifically designated for disposal by on-site burial.

Chemical investigation work in the LDA was completed in 2010; no significant contamination was found. The Naval Reactors Laboratory Field Office (NRLFO) transmitted a report of findings to NYSDEC in 2011.

5.2.3 Past Non-Radioactive Waste Management

The Knolls Laboratory has used once-through non-contact cooling systems, operated a conventional sewage treatment plant, and used conventional stormwater sewer systems typical of a facility of this size. Near the eastern boundary of the Knolls Laboratory, adjacent to the now-closed Town of Niskayuna landfill, the Laboratory operated a landfill from 1970 to 1993. For several years prior to its closure in October 1993, only demolition debris and small quantities of brush, sawdust, environmental samples, and sewage treatment plant filter bed rakings were placed in the landfill; municipal type waste was sent to municipal landfills. The Laboratory landfill was never used for disposal of radioactive waste, nor was any radioactive waste sent to municipal landfills.

Sanitary Wastewater

Until 1995, sanitary wastewater was processed at a conventional extended aeration treatment plant located at the Lower Level. The treatment process utilized extended aeration of activated sludge, followed by sand filtration, and chlorination for disinfection of the water prior to discharge. Discharges were controlled and monitored in conformance with the terms of a State permit held by the Knolls Laboratory. In 1995, the Knolls Laboratory sewage treatment plant was permanently shut down. Since that time, sanitary wastewater has been sent via a pumping station to the Town of Niskayuna sanitary sewer system. The former sewage treatment plant equalization tank was retained as an emergency hold-up tank for the current sewage pumping system; the aeration tanks and clarifier were removed for disposal; and the sand filter beds were retired in place for later remediation.

Boiler House Wastewater

Until the 1994/1995 heating season, makeup water for the Laboratory heating boilers was produced using acid-salt regenerated water softeners, resulting in the generation of potentially hazardous wastewater. This wastewater was neutralized prior to discharge. During the 1994/1995 heating season, the boiler makeup water system was switched to salt regenerated water softeners and dealkalizers, eliminating the generation of 500 tons of potentially hazardous wastewater annually.

Non-Radioactive Solid Waste

In addition, the Knolls Laboratory generated a variety of chemical wastes, some of which were disposed of by on-site land burial in accordance with the practice of the time. Figure 4 shows the chemical waste disposal locations in the Knolls Laboratory LDA (near the Drum Staging Area). The disposal locations were identified during a review of historical records, interviews with knowledgeable personnel, and inspections of suspected areas. All of these locations are within the boundaries of the Government reservation.

Waste chemicals packaged in bottles and boxes were buried in the Closed Landfill up until 1978, and from 1948 to the early 1970s in both the Former Landfill and LDA No. 1. Chemicals were also buried in LDA No. 2 for about one year in the 1950s. LDA No. 3 was found in the late 1970s to contain a small quantity of liquid mercury from old battery disposal and was subsequently excavated to remove and properly dispose of the affected soil and batteries. LDA No. 4 contains non-hazardous construction and demolition debris.

During the period from 1963 to 1978, disposal of zirconium metal chips and powder took place in LDA No. 1 by burning or burial. Burning was the normal disposal method in the early 1960s. Occasionally, small quantities of these materials were immersed in oil and buried in 1- and 5-gallon containers.

Environmental Characterization

Inspections of the above locations and reviews of past practices have been conducted to characterize the areas used for disposal of chemical wastes. The reviews have indicated that pre-existing small depressions were sometimes used for the disposal of waste chemicals and then covered over with soil. Several visual inspections of each disposal location were conducted in 1985 through 1987; these inspections confirmed the above. The types of wastes involved include acids and bases used for metal treatments, a variety of chemistry reagents used for chemical analyses, cooling system and lubricating oils, battery acid, paint, solvents, and photographic developing chemicals. Analysis of these areas was performed using the best available technology, including ground penetrating radar, magnetometry, and electromagnetic techniques.

The historical waste disposal areas have been subject to environmental characterization for residual chemicals in accordance with the Knolls Laboratory RCRA Permit Corrective Action provisions. Investigation work started in 2002 and culminated in 2010. All work was subject to review and oversight by NYSDEC. Subsequent to completing the most recent investigation, in 2011 a final report, including a remediation recommendation, was transmitted to NYSDEC, who approved the report in 2016. Characterization sample results have identified no imminent threat to human health or the environment that would warrant immediate remediation. In 2018, Knolls Laboratory transmitted to NYSDEC a Focused Corrective Measures Study Report that evaluated remediation alternatives and identified a proposed remedy that includes excavation and consolidation of contaminated soil that will be covered with a clean soil cover, followed by groundwater monitoring. NYSDEC approved the proposed remedy in 2019, and has been working with KAPL to incorporate the remedy into the Knolls Laboratory RCRA Permit. The remedy is anticipated to be completed by the mid to late 2020s.

