

KAPL-4874

Knolls Atomic Power Laboratory

Knolls Site

Environmental

Summary Report

March 2014



**Operated for the United States Department of Energy
By Bechtel Marine Propulsion Corporation
Under Contract No. DE-NR0000031**



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KNOLLS SITE
ENVIRONMENTAL SUMMARY REPORT

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Prepared for the U.S. Department of Energy
By Bechtel Marine Propulsion Corporation
Knolls Atomic Power Laboratory
Schenectady, New York

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1.0 OVERVIEW AND CONCLUSIONS

The Knolls Site, located in Niskayuna, New York, is owned by the U.S. Department of Energy (DOE). The Site'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, and to provide the headquarters functions for all of the Knolls Atomic Power Laboratory's (KAPL's) operations (Section 4.0). The General Electric Company operated the Knolls Site under Government contract, from its inception in 1946 until 1993. In 1993, responsibility for operation of the Knolls Site 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), under contract with the DOE and U.S. Navy, has operated KAPL since February 2009.

KAPL is one of two single purpose laboratories dedicated to the Naval Nuclear Propulsion Program (NNPP); the other is the Bettis Atomic Power Laboratory located in West Mifflin, Pennsylvania. KAPL consists of two separate sites, the Knolls Laboratory and the Kesselring Site, both of which are United States Government owned facilities. BMPC, a wholly owned subsidiary of Bechtel National Inc., also operates the Bettis Laboratory.

This report describes the environmental history of the Knolls Site through 2013. A similar report describes the environmental history of KAPL's Kesselring Site located in West Milton, New York.

The west side of the Knolls Site in Niskayuna, New York contains an inactive, Cold War era facility known as the Separations Process Research Unit (SPRU) operated between 1950-1953. At that time, KAPL was operated as a general-purpose Site 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. KAPL 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 to support SPRU dismantlement and remediation. The remediation of the SPRU site will result in the removal of hazardous equipment and material from the Knolls Site and the restoring of the land for KAPL use. KAPL completed turnover of the SPRU buildings and land areas to the DOE's Office of Environmental Management (DOE-EM) in 2009, creating two separate entities at the Knolls Site: Knolls Laboratory and DOE-SPRU. DOE-EM is responsible for the remediation of the SPRU site.

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

To improve clarity in this report the following naming conventions are used:

- Knolls Atomic Power Laboratory (KAPL) refers to operations that affect, or the corporate entity that oversees both NNPP facilities at Niskayuna and West Milton, New York.
- Knolls Site refers to the NNPP facility and SPRU project in Niskayuna, New York.
- Knolls Laboratory refers to the NNPP facility in Niskayuna, New York only.
- DOE SPRU refers to the Department of Energy Office of Environmental Management (DOE-EM) SPRU project in Niskayuna, New York.
- Kesselring Site refers to the NNPP facility in West Milton, New York only.

1.1 Background

For many years, KAPL has performed environmental monitoring to demonstrate that the KAPL sites are being operated in accordance with environmental standards. The results of this monitoring have been published in annual environmental monitoring reports provided to Federal, State, and local officials. These reports demonstrate that the Knolls Site'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 Environmental Monitoring Report describes monitoring practices and results, it does not describe the nature and environmental aspects of the Knolls Site's work and facilities, nor does it give a historical perspective of the Site's operations. The purpose of this report is to provide this information as well as background information pertinent to understanding the environmental aspects of Site operations.

1.3 Conclusions

KAPL has had effective environmental control programs in place since operations at the Knolls Site 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 Environmental Monitoring Report:

- ◆ KAPL'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 Site operations is too small to be measurable. The maximum possible annual radiation dose to any member of the public resulting from Knolls Site 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 SPRU demolition during 2013. This is about one-twentieth of the radiation received from cosmic radiation sources during a one-way cross-country airplane flight. The calculations also show that if a person had lived continuously next to the Knolls Site since KAPL operations began in 1949, that person's **total** radiation exposure from operations at the Site would be less than the same individual receives in six months from natural radiation sources (Section 7.0).

- There are no designated radioactive waste disposal sites at the Knolls Site. There are, however, areas on Site property where radioactivity releases and incidental radioactive material burial occurred in the early days of Site operations. The total amount of radioactivity currently in the affected on-site areas is estimated to be about 4 curies, nearly all of which is located near the foundation of the SPRU Buildings G2 and H2. Most of the other areas of the Site that contained historical contamination have been remediated by DOE-EM. Four curies is less than 1% of the amount of naturally occurring radon radioactivity released each year from an area the size of a typical 18-hole golf course (170 acres) in the Schenectady region. It is also less than the amount of naturally occurring radioactivity in the top 4 inches of soil covering the same golf course (Sections 5.1, 5.2 and 6.0).
- ◆ Knolls Site practices for handling chemical waste conform to established regulations. KAPL 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 Site'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 Site 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 Site'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 Site. 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 Site is not listed as a Superfund site on the National Priorities List. As a result, no CERCLA remedial action is anticipated. The Knolls Site 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 a RCRA (6 NYCRR Part 373 Hazardous Waste Management Facilities) Permit issued by NYSDEC. This Permit also contains Corrective Action provisions that involve characterization and remediation, if necessary, of historical waste disposal areas. The DOE-SPRU project has a separate RCRA permit with Corrective Action provisions for characterization and remediation, if necessary, for the DOE-SPRU areas. On-going characterization continues to confirm that historical chemical or waste disposal areas at KAPL 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.
- ◆ KAPL'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 KAPL and NNPP reviews and inspections, various aspects of Knolls Laboratory and SPRU environmental programs continue to be periodically inspected by Federal and State agencies. Inspections in 2011-2013 have found the Knolls Site operations to comply with all substantive requirements (Section 8.0). One area of non-compliance identified by the EPA during 2010, radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAPs), was a result of their investigation into the unplanned airborne release of radioactivity by DOE-SPRU during open-air demolition of Building H2 that occurred on September 29, 2010. EPA and DOE signed a Compliance Order of Consent in March 2012. All short-term corrective actions specified in the Consent Order were completed in May 2012. On June 5, 2012, the EPA informed DOE of EPA's conclusion that the Knolls Site was back in compliance with the radionuclide NESHAPs regulations. The remainder of the corrective actions specified in the Consent Order were completed on February 28, 2013. This is further discussed in Section 8.0.
- ◆ The EPA has also performed an extensive evaluation of KAPL'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 the Knolls Site operations (Section 8.0).
- ◆ The Government Accountability Office (GAO) (known as the General Accounting Office until 2004) reviewed KAPL'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 six decades of operation, there has been no significant impact from Knolls Site operations on the environment or adverse effect on the community or the public. KAPL 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 ATOMIC POWER LABORATORY, KNOLLS SITE

2.1 Knolls Site History

Construction of the Knolls Site began in 1948 and operations began at the Site in 1949. The original mission of the Knolls Atomic Power Laboratory (KAPL) 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 the Separations Process Research Unit (SPRU), was under the direction of the Atomic Energy Commission'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 Naval nuclear propulsion project utilizing 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, KAPL 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 Naval Nuclear Propulsion Program, operating initially as an element of the Atomic Energy Commission and the Department of the Navy, and today as a Department of Energy and Navy organization.

