Kenneth A. Kesselring Site Environmental Summary Report

September 2022

Prepared for the United States Department of Energy
by Fluor Marine Propulsion, LLC

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KENNETH A. KESSELRING SITE

ENVIRONMENTAL SUMMARY REPORT

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By Fluor Marine Propulsion, LLC
Kesselring Site
West Milton, New York
Document Number: KS-REA-ESH-00222

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CERCLA	Comprehensive Environment Response, Compensation, & Liability Act
CBS	Chemical Bulk Storage
Ci	Curies
COD	Chemical Oxygen Demand
CWA	Clean Water Act
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy – Office of Environmental Management
DOT	U.S. Department of Transportation
EMR	Environmental Monitoring Report
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FFCA	Federal Facility Compliance Act
FMP	Fluor Marine Propulsion, LLC
GAO	Government Accountability Office
HEPA	High Efficiency Particulate Air [filters]
LLC	Limited Liability Corporation
KAPL	Knolls Atomic Power Laboratory
MWMP	Mixed Waste Management Plan
NNL	Naval Nuclear Laboratory
NNPP	Naval Nuclear Propulsion Program
NPL	National Priorities List
NR	Office of Naval Reactors
NRC	U.S. Nuclear Regulatory Commission
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PBS	Petroleum Bulk Storage
PCB(s)	Polychlorinated Biphenyl(s)
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SBR	Sequencing Batch Reactors
SPUD	Surface Penetrating Underground Detector
TSCA	Toxic Substances Control Act

1.0 OVERVIEW AND CONCLUSIONS

The Kenneth A. Kesselring Site (Kesselring Site) located near West Milton, New York, is owned by the U.S. Department of Energy (DOE). The site's mission is to conduct operational testing of prototype nuclear propulsion plants and equipment for U.S. Navy submarines and to train U.S. Navy nuclear propulsion plant operators. The General Electric Company operated the Kesselring Site under Government contract, as part of the Knolls Atomic Power Laboratory (KAPL), from its inception in 1950 until 1993. In 1993, responsibility for operation of the KAPL facilities, including the Kesselring Site, transferred to KAPL, Inc., a subsidiary of Martin Marietta Corporation. In 1995, KAPL, Inc. became a Lockheed Martin company, after the Martin Marietta and Lockheed corporations merged. From 2009 until 2018, the Bechtel Marine Propulsion Corporation (BMPC, a wholly owned subsidiary of Bechtel National, Inc.), operated the Knolls Laboratory and the Kesselring Site. Since October 2018, Fluor Marine Propulsion, LLC, under contract with the DOE and U.S. Navy, has operated the Kesselring Site. In 2016, the Naval Nuclear Propulsion Program (NNPP) implemented the use of "Naval Nuclear Laboratory" (NNL) to refer to the collective operations of the four DOE sites that perform NNPP work and the personnel operating at the associated locations. As part of this change in naming convention, the Kesselring Site became an independently recognized site rather than a sub-section of KAPL.

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

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

Consistent with the Federal Government's objective to clean up legacy sites that are no longer needed, in 2020, funding was allocated to support the characterization and remediation of the D1G Ditch. The remediation of the D1G Ditch resulted in the removal of impacted soil and restoration of the land for Kesselring Site use. DOE-EM completed characterization of this area in 2021 and completed the remediation of the D1G Ditch in 2022.

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

- KAPL refers to the corporate entity that oversaw both facilities at Niskayuna and West Milton, New York, when the Kesselring Site was a sub-section of the Knolls Atomic Power Laboratory.
- Kesselring Site refers to the NNPP facility near West Milton, New York, only.
- Knolls Laboratory refers to the NNPP facility in Niskayuna, New York, only.

1.1 Background

For many years, the Kesselring Site has performed environmental monitoring to demonstrate that the site is being operated in accordance with environmental standards. The results have been published in annual Environmental Monitoring Reports (EMR) provided to Federal, State, and local officials. These reports demonstrate that the Kesselring Site's monitoring practices meet and are

often stricter than the requirements of applicable laws and regulations. The monitoring results confirm compliance with environmental standards in many cases by a significant margin.

1.2 Purpose

While the annual EMR describes monitoring practices and results, it does not describe the nature and environmental aspects of the Kesselring 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

The Kesselring Site has had effective environmental control programs in place since operations at the site began in 1954. 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 EMRs:

- The Kesselring Site'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 Kesselring Site operations is too small to be measurable. The maximum possible annual radiation dose to any member of the public resulting from site operation is estimated by calculations 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. This is about one-thirtieth 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 Kesselring Site since operations began in 1954, that person's total radiation exposure due to site operations would not exceed 8.3 millirem. This is less than the same individual receives in about three weeks from natural radiation sources (Section 7.0).

  — There are no radioactive waste disposal sites at the Kesselring Site. There were, however, two small areas on the site where low-level radioactivity from past site operations was detectable in soil or groundwater. The total amount of radioactivity in the affected on-site areas was estimated to be less than 0.1 curies (Ci). This is no more than the amount of naturally occurring radioactivity in the top inch of soil covering a local area of equal size to the Kesselring Site developed area (Sections 5.2 and 6.0).

- Kesselring Site practices for handling chemical waste conform to established regulations. The Kesselring Site meets or exceeds the stringent requirements that have been established by law since the late 1970's. The Resource Conservation and Recovery Act (RCRA) and Hazardous and Solid Waste Amendments of 1984 are the regulations that set forth the requirements for hazardous and solid waste management. In the past, however, chemical waste disposal was carried out in accordance with what were common industrial practices at the time. These past practices included burial of some chemicals on the Kesselring Site. The amount that was buried is estimated to be about 170 cubic feet per year through 1977, when such practices ceased. Most of the chemical waste burial was conducted at the site landfill, which was closed in 1994. Small amounts of waste were disposed of at five other locations within the site. The land area involved was less than 1% of the site. Because of these practices, several chemical constituents are detectable in groundwater in the immediate

vicinity of the landfill, but pose no threat to public health or the environment. Notably absent is any significant concentration of toxic solvents or chemicals in wells that monitor areas where chemicals were buried years ago (Sections 5.0 and 7.0).

- — Although there have been a few inadvertent environmental releases since the site began operating in 1954, none of these events have resulted in a permanent impact on the environment. In each case, prompt actions were taken by the Kesselring Site to minimize and localize the impact of the releases and to prevent a recurrence (Section 5.2).

- — The U.S. Environmental Protection Agency (EPA) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as "Superfund," has conducted an evaluation of the areas containing radioactivity and chemical residues at the Kesselring 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 site is not listed as a Superfund site on the National Priorities List (NPL). As a result, no CERCLA remedial action is anticipated. Working within the bounds of State and Federal environmental regulations, the Kesselring 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 disposal areas has been subject to the RCRA regulations administered by the New York State Department of Environmental Conservation (NYSDEC). The Kesselring Site manages hazardous waste associated with current operations in accordance with a RCRA Hazardous Waste Management Permit issued by the NYSDEC. This Permit also contains Corrective Action provisions that involve characterization of historical waste disposal areas. On-going characterization continues to confirm that there is no adverse effect on human health or the quality of the environment (Sections 5.1 and 7.0).

- — As part of the Corrective Action process, the Kesselring Site achieved two Environmental Indicator (EI) milestones established by the EPA that show no unacceptable human health exposures and no concern for the migration of contaminated groundwater. The EIs are the Migration of Contaminated Groundwater under Control EI and the Current Human Exposures under Control EI, achieved in 2010 and 2013 respectively.

- The Kesselring Site's operations and environmental performance have always been subject to continuous oversight by resident NNPP representatives of the DOE (previously the Atomic Energy Commission (AEC) and subsequently the Energy Research and Development Agency) and periodic in-depth reviews and inspections by NNPP headquarters personnel (Section 8.0).

- In addition to Kesselring Site and NNPP reviews and inspections, various aspects of the Kesselring Site environmental programs continue to be inspected by Federal and State agencies. These inspections have found site operations to comply with all substantive requirements (Section 8.0).

  - — The EPA has also performed an extensive evaluation of the Kesselring Site's operations and compliance with statutory requirements in multiple environmental areas, including waste disposal practices, pollution controls, operational procedures, internal monitoring, and external reporting as part of a "Multi-Media Compliance Inspection." The EPA found no significant environmental impact from Kesselring Site operations (Section 8.0).

- In 1991, the Government Accountability Office (known as the General Accounting Office until 2004) reviewed the Knolls Laboratory's and the Kesselring Site's environmental, health, and safety practices 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 Kesselring Site operations on the environment or adverse effect on the community or the public. The Kesselring Site has a well-defined environmental program in place to monitor current operations and address the results of past activities that occurred when regulations and common industrial practices were less stringent.

2.0 THE KESSELRING SITE

2.1 Kesselring Site History

Development of the Kesselring Site began in 1948 with Government acquisition of the 3,900 acres of land. The site was known as the West Milton Site until 1968 when it was renamed the Kenneth A. Kesselring Site in honor of a former KAPL General Manager. Groundbreaking occurred in 1950, and construction of facilities began in 1951. The site was originally developed as a location for testing of liquid metal cooled power breeder reactors, although none were ever built there.

The Kesselring Site was then developed for testing propulsion plants for the NNPP and training Navy operators for these propulsion plants. Later, extensive reforestation was implemented on the open fields that existed prior to the site's acquisition.

Operations at the Kesselring Site first began in 1954 and the first power plant at the site went into operation in 1955. This was the liquid sodium-cooled naval prototype for the second nuclear powered submarine, the original Seawolf (SSN 575). In 1958, the second plant, the S3G Prototype for the former submarine Triton (SSRN 586), was placed into operation. This plant and the subsequent plants at the Kesselring Site contained pressurized-water propulsion plants. In 1957, the prototype liquid sodium-cooled plant was shut down, and dismantlement commenced in 1958. This prototype was replaced with the D1G Prototype for the former guided missile cruiser Bainbridge (CGN 25). The D1G Prototype began its operations in 1962. An advanced test platform, the MARF Prototype, was placed in service in 1976, and the S8G Prototype for USS Ohio (SSGN 726) became operational in 1979.

As a result of the end of the Cold War and the downsizing of the Navy, and the availability of other more modern training platforms, the S3G Prototype ceased operation in 1991. In 1996, the D1G Prototype similarly ceased operation. Dismantlement and removal of the S3G Prototype from the site was completed in 2006. The D1G Prototype is in the process of being dismantled and removed. In 2019, the MARF Prototype ceased operation and planning is underway to defuel and place this plant in long-term layup pending a decision on the final disposition of the MARF Prototype.

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

2.2 Significant Accomplishments

The technology tested at the Kesselring Site is a critical element of the Nation's defense, making possible the extraordinary capabilities of U.S. nuclear-powered submarines and aircraft carriers that today comprise more than 40% of the Navy's major combatant fleet. Key achievements at the Kesselring Site include testing of several subsequent generations of nuclear propulsion plants and training of more than 58,200 nuclear plant operators for the U.S. Navy. The training of naval nuclear operators continues to be one of the Kesselring Site's most significant contributions to the National defense.