The Knolls Laboratory estimates that about 90 cubic feet (less than 3 tons) per year of chemical wastes were buried from 1950 through 1977, when such practices ceased. The land areas used for burial of chemicals comprise about 5% of the Laboratory. The Knolls Laboratory annual EMR describes the results of voluntary and NYSDEC required groundwater monitoring conducted at the Knolls Laboratory to assess the influence of these past disposal practices. Monitoring wells have been in place around the closed landfill since 1978.

Ground and Surface Water Monitoring

Groundwater and surface water monitoring has been and continues to be routinely performed on monitoring wells and surface drainage streams across the Laboratory and in particular at locations associated with the Knolls Laboratory Closed Landfill, former LDAs, and Buildings H2 and G2.

Groundwater and surface water monitoring associated with the Knolls Laboratory Closed Landfill is performed to meet the State regulatory requirements for closed landfills. The Closed Landfill monitoring wells and surface waters were sampled quarterly from 1980 to 2000 for parameters specified by the NYSDEC. NYSDEC approved reducing the chemical parameters monitored and changing the sampling frequency to semiannual in 2000 and then to annual sampling in 2018. There are currently five wells and three surface water locations being used for water quality monitoring around the Closed Landfill. Monitoring results are provided to the NYSDEC for review.

In the 1980s, monitoring wells were installed around Buildings H2 and G2 to determine the direction of groundwater flow around former radioactive material processing facilities and determine groundwater quality. Additional wells were installed in the early 1990s to evaluate site-wide hydrogeological conditions, and to provide background data and monitor the peripheral and central parts of the areas where chemical disposal took place. The number of monitoring wells in service under the voluntary groundwater monitoring program has varied over the years, as new monitoring wells are installed and old wells are retired to better facilitate understanding of groundwater conditions.

The extensive groundwater monitoring program has resulted in the generation of considerable groundwater quality data and information on hydrogeologic conditions. Previous efforts to better characterize the groundwater at the Knolls Laboratory also included changes in analysis procedures to improve sensitivity and expansion of the analytical parameters monitored. The following paragraphs summarize the information obtained through the monitoring program.

For the Closed Landfill, groundwater monitoring data indicate no detectable groundwater contaminant plumes. For monitoring wells immediately downgradient of the Closed Landfill, parameters that were historically elevated above NYSDEC groundwater quality standards included total dissolved solids, turbidity, iron, magnesium, sodium, and manganese. Those parameters that were typically elevated in some downgradient wells in relation to the upgradient wells, but not above groundwater quality standards, included nitrate, total organic carbon, alkalinity, hardness, boron, calcium, sulfate, chloride, potassium, and barium. These results were in part attributable to natural background levels in groundwater for some chemical parameters, to analytical variability at or near the limit of detection, and to salt used for deicing of adjacent roadways. All of the elevated parameters are typical of leachate from a sanitary landfill and are not migrating off-site.

Subsequent to the Landfill closure, trace levels of volatile organic compounds, less than or about equal to the NYSDEC groundwater standards, have occasionally been detected in two downgradient wells. These compounds have not been detected in recent years.

In the LDA, historical detection of volatile organic compounds above NYSDEC groundwater standards in one well prompted further investigation in accordance with the RCRA Permit Corrective Action provisions. These organics are attributed to past disposal activities in these areas. Environmental characterization shows that limits of the affected groundwater have been effectively defined, and the volatile organic compounds are not migrating significantly beyond their original location or off-site.

In an area near the former SPRU facilities, Buildings H2 and G2, and in two other areas near adjacent buildings to the south, volatile organic compounds have been detected in groundwater samples at levels above groundwater quality standards. The source of the volatile organic compounds is unknown, with no known process or practice causing these substances to become located in these areas. The presence of the volatile organic compounds prompted further environmental investigation in accordance with the Knolls Permit provisions. The absence of

volatile organic compounds in other downgradient wells and other characterization data indicate these substances are not migrating significantly beyond their original location or off-site.

The overall conclusion of the groundwater and surface water-monitoring program is that previous operations and waste disposal practices have resulted in some measurable but small effects on the groundwater quality in localized areas of the Knolls Laboratory. The geologic materials beneath the Laboratory are relatively impermeable and form very poor aquifers. This is reinforced by the absence of detectable parameters of concern in the wells at or near the Laboratory's perimeter.

