DOE/EIS-0274

FINAL ENVIRONMENTAL IMPACT STATEMENT

Disposal of the S3G and D1G Prototype Reactor Plants

Volume 1 of 2

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COVER SHEET

PROPOSED ACTION: Determine and implement a disposal strategy for the defueled S3G and D1G Prototype reactor plants.

TYPE OF STATEMENT: Final Environmental Impact Statement (DOE/EIS-0274)

RESPONSIBLE AGENCY: U.S. Department of Energy, Office of Naval Reactors

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ABSTRACT: This Final Environmental Impact Statement evaluates in detail three alternatives for the disposal of the S3G and D1G Prototype reactor plants. These alternatives include: "no action," which means continuing surveillance and monitoring for an indefinite period of time; prompt dismantlement (the preferred alternative) and disposal of the S3G and D1G Prototype reactor plants; and deferred dismantlement, which allows for decay of some radioactivity prior to dismantlement and disposal. The analyses demonstrate that the environmental and socioeconomic impacts for each of the disposal alternatives would be small.

The Naval Reactors Program received written comments on the Draft Environmental Impact Statement during a 45-day public comment period lasting from July 25, 1997 to September 8, 1997. Oral comments were received during a public hearing held on August 13, 1997. This Final Environmental Impact Statement includes copies of all written and oral comments that the Naval Reactors Program received on the Draft Environmental Impact Statement. All comments were taken into consideration during preparation of this Final Environmental Impact Statement.

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SUMMARY

S.0 Introduction

> **National Environmental Policy Act :** A Federal law passed in 1969, which requires all Federal agencies to consider in their decision making processes potential environmental effects before implementing any major action, and established the Council on Environmental Quality within the Office of the President.
>
> **Alternatives:** The range of reasonable options considered in evaluating and selecting an approach to meet the need for agency action.
>
> **Environmental Impact Statement:** A detailed environmental analysis for a proposed action that could significantly affect the environment. A tool for decision making, it describes the positive and negative environmental effects of the alternatives.
>
> **Record of Decision:** A concise public record of the agency's decision, which discusses the alternative selected. The discussion will include whether all practicable means to avoid or minimize environmental harm from the selected alternative were adopted (and if not, why they were not).

The U.S. Department of Energy Office of Naval Reactors (Naval Reactors Program) is currently evaluating alternatives for the disposal of the S3G and D1G Prototype reactor plants, located at the Knolls Atomic Power Laboratory Kesselring Site (Kesselring Site) near West Milton, New York. A key element of the Naval Reactors Program's decision making process is a thorough understanding of the environmental impacts associated with each alternative. The National Environmental Policy Act requires Federal agencies to analyze the potential environmental impacts (both positive and negative) of their proposed actions to assist them in making informed decisions. In following this process, the Naval Reactors Program prepared a Draft Environmental Impact Statement to assess various alternatives and to provide necessary background, data and analyses to help decision makers and the public understand the potential environmental impacts of each alternative. Following consideration of public comments, the Naval Reactors Program prepared this Final Environmental Impact Statement. The Naval Reactors Program decision will be presented in a Record of Decision to be issued 30 days after publication of the Final Environmental Impact Statement.

The Kesselring Site is located on a Federal reservation approximately 14 kilometers (9 miles) southwest of Saratoga Springs, New York. The Federal reservation consists mostly of wooded areas. The areas surrounding the reservation are mostly rural and include a mixture of woodlands, farmlands, and small residential tracts. The Site has been operated as a reactor testing and training facility under Naval Reactors Program control since the mid-1950s and is expected to continue operating in this manner into the foreseeable future.

The S3G and D1G Prototype reactor plants were permanently shut down in May 1991 and in March 1996, respectively, reflecting the end of the Cold War and projected downsizing of the U.S. Navy fleet. All spent nuclear fuel was removed from the S3G Prototype reactor and shipped off-site in July 1994. All spent nuclear fuel was removed from the D1G Prototype reactor and shipped off-site in February 1997. The high integrity nuclear fuel represented approximately 95 percent of the radioactivity originally at the S3G and D1G Prototypes. Management of Naval spent nuclear fuel has been addressed in a separate U.S. Department of Energy evaluation, Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7). The MARF and S8G Prototype reactor plants continue to operate at the Kesselring Site to fulfill the mission of training U.S. Navy personnel and testing Naval nuclear propulsion plant equipment. Future disposal of these prototypes would be considered a major Federal action which would require preparation of a separate Environmental Impact Statement. Since there are no plans to permanently shut down the remaining operating prototypes in the foreseeable future, an evaluation of their disposal and release of the Kesselring Site and Federal reservation lands for other uses is not required at this time.

The S3G and D1G Prototype reactor plants are located within separate prototype reactor compartments at the Kesselring Site. The reactor compartments are shielded and serve as holding structures for the radioactive reactor plant systems. The S3G and D1G Prototype reactor plant systems have been inactivated (that is, defueled and placed in a safe and stable condition). However, the defueled reactor plants still contain radioactive materials such as activated metals and corrosion products, which must be managed in a way that protects public health and the environment.

The identification of a preferred alternative in this Environmental Impact Statement reflects consideration of the following factors: (1) public comments; (2) protection of human health and the environment; (3) cost; (4) technical feasibility; (5) operational efficiency; and (6) regulatory impacts. Based on these factors, the Naval Reactors Program has identified prompt dismantlement as the preferred alternative for the disposal of the S3G and D1G Prototype reactor plants for the following reasons:

- An experienced work force is currently available at the Kesselring Site.
- Eventual release of the Kesselring Site is more readily achievable since two of the four prototype reactor plants would be dismantled and disposed of.
- Prompt dismantlement has a greater degree of certainty in completing the dismantlement and disposal within predicted costs and with small environmental impacts.

The environmental impacts associated with all of the considered alternatives would be small. The Naval Reactors Program's preferred alternative would allow for the safe dismantlement, shipment, and disposal of the S3G and D1G Prototype reactor plant components.

S.1 Alternatives

This Environmental Impact Statement evaluates three alternatives in detail for disposal of the S3G and D1G Prototype reactor plants. Each of these alternatives is briefly described below; full descriptions are provided in Chapter 3.

No Action - The S3G and D1G Prototype reactor plants would be left in a defueled, safe and stable condition, and monitored for the indefinite future. This Environmental Impact Statement provides the results of evaluating only the first 30 years of caretaking for the purpose of comparison and does not include the impacts of actions after that time, such as final disposal.

Prompt Dismantlement (Preferred Alternative) - The S3G and D1G Prototype reactor plants would be dismantled shortly after the Record of Decision, and materials would be disposed of off-site or recycled at existing U.S. Department of Energy or commercial facilities. The project would be completed as soon as practicable, subject to available appropriated funding.

Deferred Dismantlement - The S3G and D1G Prototype reactor plants would be left in a defueled, safe and stable condition, and monitored for a period of 30 years to allow the radioactive material to decay prior to dismantlement. The Naval Reactors Program considers 30 years appropriate for the caretaking period because it would allow cobalt-60 to decay to less than 2 percent of the radioactivity levels present in each prototype reactor plant in 1997. Nearly all of the gamma radiation within the defueled S3G and D1G Prototype reactor plants comes from cobalt-60, which has a 5.27-year half-life. A longer deferment period would not provide much additional benefit. Although radiation levels would be reduced, in comparison to the prompt dismantlement alternative, this alternative would not change the amount of material to be handled as low-level radioactive waste due to the presence of long-lived radionuclides.

Alternatives Eliminated from Detailed Analysis - Three alternatives were evaluated and subsequently eliminated from further analysis. They include the one-piece reactor plant off-site disposal alternative, the entombment alternative, and the on-site disposal alternative.

The one-piece reactor plant off-site disposal alternative would involve the removal and disposal of the entire S3G and D1G Prototype reactor compartments each as one-piece units. This alternative is based on the reactor compartment disposal program currently in use for dismantling decommissioned nuclear-powered U. S. Navy warships. In that program, defueled reactor plant systems and lead shielding are left intact, and each reactor compartment is sealed as a single package. The sealed packages provide an excellent barrier to the environment, and result in low person-rem and cost. Defueled reactor compartments are packaged at the Puget Sound Naval Shipyard and are then sent by barge and special ground transport to the U.S. Department of Energy Low-level Waste Burial Grounds, Hanford Site, Washington State for disposal. Overland transport of whole reactor compartments by either truck or rail from the Kesselring Site to a U.S. Department of Energy disposal site is physically impractical. The weights of the entire S3G and D1G reactor compartments would exceed the weight limits for some bridges along the route from the Kesselring Site to the disposal sites. Similarly, the reactor compartment packages would not be able to clear all underpasses along the routes. The load-limiting bridges and underpass interferences of the available routes make this alternative impractical, and it was eliminated from further detailed evaluation.

The entombment alternative would involve leaving the S3G and D1G Prototype reactor plants permanently at the Kesselring site within one or two strong, durable structures. The entombment structures could be located either above grade or below grade and would be designed to last at least several hundred years to ensure that radionuclides in the reactor plant could not reach the environment. The entombment alternative for decommissioning commercial nuclear power plants is intended for use where the residual radioactivity will decay to levels permitting unrestricted release of the facility within a reasonable time period of about 100 years (Reference 3-3). Since nuclear reactors typically contain long-lived radionuclides (with half-lives in excess of 100 years), these radionuclides would not decay below the criteria for unrestricted release of the site within the anticipated lifetime of any man-made structure. The S3G and D1G Prototype reactor plants contain radionuclides with long half-lives and therefore, entombment would not be considered a viable alternative. This alternative would not offer any appreciable advantage in terms of health risk or other environmental benefit.

The on-site disposal alternative would involve placing the S3G and D1G Prototype reactor plants into an engineered land disposal unit. This disposal unit would be designed with impervious materials and liners beneath and over the reactor compartments and covered with earth. This on-site disposal alternative would require the approval of State regulatory agencies to use the Kesselring Site for the permanent disposal of hazardous materials. Similar to the entombment alternative, on-site disposal was eliminated from detailed evaluation because there would be no appreciable health or environmental benefit and it would prevent future unrestricted release of the Kesselring Site for other uses.

S.2 Impacts of Facility Activities

Evaluation of the full range of environmental impacts and other effects associated with the caretaking and dismantlement of the S3G and D1G Prototype reactor plants shows that the impacts would be small for each alternative. These impacts would be so small that they offer little assistance in differentiating among the alternatives. Topics considered in the evaluation included the effects on the land use, ecological resources, air and water resources, terrestrial resources, cultural resources, environmental justice, aesthetic and scenic values, noise, traffic and transportation, and energy usage. All environmental impacts in these topics would be small.

This Final Environmental Impact Statement evaluates the risk to the public and workers from exposure to radiation or radioactive material. Risk is defined as the product of the consequences of an event multiplied by the probability of that event. Since exposure to radiation could result from incident-free activities or from a hypothetical accident, the radiological impacts of each alternative were thoroughly evaluated from many perspectives. Analyses indicate that the risks to the public and to workers would be small for all of the alternatives considered in detail. Health effect risks resulting from exposure to radiation or radioactive materials are most commonly presented in terms of latent fatal cancers. For completeness, health effect risks from other nonradiological conditions, such as potential occupational injuries, were also evaluated.

Expressing numbers in terms of powers of ten is known as scientific notation (see Glossary). For example, 0.000026 can be expressed in scientific notation as 2.6×10^{-5}. To assist readers who are unfamiliar with scientific notation, data is presented in decimal form where practicable.

Table S-1 provides a comparison of the alternatives in terms of the annual average radiological risk per person due to facility activities and hypothetical accidents.

Table S-1: Collective Dose and Average Annual Radiological Risk per Person Due to Facility Activities

	Alternatives		
	No Action (first 30 years only)	**Prompt Dismantlement (preferred alternative)**	**Deferred Dismantlement**
Collective Dose (person-rem): Incident-Free Facility Activities			
Occupational [b]	22	205	26
Public [c]	9.9×10^{-6}	8.6×10^{-6}	1.3×10^{-5}
Average Annual Radiological Risk per Person: Incident-Free Facility Activities [a]			
Occupational [b]	4.2×10^{-5}	5.8×10^{-4}	4.0×10^{-5}
Public [c]	1.4×10^{-16}	1.6×10^{-15}	1.9×10^{-16}
Average Annual Radiological Risk per Person: Hypothetical Facility Accidents [a]			
Public [d]	4.2×10^{-17}	5.2×10^{-14}	1.4×10^{-15}

a. Risks of developing a latent fatal cancer.
b. Data from Table B-7, Radiation Worker average.
c. Data from Table B-7, Population average.
d. Hypothetical facility accidents resulting in the maximum risk to the public from the following tables:
No action alternative - High efficiency particulate air filter fire at the S3G Prototype, Table B-20.
Prompt & deferred dismantlement alternatives - Component drop accident at the D1G Prototype, Table B-12.

Public and Occupational Health Impacts From Incident-Free Facility Activities

As shown in Table S-1, the average annual risks per person associated with each alternative would be very small. Occupational (worker) radiation exposures were assessed for each alternative. The collective dose to workers associated with the prompt dismantlement alternative would be within a range of approximately 205 to 460 person-rem. Based on many years of experience in planning and executing other refueling and maintenance operations, it is reasonable to expect that the actual collective dose to workers would be close to the lower end of the range. Although the collective dose to workers would be higher for the prompt dismantlement alternative, average doses per worker would be comparable in magnitude to those routinely received during operation and maintenance of Naval prototype reactor plants. The occupational radiation doses that the workers would receive during dismantlement activities would be kept as low as reasonably achievable, consistent with the practices and policies of the Naval Reactors Program (Reference 4-22). Even on a cumulative basis for the entire work force, analyses showed that no immediate fatalities or latent cancer fatalities due to radiation exposure would be expected from incident-free activities for any of the alternatives considered. Health effects to workers from nonradiological conditions would be similarly small.

The radiation exposures to the general public would be so small for each alternative that they would be indistinguishable from naturally occurring background radiation. As shown in Table S-1, the collective dose to the public would be small for each alternative. The average annual risk per person to individuals in the general population would be very small (much less than 1 chance in 1 trillion). Analyses showed that no immediate fatalities or latent cancer fatalities due to radiation exposure would be expected from incident-free activities.

Public Health Impacts From Hypothetical Facility Accidents

Several hypothetical facility accident scenarios were analyzed, including dropping a large radioactive component, a high-wind event, a fire in a radioactive air filter, and a large volume spill of radioactive liquid. The analyses applied conservative modeling assumptions and considered many exposure pathways. As shown in Table S-1, hypothetical facility accidents would result in a very small average annual risk per person to an individual in the general population. Analyses showed that no immediate fatalities or latent fatal cancers would result from hypothetical accidents for any of the alternatives considered.

Two nonradiological facility accidents were also evaluated. These accident scenarios included a diesel fuel fire and a spill of stored chemical products. The source term for the fire involved four typical combustion products. The source term for the chemical spill considered eight compounds contained in various adhesives, strippers, solvents and lubricants. The analysis results indicated that all toxic chemical concentrations would be at or below Emergency Response Planning Guidelines level 1 values for the maximally exposed off-site individual. Emergency response plans are in place at the Kesselring Site to mitigate the effects on workers and the environment from these types of accidents.

S.3 Impacts of Transportation Activities

Since materials from S3G and D1G Prototype reactor plant dismantlements would require disposal outside of the Kesselring Site, the effects from transporting materials were analyzed from many perspectives. Transportation analyses apply to the prompt and deferred dismantlement alternatives only. Transportation analyses do not apply to the no action alternative since there would be no prototype reactor plant dismantlement activities and no waste shipments.

Risks to the public and workers from shipments of radioactive materials were thoroughly evaluated. Transportation analyses considered the impacts of these shipments to different disposal sites, both under incident-free conditions and considering hypothetical accident scenarios, using conservative assumptions. Transportation analyses indicated that the overall impacts would be small for either dismantlement alternative, and that no immediate fatalities or latent fatal cancer fatalities would be expected from any radioactive package shipments.

Transportation analyses considered health effects from several nonradiological perspectives. These perspectives included consideration of shipments of nonradioactive materials, vehicle exhausts from all shipments and traffic accidents. Analyses indicated these impacts would be small.

Table S-2 provides a comparison of the alternatives in terms of the average annual risk per person due to the shipment of materials from dismantlement activities.

Table S-2: Average Annual Risk per Person Due to Transportation Activities [a]

	Alternatives		
	No Action (first 30 years only)	**Prompt Dismantlement (preferred alternative)**	**Deferred Dismantlement**
Average Annual Risk per Person: Incident-Free Transportation			
Transportation Radiological [b]			
Occupational	Not applicable [e]	6.8×10^{-4}	2.6×10^{-5}
Public	Not applicable [e]	1.5×10^{-9}	4.1×10^{-11}
Transportation Nonradiological Public [c]	Not applicable [e]	8.1×10^{-10}	8.1×10^{-10}
Average Annual Risk per Person: Hypothetical Transportation Accidents			
Transportation Radiological Public [d]	Not applicable [e]	3.1×10^{-12}	6.3×10^{-14}
Average Annual Risk: Hypothetical Transportation Accidents			
Transportation Nonradiological Public	Not applicable [e]	1.6×10^{-2} [f]	1.6×10^{-2} [f]

a. Risk of a latent fatal cancer
b. Data from Appendix C, Tables C-13 and C-15 for prompt and deferred dismantlement alternatives, respectively.
c. Data from Appendix C, Table C-3 added to data from Tables C-13 and C-15.
d. Data from Appendix C, Tables C-17 and C-19 for prompt and deferred dismantlement alternatives, respectively.
e. Transportation impacts were not estimated for the no action alternative since there would be no shipments.
f. Nonradiological accident risk is based on national and state accident statistics for the distance traveled. Data from Appendix C, Tables C-4 and C-17 , added for prompt dismantlement, and Tables C-4 and C-19, added for deferred dismantlement.

Public and Occupational Health Impacts From Incident-Free Transportation

For either dismantlement alternative, the risk of latent fatal cancer or other health effect to the general population along transportation routes to a disposal site would be small. No immediate fatalities or latent cancer fatalities from radiation exposure would be expected from transportation of wastes to the disposal sites. Adding the public radiological and nonradiological risks from Table S-2 for the prompt dismantlement alternative only yields a 2.3×10^{-9} per person risk of a latent fatal cancer. This per person risk equates to less than 1 chance in about 430 million that transportation of dismantled materials would cause a latent fatal cancer.

As shown in Table S-2, the risk to transportation workers who receive occupational radiation exposure was also estimated. Analyses assumed that 60 radioactive material shipments would be made from the Kesselring Site. For either dismantlement alternative, thousands of transportation operations would be required before a single additional latent cancer fatality might be expected to occur among the workers.

Public Health Impacts From Transportation Accidents

The risk of transportation accidents is based on estimates of latent cancer fatalities to the general population. Analysis of transportation accidents considers workers (the transportation crew) as part of the general population. No immediate fatalities due to radiation exposure would be expected to result from a transportation accident under any alternative. Analyses which used conservative modeling assumptions and which considered many pathways, estimated the risks from several hypothetical transportation accident scenarios. As shown in Table S-2, the average annual risk per person in the general population would be very small. Analyses showed that no immediate fatalities or latent fatal cancers would result from hypothetical transportation accidents for either dismantlement alternative.

S.4 Other Impacts

Although protection of human health and the environment are typical factors used to compare alternatives, these impacts would be small for each alternative. Besides radiological consequences, additional factors are taken into consideration, such as regulations, waste management, traffic and transportation, pollution prevention, environmental justice, socioeconomics, cumulative impacts, and cost. Other considerations include technical feasibility, work force availability, mitigative measures, long-term productivity of the environment, and public comments.

Regulations

All three alternatives can be performed within the framework of existing Federal and State environmental regulations. Regulatory requirements do not distinguish among the alternatives, although the regulatory requirements for the deferred dismantlement alternative are less certain because of the 30-year period of deferment. The no action alternative could present the greatest uncertainty in the area of regulatory requirements because it extends into the future for an indefinite period of time. Although dismantlement activities would involve meeting Federal and New York State permitting requirements, no new legislation would be required to implement any of these alternatives.