3.0 DESCRIPTION OF SITE

3.1 Site Location

The Kesselring Site is located in Saratoga County near West Milton, New York, approximately 17 miles north of the City of Schenectady, 9 miles southwest of Saratoga Springs, and 13 miles northeast of Amsterdam. The site consists of 3,900 acres of Government-owned land on which are located one operating pressurized-water naval nuclear propulsion plant and support facilities. The surrounding area is a region of wooded lands through which flow the Glowegee Creek and Crook Brook, both tributaries of the Kayaderosseras Creek. The Government reservation is shown in Figure 1.

Most of the site facilities are located within a developed area of approximately 66 acres situated near the Glowegee Creek (Figure 2). Some of the site facilities (e.g., parking lots, wastewater treatment facilities, and water-supply structures) are located outside the fenced-in area. The balance of the site consists of wooded lands.

The Kesselring Site is largely self-supporting and consists of prototype plants, plant support and training buildings, offices, warehouses, maintenance shops, a boiler house for centralized heating, a cooling tower, and wastewater treatment facilities. Water for domestic purposes and fire protection is supplied by several wells on the Government reservation, and a commercial utility company supplies electrical power. The site roads and 15 acres of parking area are maintained by Kesselring Site personnel.

3.2 Land Use

The Kesselring Site is located in the western section of Saratoga County. Saratoga County, together with the counties of Albany, Schenectady, and Rensselaer, form a larger metropolitan area called the Capital District, with a combined population of approximately 1,200,000 people. The site is located in a sparsely populated rural area. Most of the land surrounding the site is either wooded or used for farming; residential development is occurring in the surrounding area.

3.3 Geology and Seismology

Regionally, the Kesselring Site lies within the moderately undulating transition zone between the Kayaderosseras Range of the Adirondack Mountains and the Hudson-Mohawk Valley lowlands. The West Milton area is characterized by a series of irregular, northeast-trending topographic steps, which descend southeastwardly between these mountains and lowlands. The developed portion of the Kesselring Site lies in a partial bowl having a bottom diameter of about 2,000 feet and a maximum height to the top of 150 feet.

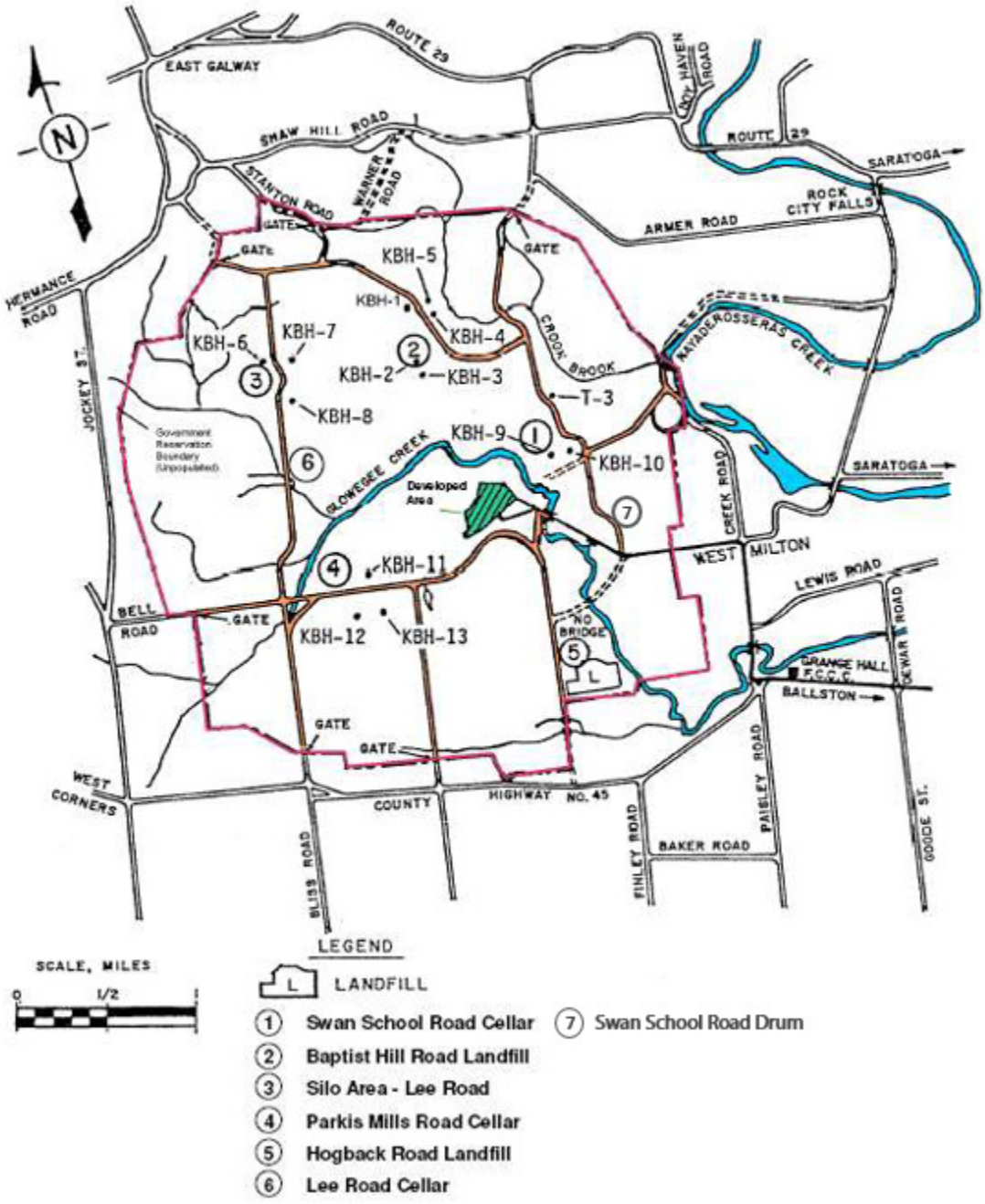

Figure 1 – Kesselring Site Reservation Map and Disposal Areas

Figure 2 – Kesselring Site Developed Area

Within the Kesselring Site, test borings show that surface deposits consist mainly of glacial till, overlain in places by silt and sand deposits. The thickness of these surface deposits overlying the bedrock generally ranges between 3 and 200 feet. Bedrock formations include various limestones and a sandstone formation, but Canajoharie Shale underlies most of the area. The till deposits underlying the site are relatively dense and impermeable as a result of being compressed by the great weight of continental glaciers during the ice ages. The silt and sand deposits are generally softer and more permeable than the till, and their exact composition varies with location. There are no natural features in the region, such as cavernous conditions or potential landslides that would affect the site.

The area in which the Kesselring 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 have been in existence for about 300 years. No earthquake of an intensity greater than about 5 on the Richter Scale (VII on the Modified Mercalli Scale—negligible damage to buildings of good construction and design) has been recorded within 100 miles of the site.

3.4 Hydrology

3.4.1 Surface Water Description

The Kesselring Site is located in the transition zone between the Adirondack Mountains and the Hudson-Mohawk Valley lowland. The Kayaderosseras Creek Valley is the main aquifer in this area. A well field located on the eastern portion of the Government reservation in the Kayaderosseras Creek flood plain is used for site domestic and service water.

Three small creeks actually drain the site: the Glowegee Creek, Crook Brook, and Hogback Brook. Crook Brook joins the Kayaderosseras on the east side of the reservation. Hogback Brook is a tributary to the Glowegee Creek. The Glowegee Creek is the primary receiving water for site drainage and discharge. The Glowegee Creek is classified under New York State Water Pollution Control Law as a Class C - Trout Stream. The Glowegee Creek joins with the Kayaderosseras approximately one mile east of West Milton, New York.

3.4.2 Groundwater Description

The groundwater under the site has not been officially classified. The natural chemical water quality of the groundwater varies from place to place due to the various unconsolidated deposits (till, sand, silt) in which it exists. It is satisfactory for many uses; however, it may need softening prior to use due to its high natural mineral content.

Deposits that could be considered as potential water supply aquifers underlie only small areas of the site. Typically, the water table is within 3 to 8 feet of the ground surface.

3.4.3 Surface Water and Groundwater Use

The Glowegee Creek, which is the primary receiving water for Kesselring Site drainage and discharge, flows into the Kayaderosseras Creek, which in turn flows into Saratoga Lake. The length of the Kayaderosseras Creek from the site to the City of Ballston Spa is about 9 miles with an additional 10 miles to the creek's mouth at Saratoga Lake. From the site to Ballston Spa, both the Glowegee and the Kayaderosseras are classified as Class C - Trout Streams by New York State but are not designated as a source of potable water.

As the area surrounding the Kesselring Site is sparsely populated, the major sources of potable water in this area are individual domestic wells. There are a few private wells off-site in the vicinity of the reservation boundaries. The closest population centers providing municipal water service, Ballston Spa and Saratoga Springs, are 5 and 9 miles away, respectively. These municipal water services draw on both surface and groundwater sources.

4.0 DESCRIPTION OF OPERATIONS

4.1 Past Operations

Operations at the Kesselring Site have focused on naval nuclear propulsion plant testing since its beginning. In addition, operations at the site have been devoted to training of nuclear propulsion plant operators for the U.S. Navy.

The first prototype reactor plant at the Kesselring Site used sodium as a coolant and started operations in 1955. The prototype operated until 1957, and was defueled and dismantled in 1958. The sodium coolant prototype was no longer useful since the technical superiority of pressurized-water propulsion plants for naval application was established. This prototype was replaced by the D1G Prototype that started operating in 1962.

The sodium-cooled reactor core was removed and shipped off-site to an approved Federal site for inspection and disposal. Radioactively contaminated reactor plant components were shipped off-site for disposal with the exception of the reactor pressure vessel. The reactor pressure vessel was sealed and placed in interim storage in the ground at a location on-site. In 1982, the pressure vessel was removed and shipped off-site to an approved DOE radioactive solid waste disposal site. Prior to and during excavation, soil samples were taken around the vessel storage location. No radioactivity above natural background levels was detected.

In 1958, the pressurized-water S3G Prototype started operating at the Kesselring Site, followed by the MARF Prototype in 1976 and the S8G Prototype in 1979. The newest prototype propulsion plant constructed at the Kesselring Site continues in operation, while the three oldest prototypes, D1G, S3G and MARF Prototypes, have ceased operation. The spent nuclear fuel has been removed from the D1G and S3G decommissioned prototype reactor plants and shipped off-site to an approved Federal site for disposition (Section 5.2.1). Planning is underway to defuel and decommission the MARF Prototype.