2.2 Significant Accomplishments

The technology developed at KAPL 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 approximately 45% of the Navy's major combatant fleet. Key achievements at the Knolls Site 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 utilized in the former submarine TRITON; and development of the dual nuclear propulsion plant utilized in the former guided missile cruiser BAINBRIDGE and subsequent nuclear powered cruisers. KAPL 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 (OHIO replacement).

3.0 DESCRIPTION OF SITE

3.1 Site Location

The Knolls Site is located in Schenectady County in the Town of Niskayuna, New York on the south bank of the Mohawk River. The Site consists of 170 acres of government-owned land, extending approximately 4,200 feet along the river. Most of the Site 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 Site 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 Site property consists of woods and fields.

The Knolls Site 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 Site roads and approximately 17 acres of parking lots are owned by the Department of Energy (DOE) and maintained by the Knolls Atomic Power Laboratory.

In 2007, the DOE purchased a residential house located at the south side of the Knolls Site 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 Site 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 838,000 people. The section of the Town of Niskayuna in which the Knolls Site is located is zoned as Research and Development - Industrial. On Knolls Site'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 Site is consistent with the planned future land uses for the area.

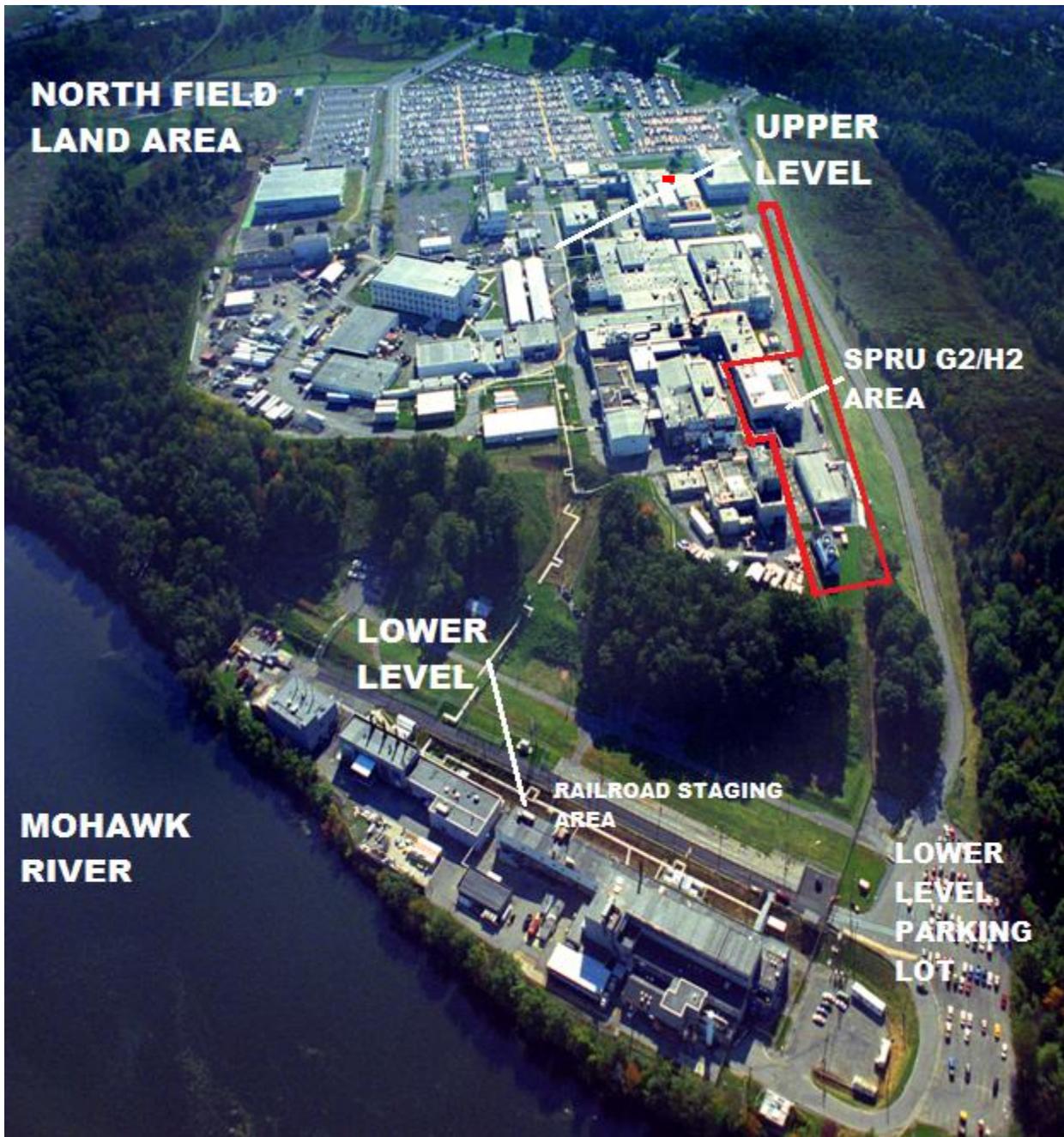


Figure 1 – Knolls Site Reservation

This figure provides an overview of the Upper and Lower Levels. The DOE-EM SPRU Project area on the Upper Level is identified in the outlined area. In addition, the three SPRU excavated areas (North Field Land Area, Lower Level Railroad Staging Area, and Lower Level Parking Area) are included.
Note: Identified areas are not designated to scale.

3.3 Geology and Seismology

The Knolls Site is located in the eastern 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 Site, 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 Site 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 Site 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 Site.

3.4 Hydrology

3.4.1 Surface Water Description

The major surface water in the vicinity of the Knolls Site 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 Site 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 Site drains to the Mohawk by way of three small intermittent streams.

3.4.2 Groundwater Description

KAPL has extensively studied the groundwater conditions at the Knolls Site. The geologic materials (till and shale) underlying the Site 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. Water moves under the Knolls Site 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 Site, 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 3.5 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 eastern 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 Site, research was conducted on several new technologies but was focused primarily in two areas: the Separations Process Research Unit (SPRU) and, beginning in 1950, Naval nuclear propulsion plant development.