Waste Management

The prompt and deferred dismantlement alternatives would involve the generation of some wastes. While the no action alternative would result in the generation of only small amounts of waste as part of caretaking activities, this alternative does not provide for final reactor plant disposals. Even though the S3G and D1G Prototype reactor plants are small when compared to commercial reactors, emphasis would be placed on recycling as much material as practical under the prompt or deferred dismantlement alternatives. A variety of waste materials would be generated during dismantlement activities. Waste materials would include nonhazardous debris, low-level radiological waste, mixed waste, hazardous, and toxic wastes. All of the materials would be managed and controlled in accordance with Federal, State, and local regulations. Waste volumes would be reduced by using various technologies such as recycling, smelting and compaction. Recyclable materials would include elemental lead from shielding, carbon steel from the hull and deckplate structures, and corrosion resisting metals from reactor plant systems. Low-level radioactive metals would be recycled using various commercial vendors. The U.S. Department of Energy Savannah River Site in South Carolina currently receives low-level radioactive wastes from Naval Reactors Program sites in the eastern United States. The U.S. Department of Energy Hanford Site in Washington State is also available for disposal of low-level radioactive wastes generated by Naval Reactors Program activities. Mixed wastes would be temporarily stored and disposed of in accordance with the Kesselring Site Treatment Plan, which was approved by the New York State Department of Environmental Conservation. Analyses assumed that nonradioactive materials would be recycled or disposed of at commercial facilities located within approximately 310 kilometers (200 miles) of the Kesselring Site. The impacts of waste management would be small and would last for the relatively short duration of the dismantlement and disposal operations.

Traffic and Transportation

Shipments from dismantlement activities would represent less than 5 percent of total Kesselring Site shipments over a similar period and would not have a significant impact on area traffic and transportation. Although there would be no shipments associated with the no action alternative, a final means for disposal would be required in the future, which could eventually result in shipments of radioactive and nonradioactive material.

Pollution Prevention

Stringent pollution prevention practices are implemented at the Kesselring Site as part of normal operations. Airborne and waterborne releases to the environment are strictly controlled. These releases are monitored for compliance with applicable Federal and State regulations and permits. At the Kesselring Site, a water reuse system is employed. Liquids that may contain radioactivity are collected in holding tanks and processed through a series of filters and demineralizers. To minimize releases of radioactivity in air to the environment, high efficiency particulate air filters are routinely used in radioactive work applications. These filters effectively remove more than 99.95 percent of airborne particulate radioactivity. As a result of rigorous practices and Naval Reactors Program standards aimed at controlling radioactivity and protecting the environment, the annual releases of long-lived gamma radioactivity from all Naval Reactors Program activities are comparable to the annual releases from a single typical U.S. commercial nuclear reactor operating in accordance with its U.S. Nuclear Regulatory Commission license.

Actions involving waste minimization, recycling and procurement practices also serve to prevent pollution. For example, to reduce the volume of mixed wastes, the Naval Reactors Program is evaluating recycling options to reuse lead containing low levels of radioactive impurities in shielding applications at other U.S. Department of Energy facilities. The

Kesselring Site has participated in the New York State Hazardous Waste Reduction Plan since 1990. Since tracking of applicable waste streams began, 6 of 12 waste streams have been eliminated. Where practicable, the Kesselring Site recycles materials which are normally considered to be industrial waste. These materials include waste oil, batteries and lead. In the area of procurement practices, alternate materials which reduce or eliminate acquisition of products containing hazardous substances or toxic chemicals are considered. As a result of these many programs and practices currently in place, pollution prevention standards would continue to be met under any of the alternatives for S3G and D1G Prototype reactor plant disposal.

Environmental Justice

Environmental justice evaluations were based on 1990 U.S. Census Bureau data for the region within an 80-kilometer (50-mile) radius of the Kesselring Site. The data showed only a few localized areas in the region having minority populations which exceed an average of 6 percent of the overall population. The nearest of these areas is located more than 8 kilometers (5 miles) from the Kesselring Site.

The U.S. Census Bureau characterizes persons living in poverty as those whose income is less than a "statistical poverty threshold." For the 1990 Census, the statistical poverty threshold was based on a 1989 income of $12,500 per household. Persons living in poverty comprised approximately 9 percent of the overall population in the region surrounding the Kesselring Site. U.S. Census data showed only a few very small areas in the region having low income status populations comprising 25 percent or more of the population. Figures show that none of these populations are located within 8 kilometers (5 miles) of the Kesselring Site.

There would be no significant and adverse environmental impact to any person from any of the alternatives. Therefore, pursuant to Executive Order 12898, there would be no disproportionately high and adverse human health or environmental effects on any minority or low-income population. Analyses included consideration of unique consumption and cultural factors.

Socioeconomics

All of the alternatives would involve a reduction of about 200 jobs at the Kesselring Site in the short-term (less than 5 years). Under the prompt dismantlement alternative, the existing work force would be retained for the duration of dismantlement activities, which would be about a 3 to 4-year period. Although the 200 job reduction would be noticeable in the civilian work force at the Kesselring Site, it would represent only about 0.1 percent of the employment level in the surrounding region. Therefore, none of the alternatives would have any discernible socioeconomic impact.

Cumulative Impacts

A cumulative impact results when the incremental impact associated with implementation of an alternative is added to the impacts of other past, present, or reasonably foreseeable future actions. Cumulative impacts take into consideration the expectation that the other two prototype reactor plants at the Kesselring Site, MARF and S8G, will continue to operate for the foreseeable future to fulfill the mission of training U.S. Navy personnel and testing Naval nuclear propulsion plant equipment. The small impacts associated with any of the alternatives would not make a substantial contribution to the cumulative effects of Kesselring Site operations, especially when considered on a regional, state, or national basis. Dismantlement or caretaking activities would not result in discharges of radioactive liquids. None of the alternatives would cause the total air emissions to exceed any applicable air quality requirement or regulation in any radiological or nonradiological category. No additional land would have to be set aside for waste disposal. Impacts to existing land use or land conditions would not be expected. The cumulative transportation impacts associated with dismantlement activities would be small. The approximately 60 radioactive material shipments from dismantlement would be a small part of the more than 2 million shipments of radioactive materials made annually in the United States (Reference 4-33). Therefore, cumulative effects do not provide a basis for distinguishing among the alternatives.

Costs

The cost differences between the deferred dismantlement alternative (estimated to be approximately $114,000,000) and the prompt dismantlement alternative (estimated to be approximately $78,000,000) are primarily due to the cost of demobilizing the work force, preparing the S3G and D1G Prototype reactor plants for long-term caretaking, and remobilizing the dismantlement work force following the caretaking period. Although at first glance the no action alternative appears to be lowest in estimated cost (approximately $25,000,000 for the first 30 years of caretaking), it does not include final disposal actions. Therefore, final cost of the no action alternative is indeterminate.

Other Considerations

Based on a wide range of experience in dismantling reactor plants throughout the nuclear industry, any of the alternatives would be technically feasible. The Naval Reactors Program has removed the defueled reactor compartments from more than 60 decommissioned nuclear-powered U.S. Navy warships at the Puget Sound Naval Shipyard in Bremerton, Washington and shipped the reactor compartments for disposal at the U.S. Department of Energy Hanford Site. Several similar or larger sized reactor plants have been totally or partially dismantled by the U.S. Department of Energy or commercial utilities, including the Shippingport reactor plant in Pennsylvania, the Elk River demonstration reactor in Minnesota, the Pathfinder reactor plant in South Dakota, the Trojan reactor plant in Oregon, the Yankee Rowe reactor plant in Massachusetts, and the Fort St.Vrain reactor plant in Colorado. The technology and techniques used in these previous dismantlements are now proven. Activities under any of the alternatives would be conducted consistent with stringent Naval Reactors Program practices.

As discussed in the summary of socioeconomics impacts, all three alternatives evaluated in detail would involve a reduction of about 200 jobs within less than 5 years. The reduction in jobs would involve a work force experienced in the support of prototype refuelings, defuelings, overhauls and inactivations. The prompt dismantlement alternative would allow an efficient use of this trained and skilled work force for 3 to 4 years more than the deferred dismantlement and no action alternatives. Under the deferred dismantlement alternative, a future temporary staff increase would be required after the 30-year caretaking period to support dismantlement activities. This future work force may not start with the same knowledge and skills as the work force that currently exists at the Kesselring Site.

Since the adverse impacts would be small for any of the alternatives evaluated in detail, there are no mitigative measures identified or required for any of the alternatives. Stringent Naval Reactors Program requirements would further ensure that small, unavoidable effects are reduced to as low as reasonably achievable. The only discernible irreversible and irretrievable commitments of resources would be the relatively small amounts of energy that would be required to accomplish any of the alternatives.

Since there are no plans to shut down the other operating prototypes or to release the Kesselring Site or Federal reservation lands for other uses in the foreseeable future, none of the alternatives would have any impact on the long-term productivity of the environment. However, the prompt dismantlement alternative would make the eventual release of the Kesselring Site more readily achievable since dismantlement and disposal of two of the four prototype reactor plants would be completed. None of the alternatives involve construction of new structures or development of undisturbed lands.

Half of the agencies and individuals commenting on the Draft Environmental Impact Statement during the public comment period indicated support for one of the dismantlement alternatives (36 percent for prompt and 14 percent for deferred). The remainder of the commenters did not indicate a preference for any particular alternative. There was no support indicated for the no action alternative.

S.5 Conclusion

Although comparison of the three alternatives shows that the no action alternative would have the smallest environmental, health and safety impacts, the impacts associated with all of the alternatives would be small and consistent with ongoing Kesselring Site operations. Based on current conditions, any of the alternatives could be accomplished within Federal and State requirements, in both the short-term and the long-term. However, 30 years from now, changing conditions associated with the regulatory environment, and the availability of trained personnel and waste disposal facilities could result in unforeseeable complications or delays.

Such future unforeseeable conditions cause additional uncertainty in the impacts associated with the deferred dismantlement and no action alternatives.

The Naval Reactors Program has identified the prompt dismantlement alternative as the preferred alternative since it is consistent with the Naval Reactors Program's record to manage waste efficiently and minimize its generation. Prompt dismantlement would allow the Naval Reactors Program to utilize an experienced work force that is presently located at the Kesselring Site. Prompt dismantlement could be accomplished safely, economically, and with a high degree of certainty that the environmental impacts would be small.

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CHAPTER 1

PURPOSE AND NEED FOR AGENCY ACTION

1.0 Purpose and Need for Agency Action

The Naval Reactors Program is currently evaluating alternatives for disposal of the S3G and D1G Prototype reactor plants, located at the Knolls Atomic Power Laboratory Kesselring Site near West Milton, New York. The function of the S3G and D1G Prototype reactor plants was to train U.S. Navy personnel and test Naval nuclear propulsion plant equipment. As a result of the end of the Cold War and the downsizing of the U.S. Navy, the S3G and D1G Prototype reactor plants were permanently shut down in May 1991 and March 1996, respectively.

Since there is no further need for the S3G and D1G Prototype reactor plants, a decision is needed on their disposal. The S3G and D1G Prototype reactor plants must be preserved or dismantled in a way which will protect public health and the environment. The actions to manage these reactor plants must comply with all applicable Federal and State regulations and Kesselring Site permits.

Consistent with the Naval Reactors Program commitment to take care of its legacies in a responsible manner, this Environmental Impact Statement is designed to provide a comprehensive evaluation of potential impacts to human health and to the environment from a range of reasonable disposal alternatives. Two other prototype reactor plants, MARF and S8G, continue to operate at the Kesselring Site to fulfill the mission of training U.S. Navy personnel and testing Naval nuclear propulsion plant equipment. Future disposal of these prototypes would be considered a major Federal action which would require preparation of a separate Environmental Impact Statement. Since there are no plans to permanently shut down the remaining operating prototypes in the foreseeable future, an evaluation of their disposal and release of the Kesselring Site and Federal reservation lands for other uses is not required at this time.

1.1 Proposed Action

The Naval Reactors Program proposes to determine and implement a disposal strategy for the defueled S3G and D1G Prototype reactor plants. The preferred alternative is prompt dismantlement, which is discussed in detail in Section 3.6.

1.2 Public Involvement

As required by Council on Environmental Quality regulations (40 CFR Parts 1500 - 1508) and U.S. Department of Energy implementing procedures for the National Environmental Policy Act (10 CFR Part 1021), the decision making process includes providing the opportunity for public involvement. On July 16, 1997, the Naval Reactors Program began distribution of the Draft Environmental Impact Statement on the Disposal of the S3G and D1G Prototype Reactor Plants. Over 200 notices and Draft Environmental Impact Statements were distributed to regulatory agencies, elected officials, organizations, and individuals who have expressed an interest in the disposal of the defueled S3G and D1G Prototype reactor plants. The public comment period began with publication of the Notice of Availability in the *Federal Register* (62FR40074) on July 25, 1997 and remained open for 45 days, ending on September 8, 1997. In addition to the *Federal Register* notice, a public notice was published in the *Times Union*, *The Daily Gazette*, *The Saratogian*, and the *Ballston Journal* newspapers. During the comment period, a public hearing was held in the Town of Milton, New York, as announced in the *Federal Register* and the above listed newspaper notices.

The Naval Reactors Program received a total of 10 written statements and 4 oral statements during the public scoping process. Copies of the written statements and the stenographic record of the public hearing are contained in Appendix E. All comments were taken into consideration during preparation of this Final Environmental Impact Statement.

CHAPTER 2

BACKGROUND

2.0 Background

This chapter provides general background information on the Kesselring Site facilities, the S3G and D1G Prototype reactor plants and associated reactor compartment structures, and the Naval Reactors Program. This chapter also provides general discussions on Federal and State environmental statutes and regulations, Executive Orders, and U.S. Department of Energy Orders and regulations that are related to Kesselring Site activities.

2.1 Kesselring Site - General Description

The Kesselring Site is an approximately 26-hectare (65-acre) developed area situated within an approximately 1,600-hectare (3,900-acre) Federal reservation owned by the U.S. Department of Energy. The Kesselring Site is located near West Milton, Saratoga County, New York, approximately 27 kilometers (17 miles) north of the City of Schenectady, 14 kilometers (9 miles) southwest of Saratoga Springs, and 21 kilometers (13 miles) northeast of Amsterdam (see Figures 2-1 and 2-2). The Kesselring Site is currently operated by KAPL, Inc., a Lockheed Martin company, under contract with the U.S. Department of Energy.

The Kesselring Site mission is to train U.S. Navy personnel in the operation and maintenance of Naval nuclear propulsion plants for the U.S. Navy fleet and to test Naval nuclear propulsion plant equipment. The Kesselring Site includes four pressurized-water Naval nuclear propulsion prototype plants. Two of the prototypes, known as S3G and D1G, are permanently shut down and defueled. Management of Naval spent nuclear fuel has been addressed in a separate U.S. Department of Energy evaluation, Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7). Two other prototypes, known as MARF and S8G, and miscellaneous support facilities continue to operate to fulfill the mission of the Kesselring Site (see Figure 2-3). There are no plans to shut down the operating prototypes or to release the Kesselring Site or Federal reservation lands for other uses in the foreseeable future.

Descriptive and historical information regarding the Kesselring Site are contained in the Kesselring Site Environmental Summary Report (Reference 2-1). The Environmental Summary Report, issued periodically, describes the environmental conditions and impacts of Kesselring Site facilities and operations, and has concluded that there has been no significant impact from Kesselring Site operations on the environment or adverse effect on the community or the public. Additionally, the Environmental Summary Report provides an historical perspective on Kesselring Site operations and waste management practices.