In accordance with the National Environmental Protection Act, an evaluation of prototype disposal alternatives was performed for the D1G and S3G Prototypes. In 1998, the Environmental Impact Statement resulting from this disposal evaluation identified prompt dismantlement as the preferred alternative and confirmed the dismantlement of these two prototypes would have no significant environmental impact. The prompt dismantlement alternative was chosen and disassembly of the first prototype plant began shortly thereafter. Dismantlement and removal of the S3G Prototype from the site was completed in 2006.

4.2 Present Operations

The Kesselring Site continues to be engaged in nuclear propulsion plant testing and propulsion plant operator training for the U.S. Navy. The Kesselring Site employs engineers, scientists, and support personnel in prototype plant operations, operator training, training development, prototype plant maintenance, and procedure preparation activities. These activities are supported by the Kesselring Site facilities described below.

Prototype Plant

The operating prototype plant consists of a pressurized-water nuclear reactor, auxiliary equipment, and propulsion systems necessary for the training of naval personnel and for the testing and evaluation of design concepts.

Chemical and radioactive liquid wastes resulting from operations are directed to controlled collection systems for monitoring and processing for reuse, discharge, or disposal as appropriate. Exhaust air from the prototypes is filtered and monitored prior to release.

The decommissioned D1G Prototype propulsion plant and its auxiliary support equipment are undergoing dismantlement and removal from the site. Planning is underway for defueling the MARF Prototype and placing the prototype into long-term layup pending a decision on the final disposition of the MARF Prototype.

Cooling Tower

There is one evaporative cooling tower in operation at the Kesselring Site; it is used to dissipate the heat generated by prototype operations. Four other cooling towers were removed after the three decommissioned prototypes they supported ceased operation.

During operation, periodic discharge of cooling tower water is used to control the concentration of soluble minerals, naturally present in the supply water, and cooling tower treatment chemicals. This water is directed into the site drainage system and subsequently to the Lagoon Wastewater Treatment System, which discharges to the Glowegee Creek through two outfalls that are routinely sampled to ensure compliance with New York State discharge permit requirements.

Fuel Service Facility

This facility was previously used to prepare reactor fuel, upon its infrequent removal from the prototypes, for off-site shipment. The facility is no longer used for fuel handling operations. The facility was also occasionally used as a maintenance area for work involving radioactive materials, but is no longer used for that purpose. Currently, this area is being used for MARF support activities. The facility is serviced by filtered and monitored exhaust systems.

Radioactive Waste Management Facilities

Radioactive waste management facilities collect and process water containing small amounts of radioactivity and collect, process, package, and ship solid radioactive waste. As with other facilities handling radioactive materials, the processing facilities for liquid and solid wastes are serviced by filtered and monitored exhaust systems. Processed water is very pure and therefore is reused in appropriate site operations to the maximum extent practicable. See Section 5.1 for a complete description.

Chemical Laboratories

The chemical laboratories consist of several individual laboratories for chemical analysis, radiochemistry, and other related analytical functions. Most of the chemical laboratory work involves non-radioactive materials and is controlled within appropriate containment areas such as hoods. For radioactive work, containment areas are provided with filtered and monitored ventilation exhaust systems and controlled drainage systems or portable bottles used to convey liquids to collection

tanks for processing. Hazardous chemical waste and most non-hazardous analytical waste are collected for proper off-site disposal. Small amounts of non-hazardous analytical waste and wash water drain to the site's sanitary wastewater system.

Hazardous and Mixed Waste Management Facilities

The hazardous waste management facility is operated in accordance with the provisions of a hazardous waste management 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. A separate mixed waste management facility is operated under the same hazardous waste management permit; mixed waste contains both chemically hazardous and radioactive constituents. This facility is also designed to contain any potential spill. The amount of waste stored in the above facilities is limited as specified in the waste management permit. The facilities' construction and operation are in compliance with applicable Federal and State regulations.

Boiler House

The boiler house has three operational boilers, with a total design capacity of about 46,000 pounds per hour of steam, that burn ultra-low sulfur No. 2 fuel oil. The oil is received at the site in tank trucks and stored in an above ground revetted storage tank near the boiler house. Three exhaust stacks dissipate the combustion products from the boilers. Auxiliary support facilities in the building include feed water treatment components and systems for treatment of boiler blow down water. The boiler house emissions are controlled in accordance with New York State and Federal requirements.

Machine Shops

Machine shop facilities are used to perform machining operations such as turning, milling, grinding, and drilling on a variety of metal products, including non-radioactive metals and some radioactive materials. These operations support maintenance of operating prototypes and the site facilities. Facilities for work on radioactive materials are segregated from the other work areas and are provided with special containments and filtered and monitored ventilation exhaust systems.

Demineralized Water Production Facilities

Demineralized water is produced at the Kesselring Site using two parallel reverse-osmosis systems. The reverse-osmosis systems went into operation in 2004, which eliminated the need for the acid-base regeneration solutions used in the previous ion exchange resin-column demineralizing system. Non-hazardous chemicals now in use with the reverse-osmosis system are discharged to the site drainage system.

Wastewater Treatment Facility

The wastewater treatment system is designed to minimize total suspended solids levels resulting from algae blooms in the site's holding lagoon during warm weather and from sediment in stormwater runoff. Spray recirculation used previously to control the algae in the lagoon was discontinued in 2012. Water discharged from the site passes through the holding lagoon prior to being released to the Glowegee Creek, which allows for settling of solid particles. Treatment is necessary in order to maintain site operations in compliance with the site's New York State discharge permit. The treatment system minimizes the growth of algae by means of indirect chlorination and an ultra-sonic system that destroys algae cells. In addition, the treatment system

removes residual chlorine from the discharged water, and provides for temperature and pH control of the lagoon effluent.

As a voluntary pollution prevention initiative, systems to reduce the amount of phosphates contained in water discharged from the site were installed upstream of the wastewater treatment facility.

A portion of the groundwater on-site has been historically treated with sodium hypochlorite due to elevated levels of ammonia in the groundwater. In 2007, elevated ammonia levels were detected in groundwater collected from the drainage system underlying a newly constructed building. Investigation of the elevated ammonia levels indicated that leaking sewage lines were a contributing source. These sewage lines were fixed in 2007. In 2011, a permanent Nitrite and Ammonia Treatment Facility was completed to treat the contaminated groundwater. Treated effluent from the facility was discharged to the site storm drainage system that flows to the site lagoon, which is discharged to the Glowegee Creek via the site's wastewater treatment facility. In 2018, treatment of this groundwater ceased with New York State approval based on lowering ammonia levels in the groundwater.

Sanitary Wastewater Treatment Facilities

The original sanitary waste treatment plant used extended aeration of activated sludge and sedimentation to reduce the biochemical oxygen demand and suspended solids in the raw sewage. In 1990, a tertiary treatment system was installed to remove phosphates. In December of 2013, the site began transitioning from the old sanitary waste treatment plant to a new NYSDEC-approved Sanitary Wastewater Treatment Facility. The new system consists of influent wastewater grinding, a biological treatment process consisting of pre-equalization, chemical coagulation for phosphorous removal, sequencing batch reactors (SBR), post-equalization and aeration, followed by filtration. The transition was completed during 2014. Treated effluent is discharged from the Sanitary Wastewater Treatment Facility to the Glowegee Creek in accordance with the site's New York State discharge permit. The old system was decommissioned and NYSDEC approved the closure in July 2015. The site completed dismantlement and removal of the old system in 2019.

Petroleum Bulk Storage Tanks

There are several stationary and portable aboveground bulk storage fuel tanks at the site. These various tanks store No. 2 fuel oil for the Boiler House steam boilers, diesel fuel for emergency electrical generators and site equipment and gasoline for use in site vehicles. All of these tanks are situated within secondary containments. The stationary fuel storage tanks at the Kesselring Site are registered with New York State and comply with applicable regulations. Two large bulk storage tanks for the site's boilers that had been in service since 1983 were removed and replaced with a new tank in 2014. An aboveground diesel fuel storage tank that had been in service since 2001 was replaced in 2017. An aboveground gasoline tank that had been in service since 1992 was replaced in 2019. An underground storage tank that had been in service since 1990 was closed and removed in 2021.

Chemical Bulk Storage Tanks

Currently, there are two tanks used for Chemical Bulk Storage (CBS) at the Kesselring Site. One tank is used for storage of sulfuric acid to support S8G Prototype operations. The other tank stores sodium hypochlorite, which is used in the disinfection of Site Service Water. Both of these tanks are situated within secondary containments. The CBS tanks at the Kesselring Site are registered with New York State and are compliant with the applicable regulations. A CBS tank, which was

placed in service in 2000 for storage of sodium hypochlorite, was closed and removed in 2020. A second CBS tank, which was placed in service in 2010 for storage of sodium hypochlorite, was closed in place in 2015 and ultimately removed from the site in 2016.

5.0 WASTE GENERATION AND CONTROLS

The Kesselring Site is not, and has never been, a manufacturing facility. Consequently, the total quantities of chemical and radioactive materials handled incidental to prototype operations on the Kesselring Site have been relatively small when compared to other waste streams generated on site. For example, during the past five years, the total quantity of routine chemically hazardous waste shipped off-site from site operations averaged about 21 tons per year. This waste consists of solvents, analytical waste, paint waste, unused or expired reagents, and material and debris from routine building and equipment maintenance.

During the period 2017–2021, the site also shipped an average of 63.6 tons of mixed waste annually; mixed waste contains both chemically hazardous and radioactive constituents. Mixed waste is principally generated by facility inactivation and remediation projects, including prototype propulsion plant dismantlement. These one-time wastes consisted primarily of polychlorinated biphenyls (PCBs) and heavy metal (lead and cadmium) containing materials and equipment.

When sufficient quantities are accumulated, lead scrap metal and lead acid batteries are shipped for reclamation, typically one shipment annually. Other hazardous material recycling efforts include used oil, batteries, fluorescent lights and light bulbs, and liquid mercury and mercury compounds. In the past, silver-containing photographic solutions were sent out for silver recovery; however, this waste stream no longer exists at the Kesselring Site. Previously implemented waste reduction initiatives have included better segregation of hazardous and non-hazardous waste streams and substitution of non-hazardous paints and solvents where feasible. Non-hazardous, non-chemical solid waste is also recycled as practical.

The Kesselring Site contains one operating prototype reactor plant and support facilities, which generate small quantities of low-level radioactive waste during operation and maintenance. There are also two permanently shutdown prototype reactor plants (D1G and MARF) that generate small quantities of low-level radioactive waste and mixed waste as part of dismantlement and caretaking activities. The annual amount of low-level radioactive solid waste material generated by current operations has averaged about 155 cubic yards in recent years. By volume, this is equal to the yearly amount of ordinary trash generated by about 7 average households. A significant portion of this radioactive waste was generated from facility inactivation and remediation projects, including prototype dismantlement.

A discussion of current and past waste management operations follows.