The SPRU work was conducted under the direction of the Atomic Energy Commission'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 Atomic Energy Commission's Hanford Site in Washington State and Savannah River Plant in South Carolina.

SPRU work occupied several buildings on the Upper Level of the Site. 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. SPRU facilities on the Upper and Lower Levels are shown in Figure 2.

Separations research work at the Knolls Atomic Power Laboratory (KAPL) 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 to 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. What remains today are some of the SPRU system components and buildings. Some radioactive residues remain in components and in the soil adjacent to the SPRU buildings and waste handling and storage areas. The residues are discussed in Section 5.2. In 1989, a physical inspection was made of the normally isolated SPRU areas. All areas were found to be in good condition, with the residues satisfactorily contained.

Since the mid-1950s, KAPL's work has been devoted exclusively to the Naval Nuclear Propulsion Program.

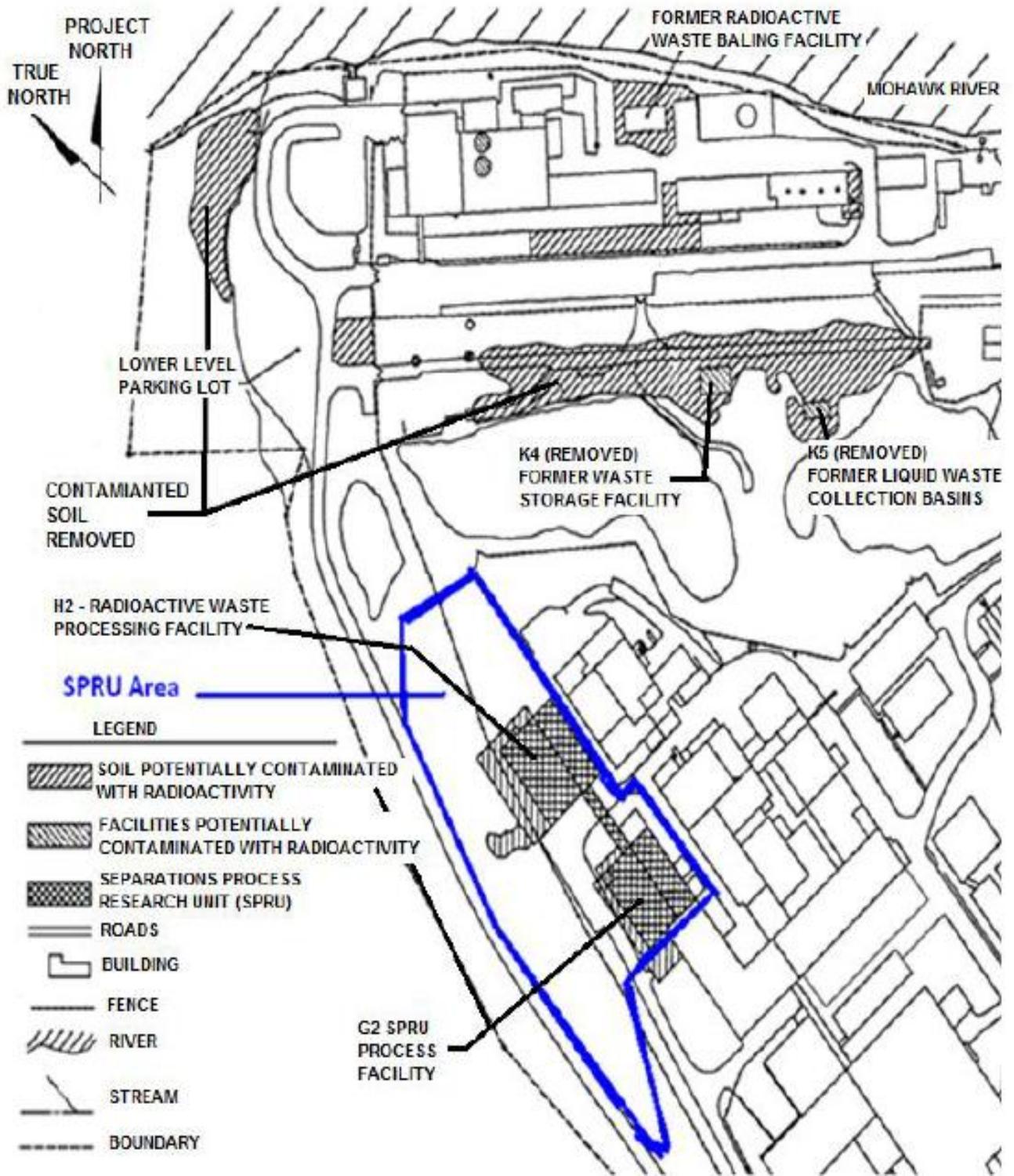


Figure 2 – SPRU Facilities on Upper and Lower Levels

4.2 Present Operations

KAPL's work at the Knolls Laboratory continues 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. The liquids are ultimately absorbed 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 Vault

Materials for use in reactor development are stored in a vault with special safety and security provisions. Only a small amount of such material is kept at the Knolls Laboratory. The storage vault is 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 new 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. As an emergency backup fuel supply, low-sulfur No. 2 fuel oil is stored in two above ground, revetted storage tanks 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 at the Knolls Laboratory is produced 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 Site. A commercial vendor regenerates these columns off-site.

Cooling Towers

There are five 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. The small quantity of blow down water is directed into the Site storm water 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 a 6 NYCRR Part 373 Hazardous Waste Management Permit (Permit) issued by New York State. 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 KAPL 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

Two 15,000 gallon above ground fuel oil tanks hold the backup fuel oil supply for the Site Boiler House. Both tanks sit in individual secondary containment revetments. A 5,000 gallon gasoline storage tank, used for fueling Site vehicles until 2010, was contained in an underground concrete vault. This gasoline tank was taken out of service in 2011 and replaced with an above ground 2,000 gallon double-walled storage tank. Also in 2011, a 1,000 gallon above ground diesel fuel oil tank was replaced with a 1,000 gallon double-walled diesel fuel oil tank. 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 New York State and comply with applicable petroleum bulk storage (PBS) regulations.

A small number of petroleum product storage tanks are also staged for use at the adjacent DOE-EM SPRU project site that range from 90 to 500 gallons. These tanks are all equipped with integral secondary containment systems and are used for fueling DOE-EM contractor vehicles and equipment supporting the SPRU demolition project. The total volume of fuel stored on the DOE-EM SPRU site is below the 1,100 gallon registration threshold under the New York State Petroleum Bulk Storage program, and below the 1,320 gallon Spill Prevention Control and Countermeasure Plan threshold.