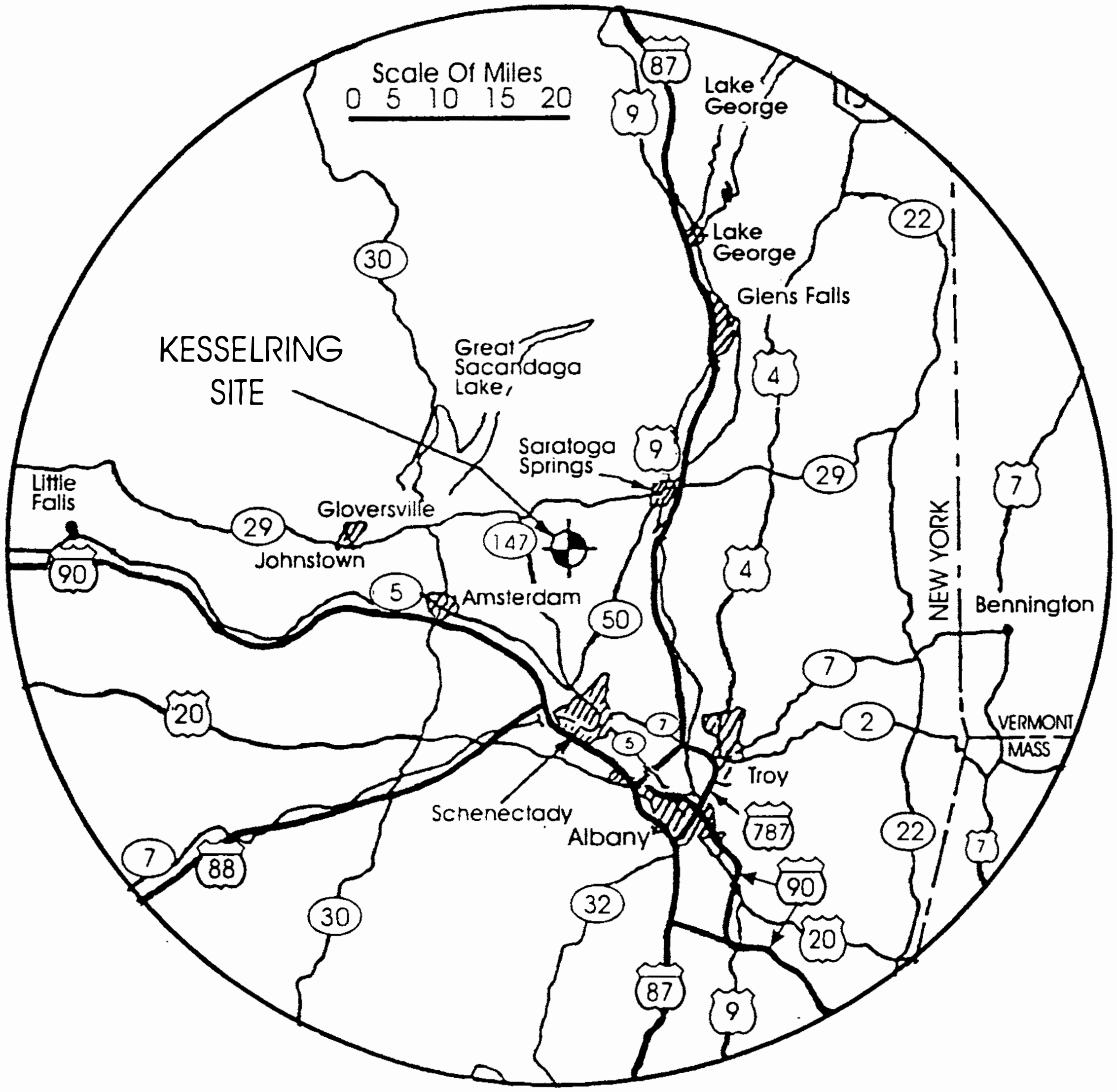

Figure 2-1: 80 Kilometer (50 Mile) Assessment Area Map of the Kesselring Site

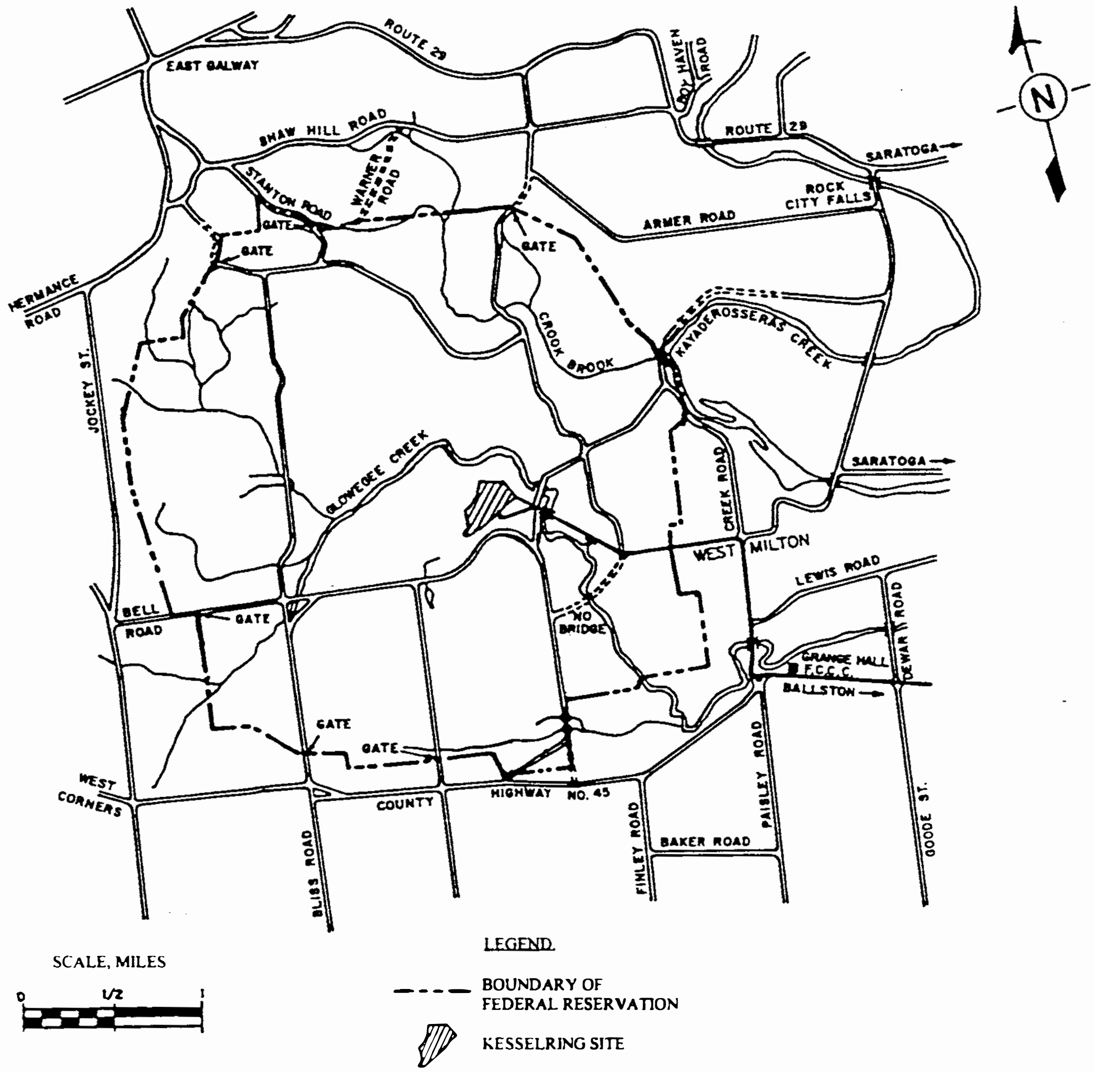

Figure 2-2: Map of the Federal Reservation and Surrounding Area

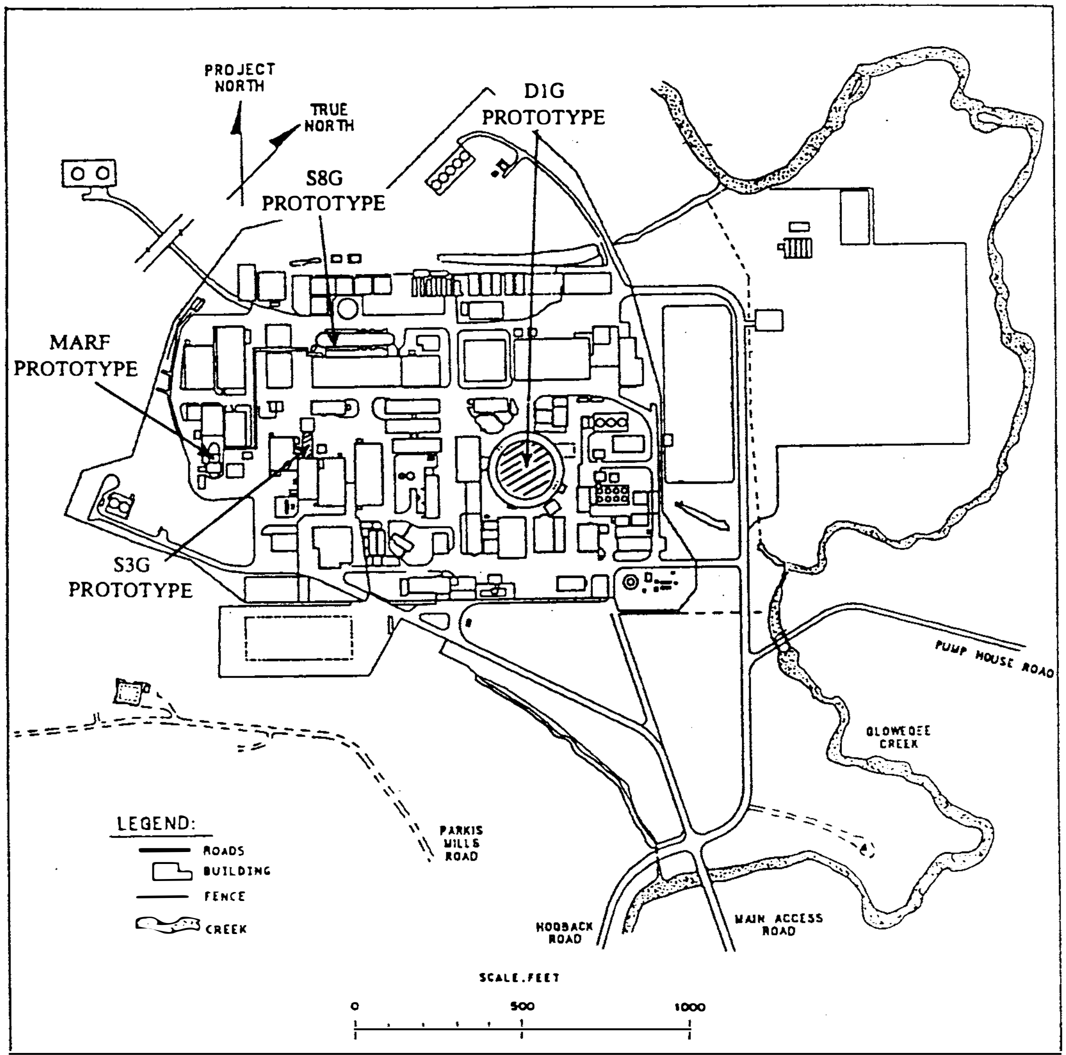

Figure 2-3: Map of the Kesselring Site

2.2 S3G Prototype - General Description

The S3G Prototype was placed in operation in 1958. In addition to its use as a training platform, the S3G Prototype served as a test facility for propulsion plant equipment. Removal of the spent nuclear fuel from the S3G Prototype reactor (defueling) and shipment of the spent nuclear fuel to the Expended Core Facility at the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory were completed in July 1994.

During defueling, all of the fuel assemblies, which fully contain uranium and fission products, were removed. More than 95 percent of the radioactive material inventory from the S3G Prototype reactor plant was removed during defueling. After defueling, the S3G Prototype reactor plant systems were placed in a safe and stable condition.

Figure 2-4 provides a sketch of the S3G Prototype reactor compartment in relation to the rest of the S3G Prototype prior to shutdown. The hull construction duplicates as completely as possible the comparable section in a seagoing submarine. The S3G Prototype reactor compartment is a horizontal cylinder, approximately 8.8 meters (29 feet) in diameter by 11.3 meters (37 feet) in length, formed by a section of the prototype's pressure hull. The prototype hull provided containment during reactor plant operations. Stiffened steel bulkheads separate the reactor compartment from the remainder of the prototype. The reactor compartment bulkheads are shielded to minimize radiation exposure to personnel.

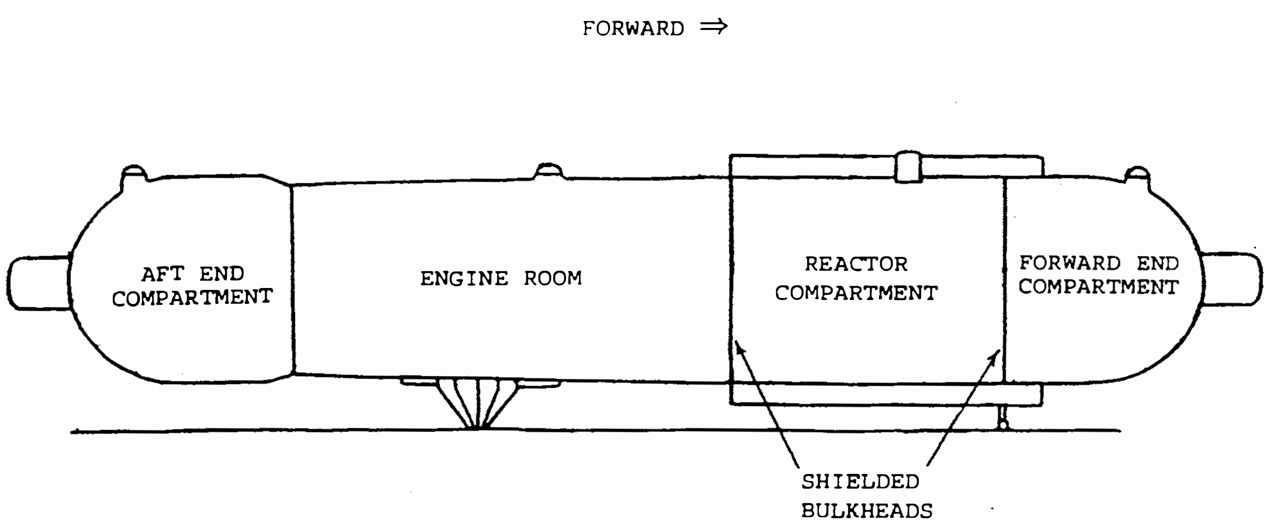

Figure 2-4: S3G Prototype

2.3 D1G Prototype - General Description

The D1G Prototype was placed in operation in 1962. In addition to its use as a training platform, the D1G Prototype served as a test facility for propulsion plant equipment. Removal of the spent nuclear fuel from the D1G Prototype reactor (defueling) and shipment of the spent nuclear fuel to the Expended Core Facility at the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory were completed in February 1997.

During defueling, all of the fuel assemblies, which fully contain uranium and fission products, were removed. More than 95 percent of the radioactive material inventory from the D1G Prototype reactor plant was removed during defueling. After defueling, the D1G Prototype reactor plant systems were placed in a safe and stable condition.

Figure 2-5 provides a sketch of the D1G Prototype reactor compartment in relation to the rest of the D1G Prototype prior to shutdown. The D1G Prototype reactor compartment is a vertical cylinder, approximately 8.2 meters (27 feet) in diameter by 9.1 meters (30 feet) in height, which holds the reactor plant. The reactor compartment stands within a partial section of a ship's hull, which duplicates as completely as possible the comparable section in a seagoing vessel. A stiffened steel bulkhead separates the reactor compartment from the remainder of the prototype. The reactor compartment bulkhead is shielded to minimize radiation exposure to personnel.

The D1G Prototype reactor compartment is located inside a steel sphere, approximately 69 meters (225 feet) in diameter, known as a Hortonsphere (see Figure 2-6). This structure, completed in 1953, provided containment during reactor plant operations and also housed support systems and miscellaneous facilities. The Hortonsphere shell is approximately 2.5 centimeters (1 inch) thick and is covered by foam insulation. The Hortonsphere lies partially below grade and is filled to grade with grout, sand, and crushed stone; the floor is concrete. Twenty-six column supports, connecting brace rods and struts support the structure externally. The Hortonsphere includes two airlocks for the passage of personnel and small equipment and an approximately 7-meter (22.5-foot) diameter sliding door for the passage of large equipment. Section 4.7 provides additional discussion on the Hortonsphere.

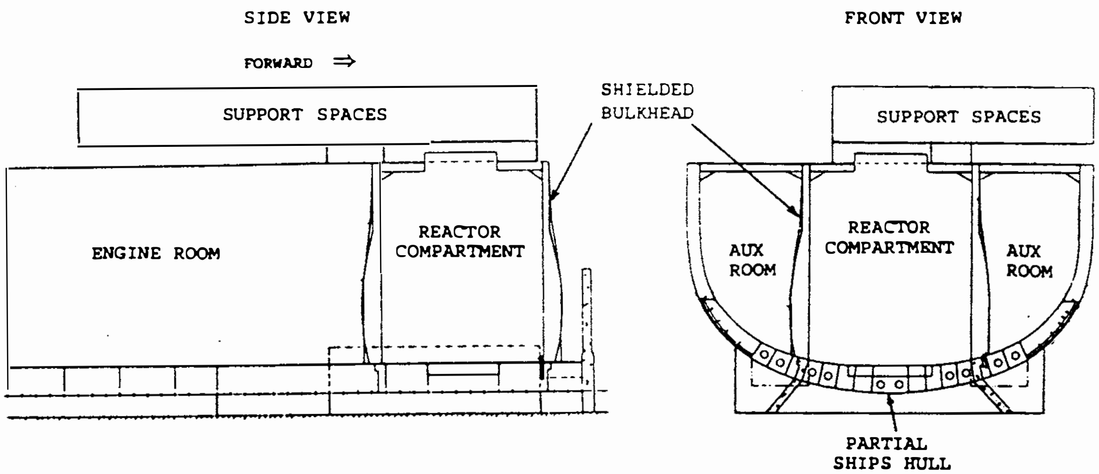

Figure 2-5: D1G Prototype

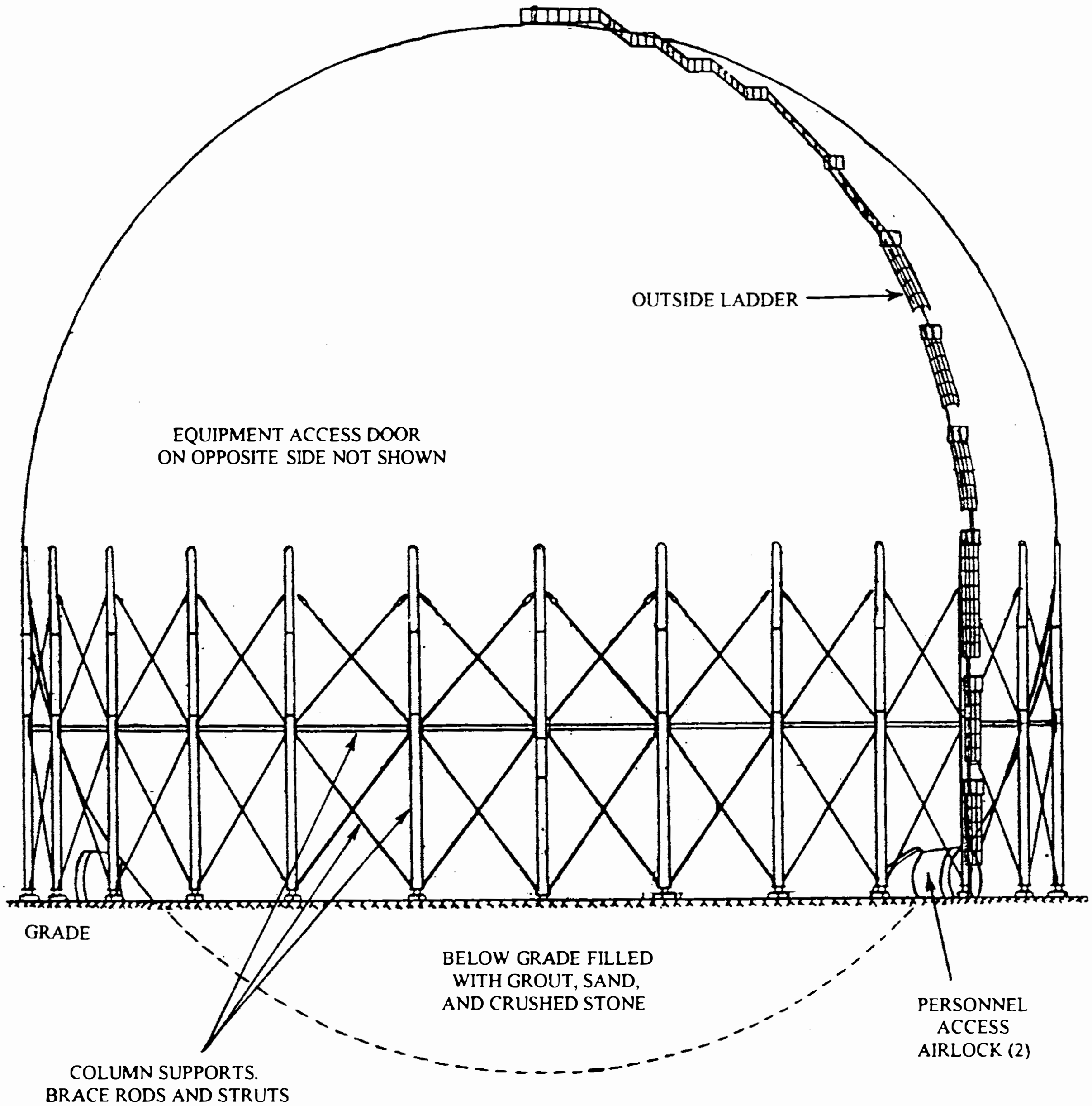

Figure 2-6: D1G Hortonsphere

2.4 Perspectives on the Naval Reactors Program

The following sections provide a general overview of the Naval Reactors Program. More detailed discussions are available in References 2-3, 2-4, and 2-5.

2.4.1 History and Mission of the Naval Reactors Program

In 1946, at the conclusion of World War II, Congress passed the Atomic Energy Act, which established the U.S. Atomic Energy Commission to succeed the wartime Manhattan Project, and gave it the sole responsibility for developing atomic energy. At that time, Captain (later Admiral) Hyman G. Rickover was assigned to the Navy Bureau of Ships, the organization responsible for Naval ship design. Captain Rickover recognized the military implications of successfully harnessing atomic power for submarine propulsion and that it would be necessary for the U.S. Navy to work with the U.S. Atomic Energy Commission to develop such a program. By 1949, Captain Rickover had forged an arrangement between the U.S. Atomic Energy Commission and the U.S. Navy that led to the formation of the Naval Reactors Program. In 1954, the first nuclear submarine, USS NAUTILUS, put to sea and demonstrated the basis for all subsequent Naval nuclear-powered warship propulsion designs. In the 1970s, government restructuring moved the U.S. Atomic Energy Commission part of the Naval Reactors Program from the U.S. Atomic Energy Commission (which was disestablished) to what ultimately became the U.S. Department of Energy. Although the Naval Reactors Program grew in size and scope over the years, it retained its dual responsibilities within the U.S. Department of Energy and the U.S. Department of the Navy, and its basic organization, responsibilities, and technical discipline have remained much as when it was first established.

Naval Reactors Program authority derives from the Atomic Energy Act of 1954 (as amended) and Presidential Executive Order 12344 issued February 1, 1982, and enacted as permanent law by Public Law 98-525 on October 19, 1984 (42 USC §7158). Pursuant to this authority, the Naval Reactors Program exclusively regulates the following areas at the Kesselring Site: reactor safety; radiological and nonradiological occupational safety and health; and waterborne emissions of Atomic Energy Act radioactivity. The Naval Reactors Program and the U.S. Environmental Protection Agency both have regulatory authority for airborne emissions of Atomic Energy Act radioactivity. The Naval Reactors Program and the New York State Department of Environmental Conservation both have regulatory authority for mixed waste (Atomic Energy Act radioactivity aspects are regulated by the Naval Reactors Program and chemically hazardous aspects are regulated by New York State). The Naval Reactors Program, the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation all have regulatory authority for radiological cleanup standards. Sections 2.5 through 2.8 provide more detail regarding Federal statutes and regulations, Executive Orders, and State statutes and regulations that are applicable at the Kesselring Site.

The Naval Reactors Program is comprised of military personnel and civilians who design, build, operate, maintain, and manage the Naval nuclear-powered warships and many facilities which support the Naval nuclear-powered fleet. Naval Reactors Program elements include:

- The nuclear propulsion plants aboard nuclear-powered U.S. Navy warships;
- Moored Training Ships used for training of Naval nuclear propulsion plant operators;
- Land-based prototype Naval reactors used for research and development work and training of Naval nuclear propulsion plant operators;
- Research and development laboratories;
- Contractors responsible for the design, procurement, and construction of propulsion plant equipment;
- Shipyards that construct, overhaul, and service the propulsion plants of nuclear-powered U.S. Navy warships;
- Naval support facilities and tenders;
- The Expended Core Facility, located at the Idaho National Engineering and Environmental Laboratory; and
- The Naval Reactors Program headquarters organization and field offices.

Naval Reactors Program headquarters provides oversight and direction for all elements of the Program. Based on decades of engineering experience in nuclear propulsion, the headquarters organization exercises exacting control over all aspects of the Naval Reactors Program, demanding technical excellence and discipline unique in nuclear programs.

2.4.2 Philosophy of the Naval Reactors Program

Since radioactive material is an inherent by-product of the nuclear fission process, its control has been a central concern for the Naval Reactors Program. Radiation levels and releases of radioactivity have historically been controlled well below the limits permitted by national and international standards. Design, construction, operation, maintenance, and personnel selection, training and qualifications have been oriented toward minimizing environmental effects and ensuring the health and safety of workers, ships' crew members, and the general public. Conservative reactor safety design has been, from the beginning, a hallmark of the Naval Reactors Program.

2.4.3 Environmental Protection

From its inception, the Naval Reactors Program recognized that the environmental aspects of nuclear-powered U.S. Navy warships and their operations would be key to their acceptance in ports both at home and abroad. The Naval Reactors Program maintains the same rigorous attitude toward the control of radioactivity and protection of the environment as it does toward reactor design, testing, operation, and servicing. As a result, the Naval Reactors Program has a well-documented record of environmental responsibility; this record supports nuclear-powered U.S. Navy warships being welcomed into over 150 ports in over 50 foreign countries and dependencies, as well as U.S. ports.