In addition, the groundwater at the Knolls Laboratory is limited in quantity and is not used as a drinking water supply; the Laboratory uses city water. Finally, upstream and downstream monitoring of the Mohawk River shows that there is no discernible effect on river water quality as a result of past or present Knolls Laboratory operations. Therefore, the limited effects on the groundwater pose no threat to public health or the environment.

6.0 MONITORING PROGRAMS

The Knolls Laboratory maintains a comprehensive environmental monitoring program covering all aspects of Knolls Laboratory operations. This program is described in detail in the annual EMR provided each year to Federal, State, and local officials. In addition to routine monitoring, Knolls Laboratory has conducted extensive special monitoring of the areas of the Knolls Laboratory potentially affected by chemical and radiological residues.

6.1 Aerial Survey

Convincing evidence that the Knolls Laboratory does not represent a significant radiological problem comes from the results of an aerial radiation survey of the Laboratory and the surrounding areas, including the City of Schenectady, conducted in 1982. The results for the Knolls Laboratory showed readings of 1.4 times background in the immediate vicinity of the SPRU buildings on the Upper Level. Elsewhere at the Knolls Laboratory, including the Lower Level, its parking lot, and the LDA, the readings were within the range of background radiation levels in the surrounding Schenectady County area. No changes in radiological conditions have occurred at the Knolls Laboratory that would affect the conclusion of the 1982 aerial survey, other than a reduction associated with the removal and remediation of the former SPRU facilities.

6.2 Soil Survey

During the 1980s, over 10,000 ground measurements were made for residual radioactive materials in the soil on the Knolls Laboratory. The measurements for radioactivity used a Knolls Laboratory developed technique designated the Surface Penetrating Underground Detector (SPUD). This technique used a small portable radiation detector adjusted to detect cesium-137. This radionuclide is the most common radionuclide resulting from early Laboratory operations that can be found in soil at the facility. The detector was lowered into a small hole punched to a depth of about 6 feet by a hydraulic machine. This technique permitted a large area to be evaluated much more quickly and thoroughly than the conventional technique of removing soil samples for analysis in a laboratory.

In addition to SPUD monitoring, numerous soil samples have been taken to verify the SPUD results and to confirm that the concentrations of other radionuclides including strontium-90, uranium, and plutonium are also very low. Numerous monitoring wells have also been installed to check for chemicals and radioactivity in the groundwater beneath many areas of the Site. Based on the SPUD monitoring, soil sampling, and groundwater monitoring results, Knolls Laboratory estimates that about 0.5 Ci of radioactivity remain contained in Knolls Laboratory soils, essentially all attributed to the operation of SPRU. This is a decrease from the historically estimated 15 Ci reported in previous Knolls Laboratory Environmental Summary Reports, a result primarily due to DOE-EM remediation of contaminated soil. The remaining 0.5 Ci in the soil is less than the amount of naturally occurring radioactivity in the top 0.5 inches of soil covering an area the same size as a typical 18-hole golf course (170 acres) in the Schenectady region.

For a complete description of the routine monitoring program results, refer to the annual Knolls Laboratory EMR.

7.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

The impact of Knolls Laboratory operations on the environment can be assessed separately in terms of radioactive and non-radioactive effects.

7.1 Radiological Assessment

With respect to radioactivity, the Knolls Laboratory has always monitored all known or suspected releases of radioactivity to the environment from Knolls Laboratory liquid and airborne effluents. All releases of radioactivity have been at levels below limits prescribed by the appropriate Federal, State, and local authorities.

The Knolls Laboratory has never maintained a designated on-site radioactive waste burial ground. However, activities in the past have resulted in the release of small amounts of radioactive material to localized areas of soil. The total amount of radioactive material in the affected on-site areas is estimated to be about four curies, nearly all being near the foundation of the SPRU Buildings G2 and H2 and was removed by the end of 2019. DOE-EM has remediated most of the other areas of the site that contained significant historical contamination. During the early years of the Laboratory's operations, the Mohawk River was used to dilute and disperse liquid radioactive wastes in accordance with applicable Federal, State and local guidelines. The Laboratory ceased this practice in 1964. However, as a consequence of past disposal practices, the riverbed in the vicinity of the Knolls Laboratory retains less than one curie of Knolls Laboratory-produced radioactivity.

The total of less than five curies at the Laboratory and in the adjacent riverbed is less than the amount of naturally occurring radioactivity in the top five inches of soil covering a local area the size of a typical 18-hole golf course (170 acres).