SPRU Remediation

The DOE-SPRU Project has evaluated the inactive facilities and contaminated soil associated with SPRU for future disposition. After obtaining community input on the subject through public meetings, the DOE selected the removal and disposal option. Removal of contaminated soil occurred in 2008, 2009, and 2010. Building G2 and H2 demolition activities began in 2009, but were suspended in September 2010 after an unplanned release of airborne radioactivity during open-air demolition of Building H2. In 2012 and 2013, two enclosures with high efficiency air particulate (HEPA) filtered ventilation were constructed around the G2 and H2 buildings, respectively. The demolition work for

Buildings G2 and H2 has resumed under these enclosures. In 2013, removal of the residual sludge material from SPRU tanks contained in the H2 Tank Vaults began. In February 2014, DOE completed removal, solidification, and off-site shipment for disposal of 9700 gallons of contaminated sludge from the tanks in the H2 tank vaults. This action resulted in removal of the majority of the radioactivity at the SPRU facilities.

5.0 WASTE GENERATION AND CONTROLS

The Knolls Site is not, and has never been, a manufacturing facility. Consequently, the total quantities of chemical and radioactive materials handled on the Knolls Site have been small. During the past three years, the quantity of routine chemically hazardous waste shipped off-site from the Knolls Laboratory averaged about 2.2 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 three years, the Knolls Laboratory also shipped an average of 2.2 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 Site 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 360 cubic yards per year in recent 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 Atomic Power Laboratory (KAPL) 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). Department of Energy (DOE) regulations also permit similar discharges of these liquids. KAPL has operated to a far more rigid standard for over three 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 Site operations and SPRU demolition and decontamination (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 U.S. Environmental Protection Agency (EPA) for drinking water. Since October 2010, water from SPRU D&D activities has been shipped by the Department of Energy Office of Environmental Management (DOE-EM) to an out-of-state disposal facility. In 2012, DOE-EM constructed and tested a new system to treat water to remove radioactivity and trace organic compounds. A modification to the Knolls Laboratory State Pollutant Discharge Elimination System Permit was submitted to NYSDEC to allow use of this system for discharge to the Mohawk River. This request is currently under review by NYSDEC.

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 Site.

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 Site Mixed Waste Management Plan and a 6 NYCRR Part 373 Hazardous Waste Management Permit administered by New York State. On July 30, 2012, the elements of the KAPL-Knolls Site Mixed Waste Management Plan were integrated into the Knolls

Laboratory's Hazardous Waste Management Permit. Mixed waste is now managed under the Part 373 Hazardous Waste Management 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 Substance 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 (DOP) 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 SPRU airborne emissions has been less than 1% of the EPA standard over the past several years.

Radioactive Waste Minimization

KAPL 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 several years, averaging about 360 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. In recent years, an average of 7 tons of such metal was recycled each year. This metal was primarily generated by inactivation of facilities and equipment.

Remediation Programs for Radioactivity

In 1977, KAPL established a Facilities Deactivation 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 approximately 150,000 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 2,000 cubic yards of soil from the Knolls Site land area containing radioactive residues from past Site 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 Facilities 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 Site 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.

DOE-SPRU Project

The SPRU buildings and related land areas are included in the DOE-SPRU Project's remediation program. The DOE commenced planning and preparation for the future disposition of the SPRU facilities over a decade 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 K6, that had been used in the 1950s for storage of SPRU radioactive waste. In 2006, the DOE dismantled and removed a concrete structure, known as K5, 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 H1, that 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 DOE-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. In 2009, the demolition and decontamination (D&D) activities on Buildings G2 and H2 started. In September 2010, D&D activities were suspended after an unplanned release of airborne radioactivity during an open-air demolition of Building H2. In September 2012, an enclosure with HEPA-filtered ventilation was completed over Building G2. In February 2013, an enclosure with HEPA-filtered ventilation was completed over Building H2. The demolition work for Buildings G2 and H2 has resumed under these enclosures.

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, KAPL 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 Site's discharge permit issued by New York State. Likewise, storm water runoff from the Site 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 the Resource Conservation and Recovery Act (RCRA) and/or as PCB waste in accordance with the Toxic Substance Control Act (TSCA), are managed compliant with the RCRA hazardous waste management program administered by New York State and/or the TSCA 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 Site. In 1995, the Site initiated a program to replace all its transformers containing PCBs with PCB-free equivalent units as part of an electrical upgrade project. The last PCB-containing transformer was removed from the Site in 1999.

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. During the period 2011–2013 approximately 4,000 tons of materials were recycled.

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 low-sulfur distillate 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

KAPL has long recognized the need to minimize the generation of hazardous waste. In accordance with RCRA, KAPL prepared a hazardous waste minimization plan. In 1991, KAPL submitted this plan to the New York State Department of Environmental Conservation (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. As of 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 New York State. Site efforts to minimize waste generation will continue.

Actions taken by the Knolls Laboratory during the period 2011–2013 include:

- Recycling 30 tons of lead acid batteries;
- Recycling 5 tons of used lubricating oils;
- Recycling 3,117 tons of concrete and asphalt; and
- Recycling 416 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.

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

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

Remediation Programs

The Federal Comprehensive Environmental Response, Compensation, and Liability Act (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 a National Priorities List (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 Site 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 KAPL's annual Environmental Monitoring Report, indicates there is no adverse effect on environmental quality. KAPL will continue to perform environmental monitoring of these areas.

Beginning in 1998, environmental characterization of Knolls Site historical waste disposal areas has been performed in accordance with Knolls Laboratory 6 NYCRR Part 373 Hazardous Waste Management 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 Site waste handling and disposal practices, there is no threat to human health or the environment that warrants immediate remediation. Characterization work is continuing to further assess residual chemicals in the environment and determine the need for future remediation. Any RCRA remediation plans will require approval by NYSDEC. Additional information is provided in Section 9.

The Knolls Site'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 KAPL's on-going remediation program. As required by CERCLA, KAPL will incorporate New York State direction into this program as appropriate.

Apart from the CERCLA and RCRA programs, KAPL formally closed the Knolls Site 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 Site voluntarily remediated a former on-site firearms practice range in 1997.

Although not required at the time by any rule or regulation, the Knolls Site 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 Site has always maintained an environmental program substantially more strict than the rules in effect at the time. For example, in 1964, the Knolls Site took unilateral action to significantly reduce discharges of radioactivity to the Mohawk River. In 1977, the Knolls Site 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 KAPL 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 Site'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 Site 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 Site 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/hour on the surface), intermediate radiation level (200 millirem/hour to 25 rem/hour), and high radiation level (above 25 rem/hour).