The policy of the Naval Reactors Program is to reduce radiation exposure to personnel to as low as reasonably achievable. In carrying out this policy, the Naval Reactors Program has consistently maintained more stringent personnel radiation exposure standards than those in the civilian nuclear power industry or in other government nuclear programs. As a consequence, radiation exposure to the public and to personnel in the Naval Reactors Program has always been very low, in fact much lower than limits established by the U.S. Nuclear Regulatory Commission, the U.S. Department of Energy, or the U.S. Environmental Protection Agency for other activities involved in radiological work. For further information on the Naval Reactors Program radiological controls practices and performance, refer to References 2-9 and 4-22.

Routine, small environmental releases, both airborne and waterborne, are authorized or allowed by regulations and are strictly controlled. As a result, the annual releases of long-lived gamma radioactivity from all Naval Reactors Program activities are comparable to the annual releases from a single typical U.S. commercial nuclear reactor operating in accordance with its U.S. Nuclear Regulatory Commission license. For further information on the Naval Reactors Program radiological monitoring practices and performance associated with environmental protection, refer to References 2-1, 2-10, and 4-4. Existing radiological conditions in the environment surrounding the Kesselring Site are discussed further in Sections 4.3, 4.4, and 4.5 of this document. The Naval Reactors Program's conservative design practices and stringent operating procedures have resulted in the demonstrated safety record of Naval nuclear propulsion plants. Through the entire history of the Naval Reactors Program, over 4,800 reactor years of operation and over 110 million miles steamed on nuclear power, there has never been a reactor accident, or any release of radioactivity that has had an adverse effect on the public or the environment. The Naval Reactors Program's standards and record surpass those of any other national or international nuclear program.

The Naval Reactors Program has an environmental monitoring program at each of its major installations and facilities, including nuclear-capable shipyards and the home ports of nuclear-powered U.S. Navy warships. This monitoring program consists of analyzing water, sediment, air, and aquatic samples for radioactivity to verify that Naval Reactors Program operations have not had a significant effect on the environment or the public. For further information on the Naval Reactors Program environmental monitoring practices and performance, refer to References 2-1, 2-10, and 4-4. Independent surveys conducted by the U.S. Environmental Protection Agency, state and local governments confirm that Naval nuclear-powered warships and facilities have had no significant radiological effects on the environment.

Naval Reactors Program facilities are responsible for nonradiological as well as radiological environmental matters. Regular inspection of the Naval Reactors Program's laboratory and prototype sites by the U.S. Environmental Protection Agency and state officials in accordance with the Clean Air Act, the Resource Conservation and Recovery Act, and the Clean Water Act, has shown no significant problems. None of these sites qualifies for inclusion on the U.S. Environmental Protection Agency's National Priorities List (NPL) for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act. The Naval Reactors Facility in Idaho is included under a Federal Facility Agreement and Consent Order as part of the Idaho National Engineering and Environmental Laboratory, but does not qualify for inclusion on the NPL by itself.

2.4.4 Past Experience

There is a wide range of experience in dismantling reactor plants throughout the nuclear industry. The Naval Reactors Program has removed the defueled reactor plants from more than 60 decommissioned nuclear-powered U.S. Navy warships at the Puget Sound Naval Shipyard in Bremerton, Washington and shipped the reactor plants for disposal at the U.S. Department of Energy Hanford Site. Several similar or larger sized reactor plants have been totally or partially dismantled by the U.S. Department of Energy or commercial utilities, including the Shippingport reactor plant in Pennsylvania, the Elk River demonstration reactor in Minnesota, the Pathfinder reactor plant in South Dakota, the Trojan reactor plant in Oregon, the Yankee Rowe reactor plant in Massachusetts, and the Fort St. Vrain reactor plant in Colorado. The technology and techniques used in these previous dismantlements are now proven. Waste from these dismantlement projects were disposed of at a variety of sites, including the U.S. Department of Energy Hanford Site, the commercial Barnwell Site in South Carolina, and the commercial Richland Site in Washington State.

Over the course of more than 40 years of Naval reactor plant operation and maintenance, including refuelings, the Naval Reactors Program has gained vast experience in the safe handling and shipment of radioactive material and large components. For example, the Naval Reactors Program has safely made more than 680 shipments of spent nuclear fuel. The Naval Reactors Program has safely made numerous other shipments of low-level radioactive materials. A total of approximately 1,000 shipments are made annually from nuclear-powered U.S. Navy warships and their support facilities, which is a small part of the more than 2 million shipments of radioactive materials made annually in the United States (Reference 2-10). All shipments have met applicable Federal, State, and local regulations.

2.5 Federal Environmental Statutes and Regulations

This section provides a general discussion of Federal environmental laws and regulations that are related to Kesselring Site activities. Additional detailed summaries of many of these laws, regulations and other requirements can be found in Volume 1, Chapter 7 of the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7).

2.5.1 National Environmental Policy Act of 1969, as amended (42 USC §4321 et seq.)

The National Environmental Policy Act establishes a national policy promoting awareness of the environmental consequences of human activities and promoting consideration of the environmental impacts during planning and decision making stages of a project. This Act requires all Federal agencies to prepare a detailed statement on the environmental effects of proposed major Federal actions that may significantly affect the quality of the human environment. This Environmental Impact Statement has been prepared in accordance with the Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR Parts 1500 through 1508) and U.S. Department of Energy National Environmental Policy Act Implementing Procedures (10 CFR Part 1021).

2.5.2 Atomic Energy Act of 1954, as amended (42 USC §2011 et seq.)

The Atomic Energy Act, as amended, authorizes the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency to issue regulations and establish standards for utilizing atomic energy for peaceful purposes consistent with public health and safety.

2.5.3 Clean Air Act, as amended (42 USC §7401 et seq.)

The Clean Air Act is intended to protect and enhance the quality of the Nation's air resources and to promote the public health and welfare and the productive capacity of its population. This Act requires each Federal agency to comply with all Federal, state, interstate, and local requirements with regard to the control and abatement of air pollution to the same extent as any nongovernmental entity. The Clean Air Act established the National Ambient Air Quality Standards program for criteria pollutants. Criteria pollutants include sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, ozone and lead. This Act also addresses specific pollutants called hazardous air pollutants (which include radionuclides), visibility impairment, and through issuance of New Source Performance Standards, establishes specific, more stringent criteria for various categories of emission sources, such as boilers, coating operations and other manufacturing processes. Some associated regulations include:

- 40 CFR Part 50 - National Primary and Secondary Ambient Air Quality Standards
- 40 CFR Part 60 - Standards of Performance for New Stationary Sources
- 40 CFR Part 61 - National Emission Standards for Hazardous Air Pollutants
- 40 CFR Part 70 - State Operating Permit Programs
- 40 CFR Part 81 - Designation of Areas for Air Quality Planning Purposes
- 40 CFR Part 82 - Protection of Stratospheric Ozone
- 40 CFR Part 93 - Determining Conformity of Federal Actions to State or Federal Implementation Plans

As described in Section 2.8, the New York State Department of Environmental Conservation has been delegated authority by the U.S. Environmental Protection Agency to implement and enforce many portions of the Clean Air Act through approval of a State Implementation Plan.

2.5.4 Clean Water Act, as amended (33 USC §1251 et seq.)

The Clean Water Act was enacted to restore and maintain the chemical, physical and biological integrity of the Nation's water. This Act requires each Federal agency to comply with Federal, state, interstate, and local requirements with regard to any activity that might result in the discharge or runoff of pollutants to surface waters in the same manner and to the same extent as any nongovernmental entity. The regulations implementing major provisions of this Act, including controlling, permitting, and monitoring water discharges, are found in 40 CFR Part 122 et seq., National Pollutant Discharge Elimination System. The National Pollutant Discharge Elimination System program is administered by the Water Management Division of the U.S. Environmental Protection Agency. As described in Section 2.8, the New York State Department of Environmental Conservation, Division of Water Resources, has been granted regulatory authority by the U.S. Environmental Protection Agency for the National Pollutant Discharge Elimination System program in New York State.

2.5.5 Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (42 USC §6901 et seq.)

The treatment, storage, or disposal of hazardous and nonhazardous waste is regulated under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, the Hazardous and Solid Waste Amendments of 1984, and the Federal Facility Compliance Act. Hazardous wastes are regulated by the provisions of Subtitle C of the Resource Conservation and Recovery Act. The U.S. Environmental Protection Agency regulations implementing Subtitle C of the Resource Conservation and Recovery Act are found in 40 CFR Parts 260 through 280. These regulations define hazardous wastes and allowable methods for the proper handling, treatment, storage, and disposal of hazardous waste. The regulations imposed on a generator or a treatment, storage and/or disposal facility vary according to the type and quantity of materials or wastes involved. As with the Clean Air Act and Clean Water Act, there is a dual State and Federal regulatory program in New York State. As discussed in Section 2.8, the U.S. Environmental Protection Agency has granted final authorization to the New York State Department of Environmental Conservation to operate its hazardous waste program, subject to the authority retained by the U.S. Environmental Protection Agency in accordance with the Hazardous and Solid Waste Amendments of 1984. Where Hazardous and Solid Waste Amendments of 1984 apply, the U.S. Environmental Protection Agency administers and enforces these provisions until New York State receives final authorization to do so. Nonhazardous wastes are regulated in accordance with Subtitle D of the Resource Conservation and Recovery Act. The U.S. Environmental Protection Agency regulations implementing provisions of Subtitle D are found in 40 CFR Parts 257 through 258.

2.5.6 Comprehensive Environmental Response, Compensation, and Liability Act (42 USC §9601 et seq.), as amended by the Superfund Amendments and Reauthorization Act

This Act provides a statutory framework for the clean up of waste sites containing hazardous substances and, as amended by the Superfund Amendments and Reauthorization Act, provides an emergency response program in the event of a release (or threat of a release) of a hazardous substance to the environment. Under this Act, the Hazard Ranking System is used to rank past hazardous waste disposal sites located on Federal and private lands for possible inclusion on the National Priorities List. This Act requires Federal facilities having such sites to undertake investigations and remediation as necessary. The Superfund Amendments and Reauthorization Act includes requirements for reporting yearly use and immediate reporting of accidental releases of certain hazardous substances in excess of specified amounts to State and Federal agencies. Associated regulations include 40 CFR Parts 300, 302, 350, 355, 370, 372 and 373.

2.5.7 Emergency Planning and Community Right-to-Know Act of 1986 (42 USC §11001 et seq.) (also known as Superfund Amendments and Reauthorization Act Title III)

Under Subtitle A of the Emergency Planning and Community Right-to-Know Act, Federal facilities must provide various information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to state emergency response commissions and local emergency planning committees to ensure emergency plans are in place to respond to unplanned releases of hazardous substances. The requirements for this Act were promulgated by the U.S. Environmental Protection Agency in 40 CFR Parts 350 through 372. Related Kesselring Site information has been provided to the New York State Emergency Management Office and to the Saratoga County Office of Emergency Services.

2.5.8 Toxic Substances Control Act (15 USC §2601 et seq.)

The Toxic Substances Control Act requires that the health and environmental effects of all new chemicals be reviewed before they are manufactured for commercial purposes. This Act authorizes the U.S. Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. Regulated activities under 40 CFR Part 761 include the manufacture, use, distribution in commerce, and disposal of chemical substances, including polychlorinated biphenyls, and abatement of asbestos and lead.

2.5.9 Federal Facility Compliance Act (42 USC §6921 et seq.)

The Federal Facility Compliance Act amended the Resource Conservation and Recovery Act and requires the U.S. Department of Energy to prepare plans for developing the required treatment capacity for mixed waste (see definition in the glossary) stored or generated at each facility. The New York State Department of Environmental Conservation, which has regulatory authority for mixed waste in New York State, approved a Site Treatment Plan for Mixed Wastes Generated at the Kesselring Site and issued an Administrative Consent Order that became effective on October 24, 1995 (Reference 2-2). The Administrative Consent Order authorizes implementation of the Site Treatment Plan.

2.5.10 Safe Drinking Water Act, as amended (42 USC §300f et seq.)

The Safe Drinking Water Act was enacted to protect potable water resources and ensure potable water quality. Among other things, this Act requires each Federal agency and department that owns or operates a public water system to comply with all Federal, state and local safe drinking water requirements. The U.S. Environmental Protection Agency has promulgated the Safe Drinking Water Act regulations in 40 CFR Parts 140 through 149. The New York State Department of Health has primary enforcement responsibility for the regulations implementing the potable water quality requirements and protection of potable water resources.

2.5.11 National Historic Preservation Act, as amended (16 USC §470 et seq.)

The National Historic Preservation Act, as amended, provides that properties with significant national historic value are placed on the National Register of Historic Places. There are no permits or certifications required under the Act. However, if a proposed Federally-funded activity could result in an impact on a listed property or a property potentially eligible for listing, then the Advisory Council on Historic Preservation has to be provided the opportunity to comment. The State Historic Preservation Officer may also be contacted to ensure that potentially significant sites are properly identified and appropriate mitigative actions are implemented. These consultations may result in the issuance of a Memorandum of Agreement which includes stipulations that must be followed to minimize adverse impacts.

2.5.12 Endangered Species Act, as amended (16 USC §1531 et seq.)

The Endangered Species Act, as amended, is intended to prevent the further decline of endangered and threatened species and to restore these species and habitats. This Act is jointly administered by the U.S. Departments of Commerce and the Interior. Section 7 of the Act requires consultation with the U.S. Fish and Wildlife Service to determine whether endangered species or their critical habitats are known to be in the vicinity of the proposed action, and whether an action will adversely affect listed species or designated critical habitats. The Fish and Wildlife Service list of endangered and threatened wildlife and plants can be found in 50 CFR Part 17.

2.5.13 Occupational Safety and Health Act of 1970, as amended (29 USC §651 et seq.)

The Occupational Safety and Health Act establishes standards to enhance safe and healthful working conditions in places of employment throughout the Nation. Implementing regulations are found in 29 CFR Parts 1910 and 1926. In general, under this Act, it is the duty of each employer to furnish all employees with a place of employment free of recognized hazards likely to cause death or serious physical harm. This Act excludes from coverage those activities which are regulated under separate statutory authority. Within the U.S. Department of Energy, the Naval Reactors Program is responsible for the regulation of occupational safety and health at Naval Reactors Program facilities under the authority of the Atomic Energy Act and Executive Order 12344 (enacted as permanent law in 42 USC §7158). Applicable U.S. Department of Energy Orders include 440.1, Worker Protection Management for DOE Federal and Contractor Employees.

2.5.14 Noise Control Act of 1972, as amended (42 USC §4901 et seq.)

Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out to the fullest extent within their authority programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.

2.5.15 Hazardous Materials Transportation Act, as amended (49 USC §5101 et seq.)

The Hazardous Materials Transportation Act provides for the regulation of hazardous materials in commerce during the transportation cycle. This Act establishes requirements for the packaging of hazardous materials and for communicating hazards through the use of labels, markings, vehicle placards, and manifests. This Act also establishes emergency response responsibilities for both the shipper and transporter of hazardous materials.

In general, the transportation of hazardous and/or radioactive materials, including wastes, is governed by the U.S. Department of Transportation under authority of the Hazardous Materials Transportation Act. Applicable regulations include 49 CFR Parts 171 through 178 and Parts 383 through 397. Specifically, radiation level limitations are included in 49 CFR Part 173; requirements for rail transport are included in 49 CFR Part 174; and truck routing requirements are included in 49 CFR Part 397.

Both the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission have also promulgated regulations which govern certain aspects of hazardous and/or radioactive material shipments. U.S. Environmental Protection Agency regulations, found in 40 CFR Parts 262 and 263, apply to transportation of hazardous waste defined by the Resource Conservation and Recovery Act. These regulations require the identification of hazardous wastes and use of a uniform hazardous waste manifest for shipment documentation. U.S. Nuclear Regulatory Commission regulations, found in 10 CFR Part 71, apply to the transportation of radioactive materials. These regulations define detailed packaging design requirements and package certification testing requirements. For certain categories of packages, complete documentation of design development, safety analysis and results of testing is submitted to the U.S. Nuclear Regulatory Commission to certify packages for use.

2.6 Executive Orders

This section provides a general discussion of Executive Orders that are related to Kesselring Site activities. Additional detailed summaries of many of these Executive Orders can be found in Volume 1, Chapter 7 of the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7).

2.6.1 Executive Order 12344 (Naval Nuclear Propulsion Program)

Executive Order 12344, enacted as permanent law by Public Law 98-525 (42 USC §7158) prescribes the authority and responsibility of the Naval Nuclear Propulsion Program (Naval Reactors Program), a joint U.S. Navy and U.S. Department of Energy organization, for matters pertaining to Naval nuclear propulsion. These responsibilities include all environmental and occupational safety and health aspects of the Program.

2.6.2 Executive Order 11514 (National Environmental Policy Act)

This Order directs Federal agencies to continually monitor and control their activities to protect and enhance the quality of the environment. This Order also directs Federal agencies to develop procedures to ensure full and timely provision of information to public officials and citizens. The U.S. Department of Energy implements its National Environmental Policy Act compliance through its own regulations (10 CFR Part 1021) and the Council on Environmental Quality regulations (40 CFR Parts 1500-1508). The regulations include provisions to actively seek and consider public and other agency comments in making decisions.

2.6.3 Executive Order 11593 (National Historic Preservation)

This Order directs all Federal agencies to locate, inventory, and nominate properties under their jurisdiction or control to the National Register of Historic Places, if those properties qualify. This process requires the U.S. Department of Energy to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed properties.

2.6.4 Executive Order 11990 (Protection of Wetlands)

This Order directs Federal agencies to avoid, to the extent practicable, any short and long-term impacts on wetlands wherever there is a viable alternative.

2.6.5 Executive Order 12088 (Federal Compliance with Pollution Control Standards), as amended by Executive Order 12580 (Superfund Implementation)

This Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and the Resource Conservation and Recovery Act.

2.6.6 Executive Order 12580 (Superfund Implementation)

This Order delegates to the heads of executive departments and agencies the responsibility for undertaking remedial actions for the releases, or threatened releases that are not on the National Priorities List and removal actions, other than emergencies, where the release is from any facility under the jurisdiction or control of the executive departments and agencies.

2.6.7 Executive Order 12856 (Right-to-Know Laws and Pollution Prevention Requirements) as amended by Executive Order 12873 (Federal Acquisition, Recycling, and Waste Prevention)

Executive Order 12856, issued on August 3, 1993, directs all Federal agencies, including the U.S. Department of Energy, to comply with the Emergency Planning and Community Right-to-Know Act of 1986 (Superfund Amendments and Reauthorization Act Title III) and the Pollution Prevention Act of 1990. These Orders direct all Federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and public notification in the event of an accident; and encourage clean technologies and testing of innovative prevention technologies. The U.S. Department of Energy's goal is to reduce its total releases of all toxic chemicals by 50 percent by December 31, 1999.

2.6.8 Executive Order 12898 (Environmental Justice)

This Order directs all Federal agencies to achieve environmental justice to the extent practicable by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. This Order directs each Federal agency to develop strategies to identify and address environmental justice concerns.

2.7 U.S. Department of Energy Regulations and Orders

U.S. Department of Energy regulations are generally found in Title 10 of the Code of Federal Regulations. U.S. Department of Energy Orders generally set forth policy and programs and internal procedures for implementing department policies. These regulations address such areas as administrative requirements and procedures, general environmental protection, radiation protection of the public and the environment, radioactive waste management, and occupational health and safety. U.S. Department of Energy Orders are implemented by the Naval Reactors Program under authority of Executive Order 12344.

2.8 New York State Environmental Statutes and Regulations

In addition to Federal laws, New York State legislation includes a series of Environmental Conservation Laws. State implementing regulations are found in various titles of the New York State Code of Rules and Regulations (NYCRR). This section provides a general discussion of New York State regulations that are applicable to Kesselring Site activities.

2.8.1 New York State Air Regulations

The New York State Department of Environmental Conservation, in Environmental Conservation Law Article 19, has been delegated authority to implement and enforce many portions of the Clean Air Act through approval of a State Implementation Plan which includes regulation of hazardous air pollutants such as asbestos and lead. New York State air pollution control standards and air emission permitting requirements are contained in NYCRR Title 6, Parts 200 through 250, and 256, 257 and 301. In addition to the Federal criteria pollutants such as carbon monoxide, sulfur dioxide, oxides of nitrogen, particulate matter, ozone, and lead, the Federal and State regulations cover other general categories of air pollutants. The general categories include classes of air contaminants defined as hazardous air pollutants such as chlorine and volatile organic compounds such as acetone.