5.1 Current Waste Management Programs

5.1.1 Radioactive Waste Management

Liquid, solid, and gaseous radioactive wastes are generated and controlled in site operations. The Kesselring Site maintains a vigorous radioactive waste control and minimization program. The generation processes and the minimization program are described below.

Radioactive Liquid Waste

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

liquids. The Kesselring Site has operated to a far more rigid standard for nearly seven decades. At the Kesselring Site, water used for reactor coolant is collected and processed to remove the radioactivity prior to reuse in appropriate site operations. The reuse processing systems include collection tanks, particulate filters, and activated carbon columns to remove organics and/or mixed-bed ion-exchange columns to remove inorganics. The water is reused in operations involving radioactivity to the maximum extent practicable. Starting in 2010, processed water that is not reused is evaporated to minimize effluent discharges. The water processing and reuse practices assure that over 99.9% of the particulate radioactivity contained in liquids associated with site operations is removed and disposed of off-site in approved Federal radioactive solid waste disposal sites.

Other sources of water that may contain small amounts of radioactivity are sampled prior to discharge in order to ensure that any radioactivity concentration is significantly below applicable Federal, State, Local and NNPP limits. In all cases, this level is far lower than any applicable standard. For example, during 2021 the radioactivity concentration in the processed water released to the Glowegee Creek was over 100 times lower in concentration than NRC limits for unrestricted use and was a fraction of the concentration permitted by the EPA for drinking water.

Radioactive Solid Waste

Solid radioactive wastes are generated at the Kesselring Site as a result of prototype operations, facility dismantlement, and maintenance. Included in this waste are such radioactive items as process system and ventilation filters, expended activated charcoal and resin, contaminated components, pieces of insulation, rags, sheet plastic, paper, sampling planchets, filter papers and towels resulting from radiochemistry and radiation monitoring operations. Also included are solidified liquid wastes, and construction material and equipment from facility dismantlement.

Solid radioactive wastes are packaged and shipped in accordance with the requirements of the U.S. Department of Transportation (DOT). These wastes are disposed of only in land disposal sites operated by the DOE or licensed commercial contractors. All such sites are outside 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. Specific types of mixed waste are disposed of at commercial disposal sites licensed to receive those types of waste. Mixed waste was managed until December 2013 in accordance with both the Kesselring Site Mixed Waste Management Plan (MWMP) and a 6 New York Code, Rules, and Regulations (NYCRR) Part 373 Hazardous Waste Management Permit administered by New York State. On December 13, 2013, the elements of the Kesselring Site MWMP were integrated into the Kesselring Site's Hazardous Waste Management Permit.

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 or licensed commercial 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. Nearly all systems include high efficiency particulate air (HEPA) filters for the removal of particulate radioactivity from the exhaust air.

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 HEPA filters are tested upon installation and periodically thereafter. The testing is performed using 0.7-micron diameter Polyalphaolefin (PAO) 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, nearly all controlled exhaust systems from radiological facilities are continuously sampled for radioactivity. Systems servicing prototype facilities are provided with continuous monitoring equipment with alarm capability. The prototype ventilation systems also contain fast acting automatic isolation valves. Air monitoring results are reported annually to Federal and State agencies.

In recent years, releases have averaged approximately one curie per year, consisting mainly of inert gases and tritium. The annual airborne radioactivity concentration at the nearest site boundary currently averages less than 0.01% of that permitted for off-site areas based on applicable DOE guidelines and results in a dose less than 1% of the EPA standard.

Radioactive Waste Minimization

The Kesselring Site 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 Kesselring Site has generated an average of 155 cubic yards of radioactive wastes per year from prototype plant operations, maintenance, and facility inactivations for the past five years.

Remediation Programs for Radioactivity

In 1977, Kesselring Site began the 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, and previous remedial actions, accomplished the following:

- Removal of the reactor vessel from the decommissioned sodium coolant prototype.
- Removal of about 1,900 cubic yards of soil containing radioactive residues from past operations.
- Removal of several deactivated systems used to handle low-level radioactivity.
- Removal of low-level residual radioactivity from the site discharge channels.
- Removal and off-site disposal of the reactor vessels from the decommissioned S3G and D1G Prototypes.
- Removal and off-site disposal of the decommissioned S3G Prototype power plant components and hull structure.

Future Kesselring Site activities will include removing various additional systems and structures used to handle low-level radioactivity that are no longer needed, as well as completing the removal of the decommissioned D1G Prototype reactor plant.

5.1.2 Non-Radioactive Waste Management

Site operations produce a variety of industrial waste products including the Sanitary Wastewater Treatment Facility sludge and effluent, 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 laws. In addition, the Kesselring Site has a hazardous waste minimization program. Each area is discussed below.

Non-Radioactive Liquid Wastes

Domestic sewage, cafeteria wastewater, grey water from utility sinks and locker room drains, and laboratory wastes are collected by a separate drain system and conveyed to the sanitary wastewater treatment facility.

Until late 2013, the site's sanitary wastewater was processed by a conventional extended aeration treatment plant. This treatment process train consisted of equipment to break down large solids, aeration tanks in which air is bubbled through the waste to provide mixing with activated sludge to reduce biochemical oxygen demand (BOD), and a clarifier for the separation of liquids and solids. Phosphate reduction was accomplished by chemical precipitation and removal in the clarifier. The entire effluent stream passed through a final sand filter for polishing. The treatment plant, including the chemical precipitation system and final filter, was effective in reducing BOD, suspended solids, and phosphates by over 90% in the effluent.

In 1990 voluntary installation of additional sanitary wastewater treatment, called "tertiary" treatment, occurred to reduce phosphate discharges and remove fine suspended matter to reduce phosphate inputs into Saratoga Lake. While phosphate is non-hazardous in the concentrations discussed here, phosphate is a nutrient that contributes to undesirable aquatic plant and algae growth in Saratoga Lake. Although a previous study indicated the Kesselring Site contributed less than 5% of the total phosphate input to Saratoga Lake, the intent is to reduce this discharge wherever practicable.

In December of 2013, the site initiated the transition to a new NYSDEC approved Sanitary Wastewater Treatment Facility. The new system consists of influent wastewater grinding, a biological treatment process consisting of pre-equalization, chemical coagulation for phosphorous removal, SBR, post-equalization and aeration, followed by filtration. The transition was completed in 2014. The new treatment plant is designed to reduce BOD, suspended solids, and phosphates by at least 85% in the effluent, and to date has shown a removal efficiency in excess of 95%. Waste sludge is stored in a holding tank and removed periodically by a licensed contractor for disposal at a State approved off-site disposal facility.

The treated effluent is discharged from the Sanitary Wastewater Treatment Facility to the Glowegee Creek in accordance with the site's New York State Pollutant Discharge Elimination System (SPDES) permit. The old sanitary treatment plant was decommissioned and NYSDEC approved the closure in July 2015. Removal of the old system was completed in 2019.

During the mid to late 1990s, additional actions were voluntarily taken to reduce phosphate discharges for the reasons previously discussed. Treatment systems were installed for process water transmitted directly to the site's lagoon that does not pass through the Sanitary Wastewater Treatment Plant. Again, phosphate reduction is accomplished by chemical precipitation and removal.

The small quantity of industrial waste liquids from site operations is controlled by several methods depending on the volume and nature of the waste. Methods used to assure the safe disposal include:

- Employee training in waste management requirements.
- Local collection and 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.
- Careful monitoring and control of chemical constituents to ensure that concentrations in effluent water comply with applicable standards.
- Chemical wastes defined as hazardous in accordance with RCRA are managed under a RCRA hazardous waste management permit administered by New York State.

In the case of storage tanks containing environmentally hazardous materials, precautionary measures are taken to prevent or retain any leakage. These measures include periodic inspections, use of revetments, sealing of drains, and inclusion of liquid level gages and alarms in selected storage tanks. In 1997, the site completed a program to replace electrical transformers known to contain PCBs with PCB-free equivalents.

Non-Radioactive Solid Wastes

Non-hazardous demolition debris and other similar materials are disposed of in off-site landfills permitted for such waste. Sanitary wastes such as cafeteria waste and scrap paper are also disposed of off-site at a permitted disposal facility. Newspaper, magazines, corrugated cardboard, tin cans, glass, printer toner cartridges, wood, asphalt, concrete, metal, computers, oil, drums, fluorescent light bulbs, batteries, and some types of plastic are recycled. From 2017 through 2021, approximately 8,921 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-metal reclaimer. Asbestos waste is packaged and transported to an approved asbestos waste disposal facility.

Non-Radioactive Airborne Effluents

The combustion gases from the three site heating plant steam boilers are discharged through elevated exhaust stacks. Two stacks are at a height of approximately 30 feet above ground level and the third stack is approximately 23 feet above the ground. The boilers provide steam primarily for heating and are therefore in maximum use during the colder months. The grade of fuel oil used in the boilers is controlled and monitored to ensure compliance with State standards. The boilers are operated under a State Air Registration issued by New York State and applicable State and EPA requirements.

Historically, there were three heating boilers that exhausted their emissions through two 75-foot stacks, and two other minor air emission points, a portable grit-blasting unit, and a spray-painting booth. These emission sources operated in accordance with air emission permits issued by New York State. Because the emissions from the grit-blasting and spray-painting units were considered trivial, the permits for these units were no longer considered necessary by New York State and were cancelled in 2003. In 2006, the site's heating boilers were placed under a New York State Air

Registration with an emissions cap that limited fuel usage. The original air permits were cancelled. Kesselring Site decommissioned one of the heating boilers prior to the 2014 renewal of the Air Registration for the heating boilers, which resulted in the site no longer having the potential to exceed the emissions requiring a major source permit or to have emissions capped. The renewed Air Registration for the two remaining heating boilers was issued in 2014 with no emissions cap. In 2016, the two 75-foot heating boiler stacks were replaced by two 30-foot stacks, which necessitated an update to the site's Air Registration, which was issued later in 2016. In 2019, Kesselring Site determined that the site's potential emissions exceeded the thresholds to require a cap and requested a modification to the Air Registration. This modification was completed on January 3, 2020, to comply with Federal and State requirements. On July 20, 2020, the Air Registration was again modified to support installation of a third boiler and a new 23-foot stack, which is also subject to the emissions cap. Installation of the new boiler and stack was completed on April 28, 2022.

Non-Radioactive Waste Minimization

Kesselring Site has long recognized the need to minimize the generation of hazardous waste. In accordance with RCRA, Kesselring Site has a Hazardous Waste Reduction Plan. From 1991 through 2005, the site submitted this plan annually to NYSDEC as required by State law. NYSDEC directed the site to stop submitting the plan after the 2005 plan because the annual waste generation rate was less than 25 tons per year. In 2016, NYSDEC directed the Kesselring Site to resume submitting the plan annually starting with the waste generated in 2015. The plan details actions to identify and minimize waste producing operations, compare minimization efforts year to year to demonstrate progress, and establish waste minimization goals. This is accomplished by establishment of strict procurement procedures, substitution of non-hazardous materials where practical, and other similar measures.