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 Site, 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 Site also initiated a preoperational monitoring program during the construction of the Site 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 Site in 1950, shortly after operations began.

In response to contacts made by the Atomic Energy Commission 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 KAPL waste management program, concurred with program changes, and participated in the establishment of limits for radioactivity in Knolls Site 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 Site. 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 Site showed an increase in radioactivity, primarily cesium-137. At first, it was seen immediately adjacent to the Site 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, 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 Site effluent water has been substantially below any applicable limits.

KAPL has performed comprehensive environmental monitoring of the Mohawk River since 1948, before operations at the Site began. Water, fish, and sediment samples have been evaluated for the effects of Site 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 KAPL 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 Site 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 KAPL 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 KAPL 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. In 2005, the results were published in 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.

Since Knolls Site operations began in 1949, about 153 curies of KAPL-produced radioactivity have been released to the Mohawk River, about 150 curies of which were released prior to 1964. The most radioactivity released in any one year was about 37 curies in 1963, compared to the Mohawk River Advisory Committee limit of 40 curies per year. (The reported 3 curies 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 curie of radioactivity in the river sediments in the vicinity of the Site. The KAPL - produced radioactivity 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 Site 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 KAPL Environmental Monitoring Report. 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 Site operations are low and not of a health or environmental concern.

Periodic environmental monitoring continues to this day, with the results reported in the Site's annual Environmental Monitoring Report. The conclusions remain unchanged. Fish and water samples taken in the Mohawk River, both upstream and downstream of the Knolls Site, show only naturally occurring radionuclides (e.g., potassium-40) and radionuclides from atmospheric weapons testing, but no radionuclides attributable to Site operations. The residual radioactivity from Site 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 Site 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 Radioactive Materials Laboratory (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 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 Site 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 2,525 curies of Site-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 disperse in the atmosphere. Smaller amounts, approximately 90 curies, 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 Site 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, KAPL 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 3.0, that the total accumulated radiation exposure to a member of the public living continuously next to the Knolls Site during the entire time the facility has been operating would not exceed 90 millirem due to airborne radioactive effluents. This is less than the exposure an average person receives in four months due to naturally occurring radiation sources.

5.2.2 Residual Radioactivity in Soil

The Knolls Site has no designated radioactive waste disposal sites. However, 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 6 NYCRR Part 373 Permit Corrective Action provisions, and subsequently under the DOE-EM 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.

Separations Process Research Unit (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 Site 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 Site 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 is 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 has taken additional measures to reduce the source of groundwater flow, including controlling surface run-off and installation of French drains.

Since 1993, occasionally 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 Site'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 being 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, some portions of the SPRU complex have been removed from the Knolls Site along with some of 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.

Results from Corrective Action investigation work show that soil (and groundwater) in the vicinity of Building H2 has been contaminated with chemicals. As a result, during the course of Buildings H2 and G2 dismantlement, excavation soil and water will be sampled in accordance with a NYSDEC approved plan to ensure that chemical contamination is effectively remediated.

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. This was the source of low levels of radioactivity detectable in the fringe of the Lower Level parking lot as shown on Figure 2. 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 Site 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 Site 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 were 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 3). 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 3. 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, KAPL estimated that there were about 0.4 curies of radioactivity in the Land Disposal Area. The former Drum Staging Area is near the original Site 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 Site'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. The Knolls Site 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.

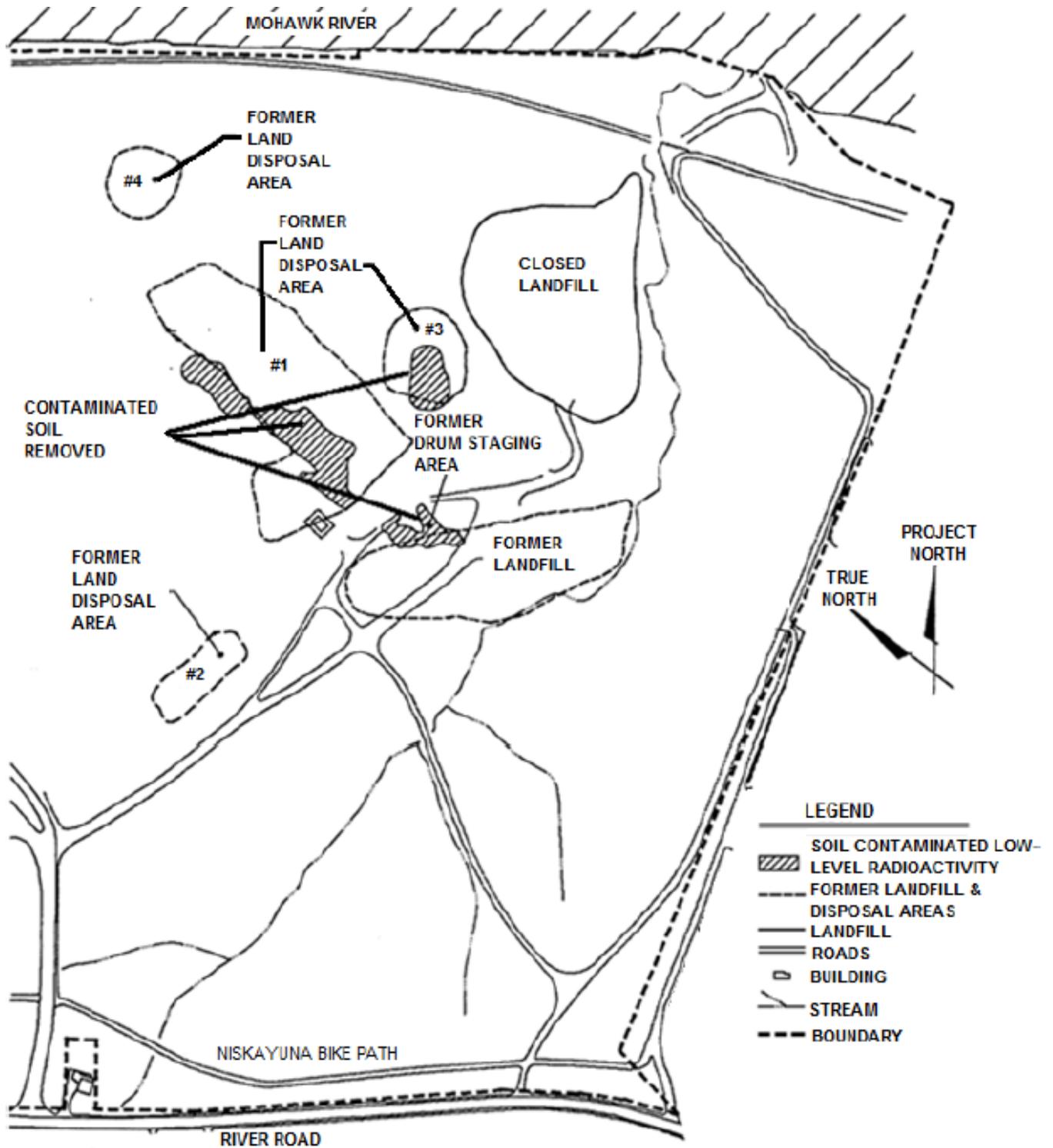


Figure 3 - Knolls Site Land Disposal Areas

Therefore, KAPL 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 with a report of findings transmitted to NYSDEC in 2011; no significant contamination was found.