2.8.2 New York State Freshwater Wetlands Regulations

New York State freshwater wetlands are regulated under the authority of the State's Freshwater Wetlands Act (Environmental Conservation Law Article 24). This Act directs the New York State Department of Environmental Conservation to "preserve, protect and conserve freshwater wetlands and the benefits derived therefrom, to prevent the despoliation and destruction of freshwater wetlands, and to regulate use and development of such wetlands to secure the natural benefits of freshwater wetlands, consistent with the general welfare, beneficial economic, social and agricultural development of the State." Implementing regulations for this Act are found in NYCRR Title 6, Parts 647, and 662 through 665. The New York State Department of Environmental Conservation maintains a data base of freshwater wetlands locations that meet State criteria.

2.8.3 New York State Water Regulations

The New York State Department of Environmental Conservation, Division of Water Resources, has been granted regulatory authority for the National Pollutant Discharge Elimination System program in New York State (Environmental Conservation Law

Article 17). Discharges to waters of the State are regulated by the New York State Department of Environmental Conservation through issuance of State Pollutant Discharge Elimination System permits. New York State water pollution control standards and permitting requirements for liquid discharges to the waters of the State are contained in NYCRR Title 6, Parts 700 through 705 and 750 through 758. Liquid discharges include industrial waste waters, sanitary system effluents, and storm water runoff. Waters of the State include all surface waters and ground waters.

2.8.4 New York State Hazardous Waste Regulations

New York State hazardous waste regulations are found in NYCRR Title 6, Parts 361, 362, 364, and 370 through 376. In general, these regulations have adopted Federal regulations pursuant to Subtitle C of the Resource Conservation and Recovery Act, with some specific differences. Many of these differences are administrative in nature. However, one important difference concerns New York State regulation of polychlorinated biphenyl-containing waste as a hazardous waste. These regulations implement Environmental Conservation Law Article 27 (Titles 7 and 9) and Article 70.

2.8.5 New York State Hazardous Waste Reduction Plans

New York State Hazardous Waste Reduction Plans are contained in Environmental Conservation Law Article 27, Title 9, Section 27-0908. This Law was modified to help the State achieve an overall reduction in the generation and release of hazardous waste. The State Hazardous Waste Reduction Plan requires hazardous waste generators to certify that they have a program in place at each facility to reduce the volume and toxicity of their hazardous waste. Hazardous waste generators are required to submit their hazardous waste reduction plans to the New York State Department of Environmental Conservation biennially with an update in alternate years. No implementing regulations have been published; however, the New York State Department of Environmental Conservation has published a technical guidance document which provides instructions for required plans and submittals (Reference 2-8). The Kesselring Site Waste Reduction Plan includes a description of the waste processes at the facility, disposal costs, and evaluation of waste reduction methods.

2.8.6 New York State Solid Waste Regulations

New York State governs solid waste under separate statutes from hazardous waste. Environmental Conservation Law Article 27, Title 7, governs the management and disposal of solid waste in New York State. Implementing regulations for this statute are found in NYCRR Title 6, Parts 360 through 369. These regulations cover matters pertaining to siting, construction and closure of landfills; handling and disposal of waste oil; recycling and medical waste. New York State waste transporter permit requirements are contained in NYCRR Title 6, Part 364.

2.8.7 New York State Petroleum Bulk Storage Regulations

New York State regulations (based on Environmental Conservation Law Article 17, Title 10) governing the bulk storage of petroleum products are found in NYCRR Title 6, Parts 612 through 614, and are designed to prevent spills and leaks of petroleum products to the environment. This is accomplished by requiring registration and permitting of affected above ground and underground petroleum storage facilities with a combined storage capacity of more than 1,100 gallons. The regulations define proper handling and storage of petroleum products, periodic tank testing, inspections and record keeping requirements to document compliance. In addition, the regulations establish design standards which address tank performance, integrity, secondary containment, and monitoring system specifications for new and existing tanks and piping systems.

2.8.8 New York State Chemical Bulk Storage Regulations

New York State regulations (based on Environmental Conservation Law Article 40) for bulk storage of chemical products are found in NYCRR Title 6, Parts 595 through 599, and are designed to prevent spills and leaks of hazardous chemical products to the environment. The regulations apply to facilities that store hazardous chemical products in tanks which meet specified criteria. Regulated hazardous chemical bulk storage tanks include aboveground tanks with a capacity of 185 gallons or more; underground tanks of any capacity; and nonstationary tanks used to store greater than 1,000 kilograms (2,200 pounds) of product for a period of 90 or more consecutive days. Each tank that meets these criteria must be registered with the New York State Department of Environmental Conservation. The regulations cover all aspects of chemical bulk storage facilities including design, installation, operation, periodic testing, maintenance and repairs. The regulations identify applicable hazardous chemical substances, establish reportable quantities in the event of a spill, and provide requirements for spill cleanup.

2.8.9 New York State Drinking Water Standards

New York State drinking water standards are contained in the New York State Sanitary Code (Public Health Law Article 2, Title II, Section 225). Implementing regulations for drinking water suppliers are found in NYCRR Title 10, Chapter 1, Part 5, which are designed to protect potable water sources. These standards, which are administered by the New York State Department of Health, require each organization that owns and operates a public water system to comply with all Federal, State, and local drinking water requirements. These requirements include the treatment, sampling, and protection of the potable water sources.

2.8.10 New York State Environmental Quality Review Regulations

New York State Environmental Quality Review regulations (based on Environmental Conservation Law Article 8) are found in NYCRR Title 6, Part 617. The purpose of the State Environmental Quality Review is to incorporate consideration of environmental factors into the existing planning, review, and decision making processes of State, regional and local government agencies at the earliest possible time. Based on NYCRR Title 6, Part 617, Section 617.15, State Environmental Quality Review regulations do not apply to the Kesselring Site since the proposed actions covered by this Environmental Impact Statement are solely Federal activities (although they do apply to the approval of State permits connected to actions considered in this Environmental Impact Statement). Nevertheless, State Environmental Quality Review regulations were considered during preparation of this Environmental Impact Statement to assist reviews by New York State regulatory personnel. For example, the checklist contained in NYCRR Title 6, Part 617.20, Appendix A, was reviewed to ensure completeness of information contained in this Environmental Impact Statement.

2.8.11 New York State Low-Level Radioactive Waste Transportation Regulations

New York State regulations (based on Environmental Conservation Law Article 27, Title 3) governing the transportation of low-level radioactive waste are found in NYCRR Title 6, Part 381. These regulations establish transporter permit standards for low-level radioactive waste generators relating to the use of a waste manifest system and other record keeping requirements. The Kesselring Site, which is operated under DOE contract, is exempt from these regulations (§381.2(b)) with the exception of Section 381.16 which stipulates reporting requirements and emergency actions to be followed in the event of a transportation-related accident.

CHAPTER 3

ALTERNATIVES AND COMPARISONS

3.0 Alternatives

The following sections describe in detail three alternatives for disposal of the defueled S3G and D1G Prototype reactor plants: no action, prompt dismantlement, and deferred dismantlement. Several other alternatives are also considered in limited detail.

The MARF and S8G Prototype reactor plants continue to operate at the Kesselring Site to fulfill the mission of training U.S. Navy personnel and testing Naval nuclear propulsion plant equipment. Since there are no plans to permanently shut down the remaining operating prototypes in the foreseeable future, an evaluation of their disposal in connection with any of the S3G and D1G Prototype reactor plant disposal alternatives is not required at this time. None of the alternatives evaluated in detail for S3G and D1G Prototype reactor plant disposal would change the long-term use of the Kesselring Site or Federal reservation; therefore, it is not expected that any of these lands will be returned to the commercial or public domain in the foreseeable future. If, subsequent to issuance of this Environmental Impact Statement and a Record of Decision, a decision is made to permanently shut down the MARF and S8G Prototype reactor plants, the Naval Reactors Program would issue a separate Environmental Impact Statement and Record of Decision.

3.1 No Action Alternative

The no action alternative would include maintaining and monitoring the defueled S3G and D1G Prototype reactor plants in place and in a stable condition for a caretaking period of indefinite duration. This alternative involves no prototype reactor plant dismantlement activities and, hence, no waste shipments from dismantlement. This alternative does not provide for permanent disposal of the S3G and D1G Prototype reactor plants; disposal of these prototype reactor plants would be required at some time in the future.

3.1.1 Caretaking Period Activities

During the first 10 years of the caretaking period, a limited work force would place the defueled S3G and D1G Prototype reactor plants in a condition suitable for long-term caretaking. During the entire caretaking period, the defueled reactor plants would be periodically monitored. The purpose of this monitoring would be to verify overall physical integrity of the reactor plants and to verify that all radioactivity remains contained. The cost of these activities is summarized in Section 3.5.4, and compared to the estimated costs of the other alternatives.

Periodic monitoring would involve radiological surveys, air samples, and radiation monitoring, inside and outside of the reactor compartments. These surveys would identify any changes in radiological conditions. The only expected change would be the decay of residual radioactivity.

During the caretaking period, the reactor compartments would be periodically ventilated. The ventilation systems have high efficiency particulate air filters installed and have a 99.95 percent efficiency for removal of potential airborne particulate radioactivity. When operated, the reactor compartment ventilation exhaust would be sampled to verify that the applicable National Emission Standards for Emission of Radionuclides Other than Radon from Department of Energy Facilities (Reference 3-2), established by the U.S. Environmental Protection Agency, are met.

Visual inspections would be performed periodically to verify that physical conditions of the reactor plants remain stable. These visual inspections would be performed inside and outside of both reactor compartments. Potential deficiencies would be identified and corrective actions would be performed as needed.

3.2 Prompt Dismantlement Alternative

This alternative would dismantle the S3G and D1G Prototype reactor plants and would recycle or dispose of waste materials. Dismantlement of the defueled S3G and D1G Prototype reactor plants would begin shortly after the Record of Decision for this Environmental Impact Statement is issued. The project would be completed as soon as practicable, subject to available appropriated funding. The cost of these activities is summarized in Section 3.5.4 and compared to the estimated costs of the other alternatives.

3.2.1 Dismantlement Activities

Dismantlement activities would involve mechanical disassembly of all S3G and D1G Prototype reactor plant systems and the reactor compartment structures. Dismantlement activities are estimated to take approximately 2 years for S3G and approximately 3 years for D1G. Preliminary sequencing plans indicate that some overlap in S3G and D1G Prototype dismantlement operation schedules would be possible. As a result, dismantlement activities would occur over an estimated 3 to 4-year period.

The S3G and D1G Prototypes each have a dedicated, permanently installed crane that would be used to support lifting and handling operations during reactor plant disassembly. The S3G Prototype reactor compartment and reactor plant components are within the reach of a derrick crane. The derrick crane is located above a support building adjacent to the S3G Prototype hull. The D1G Prototype reactor compartment is located beneath a bridge crane in the Hortonsphere. Other lifting and handling equipment such as mobile cranes, fork lifts, jacking and blocking gear would also be used.

Large components would be cut free of interferences and packaged individually for shipment off-site. Large reactor plant components include the reactor pressure vessels, steam generators, pressurizers, and the S3G primary shield tank. Prior to the removal of each large component, interferences such as electrical cables, reactor system piping, pumps, deckplates, and hull sections would be removed. These smaller components would be disposed of periodically as warranted by the accumulated volume. Disassembly techniques would include proven methods such as machine cutting of piping, grinding, sawing, flame cutting, and plasma arc cutting. Cutting techniques would vary depending on the application, location and radiological status of the affected component.

Operations on radiologically contaminated piping and components would use appropriate measures to prevent the spread of radioactivity and to protect human health and the environment. The protective measures would adhere to the same stringent standards and practices that are used throughout Naval Reactors Program operations to successfully control maintenance evolutions on operating reactor plants (see Appendix A, Section A.3 for further detail).

In order to minimize the volume of waste generated from prototype dismantlement, emphasis would be placed on recycling as much material as practicable, consistent with current standards and practices. Most of the recyclable materials from dismantlement activities would be metals, such as carbon steel, corrosion resisting metals, and lead. These materials would be recycled through various commercial vendors. Types of wastes (waste streams) and estimated waste volumes are discussed in further detail in Chapter 5.

3.2.2 Packaging and Transport of Recyclable Material and Waste

All recyclable material and waste shipments would comply with applicable Federal and State regulations and disposal site waste acceptance criteria. All shipments would be properly categorized, described, packaged, marked and labeled. Dismantlement of the S3G and D1G Prototype reactor plants would require approximately 60 shipments of low-level radioactive recyclable material and waste, and approximately 50 shipments of nonradioactive recyclable material and waste. These waste materials would not be transferred to other Knolls Atomic Power Laboratory sites.

The largest waste shipments by weight, and radioactivity content would be the two reactor pressure vessels. Each reactor pressure vessel package, which includes the reactor pressure vessel and non-fuel internal structural components within a shipping container, would measure approximately 5.69 meters (224 inches) long by 3.23 meters (127 inches) in diameter and would weigh approximately 177 metric tons (195 tons). These packages would be moved individually by a heavy hauler over public roads to the Delaware and Hudson railroad terminus, located in Ballston Spa, approximately 13 kilometers (8 miles) southeast of the Kesselring Site. Because of their oversize dimensions and weight, transport of the two reactor pressure vessel packages from the Kesselring Site to the railroad terminus would require New York State approved permits. Due to the short distance involved, the reactor pressure vessel packages would likely be transported over the same route between the Kesselring Site and the railroad terminus that has been used for past shipments of similar size and weight. Due to their radioactivity content, the two reactor pressure vessel shipments would be considered highway route controlled and would require the use of a New York State preferred route; the route used in this case would coincide with the route used to meet oversize requirements. The reactor pressure vessel packages would then be transported individually by railroad to the U.S. Department of Energy Savannah River Site in South Carolina for disposal.

Although Naval Reactors Program low-level radioactive waste generated at sites in the eastern United States is usually disposed of at the Savannah River Site, the U.S. Department of Energy Hanford Site in Washington State is also available for disposal of low-level radioactive waste generated by Naval Reactors Program activities. Transportation analyses contained in Appendix C take into consideration both of these disposal sites as possible destinations for low-level radioactive wastes.

3.2.3 Final Kesselring Site Conditions After Dismantlement Activities

The Kesselring Site and the remaining prototypes, MARF and S8G, would continue to operate after completion of the S3G and D1G Prototype reactor plant dismantlements. There are no plans to shut down the operating prototypes or to release the Kesselring Site or Federal reservation lands for other uses in the foreseeable future. No buildings at the Kesselring Site are expected to be affected by S3G and D1G Prototype reactor plant dismantlement activities. The D1G Hortonsphere, which houses the D1G Prototype, would remain intact for possible future Naval Reactors Program use, although no future use is planned at this time.

Since the preferred alternative would not result in release of any lands for other uses, establishing radiological standards for unrestricted release of the Kesselring Site would not be appropriate at this time. For information and perspective, other Naval Reactors Program sites have recently been closed or are in the process of closure, including the former Mare Island and Charleston Naval Shipyards (both closed April 1, 1996) and the ongoing S1C Prototype dismantlement and site release project at Windsor, Connecticut. For these sites, the Naval Reactors Program has used radioactivity concentration limits for unrestricted site release which are substantially below the most restrictive site release criteria currently under consideration by other Federal agencies (that is, the maximum possible exposure to any future site resident is well below the March 16, 1995 draft U.S. Environmental Protection Agency release criteria of 15 millirem per year above background, with no more than 4 millirem per year from man-made beta/gamma radioactivity in ground water, and other guidance currently under consideration). Any future initiative to release the Kesselring Site for unrestricted use would also adhere to New York State guidelines applicable at that time. Currently, the New York State Department of Environmental Conservation Technical & Administrative Guidance Manual (TAGM) 4003 describes "the policy and procedure to be followed by Division of Hazardous Substances Regulation, Bureau of Radiation staff in evaluating cleanup plans for soils contaminated with radioactive materials" (Reference 4-25). However, these provisions are considered unnecessary at this time since S3G and D1G Prototype dismantlement alternatives do not involve Kesselring Site release activities.

3.3 Deferred Dismantlement Alternative

This alternative would dismantle the S3G and D1G Prototype reactor plants after a 30-year caretaking period. Deferred dismantlement would allow the radioactivity in reactor plant materials to decay to a lower amount. Deferred dismantlement activities would include recycling or disposal of waste materials. The cost of these activities is summarized in Section 3.5.4 and compared to the estimated costs of the other alternatives.

Similar analyses sponsored by the U.S. Nuclear Regulatory Commission have considered deferment periods of 50 or 60 years for commercial nuclear power plant dismantlements (Reference 3-1). However, based on differences between commercial and Naval nuclear fuels, described in Appendix A, which affect the type and amount of radioactivity in the plant, the Naval Reactors Program considers 30 years to be appropriate, for analytical purposes, for the S3G and D1G Prototype reactor plant caretaking period. Nearly all of the gamma radiation within the defueled S3G and D1G Prototype reactor plants comes from cobalt-60, which has a 5.27-year half-life. Deferring dismantlement for 30 years would allow cobalt-60 to decay to less than 2 percent of the radioactivity levels present in each prototype reactor plant in 1997.

Appendix A, Tables A-2 and A-3, provide detailed listings of the radionuclide inventories that are expected in the defueled S3G and D1G Prototype reactor plants, respectively, at various times after shutdown. Defueled commercial nuclear power plants contain a substantial amount of residual fission products, such as cesium-137 and strontium-90 which have approximately 30-year half-lives. Even after a longer deferment period of 60 years, commercial power plants would still contain approximately 25 percent of the cesium-137 and strontium-90 levels present at reactor shutdown. On the other hand, fission products present after the defueling of a Naval reactor plant are at very low levels and come only from fission events with trace amounts of uranium-238 in the fuel cladding. This is due to the high integrity of Naval nuclear fuel assemblies, which prevents release of fission products from the fuel.

Thus, because cobalt-60 decays relatively quickly, deferment beyond 30 years for the S3G and D1G Prototype reactor plants would provide little additional benefit in reducing the amount of remaining radioactivity. If the cobalt-60 were allowed to decay to much lower levels, the amount of materials handled as low-level radioactive waste would not be expected to change, due to the presence of other longer-lived radionuclides. Deferment for less than 30 years would be a variation between the prompt and deferred dismantlement alternatives, which bound the range of environmental impacts. If a deferment period of less than 30 years were to be selected, the radiological impacts can be roughly approximated by applying the radioactive half-life of cobalt-60 (5.27 years) to the prompt dismantlement alternative. For example, after a deferment of 5.27 years, the occupational radiation exposure associated with dismantlement would be approximately half of that expected for prompt dismantlement.

3.3.1 Caretaking Period Activities

Caretaking period activities for the deferred dismantlement alternative would be identical to caretaking period activities described for the no action alternative in Section 3.1.1. The only difference would be a defined end date for this alternative.

3.3.2 Deferred Dismantlement Activities

Following completion of the 30-year caretaking period, reactor plant dismantlement would commence. For the purposes of comparison, deferred dismantlement activities are assumed to be identical to dismantlement activities described for the prompt dismantlement alternative in Section 3.2.1. In order to compare the deferred and prompt dismantlement alternatives based on known and equal facts, no credit is taken in the deferred dismantlement evaluations for possible advances in technology 30 years in the future.

3.4 Other Alternatives

Other alternatives were also considered for this Environmental Impact Statement, but were eliminated from detailed evaluation. The following sections describe these alternatives and provide the reasons for eliminating them from further evaluation.

3.4.1 One-Piece Reactor Plant Off-Site Disposal Alternative

This alternative is based on the reactor compartment disposal program currently in use for dismantling decommissioned nuclear-powered U.S. Navy warships. Defueled reactor plant systems and lead shielding are left intact and each reactor compartment is sealed as a single package. Defueled reactor compartments are packaged at the Puget Sound Naval Shipyard and are then sent by barge and special ground transport to the U.S. Department of Energy Low-Level Waste Burial Grounds, Hanford Site, Washington State for disposal. A single package containing the S3G Prototype reactor compartment would measure approximately 12 meters (40 feet) in length, 8.8 meters (29 feet) in diameter and would weigh approximately 910 metric tons (1,000 tons). A single package containing the D1G Prototype reactor compartment would measure approximately 11 meters (37 feet) in height, 9.4 meters (31 feet) in diameter and weigh approximately 1,300 metric tons (1,400 tons).