The comprehensive Laboratory radiation monitoring program, which is described in Knolls Laboratory's annual EMR, shows that the radiation exposure to persons off-site is too small to be measured. Knolls Laboratory has employed calculation techniques that conservatively estimate potential exposures. These calculation techniques consider exposure pathways that include fishing, boating, and swimming in the Mohawk River, using the river water for drinking and irrigation, breathing the air, and eating regionally produced animal and vegetable food. The most recent assessment for 2021 shows that the maximum potential radiation exposure to a member of the public from both Knolls Laboratory, SPRU remediation, and DOE-EM activities was substantially less than 0.1 millirem for the entire year. This is about one-thirtieth of the exposure that a person would receive from cosmic radiation sources during a one-way cross-country airplane flight from New York to Seattle. Knolls Laboratory conservatively estimates that the total accumulated radiation exposure from Knolls Laboratory, SPRU operations and D&D, and DOE-EM activities to a member of the public living continuously next to the Knolls Laboratory during the time the facility has been operating, i.e., over seven decades, would not exceed 90 millirem. This is less than the average exposure a person receives in four months from natural radiation sources. The updated version of the EPA approved computer model results in a lower calculation of dose than reported previously. This is due to more current dose conversion factors and updated modeling.

7.2 Non-Radiological Assessment

Regarding non-radioactive environmental effects, the Knolls Laboratory has always monitored its effluent water and air to ensure that they meet the requirements of applicable Federal and State environmental standards. This includes monitoring of Mohawk River water and surface water from the Laboratory and, more recently, groundwater sampling from monitoring wells around the Laboratory. Results of all monitoring to date support the conclusion that operation of the Knolls Laboratory has no significant impact on the environment.

Each year since 1972, Knolls Laboratory has published the EMR, which is a report of comprehensive environmental monitoring results. Over the past 50 years, the EMRs have shown that Knolls Laboratory operations have no adverse effect on human health or the quality of the environment.

Knolls Laboratory will continue to obtain and evaluate environmental sampling data and take any necessary actions to mitigate any impact on the environment from the remaining residual chemical and radioactive materials at the Laboratory, in accordance with Federal and State regulations.

8.0 AUDITS AND REVIEWS

8.1 Knolls Laboratory

The Knolls Laboratory uses training, controls, checks and crosschecks, audits, and inspections of numerous kinds to maintain high standards of environmental control.

- Each worker is specially trained in the appropriate environmental controls as they relate to their work.
- Written procedures must be followed.
- Engineers, technicians, and their supervisors oversee all environmental monitoring and related work.
- Knolls Laboratory maintains an independent audit program, which covers all environmental requirements and includes in-depth audits of specific areas.

The NNPP maintains an on-site resident office, NRLFO, with a technical staff reporting directly to the Director, NNPP in Washington, D.C. Several personnel in NRLFO are assigned full time to audit and review Knolls Laboratory environmental controls. NNPP headquarters personnel also conduct periodic in-depth inspections of these areas.

In addition, various aspects of the Knolls Laboratory environmental program are reviewed by other Government agencies. For example, NYSDEC or the EPA have conducted on-site inspections of RCRA programs at least annually for the past 25 years. Outside regulators have conducted 105 environmental inspections or visits of the Knolls Laboratory and DOE-EM SPRU Project over the past 10 years (Tables 1 & 2).

There have been two major environmental reviews conducted at Knolls Laboratory: the Government Accountability Office (GAO) (previously known as the General Accounting Office) in the early 1990s and the EPA in the late 1990s. In 1991, at the conclusion of their review of the Naval Reactors Program's environmental, health, and safety practices, the GAO testified to Congress that:

> "We have reviewed all past problems at each laboratory and site and found that they have all been characterized, are periodically monitored, and controlled where necessary."

In their final report, the GAO stated that the programs and procedures implemented by Knolls Laboratory are adequate to protect employees and the environment from exposures to radioactive and hazardous materials. Furthermore, procedures have been implemented to ensure that radioactive and hazardous wastes are handled, stored, and disposed of in a safe manner.

In 1999, the EPA and NYSDEC conducted a Multi-Media Environmental Compliance Inspection of Knolls Laboratory. A Multi-Media Inspection reviews all areas of compliance with environmental regulations governing air, water, solid waste, etc. The EPA found Knolls Laboratory operations to comply with regulations, with one exception regarding the accounting of fuel consumption for a large natural gas fired water heater. This record keeping discrepancy did not result in any environmental impact, and Knolls Laboratory corrected the record keeping practice shortly after the EPA inspection.

All other aspects of Knolls Laboratory operations inspected by the EPA were found to comply with applicable environmental laws and regulations. The EPA imposed no fines or penalties as a result of this inspection.

The EPA conducted Consolidated Multi-Media Environmental Compliance Inspections of the Knolls Laboratory in the years 2014, 2018 and 2020. A Consolidated Multi-Media Environmental Compliance Inspection, also known as a Multi-Media Screening Inspection, covers multiple EPA regulated areas usually by one or two EPA inspectors. The results of these EPA inspections found Knolls Laboratory operations to comply with the regulations and the information provided by the EPA indicated no significant concerns.