5.2.3 Past Non-Radioactive Waste Management

The Knolls Site has used once-through non-contact cooling systems, operated a conventional sewage treatment plant, and used conventional storm water sewer systems typical of a facility of this size. Near the eastern boundary of the Knolls Site, adjacent to the now-closed Town of Niskayuna landfill, the Site 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 Site 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 Site. In 1995, the Knolls Site 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 Site heating boilers was produced using acid-salt regenerated water softeners, resulting in the generation of potentially hazardous waste water. 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 Site 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 3 shows the chemical waste disposal locations in the Knolls Site 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.

These areas are subject to environmental characterization for residual chemicals in accordance with the Knolls Laboratory 6 NYCRR Part 373 Hazardous Waste Management Permit Corrective Action provisions. Investigation work started in 1998 and culminated in 2010. All work was subject to review and oversight by NYSDEC. Subsequent to completing the most recent investigation a final report, including a remediation recommendation, was transmitted to NYSDEC in 2011; NYSDEC's response is pending. Characterization sample results have identified no imminent threat to human health or the environment that would warrant immediate remediation.

The Knolls Site 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 Site. The KAPL annual Environmental Monitoring Report describes the results of voluntary and NYSDEC required groundwater monitoring conducted at the Knolls Site 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 Site and in particular at locations associated with the Knolls Site Closed Landfill, former Land Disposal Areas, and Buildings H2 and G2.

Groundwater and surface water monitoring associated with the Knolls Site Closed Landfill is performed to meet the State regulatory requirements for closed landfills. The Closed Landfill monitoring wells and surface waters were sampled each quarter from 1980 to 2000 for parameters specified by NYSDEC. Based on previous results, NYSDEC approved reducing the chemical parameters monitored and changing the sampling frequency to semiannual in 2000. 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 NYSDEC for review.

In the early 1990s, 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 also installed 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 Site 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 NYSDEC groundwater standards, have occasionally been detected in two downgradient wells. These compounds have not been detected in recent years.

In the Land Disposal Area, historical detection of volatile organic compounds above NYSDEC groundwater standards in one well prompted further investigation in accordance with the Knolls 6 NYCRR Part 373 Hazardous Waste Management Permit (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 the areas near the former SPRU facilities, Buildings H2 and G2, and near the two 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 Site. The geologic materials beneath the Site 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 Site's perimeter.

In addition, the groundwater at the Knolls Site is limited in quantity and is not used as a drinking water supply; the Site 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 Site operations. Therefore, the limited effects on the groundwater pose no threat to public health or the environment.

6.0 MONITORING PROGRAMS

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

6.1 Aerial Survey

Convincing evidence that the Knolls Site does not represent a significant radiological problem comes from the results of an aerial radiation survey of the Site and the surrounding areas, including the City of Schenectady, conducted in 1982. The results for the Knolls Site showed readings of 1.4 times background in the immediate vicinity of the Separations Process Research Unit buildings on the Upper Level. Elsewhere at the Knolls site, including the Lower Level, its parking lot, and the Land Disposal Area, 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 Site that would affect the conclusion of the 1982 aerial survey.

6.2 Soil Survey

During the 1980s, over 10,000 ground measurements were made for residual radioactive materials in the soil on the Knolls Site. The measurements for radioactivity used a KAPL 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 Site 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 Site.

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. In addition, numerous monitoring wells have 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, KAPL estimates that about 4 curies of radioactivity are contained in Knolls Site soils, essentially all attributed to the operation of SPRU. As previously noted, this is a decrease from the historically estimated 15 curies reported in previous Knolls Site Environmental Summary Reports, a result of Department of Energy Office of Environmental Management estimation of soil contamination remaining in the G2/H2 area and from remediation of contaminated soil. This amount of radioactivity is less than 1% of the naturally occurring radon radioactivity that is released each year from an area the size of a typical 18-hole golf course in the Schenectady region and is less than the amount of naturally occurring radioactivity in the top four inches of soil covering the same golf course.

For a complete description of the routine monitoring program results, refer to the annual KAPL Environmental Monitoring Report.

7.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

The impact of Knolls Site 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 Atomic Power Laboratory (KAPL) has always monitored all known or suspected releases of radioactivity to the environment from Knolls Site 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 Site 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 Separations Process Research Unit (SPRU) Buildings G2 and H2. The Department of Energy Office of Environmental Management has remediated most of the other areas of the site that contained historical contamination. During the early years of the Site's operations, the Mohawk River was used to dilute and disperse liquid radioactive wastes in accordance with applicable Federal, State and local guidelines. The Site ceased this practice in 1964. However, as a consequence of past disposal practices, the riverbed in the vicinity of the Knolls Site retains less than 1 curie of KAPL-produced radioactivity.

The total of less than five curies at the Site 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). This is less than 2% of the amount of naturally occurring radon radioactivity released each year from the same golf course.

The comprehensive Site radiation monitoring program, which is described in KAPL's annual Environmental Monitoring Report, shows that the radiation exposure to persons off-site is too small to be measured. KAPL 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 2013 shows that the maximum potential radiation exposure to a member of the public from both Knolls Laboratory and SPRU operations was less than 0.1 millirem for the entire year. This is about one-twentieth of the exposure that a person would receive from cosmic radiation sources during a one-way cross-country airplane flight. KAPL conservatively estimates that the total accumulated radiation exposure from Knolls Laboratory and SPRU operations to a member of the public living continuously next to the Knolls Site during the time the facility has been operating, i.e., over six decades, would not exceed 130 millirem. This is less than the average exposure a person receives in six months from natural radiation sources.

7.2 Non-Radiological Assessment

Regarding non-radioactive environmental effects, KAPL has always monitored the Knolls Site 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 Site and, more recently, groundwater sampling from monitoring wells around the Site. Results of all monitoring to date support the conclusion that operation of the Knolls Site has no significant impact on the environment.