Overland transport of whole reactor compartments by either truck or rail from the Kesselring Site to a U.S. Department of Energy disposal site is physically impractical due to load-limiting bridges and interferences, such as underpasses, along available routes. One-piece reactor plant disposal would be an attractive option if the Kesselring Site were readily accessible to public waterways to permit barge shipment. The nearest navigable waterways are the Mohawk River (Erie Canal) and the Hudson River (Champlain Canal), which are by road approximately 30 and 50 kilometers (20 and 30 miles) away, respectively. In order to transport the packaged reactor compartments by truck to either river, extensive roadway modifications would be required, which would affect public and private lands. For example, many intersections would have to be widened to allow turning of a heavy haul transport vehicle; drains, culverts, and bridges would have to be strengthened to handle the large weights involved; and interferences, such as trees, would require removal. Other interferences, such as overhead wires, would require temporary interruptions of services for short-term removal. In addition to roadway modifications, a major construction effort, including dredging, would be necessary to provide a suitable barge loading facility at either river. Therefore, transportation by truck to navigable water is considered to be impractical. Transport of the S3G and D1G Prototype reactor compartments in one-piece units by rail to navigable water is also considered to be impractical due to load-limiting bridges and underpass interferences along available routes. Based on these considerations, one-piece reactor plant disposal was eliminated from further detailed evaluation.

3.4.2 Entombment Alternative

The entombment alternative would involve leaving the S3G and D1G Prototype reactor plants permanently at the Kesselring Site within one or two strong, durable structures. There are many possible designs for suitable entombment structures, ranging from simply relying on the hull structures of the prototype reactor compartments that currently contain the respective reactor plants, to additional massively reinforced concrete enclosures. The entombment structures could be located either above grade or below grade. Entombment structures would be designed to last at least several hundred years to ensure radionuclides in the reactor plant could not reach the environment. The entombment structure would be appropriately maintained and continued surveillance monitoring would be carried out until the residual radioactivity decayed to levels which would not endanger public health or the environment.

The entombment alternative for decommissioning commercial nuclear power plants is intended for use where the residual radioactivity will decay to levels permitting unrestricted release of the facility within a reasonable time period, which would be on the order of 100 years (Reference 3-3). Detailed evaluation of an entombment alternative would have to take into consideration factors such as access restrictions and the design life of the entombing structure for containing the radioactivity. Typically, commercial fuel reprocessing plants, nuclear reactors, fuel storage facilities, and mixed oxide facilities contain radionuclides with half-lives in excess of 100 years. Since the residual radioactivity in these commercial facilities would not decay to levels below the criteria for unrestricted release within the anticipated lifetime of any man-made structure, entombment is typically eliminated as a viable alternative.

As discussed in Appendix A, the S3G and D1G Prototype reactor plants contain small but detectable amounts of radionuclides having long half-lives. Radionuclides such as carbon-14, niobium-94, and nickel-59 have half-lives of 5,730 years, 20,000 years, and 76,000 years, respectively. Similar to commercial facilities, the residual radioactivity in the S3G and D1G Prototype reactor plants would not decay to levels below the criteria for unrestricted release within the anticipated lifetime of a reasonably designed entombment structure. Maintaining engineering and institutional controls to restrict access for thousands of years would be difficult to ensure and costly.

In addition to radioactivity, the S3G and D1G Prototype reactor compartments contain significant quantities of lead shielding; lead is a hazardous material. The entombment alternative would require Federal and State regulatory approval to use the Kesselring Site for the long-term storage of hazardous materials.

The entombment alternative would offer no notable advantage in terms of health risk or other environmental benefit. From an occupational radiation exposure perspective, the environmental impacts of an entombment alternative would likely fall in the range between the no action alternative estimate and prompt dismantlement alternative estimate, described in Chapter 5 and Appendix B. Since the radiation levels from existing Kesselring Site operations are already indistinguishable from background radiation levels in areas accessible to the public, an entombment structure would not affect public radiation exposure. From an environmental perspective, the entombment alternative would serve to increase the number of long-term storage sites for radioactive and hazardous materials in the United States.

Since there would be no notable health or environmental benefit from the construction of one or more permanent entombment structures to contain the S3G and D1G Prototype reactor plants, and given that this alternative would essentially prevent future unrestricted release of the Kesselring Site for other uses, the entombment alternative was eliminated from further detailed evaluation.

3.4.3 On-Site Disposal Alternative

The on-site disposal alternative would involve placing the S3G and D1G Prototype reactor plants, within the sealed reactor compartments, into an engineered land disposal unit. This disposal unit would be designed with impervious materials and liners beneath and over the reactor compartments and covered with earth. The on-site disposal alternative would require the approval of Federal and State regulatory agencies to use the Kesselring Site for the permanent disposal of hazardous materials. From an environmental perspective, the on-site disposal alternative would serve to increase the number of permanent disposal sites for radioactive and hazardous materials in the United States.

Similar to the entombment alternative, the on-site disposal alternative would offer no notable health risk advantage or other environmental benefits. Assuming the prototype reactor compartments would be disposed of on-site as one-piece units, the conclusions relative to occupational exposure, public exposure, access restrictions, and future unrestricted release of the Kesselring Site are the same for the on-site disposal alternative as for the entombment alternative. Therefore, on-site disposal of the S3G and D1G Prototype reactor plants was eliminated from further evaluation.

3.5 Comparison of Alternatives

This section provides a comparison of the alternatives in terms of a wide variety of potential environmental consequences, all of which would be small. The impacts from all three alternatives are compared with regard to incident-free facility activities and hypothetical facility accidents. The impacts from incident-free transportation activities and potential transportation accidents are evaluated only for the prompt dismantlement and deferred dismantlement alternatives since the no action alternative would not require any shipments of wastes or materials. Environmental consequences of each alternative are discussed in detail in Chapter 5. Analyses of impacts related to facility activities are provided in Appendix B; analyses of transportation related impacts are provided in Appendix C.

Estimated impacts are expressed in terms of the risk of a single additional latent fatal cancer in the entire population that might occur due to activities associated with each of the three alternatives. Analyses show that all impacts would be small for each alternative.

Expressing numbers in terms of powers of ten is known as scientific notation (see Glossary). For example, 0.000026 can be expressed in scientific notation as 2.6×10^{-5}. To assist readers who are unfamiliar with scientific notation, data is presented in decimal form where practicable.

3.5.1 Incident-Free Facility Activity Consequences

Activities conducted at Naval Reactors Program facilities are pre-planned in detail to reduce incidents that might interfere with normal operations. The radiological consequences of incident-free facility activities at the S3G and D1G Prototype reactor plants are summarized in Table 3-1.

Table 3-1: Incident-Free Facility Activities - Radiological Risks [a]

		No Action (first 30 years)	Prompt Dismantlement	Deferred Dismantlement
Exposure (person-rem)	Worker	22	205	26
	General Population	9.9×10^{-6}	8.6×10^{-6}	1.3×10^{-5}
Average Annual Per Person Risk [b]	Worker	4.2×10^{-5}	5.8×10^{-4}	4.0×10^{-5}
	General Population	1.4×10^{-16}	1.6×10^{-15}	1.9×10^{-16}

a. All values from Appendix B, Table B-7.
b. Risk of developing a latent fatal cancer.

The radiation exposure to the general public would be small for all three alternatives and does not provide a distinguishing comparison between the alternatives. The exposures to the general public would be so small that they would be indistinguishable from naturally occurring background radiation. Analyses indicate that prompt dismantlement alternative incident-free facility activities would annually result in about a 1.6×10^{-15} risk of a latent fatal cancer to an average member of the general population. This very small risk equates to less than 1 chance in 1 trillion. For perspective, the risk of cancer for an individual from all causes is 1 chance in 5 over a lifetime. Analyses also considered the risks to a hypothetical maximally exposed off-site individual and the cumulative risk to the population. Even though analysis results indicate a hypothetical maximally exposed off-site individual would have a health risk about 100 times greater than the average member of the public (1.5×10^{-13} for the prompt dismantlement alternative, as shown in Appendix B, Table B-7), the annual risk would still be very small. Analyses indicate that the risk would be so small such that incident-free facility activities, under any of the alternatives, would be unlikely to cause even a single latent fatal cancer in the entire population.

One distinguishing comparison between the alternatives can be seen with regard to occupational (worker) exposure to radiation. As shown in Table 3-1, the worker exposure for deferred dismantlement would be less than 15 percent of the worker exposure for prompt dismantlement. This difference is primarily due to the radioactive decay of cobalt-60 in the reactor plants during the 30-year caretaking period associated with the deferred dismantlement alternative.

As shown in Appendix B, Table B-7, the occupational exposure associated with the prompt dismantlement alternative would fall within a range of approximately 205 to 460 person-rem. The higher value of this range is based on preliminary plans which include worst case assumptions regarding dismantlement operations. Based on many years of experience in planning and executing other refueling and maintenance operations, detailed work planning efforts typically result in actual occupational exposures which are well below preliminary estimates. Therefore, it is reasonable to expect that the actual occupational exposure would be close to the lower end of the range. On an annual basis, this expected exposure would be comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval prototype reactor plants. The Naval Reactors Program limits individual worker exposures to 2 rem per year even though Federal limits allow exposure up to 5 rem per year. As a result, the highest annual risk to any worker from occupational radiation exposure would be a 8.0×10^{-4} chance of developing a latent cancer (less than 1 chance in 1,200). As shown in Table 3-1, the expected average annual risk to each worker would be even lower (5.8×10^{-4}, or less than 1 chance in 1,700). Appendix A, Section A.4, provides additional perspective on calculations of cancer fatalities and risk.

3.5.2 Hypothetical Facility Accident Consequences

The radiological consequences to the general population from hypothetical facility accidents are provided in Table 3-2. As discussed in more detail in Chapter 5 and Appendix B, several accident scenarios were evaluated for each alternative. Table 3-2 only identifies the accident scenario with the maximum risk to a member of the general population for each alternative.

Table 3-2: Maximum Radiological Risks to the General Population from Hypothetical Facility Accidents [a]

	No Action (first 30 years)	Prompt Dismantlement	Deferred Dismantlement
Accident Scenario	High Efficiency Particulate Air Filter Fire	Component Drop	Component Drop
Risk Per Year to the General Population	4.8×10^{-11} [b]	6.0×10^{-8} [c]	1.6×10^{-9} [c]
Average Annual Per Person Risk	4.2×10^{-17} [b]	5.2×10^{-14} [c]	1.4×10^{-15} [c]

a. Risk of a single additional latent fatal cancer.
b. Highest single event value from Appendix B, Tables B-20 and B-22.
c. Highest single event values from Appendix B, Tables B-10 and B-12.

For the no action alternative, the accident with the greatest risk would be a high efficiency particulate air filter fire. As discussed in more detail in Chapter 5 and Appendix B, a hypothetical fire in a high efficiency particulate air filter is assumed to release radioactive material to the environment. Analyses described in Appendix B estimated the potential radiation exposure to the general population from the released airborne particulate radioactivity. Even with the application of conservative modeling assumptions, which considered many pathways, the estimated risks from this accident scenario would be small since released airborne particulate radioactivity would be widely dispersed by prevailing winds.

For both the prompt and deferred dismantlement alternatives, the accident with the greatest risk would be a component drop accident. As discussed in more detail in Chapter 5 and Appendix B, a component drop accident is assumed to release radioactive material to the environment. Even with conservative modeling assumptions, which considered many pathways, the risks associated from this accident scenario would be small for both the prompt and deferred dismantlement alternatives. The highest risk per year of 6.0×10^{-8} equates to less than 1 chance in 16 million annually that any single member in the general public would develop an additional latent fatal cancer from exposure to radiation attributable to a dropped component accident during the prompt dismantlement alternative. Since the no action alternative does not involve any reactor plant dismantlement activities, the dropped component accident scenario does not apply.

Besides radiological consequences of facility accidents, analyses considered several nonradiological perspectives. The risks associated with nonradiological accidents, such as a spill of stored chemical products or a fire in a temporary diesel fuel storage tank, would be small and do not serve to distinguish between the alternatives. Nonradiological accidents involving injury to personnel, such as slips and falls, could occur during dismantlement activities. Based on U.S. Department of Energy accident rates, which are higher than rates for Naval Reactors Program activities, approximately 25 injuries could occur during dismantlement activities over the course of 3 to 4 years (see Table 5-2). No fatalities would be expected.

3.5.3 Transportation-Related Consequences

Transportation analyses considered two separate U.S. Department of Energy destinations for the purposes of comparison - the Savannah River Site in South Carolina and the Hanford Site in Washington State. Table 3-3 summarizes the consequences of shipping radioactive materials to the more distant disposal site, the Hanford Site. Analyses that assumed the Savannah River Site as a destination yielded results that were smaller than those shown in Table 3-3. Analyses conservatively assumed that S3G and D1G dismantlement activities would result in approximately 60 shipments of radioactive materials.

Table 3-3: Radiological Risks from the Incident-Free Transportation of Radioactive Materials [a]

		Prompt Dismantlement [c]	Deferred Dismantlement [d]
Total Risk [b]	Transportation Crew	2.7×10^{-3}	9.6×10^{-5}
	General Population	2.7×10^{-3}	7.4×10^{-5}
Average Annual Per Person Risk [b]	Transportation Crew	6.8×10^{-4}	2.6×10^{-5}
	General Population	1.5×10^{-9}	4.1×10^{-11}

a. Data represents shipments from the Kesselring Site to the Hanford Site.
b. Risk of latent fatal cancer.
c. Values from Appendix C, Table C-13.
d. Values from Appendix C, Table C-15.

The risks to the general public from transportation of radioactive materials would be small for either dismantlement alternative. These risks do not provide a distinguishing comparison between the alternatives. Analyses indicate that transportation of radioactive materials under the prompt dismantlement alternative would annually result in about a 1.5×10^{-9} risk of a latent fatal cancer to an average member of the general population. This small risk equates to less than 1 chance in 670 million. Analyses indicate that the risk would be small that transportation of dismantled radioactive materials would cause even a single additional latent fatal cancer in the entire population.

As shown in Table 3-3, the risk to transportation crew members who receive occupational radiation exposure was also estimated. Even if the same crew transported all of the radioactive materials under the prompt dismantlement alternative, which is an unlikely event, the resulting health risk (6.8×10^{-4} average annual per person risk) would be small. For either dismantlement alternative, thousands of years of transportation of waste would be required before a single latent fatal cancer would be expected to occur between these workers.

Besides the radiological consequences from the shipment of radioactive materials, transportation analyses evaluated several nonradiological aspects. Transportation analyses assumed S3G and D1G Prototype reactor plant dismantlement activities would result in 50 shipments of nonradioactive materials. The potential impacts of vehicle exhausts from all shipments were evaluated. Based on data contained in Appendix C, Tables C-3 (6.4×10^{-10}) and C-13 (1.7×10^{-10}), the resulting average annual per person health risk due to vehicle pollutants from all shipments would be approximately 8.1×10^{-10}, or less than 1 chance in 1 billion that a fatality would occur.

Table 3-4 summarizes the estimated health risks which would result from transportation related accidents involving a radioactive shipment.

Table 3-4: Radiological Risks to the Public from Transportation Accidents Involving Radioactive Materials [a]

	Prompt Dismantlement [c]	**Deferred Dismantlement** [d]
Risk to the General Population [b]	1.4×10^{-6}	2.9×10^{-8}
Average Annual Per Person Risk [b]	3.1×10^{-12}	6.3×10^{-14}

a. Data represents shipments from the Kesselring Site to the Hanford Site.
b. Risk of a single additional latent fatal cancer.
c. Values for prompt dismantlement are from Appendix C, Table C-17.
d. Values for prompt dismantlement are from Appendix C, Table C-19.

The risks of transportation accidents are estimates of latent cancer fatalities to the general population. Analysis of transportation accidents considers workers (the transportation crew) as part of the general population. No immediate fatalities due to radiation exposure would be expected to result from a transportation accident under any alternative. Analyses which used conservative modeling assumptions and which considered many pathways, estimated the risks from several hypothetical transportation accident scenarios. As shown in Table 3-4, the average annual risks per person to individuals in the general population would be very small. Analyses showed that no immediate fatalities or latent fatal cancers would result from hypothetical transportation accidents for either dismantlement alternative.

Analyses in Appendix C also evaluated the health risks associated with transportation accidents from a nonradiological perspective. Based on average fatality rates per mile, the number of shipments and the distances traveled, no traffic fatalities would be expected to occur due to accidents involving transportation of dismantled S3G and D1G reactor plant materials. Detailed results of these analyses are contained in Appendix C, Tables C-4 and C-16 through C-19.

The data in Tables 3-3 and 3-4 shows that the transportation-related risks associated with deferred dismantlement would be smaller than those associated with prompt dismantlement. This is due to the radioactive decay of cobalt-60. However, the difference is so small that it does not provide a distinguishing comparison between the two alternatives. The risks associated with the prompt dismantlement alternative remain small even with conservative assumptions related to transportation distance and accident scenarios. Therefore, the risks to individual members of the population and the risks to the population as a whole from transporting radioactive materials would be small for both alternatives.

3.5.4 Cost

The costs of the alternatives, summarized in Table 3-5, are rough order of magnitude estimates for the purposes of comparison.

Table 3-5: Estimated Costs of Alternatives [a]

Cost Description	No Action	Prompt Dismantlement	Deferred Dismantlement
Terminate Work/ Demobilize Work Force	$ 5,500,000	Not applicable	$ 5,500,000
Inactivation of the S3G and D1G Prototype Reactor Plants (years 1 - 10) [b]	$ 18,000,000	Not applicable	$ 18,000,000
Caretaking (years 11 - 30) [c]	$ 1,400,000	Not applicable	$ 1,400,000
Remobilize Work Force	Not applicable	Not applicable	$ 11,500,000
Dismantlement	Not applicable	$ 76,000,000	$ 76,000,000
Demobilize Work Force	Not applicable	$ 2,000,000	$ 2,000,000
Total [d]	$ 25,000,000	$ 78,000,000	$114,000,000

a. Costs are in 1997 dollars. In the past, the cost of working with radioactive waste has increased much faster than the Office of Management and Budget established nominal rates. Due to the uncertainty of these primary risk drivers, the U.S. Department of Energy did not forecast future values and then discount the costs to constant dollars, but took a more direct approach by applying fiscal year 1997 estimates for all anticipated work. This method provides the constant dollar cost estimates required in capital budgeting and is considered by the U.S. Department of Energy to be a more accurate and valid cost comparison procedure in this instance.
b. Assumes an annual cost of $1,800,000 per year for a limited work force to inactivate the reactor plants.
c. Assumes an annual caretaking cost of $70,000 per year for a limited work force to perform maintenance, periodic monitoring, inspections and security of the reactor compartments.
d. Rounded to the nearest million.

Since the no action alternative does not provide a permanent disposal decision for the S3G and D1G Prototype reactor plants, future dismantlement-related costs are not included. Taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure.

The cost estimates associated with dismantlement of the S3G and D1G Prototype reactor plants are based on experience, engineering concepts, and comparison to similar projects, such as the Shippingport nuclear power plant dismantlement (Reference 3-4). The principal dismantlement costs included in this estimate are preparation of engineering procedures, procurement or rental of equipment, direct labor, support labor, disposal, and utilities. The highest single expense for each prototype would be the removal and disposal of the reactor pressure vessel. As discussed in Section 3.3.2, deferred dismantlement activities are assumed to be the same as prompt dismantlement activities. Assuming a constant dollar value, dismantlement costs would be the same for the prompt and deferred dismantlement alternatives.

The cost differences between the prompt and deferred dismantlement alternatives are primarily due to the cost of demobilizing the work force, preparing the S3G and D1G Prototype reactor plants for long-term caretaking, and remobilizing the dismantlement work force after the caretaking period. Caretaking costs over 30 years would be the same for the no action and deferred dismantlement alternatives since the caretaking activities would be identical.

3.5.5 Additional Factors

Although protection of human health and the environment and the cost of conducting the activities are typical factors used to compare alternatives, decision making takes into consideration additional factors to achieve a thorough and objective evaluation. Besides radiological consequences and cost, additional factors include public comments, technical feasibility, availability and efficiency of an experienced work force, regulatory impacts, pollution prevention and availability of waste disposal paths, environmental justice, mitigative measures, and long-term productivity of the environment (including future unrestricted release of the Kesselring Site). The rest of this section addresses each of these topics.

Half of the agencies and individuals commenting on the Draft Environmental Impact Statement during the public comment period indicated support for one of the dismantlement alternatives (36 percent for prompt and 14 percent for deferred). The remainder of the commenters did not indicate a preference for any particular alternative. There was no support indicated for the no action alternative. All comments were taken into consideration during preparation of this Final Environmental Impact Statement.

Technical feasibility does not distinguish among the alternatives. Activities under any of the alternatives would be conducted consistent with stringent Naval Reactors Program practices. The technology to support prototype reactor compartment dismantlements has already been proven in other dismantlement activities, such as the Shippingport nuclear power plant and decommissioned nuclear-powered U.S. Navy warships.

An experienced work force is currently available at the Kesselring Site. This experience includes prototype refuelings, defuelings, overhauls and inactivations. This work force is highly skilled and trained and could not be replaced easily or economically. An efficient use of this work force would include the complex task of reactor plant dismantlement. The presence and availability of an experienced work force is a positive aspect of the prompt dismantlement alternative. If dismantlement is deferred, even for a few years, this work force would have to be disbanded.