Actions taken by the Kesselring Site during the period 2017–2021 include:

- Recycling 38 tons of large lead-acid batteries;
- Recycling 94 tons of used lubricating oils;
- Recycling 7,544 tons of concrete and asphalt; and
- Recycling 869 tons of scrap metal, including lead.
- Reviewing and revising, when necessary, operating and training procedures to ensure the use of hazardous materials is minimized.

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.

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

The Kesselring Site continues to evaluate improvements in areas such as chemical purchases and operations to identify ways to reduce the generation of hazardous wastes. One method the Kesselring Site has implemented to reduce hazardous waste generation is a sustainable acquisition program.

Sustainable acquisition maximizes the amounts of material procured that contain recycled material. Environmentally preferable items include but are not limited to: paper and paper products, vehicular

products (e.g., engine coolants, oils), construction (e.g., insulation, carpet, concrete, paint) and transportation products (e.g., traffic barricades, traffic cones), park and recreation products, landscaping products, non-paper office products (e.g., binders, toner cartridges, office furniture), and miscellaneous products (e.g., pallets, sorbents, and industrial drums).

5.1.3 Remediation Programs

CERCLA requires all Federal facilities to identify environmentally harmful waste disposal areas that require prompt remedial action in accordance with a National ranking system. The EPA, in consultation with the States, is responsible to review and independently rank sites to determine the need for further action. Facilities with high rankings are considered for placement on a NPL 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 Kesselring Site did not qualify for inclusion on the NPL, and warranted no remedial action 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 the annual EMR indicates that the disposal areas do not adversely affect environmental quality. The Kesselring Site will continue to perform environmental monitoring of these areas.

Since 1996, environmental characterization of Kesselring Site historical waste disposal areas has been performed, and continues, in accordance with Kesselring Site's RCRA Permit issued by NYSDEC. All fieldwork and environmental data has been subject to review by NYSDEC. The data show that although small amounts of chemicals have been detected in the environment as a result of the Kesselring Site's past 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, if any. Any remediation plans will require approval by NYSDEC. Additional information is provided in Section 9.

The 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 Kesselring Site's on-going remedial program. As required by CERCLA, Kesselring Site will incorporate State direction into this program as appropriate.

Apart from the CERCLA and RCRA programs, the Kesselring Site formally closed the site landfill in 1994 in accordance with a closure plan approved by New York State. Closure included installation of a composite cover system (a geomembrane liner overlying a low-permeability soil layer) to minimize rainwater infiltration, installation of a top soil cover, and seeding and landscaping to control subsequent erosion. Groundwater monitoring will be continued in accordance with New York State-approved Post-Closure Monitoring and Maintenance Operations Manual. The Kesselring Site has also voluntarily remediated a former firearms practice range.

Although not required at the time by any rule or regulation, the Kesselring Site stopped the use of asbestos insulation products in 1976 and in 1989 initiated an ongoing program to rid the site of accessible asbestos insulation. Over 47,000 linear feet of this insulation has been removed from piping systems and over 11,000 square feet has been removed from tanks.

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 Kesselring Site has always maintained an environmental program substantially stricter than the rules in effect at the time. For example, in 1979 the Kesselring Site implemented an advanced water processing and reuse program to reduce further the already minute amount of radioactivity being released to the Glowegee Creek. This action was not required by law or regulation. It was done because it had become feasible and was consistent with the conservative engineering approach followed at the Kesselring Site 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 Kesselring 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 Kesselring Site has always been involved in handling radioactive materials and has always maintained a radioactive waste management program. Disposal practices appropriate to the waste forms were developed and implemented. Requirements for treatment and disposal of solid and liquid wastes were provided for in the design of the operating facilities. For example, retention tanks for liquid waste, facilities for temporary storage of solid waste, and air cleaning systems using HEPA filters 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

The primary methods for removal of radioactivity from water at the Kesselring Site have always been mechanical filtration and ion exchange.

In 1948, a study of the geology and hydrology of the West Milton area was conducted to determine the suitability of releases of low concentrations of radioactivity to the Glowegee Creek. The U.S. Geological Survey performed this study in cooperation with the AEC. Representatives of the New York State Department of Public Works also participated in the study. A preoperational monitoring program was also initiated by KAPL during the construction of the site to determine background concentrations in the Glowegee Creek due to naturally occurring radioactivity and fallout from nuclear weapons tests. Effluent water, which contained concentrations of radioactivity below the existing discharge concentration limits, was first released from the Kesselring Site in 1954, shortly before prototype operations began.

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

Liquid effluents from the site, including those containing low levels of radionuclides, flowed through on-site discharge channels, or ditches, prior to entering the Glowegee Creek. In the late 1950s and early 1960s, monitoring in these channels showed a slow buildup of low levels of radioactivity in the sediment from the discharge of water containing low-level radioactivity. These areas were dredged to prevent the radioactivity from entering the Glowegee Creek. The contaminated soil was shipped off-site to an approved disposal facility, and a filter and demineralizer were installed to reduce radioactivity in the water being discharged. Subsequently, low levels of radioactivity buildup were again found during channel monitoring and the radioactivity concentration discharge limits were further reduced to prevent radioactivity buildup from recurring. The areas were again dredged and the contaminated soil was shipped off-site to an approved disposal facility.

Since Kesselring Site operations began in 1954, about 15 Ci of Kesselring Site produced radioactivity have been released to the Glowegee Creek. Over 98% of the radioactivity discharged to the Glowegee Creek was tritium, but traces of other radionuclides, such as cobalt-60, iron-55, nickel-63, and antimony-125 were included. The most radioactivity released in any one year was 1.6 Ci in 1974, of which over 98% was tritium. The amount of tritium released was significantly decreased when water reuse was put in effect. In addition, the average concentration of tritium discharged to the Glowegee Creek was over 1,000 times less than that permitted by Federal regulations. Tritium is also naturally present in the environment because it is generated by cosmic radiation in the upper atmosphere. The tritium released from Kesselring Site operations is in the oxide form and is chemically indistinguishable from water; therefore, it does not concentrate significantly in aquatic life or collect on sediment, as do some other radionuclides.

KAPL has performed comprehensive environmental monitoring of the Glowegee Creek since 1948, before operations at the site began. Water, fish, and sediment samples have been evaluated for effects from site operations. Periodic monitoring continues to this day, with the results reported in the annual EMRs. The conclusions remain unchanged. There is no detectable radioactivity due to site operations present in the creek sediment. Fish and water samples taken in the Glowegee Creek, both upstream and downstream of the site outfalls, show only naturally occurring radionuclides (such as potassium-40) and no radionuclides attributable to site operation. The radioactivity discharged from Kesselring Site operations has resulted in no significant impact on the environment.

Radioactive Solid Waste

Most of the radioactive solid waste volume generated by the Kesselring Site has been low-level waste. This type of waste consisted of items such as paper and cloth wipes, protective clothing, air filters, resin/filter media, and used components. The waste was collected in waste cans, packaged in boxes or drums, and sent off-site for disposal. The site landfill was never used for disposal of radioactive waste, and no radioactive waste has ever been sent to a municipal landfill. Exhaust air from the low-level waste handling area passed through a monitored ventilation system with HEPA filters. The processed wastes were stored in monitored areas at the site prior to shipment.

Occasionally, the site was required to dispose of items that contained higher levels of radioactivity than the typical low-level wastes routinely handled. This included such waste as irradiated reactor plant components, resin/filter media, and some decontamination materials. This waste was placed in approved shipping containers and stored until shipment off-site to an approved disposal facility.

Irradiated Fuel

Infrequently, the prototype reactors at the Kesselring Site require refueling. The reactor fuel assemblies are loaded into sealed and shielded shipping containers certified to NRC and DOE requirements and are shipped in accordance with DOT regulations. The spent fuel is shipped to DOE facilities in Idaho for disposition. U.S. Government representatives escort each fuel shipment. Each shipping container is specifically designed to withstand extreme accident impacts, fire, or water immersion to prevent release of the material to the environment in the event of an accident. The cargo in the fuel shipments is non-explosive and non-flammable.

Radioactive Airborne Effluents

Ventilation air from radiological facilities was discharged to the atmosphere through elevated exhaust stacks. Prior to release, the air was passed through HEPA filters and monitored to ensure compliance with existing radiation protection guides.

Monitoring of exhaust air was accomplished through the collection and analysis of samples of the effluent. The sampling technique used included sampling with filter papers and gas chambers. Environmental air also was monitored at various distances and directions from the exhaust stacks.

Since 1954, an estimated 399 Ci of site-produced radioactivity have been released to the atmosphere. This is less than 10% of the amount of naturally occurring radon released during this time from an area the size of the developed portion of the Kesselring Site. The majority of the radioactivity, over 90%, consisted of inert gases, such as krypton-85 and the shorter-lived xenon-133, xenon-135, and argon-41. These inert gases do not deposit on surfaces and are readily dispersed in the atmosphere. Smaller amounts, approximately 34 Ci, of other beta-gamma emitting activated corrosion and wear products, carbon-14, tritium, and trace quantities of fission products comprised the remaining amount of the airborne radioactivity released. In recent years, releases to the atmosphere have averaged approximately 0.6 Ci per year, again consisting mainly of inert gases.

For perspective, the total amount of radioactivity released to the atmosphere since the start of operations at the Kesselring Site corresponds to a small fraction of that permitted by Government standards. The average radioactivity concentration in the exhaust air was well below all applicable standards. Subsequent monitoring has indicated no detectable residual radioactivity as a result of the release of radioactivity into the atmosphere. The annual airborne radioactivity concentration at the nearest site boundary currently averages less than 0.01% of that permitted for off-site areas based on applicable DOE guidelines and results in a dose less than 1% of the EPA standard.

Because the radiation exposure to people off-site is too small to be measured, the Kesselring Site has employed calculation techniques that estimate potential exposures using EPA-approved computer models. These techniques consider breathing the air and eating regional animal and vegetable food. It is conservatively estimated that the total accumulated radiation exposure to a member of the public living continuously next to the Kesselring Site during the entire time the facility has been operating would not exceed 3 millirem due to airborne radioactive effluents. This is no more than the exposure an average person receives in one week due to naturally occurring radiation sources.

5.2.2 Residual Radioactivity in Soil

The Kesselring Site has no radioactive waste disposal sites. However, operations in the past have resulted in inadvertent releases of small amounts of radioactive material. As a consequence, the site had two small areas where radioactive contamination had been identified in the soil or groundwater: the Silo Area where low-level radioactive materials were once handled, and an area in the vicinity of the former Building 29 area within the developed area of the site where low-level tritium had been detected just above natural background levels in the groundwater. Each of the affected areas is discussed below.