Each year since 1972, KAPL has published a report of comprehensive environmental monitoring results. This report shows that Knolls Site operations have no adverse effect on human health or the quality of the environment.

KAPL 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 Site, in accordance with Federal and State regulations.

8.0 AUDITS AND REVIEWS

8.1 Knolls Laboratory

The Knolls Atomic Power Laboratory (KAPL) 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.
- KAPL maintains an independent audit program, which covers all environmental requirements and includes in-depth audits of specific areas.

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

In addition, various aspects of the Knolls Site environmental program are reviewed by other Government agencies. For example, the New York State Department of Environmental Conservation (NYSDEC) or the U.S. Environmental Protection Agency has conducted on-site inspections of Resource Conservation and Recovery Act (RCRA) programs at least annually for the past twenty years. Outside regulators have conducted 105 environmental inspections or visits of the Knolls Site over the past ten years (Table 1).

There have been two major environmental reviews conducted at KAPL: the Government Accountability Office (GAO) (previously known as the General Accounting Office) in the early 1990s and the U.S. Environmental Protection Agency (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 KAPL 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 KAPL. A Multi-Media Inspection reviews all areas of compliance with environmental regulations governing air, water, solid waste, etc. The EPA found Knolls Site 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 KAPL corrected the record keeping practice shortly after the EPA inspection. All other aspects of Knolls Site 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.

8.2 DOE-SPRU Project

The DOE-EM 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 National Emission Standards for Hazardous Air Pollutants (NESHAPs) 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 in March 2012 to the DOE. All of the short-term corrective actions required by the Consent Order were completed in May 2012. On June 5, 2012, the EPA informed DOE of EPA's conclusion that the Knolls Site was back in compliance with the radionuclide NESHAPs regulations. The remainder of the corrective actions required by the Consent Order were completed on February 28, 2013.

On October 25, 2010, approximately 630 gallons of unprocessed groundwater were discharged through Outfall 004 due to an electrical control unit failure of the DOE-EM SPRU Hillside Radiological Processing System. This resulted in the shut down 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 took immediate action to trouble-shoot the problem and restore power to two of the pumps within two hours.

The Naval Reactors Laboratory Field Office and the Bechtel Marine Propulsion Corporation (BMPC)-KAPL were notified of the overflow by DOE-EM and URS-Washington Division (URS, a contractor to DOE-EM) around midnight on October 25 (approximately two hours into the event). NYSDEC was notified of the discharge on October 26, 2010, and visited the Site on November 3, 2010.

NYSDEC issued a Notice of Violation (NOV) on November 5, 2010, to NRLFO and DOE-EM SPRU regarding the unpermitted discharge from the KAPL facility to the Mohawk River. The NOV requested that DOE-EM SPRU submit a copy of the Stormwater Pollution Prevention Plan (SWPPP) required by NYSDEC General Permit for Discharges of Stormwater from Construction Activities (GP-0-08-001) for the SPRU Demolition Site to NYSDEC for review by November 22, 2010. DOE-EM SPRU issued a response to 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 of 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 Stormwater Pollution Prevention Plan and Best Management Practices document to NYSDEC by January 31, 2011. These documents were submitted by DOE to NYSDEC within these timeframes.

Table 1 - Environmental Inspections of the Knolls Site (2004-2013)		
TOPIC	DATE	AGENCY
Resource Conservation and Recovery Act (RCRA)	4/29/04	U.S. Environmental Protection Agency (EPA)
RCRA	7/15/04	New York State Department of Environmental Conservation (NYSDEC)*
RCRA	8/27/04	NYSDEC*
RCRA	1/10/06	NYSDEC
RCRA	7/5,6,10/06	NYSDEC*
RCRA	9/24/07	NYSDEC
RCRA	6/25/08	NYSDEC
RCRA	8/7/08	NYSDEC*
RCRA	9/4/08	NYSDEC*
RCRA	10/30/08	NYSDEC*
RCRA	2/4/09	NYSDEC*
RCRA	7/14/09	NYSDEC
RCRA	7/16/09	NYSDEC*
RCRA	8/27/09	NYSDEC*
RCRA	11/17/09	NYSDEC*
RCRA	12/3/09	NYSDEC*
RCRA	6/24/10	NYSDEC*
RCRA	9/16/10	EPA
RCRA	11/18/10	NYSDEC*
RCRA	6/1/11	NYSDEC*
RCRA	6/10/11	NYSDEC*
RCRA	6/16/11	NYSDEC*
RCRA	9/19/11	EPA
RCRA	11/1/11	NYSDEC*
RCRA	4/19/12	NYSDEC*
RCRA	8/8/12	NYSDEC*
RCRA	9/10/12	EPA
RCRA	3/6/13	NYSDEC*
RCRA	8/21/13	EPA
RCRA	11/25/13	NYSDEC*
RCRA	12/10/13	NYSDEC*
Landfill Monitoring	10/12,13,14/04	NYSDEC
Toxic Substances Control Act /PCB	11/30/04	EPA
Outfalls	1/23/04	NYSDEC
Outfalls	3/10/05	NYSDEC
Outfalls	11/4/05	NYSDEC
Outfalls	3/29/07	NYSDEC
Outfalls	3/20/08	NYSDEC
Outfalls	3/26/09	NYSDEC
Outfalls	9/22/09	NYSDEC
Outfalls	1/20/11	NYSDEC
Outfalls	5/20/11	New York State Department of Health (NYSDOH)
Outfalls	6/9/11	NYSDEC
Outfalls	12/13/11	NYSDEC
Outfalls	9/26/12	NYSDEC
Outfalls	3/20/13	NYSDEC