A reduction of about 200 Kesselring Site personnel would be required for all of the alternatives. Under the prompt dismantlement alternative, the existing work force would be retained for the duration of dismantlement activities. Although this would be a noticeable reduction in the civilian work force at the Kesselring Site, it represents only about 0.1 percent of the employment level in the surrounding region (see Table 4-2). Therefore, none of the alternatives would have any discernible socioeconomic impact.

Regulatory requirements also do not distinguish the alternatives. No new legislation would be required to implement any of the alternatives. Prompt dismantlement can be accomplished within the existing regulatory requirements, which would include regulatory agency review and approval of specific permits. It is assumed that deferred dismantlement could also be accomplished within future regulatory requirements. However, the extent of those regulatory requirements would be inappropriate to predict.

The U.S. Department of Energy Savannah River Site currently receives low-level radioactive waste from Naval Reactors Program sites in the eastern United States. Both the volume and radioactive content of the S3G and D1G Prototype reactor plant low-level radioactive waste fall within the projections of Naval Reactors Program waste provided to the Savannah River Site, which in turn are included in the Savannah River Site Waste Management Final Environmental Impact Statement dated July 1995 (Reference 5-1). Shipments resulting from dismantlement activities would result in approximately 60 radiological and 50 nonradiological shipments from the Kesselring Site over the dismantlement period (see Section 5.2.10). On an annual basis these shipments represent less than 5 percent of the total nonradiological and radiological shipments associated with normal Kesselring Site operations. The largest shipments by weight and radioactive content would be the two reactor pressure vessels. Transport of each of these packages from the Kesselring Site to the Delaware and Hudson railroad terminus would affect local traffic for a short period during one day each, principally on the lesser traveled secondary roads. Highway shipments of packages of similar size to the reactor pressure vessel packages have successfully occurred between the Kesselring Site and the Delaware and Hudson railroad terminus in the past.

From a pollution prevention perspective, all alternatives involve the generation of waste. Although the no action alternative does not involve any dismantlement activities, caretaking activities would generate small amounts of waste and reactor plant disposal would eventually be needed. Stringent pollution prevention practices are implemented at the Kesselring Site as part of normal operations. These practices include waste minimization, recycling and procurement practices that reduce or eliminate acquisition of products containing hazardous substances or toxic chemicals. Therefore, current technologies and practices would be in place to meet pollution prevention standards for any of the alternatives. With these practices in place, dismantlement activities would generate only a small volume of waste compared to the intact volumes of the reactor plants, which would be small compared to commercial standards.

The environmental impacts of any of the alternatives would be small for all population groups. Analyses indicate there would be no disproportionately high and adverse effect on any minority or low-income population. Therefore, none of the alternatives would create an environmental justice concern within the region. Since the adverse impacts would be small for any of the reasonable alternatives, there are no mitigative measures identified or required.

Since there are no plans to shut down the other operating prototypes or to release the Kesselring Site or Federal reservation lands for other uses in the foreseeable future, none of the alternatives would have any impact on the long-term productivity of the environment. However, the prompt dismantlement would make the eventual release of the Kesselring Site more readily achievable since dismantlement and disposal of two of the four prototype reactor plants would be completed. None of the alternatives involve construction of new structures or development of undisturbed lands.

3.6 Preferred Alternative

The identification of a preferred alternative in this Environmental Impact Statement, and the future selection of an alternative in the Record of Decision, takes into consideration the following factors: (1) public comments; (2) protection of human health and the environment; (3) cost; (4) technical feasibility; (5) operational efficiency; and (6) regulatory impacts.

Although comparison of the three alternatives evaluated in detail shows that the no action alternative would have the smallest environmental, health and safety impacts, the impacts associated with all of the alternatives would be small and consistent with ongoing Kesselring Site operations. Based on current conditions, any of the alternatives could be accomplished within environmentally responsible guidelines, in both the short-term and the long-term. However, 30 years from now, emergent conditions associated with the regulatory environment, and the availability of funds, trained personnel, and waste disposal facilities could result in unforeseeable complications or delays. Such unforeseeable conditions cause added uncertainty in the impacts associated with the deferred and no action alternatives.

Prompt dismantlement would make use of recycling and volume reduction services of commercial enterprises to minimize the volume of low-level radioactive waste and other wastes. Prompt dismantlement would make use of an existing trained work force at the Kesselring Site and would maintain approximately 200 staff positions at the Kesselring Site for the dismantlement duration. Compared to the no action and deferred dismantlement alternatives, prompt dismantlement has a greater degree of certainty in terms of predicted costs and waste disposal. While prompt dismantlement would not result in earlier unrestricted release of the Kesselring Site due to the continuing operation of the MARF and S8G Prototype reactor plants, it would make the eventual release of the Site more readily achievable since dismantlement and disposal of two of the four prototype reactor plants would be completed. Although dismantlement activities would involve meeting Federal and New York State permitting requirements, no new legislation would be required to implement any of these alternatives.

The Naval Reactors Program has identified prompt dismantlement as the preferred alternative for the disposal of the S3G and D1G Prototype reactor plants for the following reasons:

- An experienced work force is currently available at the Kesselring Site.
- Eventual release of the Kesselring Site is more readily achievable since two of the four prototype reactor plants would be dismantled and disposed of.
- Prompt dismantlement has a greater degree of certainty in completing the dismantlement and disposal within predicted costs and with small environmental impacts.

Identification of prompt dismantlement as the preferred alternative is consistent with the Naval Reactors Program's record to manage waste efficiently and minimize its generation.

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CHAPTER 4

AFFECTED ENVIRONMENT

4.0 Affected Environment

This chapter provides baseline environmental conditions pertaining to the Kesselring Site and its surrounding area. These baseline conditions are used as the starting point for establishing the potential impacts associated with S3G and D1G Prototype reactor plant dismantlement and disposal alternatives, which are discussed in Chapter 5.

Public information is readily available on the environmental performance of the Kesselring Site. The Kesselring Site Environmental Summary Report (Reference 2-1) and the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-4) are referenced frequently throughout this chapter to highlight key aspects of the environmental conditions at the Kesselring Site. Both of these reports are available in the Saratoga Springs and Schenectady County public libraries.

The Kesselring Site uses trained personnel, written procedures, installed and portable instrumentation, audits and inspections to maintain high standards of environmental control. In addition, various aspects of the Kesselring Site environmental program are reviewed by other independent government agencies. For example, the New York State Department of Environmental Conservation and the U.S. Environmental Protection Agency have conducted on-site inspections of Resource Conservation and Recovery Act programs annually for the past 10 years. Over 80 inspections covering air, water, and hazardous waste have been conducted during that period (Reference 2-1, Table 1). There have been no fines or penalties levied, no enforcement actions taken, and no other adverse regulatory actions as a result of these inspections.

The General Accounting Office, a U.S. Congressional investigative organization, performed a detailed 14-month audit of Naval Reactors Program facilities in 1990-1991. The audit covered environmental, health, and safety matters, including reactor safety, and auditors had unrestricted access to personnel, facilities, and classified information. In April 1991, the General Accounting Office testified to a Congressional committee that the Naval Reactors Program is a "positive program in DOE," and that their review found "no significant deficiencies" (Reference 4-24). Their final report was issued in August 1991 (Reference 2-6).

With regard to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review process, the U.S. Environmental Protection Agency has assigned the Kesselring Site and Federal reservation with a recommendation of Site Evaluation Accomplished (Reference 4-8). This means that, based on current information, the Kesselring Site and Federal reservation do not qualify for inclusion on the National Priorities List. No further action is anticipated under CERCLA.

4.1 Land Use

The Kesselring Site is located near West Milton, in Saratoga County, New York, approximately 27 kilometers (17 miles) north of Schenectady, 14 kilometers (9 miles) southwest of Saratoga Springs, and 21 kilometers (13 miles) northeast of Amsterdam (see Figure 2-1). The Kesselring Site is an approximately 26-hectare (65-acre) developed area situated within an approximately 1,600-hectare (3,900-acre) Federal reservation owned by the U.S. Department of Energy (see Figures 2-2 and 2-3). Most of the Kesselring Site, including the prototype reactor plants, is bounded by a security fence. The Kesselring Site is located a minimum of 1.4 kilometers (0.9 miles) from the boundary of the Federal reservation. There are no permanent residents at the Kesselring Site or on the Federal reservation.

The area surrounding the Federal reservation is mostly rural and includes a mixture of woodlands, farmlands, and small residential tracts. Individual residences are located along the Federal reservation boundary on all sides. The nearest concentration of residences is located east of the Federal reservation, approximately 1.6 kilometers (1 mile) from the Kesselring Site. Farming activities are located primarily west and south of the Federal reservation and include dairy and beef cattle, orchards, and cropland. Crops include oats, hay-alfalfa, corn, potatoes, and vegetables. Large recreational areas, including New York State-owned lands, are located primarily 4 to 8 kilometers (2.5 to 5 miles) north-northeast of the Kesselring Site. There are also several smaller private recreational areas nearby, including a Boy Scout summer camp approximately 4.5 kilometers (2.8 miles) north-northeast and golf courses approximately 3.2 kilometers (2 miles) west and approximately 2.4 kilometers (1.5 miles) southwest of the Kesselring Site. The Cottrell Paper Company is the nearest industry and is located in Rock City Falls approximately 3.7 kilometers (2.3 miles) northeast of the Kesselring Site.

4.2 Ecological Resources

4.2.1 Terrestrial

The Federal reservation consists mostly of wooded areas typical of the Hudson-Mohawk Valley lowlands region. The natural stands are primarily hardwoods such as maple and birch. In addition, approximately 280 hectares (700 acres) were reforested several decades ago with spruce, larch and pine.

The S3G and D1G Prototype reactor plants are located within the 26-hectare (65-acre) Kesselring Site, an existing developed area, and are surrounded by buildings and pavement. The character of the area was changed from agricultural to industrial during construction activities over the past 45 years. The Kesselring Site has no terrestrial resources of significance; plant and animal species sensitive to disturbance by human activities have not been observed.

4.2.2 Wetlands

There are 13 New York State designated wetlands located on the Federal reservation (References 4-1 and 4-2), and no Federally designated wetlands. There are no State or Federally designated wetlands located within the Kesselring Site. However, the Kesselring Site parking lots are located adjacent to areas which meet Federal criteria for wetlands regulation (33 CFR Parts 320-330). Some of these areas are native wetlands and others have been created by construction activities over the past 45 years. Wetlands on the Federal reservation are not being impacted by current Kesselring Site operations.

4.2.3 Aquatic

The Glowegee and Kayaderosseras Creeks are classified under New York State Codes, Rules and Regulations as Class "C" - Trout Streams (Reference 4-36). Under this classification, the waters are suitable for fishing and fish propagation (Reference 4-3). Native brook trout and brown trout, as well as trout stocked by New York State, are found in the Glowegee Creek, both upstream and downstream of the Kesselring Site. Other native fish commonly found in the Glowegee Creek include creek chub, white sucker and various species of dace, shiner, darter, minnow, and stickleback. Environmental monitoring at the Kesselring Site and Federal reservation includes periodic identification and population assessments of fish and other aquatic life (periphyton and benthic macroinvertebrates) upstream, near Site discharge points and downstream in the Glowegee Creek. The environmental monitoring program and the most recent results are discussed in Reference 4-4. As stated in this reference, liquid effluent discharges from the Kesselring Site have resulted in no observable adverse effect on fish and other aquatic life in the Glowegee Creek. Section 4.3 provides additional discussion on environmental monitoring of water resources.

4.2.4 Critical Habitats and Endangered Species

Plant and animal species considered endangered or threatened do not generally inhabit developed industrial areas such as the Kesselring Site. However, the remainder of the Federal reservation does contain environments suitable for numerous types of plants and animals. Since caretaking and dismantlement activities associated with the range of alternatives for S3G and D1G Prototype reactor plant disposal would occur only within the 26-hectare (65-acre) developed area, a survey documenting the various species of plants or animals found on the remainder of the Federal reservation has not been performed for this Environmental Impact Statement.

According to the New York State Department of Environmental Conservation Wildlife Resources Center, the karner blue butterfly, an endangered species, and the red-shouldered hawk, a threatened species, may be found in the Saratoga County area (Reference 4-21). To date, there have been no documented observations of the karner blue butterfly, the red-shouldered hawk, or any other endangered, threatened, or special concern species on the Kesselring Site. A review of the New York State Natural Heritage Program files by the

Wildlife Resources Center of the New York State Department of Environmental Conservation, for the area of the Kesselring Site, did not identify any potential impacts on endangered, threatened, or special concern species (Reference 4-5). The review also did not identify any potential impacts on known occurrences of rare plants, animals, natural communities, or other significant habitats.

4.3 Water Resources

4.3.1 Surface Water - General Information

The Federal reservation is located in the Saratoga Lake drainage basin. The Glowegee Creek, its tributaries, and the Crook Brook drain the Federal reservation (see Figure 2-2). Both the Glowegee Creek and Crook Brook empty into the Kayaderosseras Creek to the east of the Federal reservation. The Kayaderosseras Creek, its tributaries and headwaters compose most of the Saratoga Lake watershed (Reference 4-28). As reported in Reference 4-4, the annual mean average flow in the Glowegee Creek is 1.43 cubic meters (50.7 cubic feet) per second and the minimum recorded 7-day average flow for a 10-year period is 0.026 cubic meters (0.92 cubic feet) per second. The annual mean average flow in the Kayaderosseras Creek is 4.08 cubic meters (144 cubic feet) per second and the minimum recorded 7-day flow for a 10-year period is 0.48 cubic meters (17 cubic feet) per second. The Kayaderosseras Creek flows approximately 14 kilometers (9 miles) from the Federal reservation through Ballston Spa and then approximately 16 kilometers (10 miles) to Saratoga Lake. Saratoga Lake drains to the Hudson River by way of Fish Creek. As discussed in Section 4.2.3, the New York State Department of Environmental Conservation has classified the Glowegee and Kayaderosseras Creeks as Class "C" - Trout Streams (Reference 4-36). Under this classification the water quality is also suitable for primary and secondary contact recreation (Reference 4-3). Per the New York State Sanitary Code, Class “C” streams are not recommended as sources of potable water.

The Flood Insurance Rate Map prepared by the Federal Emergency Management Agency (Reference 4-6) shows that narrow areas of the Federal reservation are located within the 100-year flood boundary; these areas are associated with the Glowegee and Kayaderosseras Creeks. However, the Kesselring Site is located at elevations above the indicated 100-year flood boundary. There are no records of flooding on the Kesselring Site during its operational history.

Waste water from the Kesselring Site is discharged to the Glowegee Creek from four permitted discharge points (see Figure 4-1). Waste water includes: (1) boiler discharges, (2) sewage treatment plant effluent, (3) cooling tower water, (4) process water, (5) storm drainage, and (6) service water used for drinking and once-through noncontact cooling of equipment. With the exception of sewage treatment plant effluent and some storm drainage, waste water is collected from around the Kesselring Site and conveyed to the Site’s lagoon by underground drains and open channels.

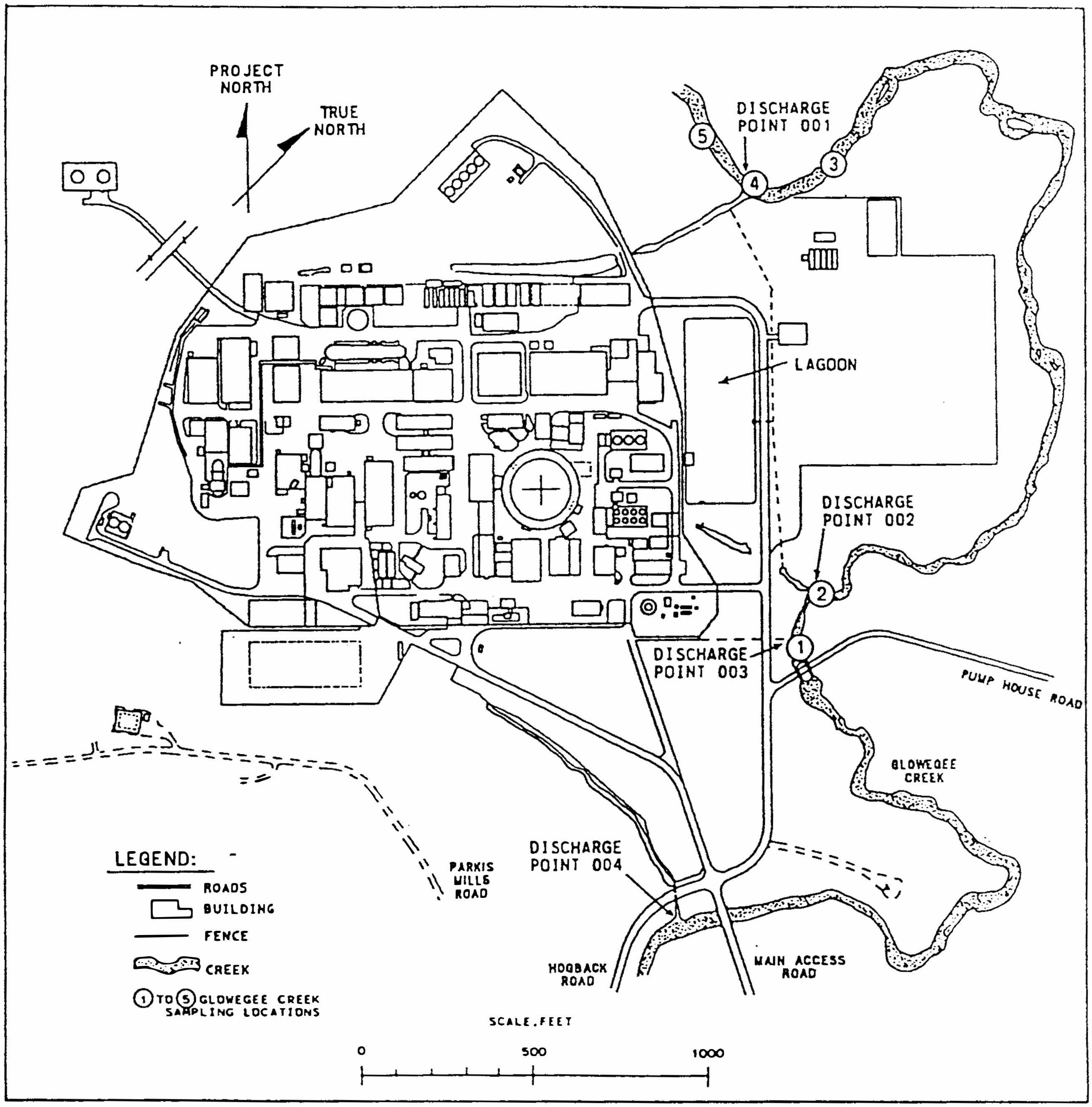

Figure 4-1: Kesselring Site Glowegee Creek Sampling Locations and Discharge Points

The lagoon has a capacity of approximately 19 million liters (5 million gallons) and receives an average of 3 million liters (800,000 gallons) per day of waste water and storm water. The function of the lagoon is to provide thermal equalization, chlorine dissipation and settling of suspended solids. In addition, pH control is necessary due to algae growth in the lagoon. The algae cause the pH to increase due to photosynthesis. The pH is controlled by a carbon dioxide treatment system which lowers the pH of the waste water prior to discharge. Algae growth and decay in the lagoon also causes an increase in the total amount of suspended solids, which is in direct contrast with one of the lagoon's intended functions. The Naval Reactors Program has developed an environmental assessment which evaluates several alternatives for reducing the amount of suspended solids in waste water discharges from the Kesselring Site lagoon (Reference 4-11). Installation of a new waste water treatment system began in July 1997. The required approval from the New York State Department of Environmental Conservation, as well as approval from the New York State Department of Health, as requested, was obtained prior to installation of this system. These actions are unrelated to the proposed action covered in this Environmental Impact Statement, and are cited here only for completeness.

Waste water is discharged from the lagoon to the Glowegee Creek through outfalls 001 and 002 (see Figure 4-1). A series of gates is located in the discharge system and the lagoon to provide a means to contain and control effluents which do not meet discharge limits. All discharges are controlled and monitored for conformance with the limits and parameters specified in the Kesselring Site's New York State Pollutant Discharge Elimination System permit (number N.Y. 0005843) and in accordance with Reference 4-3. The State Pollutant Discharge Elimination System permit contains limits for several conditions, including temperature, pH, suspended solids, and chlorine. In addition, continuous pH and temperature monitoring instrumentation are installed in the discharge system and the lagoon effluent. The instrumentation automatically control (shut) the gates and provide alarms if these waste water parameters approach specification limits.