Table 1 - Environmental Inspections/Visits − Knolls Laboratory (2011-2021)

TOPIC	DATE	AGENCY
Multi-Media Inspection	5/5/2014	EPA
Multi-Media Inspection	5/8/2018	EPA
Multi-Media Inspection	11/4/2020	EPA
Air Emissions	4/4/2011	NYSDEC / New York State Department of Health (NYSDOH)
Air Emissions	10/13/2011	EPA
Air Emissions	12/2/2011	EPA
Air Emissions	8/27/2012	EPA
Air Emissions	4/25/2013	EPA
Air Emissions	8/26/2014	EPA
Air Emissions	9/30/2015	EPA
Clean Water Act	1/20/2011	NYSDEC
Clean Water Act	5/20/2011	NYSDOH
Clean Water Act	6/9/2011	NYSDEC
Clean Water Act	12/13/2011	NYSDEC
Clean Water Act	9/26/2012	NYSDEC
Clean Water Act	3/20/2013	NYSDEC
Clean Water Act	6/27/2013	NYSDEC
Clean Water Act	5/14/2014	NYSDEC
Clean Water Act	5/13/2015	NYSDEC
Clean Water Act	7/27/2016	NYSDEC
Clean Water Act	2/21/2018	NYSDEC
Clean Water Act	6/20/2018	NYSDEC
Clean Water Act	10/16/2019	NYSDEC
Clean Water Act	6/24/2020	NYSDEC
Clean Water Act	7/21/2020	NYSDEC
Clean Water Act	5/20/2021	NYSDEC
Wetlands Delineation Review	10/26/2020	US Army Corps of Engineers (USACOE)
RCRA	9/19/2011	EPA

Table 1 - Environmental Inspections/Visits − Knolls Laboratory (2011-2021)

TOPIC	DATE	AGENCY
RCRA	9/10/2012	EPA
RCRA	8/21/2013	EPA
RCRA	5/28/2015	EPA
RCRA	6/21/2016	EPA
RCRA	8/16/2017	EPA
RCRA	3/21/2019	NYSDEC
RCRA	5/14/2019	EPA
RCRA	4/1/2021	NYSDEC
RCRA (Corrective Action) *	6/1/2011	NYSDEC
RCRA (Corrective Action) *	6/10/2011	NYSDEC
RCRA (Corrective Action) *	6/16/2011	NYSDEC
RCRA (Corrective Action) *	11/1/2011	NYSDEC
RCRA (Corrective Action) *	4/19/2012	NYSDEC
RCRA (Corrective Action) *	8/8/2012	NYSDEC
RCRA (Corrective Action) *	3/6/2013	NYSDEC
RCRA (Corrective Action) *	11/25/2013	NYSDEC
RCRA (Corrective Action) *	12/10/2013	NYSDEC
RCRA (Corrective Action) *	8/20/2014	NYSDEC
RCRA (Corrective Action) *	10/28/2014	NYSDEC
RCRA (Corrective Action) *	5/20/2015	NYSDEC
RCRA (Corrective Action) *	6/30/2015	NYSDEC
RCRA (Corrective Action) *	8/25/2015	NYSDEC
RCRA (Corrective Action) *	11/17/2016	NYSDEC
RCRA (Corrective Action) *	8/22/2017	NYSDEC
RCRA (Corrective Action) *	7/18/2018	NYSDEC
RCRA (Corrective Action) *	6/6/2019	NYSDEC
Solid Waste – Closed Landfill	1/10/2017	NYSDEC
Solid Waste – Closed Landfill	5/9/2018	NYSDEC
PBS	8/30/2016	NYSDEC
Other (Emergency Planning Outreach)	10/30/2013	NYSDOH
Other (Town Vehicle Access to Rail Bed)	7/21/2011	Town of Niskayuna
Other (Ambulance)	11/15/2017	NYSDOH
Other (Fish & Wildlife - Verification Monitoring Observation)	5/7/2018	NYSDEC
Other (Alplaus Records Review)	3/1/19	NYSDEC
Other (Radiological Health)	7/3/2019	NYSDEC

* Site visits by NYSDEC were associated with Knolls Laboratory's ongoing environmental evaluations and corrective action as specified in the Knolls Laboratory RCRA Permit (Section 9.0).