Table 1 - Environmental Inspections of the Knolls Site (2004-2013)		
TOPIC	DATE	AGENCY
Outfalls	6/27/13	NYSDEC
Air Emissions	9/22/05	NYSDEC
Air Emissions	11/5/08	NYSDEC
Air Emissions	4/13/09	EPA
Air Emissions	11/6/09	NYSDEC
Air Emissions	11/10/10	EPA
Air Emissions	4/4/11	NYSDEC / NYSDOH
Air Emissions	10/13/11	EPA
Air Emissions	12/2/11	EPA
Air Emissions	4/25/13	EPA
Emergency Planning: Emergency Planning Community Right-to-Know Act (EPCRA)	5/25/05	New York State Emergency Management Office (NYSEMO)
Emergency Planning: EPCRA	8/24/05	NYSDEC / NYSDOH
Emergency Planning: EPCRA	10/12/05	NYSEMO / NYSDEC / NYSDOH
Emergency Planning: EPCRA	9/27/06	NYSDOH
Emergency Planning: EPCRA	11/13/08	Town of Niskayuna
Emergency Planning: EPCRA	10/28/09	NYSDEC / NYSDOH
Emergency Planning: EPCRA	5/4/10	EPA /Federal Emergency Management Administration (FEMA) / Department of Energy (DOE)
Other (Wetlands Delineation Review)	5/18/07	U.S. Army Corp of Engineers (USACOE)
Other (Site Familiarization Tour)	11/13/08	Town of Niskayuna
Other (Rail Bed Access for Town Vehicle)	7/21/11	Town of Niskayuna
SPRU – Review of Lower Level remediation progress	4/22/10	NYSDEC
SPRU – Radionuclide National Emission Standard for Hazardous Air Pollutants (NESHAPs)	5/4/10	EPA
SPRU – Witness well decontamination at Lower Level	6/10/10	NYSDEC
SPRU - Discussion on remediation approach for tank vaults and review of remediation progress in the Lower Level and North Field.	7/22/10	NYSDEC
SPRU – Discuss status of RCRA Release Assessment and overview of remediation (including Sump overflow event from 10/25/10).	11/3/10	NYSDEC
SPRU - Stormwater inspection and overview of water controls	11/4/10	NYSDEC
SPRU - Discuss September 29 th event and 2009 annual report.	11/10/10	EPA
SPRU - Tour of SPRU upper level site.	11/11/10	NYSDOH / NYSDEC
SPRU – Discuss: <ul style="list-style-type: none"> • SDPES Permit Modification for use of air stripper and discharge of treated water to KAPL stormwater system. • Sump overflow from 10/25/10. 	12/1/10	NYSDEC
SPRU - Witness monitoring well decommissioning	4/7/11	NYSDEC

**Table 1 - Environmental Inspections of the Knolls Site
(2004-2013)**

TOPIC	DATE	AGENCY
SPRU – Visit for Air Sampling Locations	4/4/11	NYSDEC / NYSDOH
SPRU - Witness monitoring well decommissioning	6/1/11	NYSDEC
SPRU - Stormwater inspection	6/9/11	NYSDEC
SPRU - Witness crane pad excavation	8/12/11	NYSDEC
SPRU - Subpart H NESHAP inspection	8/16/11	EPA
SPRU - Stormwater inspection	9/16/11	NYSDEC
SPRU - Field visit inspect hillside instability and G2 and H2 enclosures construction	10/13/11	EPA
SPRU - Witness soil borings	10/17/11	NYSDEC
SPRU - Subpart H NESHAP inspection	12/2/11	NYSDEC
SPRU - Stormwater inspection	12/13/11	NYSDEC
SPRU - General site progress inspection	4/19/12	NYSDEC
SPRU - Witness micropile installation mock-up	7/19/12	NYSDEC
SPRU - Subpart H NESHAP inspection	8/27/12	EPA
SPRU - Stormwater inspection	9/26/12	NYSDEC
SPRU - General site tour	10/4/12	NYSDEC
SPRU - Witness micropile installation	11/2/12	NYSDEC
SPRU - Witness micropile installation	12/6/12	NYSDEC
SPRU - Inspect SP-27 soil pile and Equipment Staging Area	1/14/13	NYSDEC
SPRU – KAPL / SPRU SPDES Familiarization Tour & Permit Discussions	3/20/13	NYSDEC
SPRU - Subpart H NESHAP inspection	4/25/13	EPA
SPRU - General KAPL/SPRU site stormwater inspection	6/27/13	NYSDEC
SPRU - General SPRU tour	7/19/13	NYSDOH
SPRU - Witness tank sludge processing	8/29/13	NYSDEC
SPRU - Subpart H NESHAP inspection	12/11/13	EPA
SPRU – Upper Level monitoring well decommissioning	5/25/11	NYSDEC
SPRU – Upper Level monitoring well decommissioning	6/1/11	NYSDEC
SPRU – Upper Level crane pad excavation	8/12/11	NYSDEC
SPRU – Upper Level soil boring	10/17/11	NYSDEC
SPRU – Upper Level tour	4/19/12	NYSDEC
Note: *This Site visit by NYSDEC was associated with KAPL's ongoing environmental evaluations and corrective action as specified in Knolls Laboratory 6 NYCRR Part 373 Hazardous Waste Management Permit (Section 9.0).		

9.0 REGULATORY MATTERS

The Knolls Atomic Power Laboratory (KAPL) has always responded promptly and effectively to meet new Federal, State, and local requirements and will continue to do so. KAPL 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 KAPL's annual Environmental Monitoring Report.

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

This Act commonly referred to as CERCLA or 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. KAPL prepared and submitted to the U.S. Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) a Preliminary Assessment documenting such areas at the Knolls Site (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 Site scored below the value that would warrant including the Site on the National Priorities List (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 KAPL's original submittal.

At the EPA's request, KAPL also executed an Expanded Site Investigation at the Knolls Site, including limited-scope stream sediment sampling. Based on the results of this investigation and its review of KAPL submittals, the EPA independently scored the Site and designated the Site as "Site Evaluation Accomplished" in 1994; the EPA concluded the Site 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 the Resource Conservation and Recovery Act (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 Site continues to comply with the requirements of SARA. KAPL annually submits detailed information related to on-site hazardous materials to local emergency planning groups in conformance with the 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 6 NYCRR Part 373 Hazardous Waste Management Permit (Permit) and New York State regulations. This permit was originally issued by NYSDEC in 1998. During the Permit application process, KAPL 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, KAPL has prepared a list of Solid Waste Management Units (SWMUs), including the landfill and disposal areas and the SPRU waste management areas discussed in Section 5. The current Permit 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 Site's current and historical disposal documentation and a visual inspection, the State concluded that the Site posed no immediate danger to human health or the environment.

Of the waste management units identified, over 50% 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 are undergoing additional characterization prior to any required remediation, and will be addressed in accordance with KAPL's RCRA permit and State and Federal guidance.

DOE EM-SPRU obtained a 6 NYCRR Part 373 Permit in September 2008 that requires DOE-EM to conduct corrective action for SPRU SWMUs and an Area of Concern (AOC). All corrective action requirements previously under the KAPL Permit related to the SPRU SWMUs and AOC then became the responsibility of DOE-EM.

Federal Facility Compliance Act

The Federal Facility Compliance Act (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 Site 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 the RCRA did not exist. Updated Site Treatment Plans are submitted annually to New York State for approval.

Other Regulations

KAPL does not anticipate any substantial future impact on its operations from regulatory developments in other areas such as the Clean Water Act, Clean Air Act, Safe Drinking Water Act, or Toxic Substances and Control Act. All Knolls Site operations comply with applicable regulations.

EXTERNAL DISTRIBUTION

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