Silo Area

The Silo Area was used intermittently between 1958 and 1966 to burn oil and sodium contaminated with low-level radioactivity and for disposal of components potentially contaminated with mercury (See Section 5.2.3). The area is remote from any occupied area, is approximately one-half acre in size, and is named for the concrete silo foundation ring from a farm site abandoned when the Government reservation was established. The area is indicated as Item 3 on Figure 1. In 1978, numerous soil samples were collected and surveys of the area were performed that found localized areas of low-level contamination. One sample contained a cesium-137 concentration of 1,600 picocuries per gram (pCi/g). A very small piece of more highly contaminated material was also found during this survey and disposed of off-site as radioactive waste. In addition, in 1978, approximately 82 cubic yards of radioactively contaminated soil were removed from this location and sent off-site to an approved disposal facility.

In 1987, a very detailed radiological survey of this area was performed. The highest concentrations of radioactivity found in this soil during the 1987 survey were 179 pCi/g of cesium-137 and 6 pCi/g of cobalt-60. These were less than the respective New York State limits at the time of 200 pCi/g and 500 pCi/g for uncontrolled areas. At the time, Kesselring Site estimated that the soil containing radioactivity from site operations remaining in this area had an estimated total radioactivity content of about 0.05 curie. During 2002 and 2003, additional radiological data was collected at the Silo Area that was consistent with the results from previous surveys.

The Silo Area was monitored to confirm that there was no threat to Kesselring Site employees or the public and to confirm the radioactivity was remaining in place. Radiation monitoring of the area indicated natural background radiation levels except for one small localized area, which was twice the natural background level. As a measure of the significance of the radioactive residue in this soil, the total amount present was less than the amount of naturally occurring radioactivity found in the top four feet of soil covering a local area equivalent in size to the Silo Area.

As the predominant radionuclides were cesium-137 and cobalt-60, which decay with half-lives of about thirty years and five years respectively, the concentrations would naturally decline. Nevertheless, the Silo Area was cleaned up and the residual radioactivity removed. From 2006 to 2008, about 2,445 tons of soil, approximately 1,900 cubic yards, with an estimated total radioactivity content of 0.1 Ci were removed. The soil containing radioactive residue was packaged and sent off-site to an approved radioactive waste disposal site. Radiological surveys and soil sample analyses to confirm the removal of residual radioactivity have been completed. During the soil removal, several small metal items were found, some with trace radioactivity on them and some containing residual sodium-potassium mixtures; these items were removed, properly managed, and packaged for disposal. An unrestricted release from radiological controls was completed for the Silo Area in 2010.

Building 29 Area

From 1988 to 1990, tritium above normal background levels was occasionally detected in the groundwater in the vicinity of the former Building 29 area (within the developed area of the Kesselring Site). The highest concentration of tritium found in the groundwater was only 25% of the EPA limit for drinking water. The source of the tritium in the groundwater was never conclusively identified; however, it could have entered the ground from an in-ground water-holding tank constructed of concrete. The holding tank was subsequently removed from service. All subsequent groundwater tritium results were at their normal background levels, at or below minimum detectable, indicating the tritium had dissipated.

Tritium, which decays with a half-life of about 12 years, is a naturally occurring substance (due to cosmic radiation interaction with the atmosphere) and a by-product of Kesselring Site reactor operations. The total amount of localized tritium (above background levels) previously identified in the groundwater was very small (less than 0.05 Ci). For perspective, that amount of tritium is less than the amount of tritium in some radioluminescent wristwatches and more than 100 times less than the amount of tritium in some radioluminescent emergency exit markers.

5.2.3 Past Non-Radioactive Waste Management

The Kesselring Site has used once-through non-contact cooling systems, operated a conventional sanitary wastewater treatment plant, and used conventional sewage and storm water collection systems typical for a facility of this size. In addition, the site generated a variety of chemical wastes, some of which were disposed of by on-site land burial in accordance with the common industrial practices of the time.

The disposal locations shown in Figure 1 were identified during a review of historical records, interviews with knowledgeable personnel, and inspections of suspected areas. In addition, Figure 1 shows the location of a disposal area, Swan School Road Drum, which was discovered subsequent to the historical review. All of these locations are within the boundaries of the Government reservation. The review indicated the following:

- Battery acid from lead acid batteries was disposed of in the cellar hole of a demolished farmhouse on Swan School Road in the mid-1950s. Soil containing residue from this disposal was removed in 2001, and the cellar hole was backfilled and seeded.

- The Baptist Hill Road area was used for disposal of land clearing and construction debris, which included asbestos pipe insulation, over a period of years in the 1970s. Containers with paint and sealer residue were disposed of in this area in the early 1980s. The asbestos and most of the paint and sealer containers were removed, and the area was then graded and seeded.

- A facility known as the Silo Area, located on Lee Road, was used for burning waste oil and sodium contaminated with low-level radioactivity (Section 5.2.2) and for the disposal of components potentially contaminated with mercury from 1958 to 1966. The potential quantity of mercury involved is estimated at less than one pound. The mercury containing components were removed. Extensive environmental characterization of the Silo Area in 2002–2003 determined that trace amounts of mercury remain in limited areas of shallow, subsurface soil. During the 2007 radiological remediation of this area, a metal vessel was discovered that contained a small amount of liquid mercury. During removal of the vessel, the mercury spilled on the ground. The mercury, the affected soil, and the metal vessel were properly collected

and packaged for disposal. Subsequent to radiological remediation, environmental sampling work resumed and as a result, soil containing low levels of mercury was removed in 2012. NYSDEC approved a report documenting the final soil removal activity in 2013. NYSDEC completed a Statement of Basis for the Silo Area in 2015 declaring that the soil removal remedy is protective of human health and the environment.

- Cellar holes of demolished farmhouses located on Parkis Mills Road and Lee Road were used for the disposal of battery acid until about 1960. Soil containing residue from this disposal was removed in 2001, and the cellar holes were backfilled and seeded.

- The landfill located on Hogback Road was in operation from the early 1950s to 1993. The landfill began operation prior to the enactment of State regulations for solid waste disposal facilities and some potentially hazardous wastes were deposited in this landfill. These included asbestos scraps, sheets and dust; lead bricks, sheets, and wool; oil and oily water; paint; unspecified solvents; neutralized chemicals and laboratory analytical wastes; and scrap metal. Kesselring Site capped and closed the landfill in 1994 in accordance with a NYSDEC-approved closure plan, which included post-closure monitoring and maintenance discussed below.

- During the course of a 2008 site inspection, a lone 55-gallon drum was discovered in the immediate vicinity of a remote homestead foundation. The partially filled drum had leaked concentrated disinfectant/cleaning solution to the underlying soil. It was determined that the drum was unrelated to site operations, and that the solution was formulated with hazardous chemicals. The drum and impacted soil were removed in 2009. Soil and groundwater confirmation samples showed that there was no residual environmental impact.

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. Analysis of these areas was performed using the best available technology, including ground penetrating radar, magnetometry, and electromagnetic techniques.

During the closure of the Hogback Road landfill, the materials from two of Kesselring Site's construction and demolition debris disposal areas were relocated to the landfill. This was done with the agreement of New York State. No chemical waste was found except for several small barrels containing paint residue; the barrels and paint were removed and disposed of as chemical waste.

These areas are subject to environmental characterization for residual chemicals in accordance with the Kesselring Site RCRA Permit Corrective Action provisions. Environmental characterization began in 1996. All work is subject to review and oversight by the NYSDEC. Subsequent to completing the characterizations, proposed remediation, if any, will be reviewed with the NYSDEC. Characterization sample results thus far have identified no imminent threat to human health or the environment that would warrant immediate remediation, although several areas have been remediated. The Kesselring Site achieved two environmental milestones established by the EPA in 2010 and 2013 that show no unacceptable human health exposures and no concern for the migration of contaminated groundwater.

The Kesselring Site estimates that about 170 cubic feet (≈ 5 tons) per year of chemical products were buried in the Hogback Road landfill through 1977 when such practices ceased. The land areas used for disposal of chemicals comprise less than 1% of the site. The annual EMR describes the

results of groundwater monitoring conducted at the Kesselring Site to assess the influence of past disposal practices.

Groundwater Monitoring

Groundwater monitoring has been and continues to be routinely performed using wells across the site. In particular, monitoring has been performed at locations associated with the Kesselring Site closed landfill, former disposal areas, and the developed portion of the site.

Monitoring wells have been in place around the site landfill for many years, with additional wells added in 1991 to support the landfill closure plan. In the late 1980s, wells were placed around the other former disposal areas mentioned above. From 1989 to 1990, monitoring wells were also placed within the developed area to monitor groundwater flow paths in the area of active site facilities. Extensive historical monitoring has indicated no adverse effect from the land disposal areas on environmental quality.

The groundwater monitoring in the vicinity of the former Kesselring Site landfill is performed in accordance with a NYSDEC-approved Post-Closure Monitoring and Maintenance Operations Manual. Between six and eight landfill-monitoring wells were sampled for parameters specified by NYSDEC each quarter from 1980 to 2002. Sampling frequency was approved by the NYSDEC to change from quarterly to annually in 2002. A number of additional wells were installed in 1993 as part of the landfill closure study, and some older wells were later retired. There are currently six wells being used for required annual landfill groundwater monitoring. Monitoring results are provided to the NYSDEC for review. The 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 Kesselring Site 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.

The landfill groundwater monitoring data indicates some measurable but small effects on groundwater quality in the vicinity of the landfill. However, the effects are not migrating or increasing. Nearby streams also form shallow aquifer boundaries that minimize the extent of lateral groundwater migration. The monitoring wells immediately downgradient of the landfill historically showed the following parameters above NYSDEC groundwater quality standards: turbidity, chloride, total dissolved solids, iron, magnesium, manganese, and sodium. Those parameters that were typically elevated in some downgradient wells in relation to the upgradient well, but not above groundwater quality standards, included total organic carbon, Chemical Oxygen Demand (COD), ammonia, alkalinity, hardness, sulfate, nitrate, barium, potassium, boron, calcium, and specific conductivity. A number of monitoring well samples contained detectable concentrations of metals, including arsenic, iron, manganese, lead, and chromium, which were generally associated with suspended solids in the samples. Filtered sample analyses typically showed either non-detectable or significantly lower levels of these metals.

Current groundwater monitoring continues to show that while certain parameters remain elevated in most of the downgradient wells when compared to the upgradient well, these parameters are either stable or decreasing over time. The individual parameters that are typically elevated include specific conductance, alkalinity, hardness, total dissolved solids, chloride, sulfate, magnesium, manganese, potassium, sodium, and calcium. A number of other parameters exhibit variability and are generally elevated in only a few downgradient wells. These parameters routinely include COD, total organic carbon, ammonia, nitrate, and iron. Both current and historical elevated parameters are typical of leachate from a sanitary landfill.