8.2 SPRU Project

The SPRU project experienced an unplanned release of airborne radioactivity during the open-air demolition of Building H2 on September 29, 2010, that was documented in a Type B accident investigation report. As a result of EPA's investigation into the event, both SPRU and the Knolls Laboratory were determined to be not in compliance with the radionuclide NESHAP regulations. The non-compliance issues included:

- DOE failed to evaluate the potential emissions from the demolition of the K5 retention basin in 2006;
- DOE failed to report the demolition of the K5 retention basin and the fact that K5 was an emission point in the 2006 annual report to the EPA;
- DOE failed to correctly evaluate the potential for radionuclide emissions during the Building H2 demolition;
- DOE failed to maintain and perform the Building H2 demolition in a manner with good air pollution control practices for minimizing emissions; and
- DOE issued two separate radionuclide air emission reports for SPRU and the Knolls Laboratory to EPA for calendar year 2009, rather than one combined report.

As a result of these findings, EPA issued a Compliance Order on Consent (Order) in March 2012 to the DOE. In response to the Order, revised 2006 and 2009 annual radionuclide air emissions reports were submitted to the EPA, and SPRU submitted an application for Building H2 and G2 demolition to the EPA and received approved EPA permits for performing the work using ventilated enclosures. All of the short-term corrective actions required by the Order were completed in May 2012. On June 5, 2012, the EPA informed DOE of EPA's conclusion that the Knolls Laboratory had returned to compliance with the radionuclide NESHAP regulations. The remainder of the corrective actions required by the Order were completed on February 28, 2013. EPA issued a Consent Agreement and Final Order on May 28, 2014, which imposed a civil penalty of $155,000 and closed out the Order.

On October 25, 2010, approximately 630 gallons of unprocessed groundwater were discharged through Outfall 004 due to an electrical control unit failure of the SPRU Hillside Radiological Processing System. This resulted in the shutdown of the hillside sump pumps that pump groundwater with low levels of radioactivity from a sump that collects water from footing drains at the base of Building H2. When the electrical system failed, the sump filled and overflowed into a drainage ditch via an overflow pipe installed as an engineered protection for electrical equipment inside the sump containment. URS, a contractor to DOE-EM, took immediate action to trouble-shoot the problem and restore power to two of the pumps within two hours.

NRLFO and Knolls Laboratory were notified of the overflow by DOE-EM and their contractor, URS, around midnight on October 25, 2010 (approximately two hours into the event). Notification of the discharge was made to the NYSDEC on October 26, 2010, and their Regional Office representatives visited the site on November 3, 2010.

NYSDEC issued a Notice of Violation (NOV) on November 5, 2010, to NRLFO and SPRU regarding the unpermitted discharge from the Knolls Laboratory facility to the Mohawk River. The NOV requested that SPRU submit a copy of the Stormwater Pollution Prevention Plan (SWPPP) required

by the NYSDEC General Permit for Discharges of Stormwater from Construction Activities (which was GP-0-08-001 at the time) for the SPRU Demolition Site to NYSDEC for review by November 22, 2010. SPRU issued a response to the NYSDEC NOV, including a copy of their revised GP-0-08-001 SWPPP, on November 22, 2010. On December 30, 2010, NYSDEC and DOE signed an order on consent relating to the unpermitted discharge. This order required that DOE submit a Spill Reporting and Response Plan to NYSDEC by January 18, 2011, and a SWPPP and Best Management Practices document to NYSDEC by January 31, 2011. These documents were submitted by DOE to NYSDEC within these timeframes.

Table 2 - Environmental Inspections/Visits − DOE-EM Activities including the SPRU Project (2011-2021)

TOPIC	DATE	AGENCY
Air Emissions	4/4/2011	NYSDEC / NYSDOH
Air Emissions	8/16/2011	EPA
Air Emissions	10/13/2011	EPA
Air Emissions	12/2/2011	NYSDEC
Air Emissions	8/27/2012	EPA
Air Emissions	4/25/2013	EPA
Air Emissions	12/11/2013	EPA
Air Emissions	8/26/2014	EPA
Air Emissions	9/30/2015	EPA
Clean Water Act	6/9/2011	NYSDEC
Clean Water Act	9/16/2011	NYSDEC
Clean Water Act	12/13/2011	NYSDEC
Clean Water Act	9/26/2012	NYSDEC
Clean Water Act	3/20/2013	NYSDEC
Clean Water Act	6/27/2013	NYSDEC
Clean Water Act	5/14/2014	NYSDEC
Clean Water Act	5/13/2015	NYSDEC
Clean Water Act	11/20/2015	NYSDEC
Clean Water Act	10/16/2019	NYSDEC
Clean Water Act	6/24/2020	NYSDEC
Radiological Health	10/4/2012	NYSDEC
Radiological Health	7/19/2013	NYSDOH
Radiological Health	8/29/2013	NYSDEC
Radiological Health	7/17/2015	NYSDEC / NYSDOH
Radiological Health	6/9/2016	NYSDEC / NYSDOH
RCRA (Corrective Action) †	4/7/2011	NYSDEC
RCRA (Corrective Action) †	5/25/2011	NYSDEC
RCRA (Corrective Action) †	6/1/2011	NYSDEC
RCRA (Corrective Action) †	8/12/2011	NYSDEC
RCRA (Corrective Action) †	10/17/2011	NYSDEC
RCRA (Corrective Action) †	4/19/2012	NYSDEC