In addition, there are detectable volatile organic compounds in some downgradient well samples. The compounds are chlorinated solvents and their breakdown products at concentrations varying from non-detectable to slightly above New York State standards. These organics are attributed to past disposal activities in the landfill and appear to be stable or decreasing in concentration over time. Except for the landfill, data from monitoring wells in the vicinity of these former land disposal areas has demonstrated no groundwater impact.

For the Lee Road, Parkis Mills Road and Swan School Road cellars, where battery acid was disposed of, soil analyses showed that only low concentrations of heavy metals were present, and only in the upper 4 to 5 feet of soil. In 2001, this soil was removed and disposed of off-site when these areas were remediated. Based on many years of previous data demonstrating no effect on the groundwater and the remediation that has been completed in these areas, the wells surrounding these areas are no longer sampled for chemical constituents.

For the developed portion of the site, the only parameters historically detected in the groundwater that are attributable to current operations are sodium, chloride, Total Kjeldahl Nitrogen, and ammonia. All of these are associated with the use of de-icing materials. Elevated levels of ammonia were found in groundwater removed from the foundation drainage system of a building constructed in 2006. Further investigation indicated the ammonia was most likely the result of leakage from a sanitary sewer line. The sewer lines have been inspected and as a result, several have been repaired. The ammonia levels in this drainage system have decreased over time.

Trace levels of volatile organic compounds have been detected in several monitoring wells and are attributed to past operations. Finally, certain metals, attributable to particulate materials (i.e., clays/silts) in unfiltered samples and not dissolved in the groundwater, have been detected in some wells in the past.

The overall conclusion of the groundwater monitoring program is that previous waste disposal practices at the landfill have resulted in some measurable, but small effects on groundwater quality immediately downgradient of the landfill. There has been no impact on the groundwater quality due to Kesselring Site disposal practices at the other former disposal sites.

In addition, while the geologic materials and their related aquifer properties beneath the land disposal areas and the developed portion of the site vary, the aquifers have well defined boundaries and are of limited extent. Site service water is produced from an aquifer system that is hydrogeologically separate and distinct from all land disposal areas and the developed portion of the site. Therefore, the limited effects on the groundwater shown in the groundwater monitoring results pose no threat to public health or the environment.

5.2.4 Past Non-Radioactive Environmental Releases

Since site operations began in 1954, several inadvertent environmental releases have occurred. None of these releases has resulted in a permanent impact on the environment. In all cases, prompt actions were taken to minimize the impact of the release. Each release was evaluated to determine the cause and procedures or facilities were modified as necessary to prevent a recurrence. The more significant releases are discussed below.

In 1970, a leak developed in a No. 6 fuel oil heat exchanger in the site boiler house resulting in a release of about 1,000 gallons of fuel oil to a site drainage ditch. The ditch was isolated and no oil was observed in the Glowegee Creek. The majority of the oil was recovered and properly disposed

of. The leak was repaired and affected areas of the site were cleaned up. There was no impact on the Glowegee Creek.

In 1973, a release of sulfuric acid to the Glowegee Creek occurred as a result of errors during delivery of acid to the site. It was estimated that approximately 165 gallons of acid were released to the Glowegee Creek. Prompt actions were taken to minimize additional impacts on the creek. NYSDEC was promptly notified and was involved in the corrective actions taken. Although some fish were killed, on-going biomonitoring confirmed that there was no permanent impact on the Glowegee Creek. The facilities and procedures for acid delivery were reviewed and modified, as necessary, to prevent a recurrence.

In 1976, a leak developed in an underground No. 6 fuel oil tank adjacent to the site boiler house resulting in a release of approximately 30,000 gallons of fuel oil to the surrounding soil and the site drainage ditches. The leak was discovered prior to any impact to the Glowegee Creek although some on-site ditches in the immediate vicinity of the developed area were affected. The drainage ditches were isolated and there was no impact on the Glowegee Creek. The majority of the oil was recovered and disposed of by a licensed waste contractor. The affected areas of the site were cleaned up, including the soil surrounding the tank. The underground boiler fuel oil tanks have since been removed and replaced with above ground revetted tanks. All remaining underground tanks have been removed.

In 1978, an inadvertent over-addition of acid to a site process cooling water system resulted in a release of sulfuric acid and copper sulfate to the Glowegee Creek. Immediate actions were taken to stop the release. The NYSDEC was promptly notified and was involved in the corrective actions taken. Although the release did result in the death of several fish, on-going biomonitoring of the Glowegee Creek indicated no long-term impact on the creek.

In order to prevent releases of substances to the Glowegee Creek, the site has upgraded its water discharge system. In 1973, isolation gates were installed in the site discharge ditches to enable impounding of water should it be necessary. In 1978, discharge pH and temperature sensors were added along with the ability to automatically close the discharge gates should an unusual condition occur.

In 1984, a lagoon was added which provided additional holdup capacity to contain and treat inadvertent releases should they occur. In 1990, a carbon dioxide injection system was added to control lagoon discharge pH during the summer months when normal biologic growth in the lagoon tends to raise pH. In 1996, a discharge gate was installed in the parking lot storm water drain line to allow isolation of these drains in the event of a hazardous material spill in the parking lot. In 1998, a wastewater treatment facility was installed to treat the effluent from the holding lagoon. The system is designed to minimize total suspended solids, resulting from summer algae blooms, and remove residual chlorine from drinking water chlorination.

Continuing biomonitoring of the Glowegee Creek, as reported in the annual EMRs, indicates the Kesselring Site has had no significant impact on the environment.

6.0 MONITORING PROGRAMS

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

6.1 Aerial Survey

Convincing evidence that the Kesselring Site does not represent a significant radiological problem comes from the results of an aerial radiation survey of the site and the surrounding areas, conducted in 1982. All areas of the Government reservation, including the developed area, were within the range of background radiation levels in the surrounding Saratoga County area. Similar surveys of other facilities involved in management of radiological materials often show clearly elevated radiation levels up to 100 or more times background. No changes in radiological conditions have occurred at the site that would affect the conclusion of the 1982 aerial survey.

6.2 Soil Survey

In the 1980s, over 850 ground measurements were made for residual radioactive materials in the soil on the Kesselring 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 and cobalt-60. These radionuclides are the most common radionuclides resulting from Kesselring Site operations that can be found in soil at the site. The detector was lowered into a small hole punched to a depth of about 6 feet by a hydraulic machine. This technique permitted an area to be evaluated much more quickly and thoroughly than the conventional technique of removing soil samples for analysis in a laboratory.

The SPUD program surveyed the only area of the Kesselring Site outside of the developed area where residual radioactivity from site operations was believed to be present; i.e., the Silo Area (Section 5.2.2).

The Kesselring Site also checks soil excavated during construction of radiological facilities for radioactivity content to establish a baseline for future environmental monitoring. Some man-made radionuclides have been detected in soil samples obtained from construction of several facilities adjacent to the site drainage ditch. The highest level found by these samples was 0.17 pCi/g cobalt-60.

To better characterize the potential low-level radioactivity in soil adjacent to the site drainage ditches and near radiological facilities used in the past, Kesselring Site performed SPUD surveys of these areas. For these surveys, the detector was calibrated to detect cobalt-60 as well as the standard cesium-137. Cobalt-60 is the principal radionuclide of interest associated with naval nuclear propulsion plants. Of the 450 measurements obtained, only 26 indicated detectable radioactivity above background levels. All of these were from isolated spots 1.5 to 6 feet underground, and no pattern of radioactivity was indicated. The highest level of cobalt-60 found was 2.3 pCi/g, and the highest level of cesium-137 found was 4.5 pCi/g. For perspective, this is about the same level of radioactivity as the naturally occurring potassium-40 radioactivity found in bananas.
Over 100 soil samples have been taken to verify the SPUD results and to confirm that the concentrations of other radionuclides are also very low. In addition, a number of monitoring wells

have been installed to check for chemicals or radioactivity in the groundwater beneath some areas of the site.

Based on the SPUD monitoring, soil sampling, and groundwater monitoring results, Kesselring Site estimates that less than 0.1 curie of site-produced radioactivity was contained in site soil. This amount of radioactivity is no more than the naturally occurring radioactivity contained in the top one inch of soil from a local area the size of the developed area of the Kesselring Site.

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

7.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

The impact of Kesselring 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 Kesselring Site has from its beginning monitored all known or suspected sources of releases of radioactivity to the environment in 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 Kesselring Site has never maintained a radioactive waste burial ground. However, activities in the past have resulted in release of small amounts of radioactive material to localized areas of soil or groundwater in the vicinity of the activities. There were two primary locations on-site where such releases occurred in the past: the Silo Area and a small area within the fenced boundary of the Kesselring Site. The Kesselring Site monitored and, where appropriate, cleaned up and removed those structures and adjacent soil where releases occurred. The estimated total quantity of man-made radioactivity in the soil at the Kesselring Site was less than 0.1 curie.

This amount of radioactivity is no more than the amount of naturally occurring radioactivity in the top one inch of soil in a local area the size of the developed area of the Kesselring Site (approximately 66 acres).

The comprehensive site radiation monitoring program, which is described in the annual EMRs, shows that the radiation exposure to persons off-site is too small to be measured. The Kesselring Site employs calculation techniques that conservatively estimate potential exposures. These calculation techniques consider exposure pathways that include fishing, boating and swimming in the Glowegee Creek, using the creek water for drinking and irrigation, breathing the air, and eating regionally produced animal and vegetable food. The most recent assessment for 2021 shows that the maximum potential radiation exposure to a member of the public was less than 0.1 millirem for the entire year. This is about one-thirtieth of the exposure that a person would receive from cosmic radiation sources during a one-way cross-country airplane flight. The Kesselring Site conservatively estimates that the total accumulated radiation exposure to a member of the public living continuously next to the Kesselring Site since operations began in 1954 would not exceed 8.3 millirem. This is less than the exposure an average person actually receives in about three weeks from natural radiation sources.

7.2 Non-Radiological Assessment

Regarding non-radioactive environmental effects, the Kesselring Site has always monitored site effluent water and air to assure that they meet the requirements of applicable Federal and State environmental standards. This includes monitoring of Glowegee Creek water and surface water from the site and, more recently, groundwater sampling from monitoring wells throughout the site. Results of all monitoring to date support the conclusion that operation of the Kesselring Site has no significant impact on the environment.

Each year since 1972, the Knolls Laboratory has published a report of comprehensive environmental monitoring results that covered both the Knolls Laboratory and Kesselring Site. This

report shows that Kesselring Site operations have no adverse effect on human health or the quality of the environment.

The Kesselring Site will continue to obtain and evaluate environmental sampling data and take any necessary actions to preclude any impact on the environment from the remaining residual chemical or radioactive materials at the site, in accordance with Federal and State regulations.

8.0 AUDITS AND REVIEWS

The Kesselring Site 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 controls as they relate to their work.
- Written procedures must be followed.
- Engineers, technicians, and their supervisors oversee all environmental monitoring and related work.
- The Kesselring Site maintains an independent audit program, which covers all environmental, safety and health requirements and includes in-depth audits of specific areas.