Table 2 - Environmental Inspections/Visits − DOE-EM Activities including the SPRU Project (2011-2021)

TOPIC	DATE	AGENCY
RCRA (Corrective Action) †	7/19/2012	NYSDEC
RCRA (Corrective Action) †	11/2/2012	NYSDEC
RCRA (Corrective Action) †	12/6/2012	NYSDEC
RCRA (Corrective Action) †	1/14/2013	NYSDEC
RCRA (Corrective Action) †	5/20/2015	NYSDEC
RCRA (Corrective Action) †	6/30/2015	NYSDEC
RCRA (Corrective Action) †	11/17/2016	NYSDEC
RCRA (Corrective Action) †	8/22/2017	NYSDEC
RCRA (Corrective Action) †	7/19/2018	NYSDEC
RCRA (Corrective Action) †	6/6/2019	NYSDEC

† Site visits by NYSDEC were associated with DOE-EM's ongoing environmental evaluations and corrective action as specified in their 6 NYCRR Part 373 Corrective Action Only Permit and the subsequent Consent Order (Section 9.0).

9.0 REGULATORY MATTERS

The Knolls Laboratory has always responded promptly and effectively to meet new Federal, State, and local requirements and will continue to do so. Knolls Laboratory maintains a program to review changes in regulatory requirements to ensure operations remain in compliance with applicable laws and regulations. Additional information regarding compliance with major environmental regulations is available in Knolls Laboratory's annual EMR.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

This Act, commonly referred to as Superfund, was enacted in 1980, and reauthorized in 1986. CERCLA was designed to respond to situations involving the past disposal of hazardous substances and established requirements for the identification of areas where hazardous materials have been placed in soil/released to the environment. Knolls Laboratory prepared and submitted to the EPA and NYSDEC a Preliminary Assessment documenting such areas at the Knolls Laboratory (discussed in Section 5), as required by CERCLA. The submittal included hazard-ranking calculations conducted in accordance with then-current EPA methodology used to judge the significance of waste sites. Those ranking calculations concluded that the Knolls Laboratory scored below the value that would warrant including the site on the NPL for cleanup. Additional information was subsequently provided to the EPA and the State in support of their review of the Preliminary Assessment, both to supplement previous information and to reflect changes in evaluation methodology implemented by the EPA subsequent to Knolls Laboratory's original submittal.

At the EPA's request, Knolls Laboratory also executed an Expanded Site Investigation, including limited-scope stream sediment sampling. Based on the results of this investigation and its review of Knolls Laboratory submittals, the EPA independently scored the Laboratory and designated it as "Site Evaluation Accomplished" in 1994; the EPA concluded the Knolls Laboratory does not qualify for inclusion on the NPL. As a result, no CERCLA remedial action is anticipated. Subsequent characterization work related to the disposal areas is being conducted under RCRA for which the EPA has delegated authority to New York State.

Superfund Amendments and Reauthorization Act (SARA)

This Act, more commonly known as SARA, extended the programs established under Superfund (CERCLA) to clean up hazardous releases at past hazardous waste sites. In addition, SARA created a separate fund for the cleanup of leaking underground petroleum storage tanks and defined many new and independent regulatory programs such as the Emergency Planning and Community Right to Know Act (EPCRA). The Knolls Laboratory continues to comply with the requirements of SARA. Knolls Laboratory annually submits detailed information related to on-site hazardous materials to local emergency planning groups in conformance with the Community Right-to-Know requirements of EPCRA.

Resource Conservation and Recovery Act (RCRA)

This Act, and its State counterpart, establishes requirements for the proper treatment, storage, and disposal of chemically hazardous waste. Currently, the Knolls Laboratory operates in accordance with its RCRA Permit and New York State regulations. This permit was originally issued by

NYSDEC in 1998. During the RCRA Permit application process, Knolls Laboratory provided descriptive material on its waste handling operations, including identification of the hazardous wastes and waste management methods employed. Specific details regarding operations and management practices for the safe control of hazardous wastes were also provided as part of this process. The same permit also covers the handling of mixed wastes (wastes that contain both chemically hazardous and radioactive constituents).

As required by the RCRA statute, Knolls Laboratory has prepared a list of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs), including the landfill and disposal areas and the SPRU waste management areas discussed in Section 5. The current Permit (issued in 2012) includes a list of these units along with a sequence of State-approved evaluations and corrective action for each if required. Following a review of the Knolls Laboratory's current and historical disposal documentation and a visual inspection, the State concluded that the Laboratory posed no immediate danger to human health or the environment.

Of the SWMUs and AOCs identified, approximately 75% have since been classified as "no further action required" (including the landfill, which was closed in 1993 in accordance with a State-approved closure plan). Remaining SWMUs and AOCs continue to be evaluated and remediated, if necessary, in accordance with the Knolls Laboratory RCRA permit and State and Federal guidance.

DOE-EM operated under a RCRA Corrective Action Only Permit since September 2008, to address the SPRU-related SWMUs and AOC, which were transferred from the Knolls Laboratory RCRA Permit to DOE-EM. DOE-EM completed its Corrective Action obligations and forwarded the associated RCRA reports to NYSDEC in 2020.

Finally, storage of MTRU waste from the DOE-EM SPRU project that is awaiting final shipment for disposal remains in a DOE-EM controlled shielded area at the lower level area under a consent order with the NYSDEC, while DOE-EM awaits the processing of a 6 NYCRR part 373 Hazardous Waste Management Permit to address storage of the waste. As shown in Figure 3, approximately 28.8 Ci of mixed fission product and transuranic isotopes are stored in weatherproof storage containers, which are inspected and maintained in accordance with the consent order.

Federal Facility Compliance Act (FFCA)

The FFCA, enacted in 1992, requires DOE facilities to prepare plans for developing treatment capacity and technologies for sites that generate or store mixed wastes. Mixed wastes contain both chemically hazardous and radioactive constituents. Very small quantities of mixed waste are generated at the Knolls Laboratory in the course of research and development activities. These plans were needed because adequate capacity for treating some mixed waste to the standards required by RCRA did not exist. Updated Site Treatment Plans are submitted annually to New York State for approval as required.

Clean Air Act (CAA)

This Act, as amended in 1990, established requirements for the control of air emissions. The regulations promulgated pursuant to the CAA also govern use of ozone depleting substances, the use and removal of asbestos containing materials, and the emission of radionuclides to the environment. The regulatory authority for the majority of the CAA regulations that affect the Knolls

Laboratory has been delegated by the EPA to NYSDEC. The Knolls Laboratory heating boilers and the Advanced Steam Generator Test Facility water heaters are permitted under a NYSDEC Air State Facility Permit (ASFP), which was renewed in January 2010 and is still in effect. The ASFP for the Knolls Laboratory heating boilers has federally enforceable capping provisions that allow the heating boilers to be classified as synthetic minor sources. As such, the Knolls Laboratory does not require a Title V facility permit, which normally applies to major sources under the CAA. Radiological air emissions at the Knolls Laboratory are monitored and reported annually to the EPA in accordance with the requirements of NESHAP.

Clean Water Act (CWA)

The Federal CWA and the NYS Environmental Conservation Law regulate the chemical components and physical attributes of liquids discharged to the surface waters of the State of New York. Specifically, the Knolls Laboratory effluent and environmental standards are established in a site-specific State Pollutant Discharge Elimination System (SPDES) permit issued by NYSDEC. The SPDES Permit specifies the required sampling locations, parameters, and minimum sampling frequencies. The term of the permit is five years, and the NYSDEC renewed the permit in 2020, which became effective on August 12, 2020. Liquid effluent from the Knolls Laboratory enters the Mohawk River through five outfalls (which discharge process water; once-through, non-contact cooling water; and/or stormwater) and three stormwater-only outfalls that flow into natural, intermittent streams.

NYS implements the EPA Phase II Stormwater regulations under the SPDES program through two stormwater general permits applicable to the Knolls Laboratory. One is the Construction Stormwater permit, which requires the Knolls Laboratory or DOE-EM to process a Notice of Intent to participate in the NYSDEC's Stormwater general permitting program for sites disturbing one acre or greater of soil. Participation in this general permit also requires preparation of project-specific Stormwater Pollution Prevention Plans. The other Stormwater General Permit covers Municipal Separate Storm Sewer Systems and participation requires preparation and management of a site-specific Stormwater Management Programs. In addition to certain administrative documentation requirements listed in each permit, the SPDES general permit for construction activities requires an inspection of the project site at least once every seven days. Post-rainfall inspections are required for specific erosion and sediment control practices.

Other Regulations

Knolls Laboratory does not anticipate any substantial future impact on its operations from regulatory developments in other areas such as the Safe Drinking Water Act, or TSCA. All Knolls Laboratory operations comply with applicable regulations.

EXTERNAL DISTRIBUTION

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