The NNPP maintains an on-site resident office (i.e., the Naval Reactors Representative's Office) with a technical staff reporting directly to the Director, Naval Nuclear Propulsion Program in Washington, D.C.

The local Naval Reactors Representative's Office has personnel assigned full time that audit and review the Kesselring Site environmental controls. NNPP headquarters personnel also conduct periodic in-depth inspections of these areas.

In addition, various aspects of the Kesselring Site environmental program are reviewed by other Government agencies. For example, NYSDEC or EPA have conducted on-site inspections of RCRA programs for the past 25 years. Overall, outside regulators have conducted 37 environmental inspections in the past ten years (Table 1).

None of these regulatory inspections has ever identified a significant item of non-compliance in operations. Only minor administrative shortcomings have been noted, and these have been corrected. No fines or penalties were ever levied against the Kesselring Site as a result of these inspections.

There have been two major environmental reviews conducted at the Knolls Laboratory and the Kesselring Site: the Government Accountability Office (GAO) (known as the General Accounting Office until 2004) in the early 1990s and the EPA in the late 1990s. In 1991, at the conclusion of their review of the Naval Reactors Program's environmental, health, and safety practices, the GAO testified to Congress that:

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

In their final report, the GAO stated that the programs and procedures implemented at the Knolls Laboratory and the Kesselring Site 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 conducted a Multi-Media Environmental Compliance Inspection of the Knolls Laboratory and the Kesselring Site; the NYSDEC also participated. A Multi-Media Inspection reviews all areas of compliance with environmental regulations governing air, water, solid waste, etc. The EPA results found the Kesselring Site operations to comply with regulations, with one exception regarding the accounting of fuel consumption for the site boilers. This record keeping discrepancy did not result in any environmental impact, and the Kesselring Site corrected the record keeping practice shortly after the EPA inspection. All other aspects of Kesselring 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.

In 2014, 2018, and 2020, the EPA conducted Consolidated Multi-Media Environmental Compliance Inspections of the Kesselring Site. The Consolidated Multi-Media Environmental Compliance Inspection, also known as a Multi-Media Screening Inspection, covers multiple EPA regulated areas usually by one or two EPA inspectors. The EPA results found Kesselring Site operations to comply with the regulations.

Table 1 Environmental Inspections of the Kesselring Site (2011-2021)

TOPIC	DATE	AGENCY
RCRA	09/20/11	EPA
RCRA	09/12/12	EPA
RCRA*	11/29/12	NYSDEC
RCRA*	04/26/13	NYSDEC
RCRA	08/20/13	EPA
RCRA*	04/28/14	NYSDEC
RCRA	05/28/15	EPA
RCRA	06/21/16	EPA
RCRA*	12/14/16	NYSDEC
RCRA	08/15/17	EPA
RCRA	05/15/19	EPA
RCRA	12/18/19	NYSDEC
RCRA	12/17/21	NYSDEC
Consolidated Multi-Media Inspection	05/07–05/08/14	EPA
Consolidated Multi-Media Inspection	05/07/18	EPA
Consolidated Multi-Media Inspection	11/04/20	EPA
Clean Water Act	08/02/11	NYSDEC
Clean Water Act	12/31/13	NYSDEC
Clean Water Act	03/19/15	NYSDEC
Clean Water Act	07/21/15	NYSDEC
Clean Water Act	03/17/17	NYSDEC
Clean Water Act	02/15/18	NYSDEC
Clean Water Act	03/28/19	NYSDEC
Clean Water Act	03/17/21	NYSDEC
Solid Waste – Closed Landfill	12/20/17	NYSDEC
Drinking Water	12/17/13	NYSDOH
Drinking Water	06/06/18	NYSDOH
Underground Storage Tank Inspection	09/20/11	EPA
Underground Storage Tank Inspection	09/12/12	EPA
Underground Storage Tank Inspection	08/11/15	NYSDEC
Underground Storage Tank Inspection	05/15/19	EPA
Petroleum/Chemical Bulk Storage (PBS and CBS)	08/11/15	NYSDEC

TOPIC	DATE	AGENCY
Petroleum/Chemical Bulk Storage (PBS and CBS)	08/30/18	NYSDEC
Petroleum/Chemical Bulk Storage (PBS and CBS)	07/29/21	NYSDEC
Other (Historical Spill Inspection)	04/03/15	NYSDEC
Other (Historical Spill Inspection)	02/03/17	NYSDEC
Other (Wetlands Delineation Review)	01/29/20	U.S. Army Corp of Engineers
Note: *This site visit by NYSDEC was associated with Kesselring Site's ongoing environmental evaluations and corrective actions as specified in the site's RCRA Permit (Section 9.0).		

9.0 REGULATORY MATTERS

The Kesselring Site has always responded promptly and effectively to meet new Federal, State, and local requirements and will continue to do so. The Kesselring Site maintains programs 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 the annual EMRs.

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. In 1988, KAPL prepared and submitted to the EPA and the NYSDEC a Preliminary Assessment documenting such areas at the 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 Kesselring Site scored below the value that would warrant including the site on the NPL for cleanup. Additional information was subsequently provided to the EPA and the State in support of their review of the Preliminary Assessment, both to supplement previous information and to reflect changes in evaluation methodology implemented by the EPA subsequent to KAPL's original submittal.

At the EPA's request, KAPL also executed an Expanded Site Investigation at the Kesselring 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 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 Kesselring Site continues to comply with the requirements of SARA. The Kesselring Site 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 wastes. Currently, the Kesselring Site operates in accordance with its RCRA Part 373 hazardous waste management permit and New York State regulations. This permit was issued by the NYSDEC in 1995, and renewed in 2013. During the permit process, the Kesselring Site 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 the 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, the Kesselring Site prepared a list of "Solid Waste Management Units and Areas of Concern" including the landfill and disposal areas discussed in Section 5. The current RCRA permit includes a list of these units along with a sequence of State-approved evaluations and corrective actions for each if required. Following a review of the Kesselring Site's current and historic 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, more than 95% have since been classified as "no further action required" (including the landfill, which was closed in 1994 in accordance with a NYSDEC approved closure plan). Only one Solid Waste Management Unit and two Areas of Concern remain and will be undergoing additional characterization in accordance with the Kesselring Site's RCRA permit to determine if any remediation will be necessary.

Federal Facility Compliance Act (FFCA)

The FFCA, enacted in 1992, requires DOE facilities to prepare plans for developing treatment capacity and technologies for sites that generate or store mixed wastes. Mixed wastes contain both chemically hazardous and radioactive constituents. Quantities of mixed waste are generated at the Kesselring Site, principally during prototype dismantlement. These plans were needed because adequate capacity for treating some mixed waste to the standards required by the RCRA did not exist. Adequate treatment capacity is currently available to treat Kesselring Site generated mixed waste to RCRA standards. Therefore, the FFCA compliance agreement, and associated requirement to maintain an associated Site Treatment Plan, was cancelled by NYSDEC in August 2009.

Clean Air Act (CAA)

This Act, as amended in 1990, established requirements for the control of air emissions. The regulations promulgated pursuant to the CAA also govern use of ozone depleting substances, the use and removal of asbestos containing materials, and the emission of radionuclides to the environment. The regulatory authority for the majority of the CAA regulations that affect the Kesselring Site has been delegated by the EPA to NYSDEC. The Kesselring Site heating boilers are registered under a NYSDEC Air State Facility Registration, which was renewed in April 2016 and is still in effect. Radiological air emissions at Kesselring Site are monitored and reported annually to the EPA in accordance with the requirements in the National Emissions Standards for Hazardous Air Pollutants.

Clean Water Act (CWA)

The Federal CWA and the New York State Environmental Conservation Law regulate the chemical components and physical attributes of liquids discharged to the surface waters of the State of New York. Specifically, the Kesselring Site effluent and environmental standards are established in a site-specific SPDES permit issued by NYSDEC. The SPDES Permit specifies the required sampling locations, parameters, and minimum sampling frequencies. The term of the permit is five years, and the NYSDEC renewed the permit in 2018, which became effective on September 1, 2018. Liquid effluent from the Kesselring Site enters the Glowegee Creek through three outfalls, which

discharge process water, effluent from the site sanitary wastewater treatment facility, once-through, non-contact cooling water, and/or stormwater, and five stormwater-only outfalls.

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

Other Regulations

The Kesselring Site 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 Control Act. All Kesselring Site operations are in compliance with applicable regulations.

EXTERNAL DISTRIBUTION

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United States Environmental Protection Agency

Chief, Land & Redevelopment Program Branch, Region 2
United States Environmental Protection Agency

Chief, Air Compliance Branch, Region 2
United States Environmental Protection Agency

Deputy Director, Air and Radiation Division, Region 2
United States Environmental Protection Agency

Commissioner
New York State Department of Health

Director, Bureau of Environmental Radiation Protection
New York State Department of Health

Chief, Radiological Emergency Response and Radon and Environmental Radiation Section
Bureau of Environmental Radiation Protection
New York State Department of Health

Senior Sanitary Engineer
Glens Falls District Office
New York State Department of Health

Assistant Commissioner
Public Affairs Group
New York State Department of Health

Commissioner
New York State Department of Environmental Conservation

Director, Division of Materials Management
New York State Department of Environmental Conservation

Director, Division of Water
New York State Department of Environmental Conservation

Section Chief, Wastewater Permits, Central Section
New York State Department of Environmental Conservation

Director, Division of Air Resources
New York State Department of Environmental Conservation

Deputy Commissioner, Public Affairs
New York State Department of Environmental Conservation

Director, Bureau of Hazardous Waste and Radiation Management
New York State Department of Environmental Conservation

Section Chief, Radioactive Materials Management
Bureau of Hazardous Waste and Radiation Management
New York State Department of Environmental Conservation

Section Chief, RCRA Permitting
Bureau of Hazardous Waste and Radiation Management
New York State Department of Environmental Conservation

Research Scientist
Division of Fish and Wildlife
New York State Department of Environmental Conservation

Regional Director, Region 5
New York State Department of Environmental Conservation

Regional Public Participation Specialist, Region 5
New York State Department of Environmental Conservation

Regional Engineer, Region 5
New York State Department of Environmental Conservation

Regional Environmental Remediation Engineer, Region 5
New York State Department of Environmental Conservation

Regional Materials Management Engineer, Region 5
New York State Department of Environmental Conservation

Regional Water Engineer, Region 5
New York State Department of Environmental Conservation

Regional Air Pollution Control Engineer, Region 5
New York State Department of Environmental Conservation

Public Information Officer
New York State Division of Homeland Security and Emergency Services

Senior Advisor
Radioactive Waste Policy and Nuclear Coordination
New York State Energy Research and Development Authority

Federal Project Director
Environmental Management Consolidated Business Center – NY
United States Department of Energy

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