Kesselring Site domestic sewage, cafeteria waste water, and grey water from utility sinks and locker rooms are collected by a separate drain system and conveyed to the Site's sewage treatment plant. Treated effluent is discharged from the plant to the Glowegee Creek through outfall 003. The sewage treatment plant is a tertiary treatment facility that uses the extended aeration/contact stabilization process, chemical precipitation of phosphorus, and sand filtration. Waste sludge is stored in a holding tank and is periodically removed by a licensed contractor for disposal at a State-approved, off-site disposal facility. A voluntary phosphorus removal program is in place to reduce the Site's contribution to phosphate input into Saratoga Lake. Although a previous study (Reference 4-28) indicated the Kesselring Site contributed less than 6 percent of the total phosphate input to Saratoga Lake, the intent of the voluntary program is to reduce this contribution as much as practicable.

Outfall 004 discharges only storm water runoff from the southern portion of the Kesselring Site and the main parking lots. A storm water permit application has been filed with the New York State Department of Environmental Conservation identifying two other storm water discharge points, shown as storm water outfalls (SWO) 005 and 006 on Figure 4-2 (page 4-9). Outfall 005 discharges storm water runoff from a portion of Hogback Road, and outfall 006 discharges storm water runoff from the closed landfill area.

Environmental monitoring of surface water at the Kesselring Site and Federal reservation includes: (1) at a minimum, the monthly collection of Glowegee Creek water samples for chemical analyses, (2) the continuous monitoring and recording of water temperature and pH upstream and downstream of Site discharges to the Glowegee Creek, (3) the collection of quarterly samples for radiological analysis of Glowegee Creek water and sediment at the five locations shown in Figure 4-1, (4) a periodic survey of aquatic life (periphyton and benthic macroinvertebrates) upstream, near Site discharge points and downstream in the Glowegee Creek, and (5) a periodic survey of fish upstream and downstream of Site discharges to the Glowegee Creek. A few of the fish collected from each location are retained for radioanalysis. This program and the most recent results are described in Reference 4-4. Discussions on the results of this monitoring are provided in Sections 4.3.3 and 4.3.4.

4.3.2 Ground Water - General Information

There are no ground water aquifers in the vicinity of the Kesselring Site that are designated as sole source aquifers by the U.S. Environmental Protection Agency or as primary/principal aquifers by the New York State Department of Environmental Conservation. The geologic overburden sequence within the Federal reservation consists of complex glacial and lake deposits overlying bedrock. In general, glacial till directly overlies bedrock across most of the Federal reservation. The glacial till and other fine grained lake deposits (silts) which are present have characteristically low permeabilities and historically produce very low volumes of water. Section 4.5.2 provides additional details of geologic conditions within the Federal reservation.

At the Kesselring Site, depth to the ground water table ranges approximately from 1 to 3 meters (3 to 10 feet) below grade. Ground water elevation data show that the gradient is low and that the flow of shallow ground water is generally toward the east and the Glowegee Creek. The ground water table generally conforms to the surface topography of the Kesselring Site; however, building foundations and backfill associated with underground utilities may alter the expected direction and rate of ground water flow in specific areas. The ground water elevation data also indicate that the Glowegee Creek, located approximately from 60 to 300 meters (200 to 1,000 feet) east of the Kesselring Site, forms a hydrologic boundary for shallow ground water.

Ground water in New York State is classified based on its best use, which in general is as a drinking water source. Ground water under the Kesselring Site and Federal reservation is classified as "GA" by the New York State Department of Environmental Conservation (Reference 4-3). The "GA" classification indicates that the water quality standards applied to this ground water serve to protect it as a potential drinking water source.

The Kesselring Site does not discharge liquid effluents to the ground water by either injection wells or seepage basins. The Kesselring Site has an ongoing ground water monitoring program that analyzes for a variety of inorganic and organic constituents and radioactivity from monitoring wells on the Federal reservation (see Figure 4-2) and within the Site (see Figure 4-3). The ground water monitoring program focuses on the solid waste landfill (Hogback Road), closed in accordance with New York State Department of Environmental Conservation regulations in October 1994, and other inactive (former) waste disposal areas located on the Federal reservation (see Section 4.5), and the Kesselring Site. Details of the Kesselring Site's ground water monitoring program and sampling results are provided in Reference 4-4. Discussions on the results of this monitoring are provided in Sections 4.3.3 and 4.3.4.

The source of service (potable) water for the Kesselring Site is a well field, located near the east boundary of the Federal reservation, adjacent to the Kayaderosseras Creek (see Figure 4-2). The well field is composed of five production wells which draw ground water from two aquifers, one shallow and one deep. These aquifers are hydrogeologically separate from the closed Hogback Road landfill and the other former waste disposal areas and are not influenced by materials at these locations. The Kesselring Site uses approximately 7.5 million liters (2 million gallons) of well water per day.

Kesselring Site potable water is treated with chlorine and periodically monitored in accordance with New York State Department of Health regulations (Reference 4-7). Chlorine is added to Site potable water as a drinking water disinfectant. The Kesselring Site currently disinfects its drinking water at reduced chlorine levels under a New York State Department of Health issued disinfection waiver (Reference 4-15). Periodic monitoring of chemical and biological constituents in the potable water is performed in order to demonstrate conformance with drinking water standards (Reference 4-7). The results of this monitoring are reported monthly to the New York State Department of Health. Reference 4-4 provides a summary of monitoring results.

The area surrounding the Federal reservation is not serviced by any municipal water systems. Privately owned individual domestic wells and private water systems serving multiple residences provide the major sources of potable water for the population living in the immediate vicinity. The nearest municipal water services are located in Ballston Spa and Saratoga Springs, which are approximately 8 kilometers (5 miles) and 14 kilometers (9 miles) away, respectively. These municipal water services draw on both surface and ground water sources, none of which are affected by Kesselring Site operations.

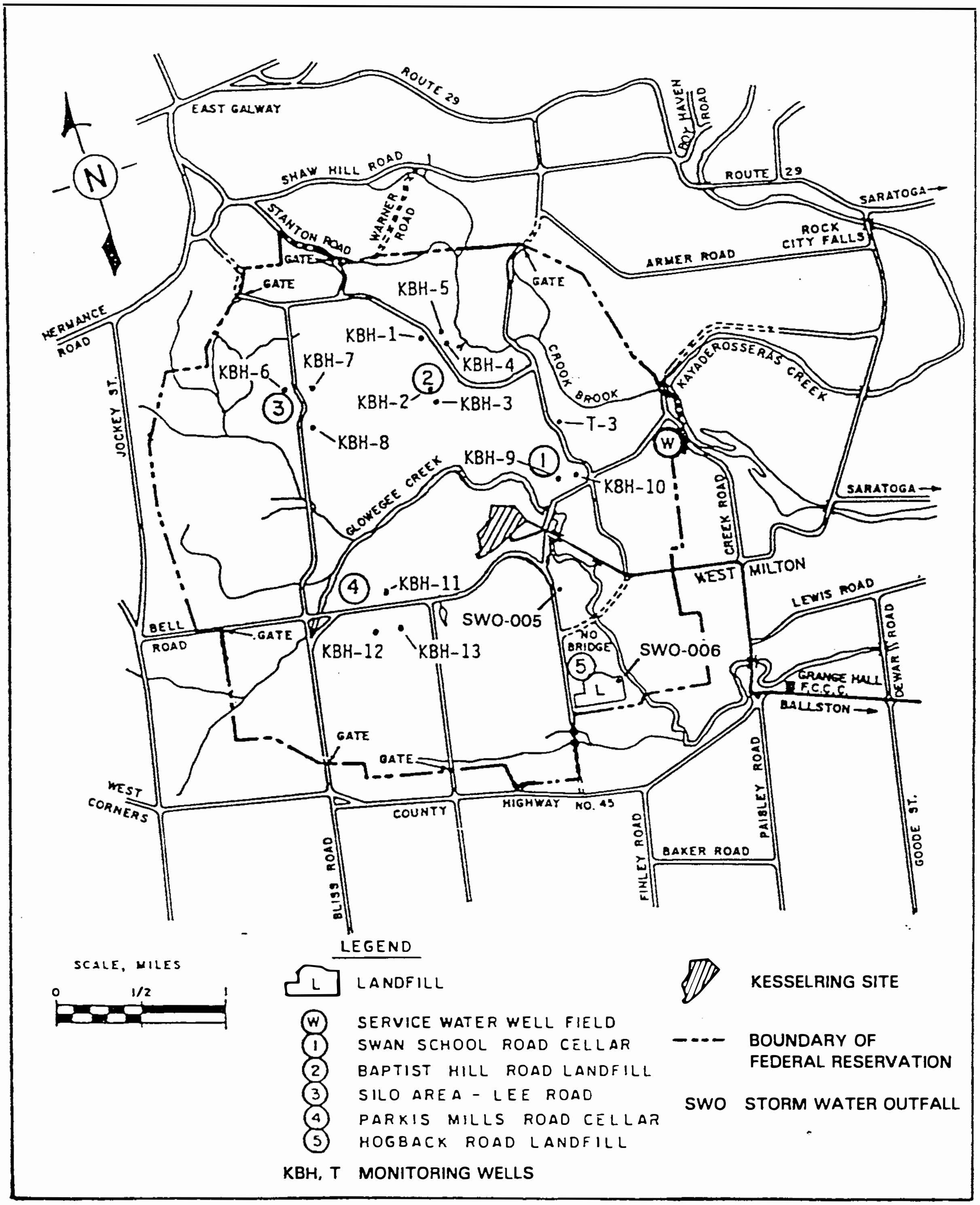

Figure 4-2: Former Waste Disposal Areas and Associated Ground Water Monitoring Wells Located Within the Federal Reservation

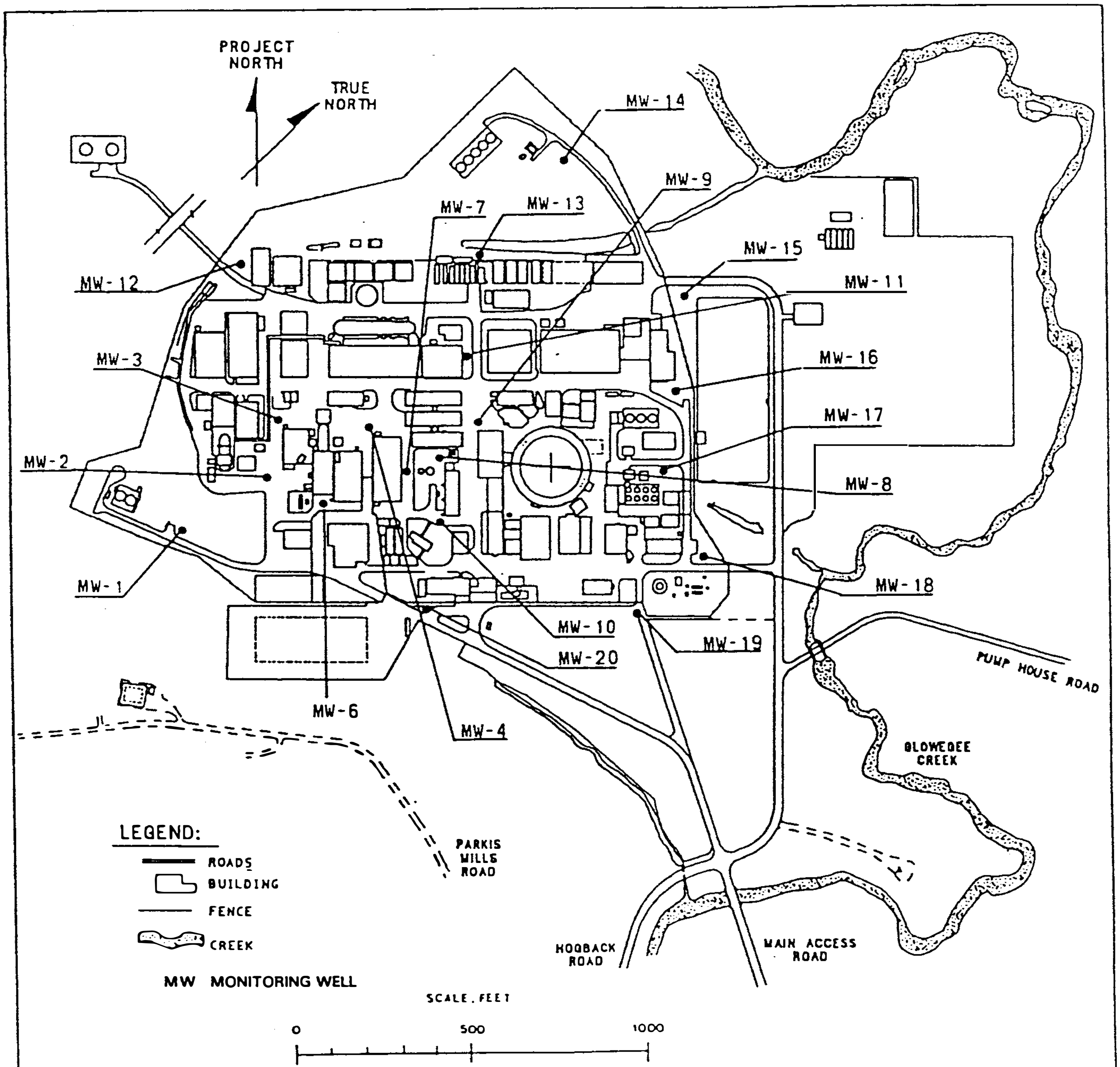

Figure 4-3: Ground Water Monitoring Wells Located Within the Kesselring Site

4.3.3 Existing Radiological Conditions - Water Resources

4.3.3.1 Existing Radiological Conditions - Surface Water

Radioactive liquid wastes are generated and controlled as part of Kesselring Site operations. As discussed in Reference 2-1, a vigorous radioactive liquid waste control and minimization program has been maintained for many years. Regulations applicable to the commercial nuclear industry in the United States permit discharge of liquids containing low levels of radionuclides if they meet concentration standards established by the U.S. Nuclear Regulatory Commission (10 CFR Part 20, Appendix B, Table 2). U.S. Department of Energy requirements permit similar discharges of these liquids. The Naval Reactors Program employs a more restrictive standard at the Kesselring Site and at other Program facilities, as described below.

Water used for reactor coolant is collected and processed to remove most of the particulate radioactivity prior to reuse in Kesselring Site operations. The reuse processing systems include collection tanks, particulate filters, activated carbon columns and ion-exchange columns. The processed water is then reused in operations involving radioactivity, such as reactor coolant makeup. Besides reactor coolant, other water that has the potential to contain low concentrations of radioactive material but which is not practicable to reuse is collected in holdup tanks and retention basins, monitored and processed in batches prior to discharge. The sources of the radioactivity in the water are small quantities of activated corrosion and wear products, and tritium. Samples are collected from each batch of processed water and analyzed. Samples are also combined into individual monthly composite samples for later analysis. Each sample is analyzed for the type and quantity of radioactive material to ensure that it has been removed to the lowest practicable level, and complies with applicable regulations and the more stringent Naval Reactors Program standards. Overall, the water processing and reuse practices ensure that more than 99.9 percent of the particulate radioactivity is removed.

As reported in Reference 4-4, the radioactivity released in liquid effluent during 1996 totaled less than 0.02 curies of tritium. The radioactivity was contained in approximately 1.4 billion liters (370 million gallons) of water. The resulting annual average radioactivity concentration in the effluent corresponded to less than 0.1 percent of the U.S. Department of Energy derived concentration guideline for effluent released to unrestricted areas (Reference 4-11) for the mixture of radionuclides present. In addition, the radioactivity concentration in the effluent was less than 1 percent of U.S. Nuclear Regulatory Commission concentration limits for unrestricted use. Liquid effluent monitoring data for radioactivity is included in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-4).

As reported in Reference 4-4, liquid discharges from the Kesselring Site have not resulted in any increase in detectable radioactivity in the Glowegee Creek and have had no observable adverse effect on fish and other aquatic life. Only naturally occurring radionuclides have been detected in the Glowegee Creek water samples. Sediment samples indicate that there is no significant difference between upstream and downstream radioactivity concentrations, and the radionuclides detected are attributed to either naturally occurring sources or to atmospheric nuclear weapons testing performed in the 1950s and 1960s. The results of the fish analyses show no radioactivity attributable to Kesselring Site operations.

The New York State Department of Health conducts independent environmental monitoring of radioactivity in water in the vicinity of the Federal reservation. State personnel collect monthly samples from the Glowegee Creek at a gaging station located downstream (southeast) of the Kesselring Site. The latest report on Environmental Radiation in New York State (Reference 4-29) states that analysis results "show values typical of normal background levels for gross alpha, gross beta, and tritium."

4.3.3.2 Existing Radiological Conditions - Ground Water

Results of Kesselring Site ground water monitoring are provided in Reference 4-4, and show that Site operations have had no measurable radiological impact on ground water within the Federal reservation and only minimal impact within the Kesselring Site. Levels of cesium-137 and cobalt-60 are consistently below minimum detection limits in samples collected in monitoring wells located at the closed Hogback Road landfill and the other former waste disposal sites, and at the Kesselring Site. Tritium was occasionally detected above normal background levels in one area at the Kesselring Site from 1988 through 1990, but has not been detected above normal background levels since then. The concentrations for all of these radionuclides were less than 0.1 percent of the derived concentration guideline values in accordance with the U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment.

4.3.4 Existing Nonradiological Conditions - Water Resources

4.3.4.1 Existing Nonradiological Conditions - Surface Water

Detailed chemical analysis results for Kesselring Site liquid effluents and Glowegee Creek water are provided in Reference 4-4. The concentrations of chemical constituents present in Kesselring Site liquid discharges have been within applicable standards and have resulted in no observable adverse effect on fish and other aquatic life in the Glowegee Creek. Results of this monitoring are reported to the New York State Department of Environmental Conservation in a monthly Discharge Monitoring Report as required by the Kesselring Site's State Pollutant Discharge Elimination System permit (number N.Y. 0005843).

Between 1986 and 1994, the Kesselring Site's State Pollutant Discharge Elimination System program reported only 35 instances of exceeding discharge limits. These releases occurred over short periods of time and did not result in any observable long-term impact on the environment or public health and safety. The parameters which exceeded discharge limits included surfactants (these substances are sometimes found in soaps or detergents), total suspended solids, biological oxygen demand (5-day), chlorine, pH, and temperature. In the last two years, there have been no instances of exceeding discharge limits. However, there was one administrative noncompliance finding. This finding, which was self-reported, was the result of a missed field reading. For perspective, more than 16,000 field readings and samples were taken during 1995 and 1996.

New York State Department of Environmental Conservation personnel are allowed access to the Kesselring Site to take independent samples in the Glowegee Creek and to ensure that all applicable permit requirements and regulations are being met. A number of these regulatory inspections have been conducted by independent regulatory personnel over the past 10 years, as listed in the Knolls Atomic Power Laboratory Kesselring Site Environmental Summary Report (Reference 2-1). Some of these inspections have been made without prior notification. New York State Department of Environmental Conservation inspections have included taking independent water samples at the Kesselring Site outfall locations as well as observing the collecting, handling and control of environmental samples taken by Knolls Atomic Power Laboratory personnel. For compliance with the Site's State Pollutant Discharge Elimination System permit, samples are analyzed at an independent New York State Department of Health certified laboratory. The most recent New York State Department of Environmental Conservation inspection of the Kesselring Site outfalls occurred in October 1997. There have been no fines or penalties levied, no enforcement actions taken, and no other adverse regulatory actions as a result of these inspections.

4.3.4.2 Existing Nonradiological Conditions - Ground Water

Operations and past practices at the Kesselring Site and Federal reservation have had some observable effects on shallow ground water quality in localized areas. Due to the remoteness and hydrogeologic setting of these locations, there have been no identified potential threats to potable water sources in the surrounding area.

As reported in Reference 4-4, past waste disposal at the closed Hogback Road landfill (see Section 4.5.6.2) has resulted in some observable effects on shallow ground water quality downgradient of the landfill. The contaminants observed in ground water downgradient of the landfill are predominantly inorganic, typical of leachate from a sanitary landfill (Reference 4-30). Monitoring data are reported to the New York State Department of Environmental Conservation in Quarterly Monitoring Reports as required by New York State solid waste management facilities regulations (NYCRR Title 6, Part 360). As part of the Hogback Road landfill closure, a hydrogeologic study (Reference 4-34) was conducted to assess the potential impact of past waste disposal at the landfill to sources of potable water in the surrounding area. Based on the findings of this investigation, the overburden and bedrock aquifers at the landfill have not been significantly impacted by leachate generated from the landfill. The ground water analytical results from this investigation, which are consistent with historical ground water results, indicate slightly elevated levels of a number of parameters in the overburden aquifer immediately adjacent to the landfill. Elevated inorganic parameters include total dissolved solids, alkalinity, hardness, chloride, sulfate, boron, iron, manganese, sodium, calcium, and magnesium. Several volatile chlorinated organic compounds detected include 1,1-dichloroethane, chloroethane, dichlorodifluoromethane, and trichloroethylene.

The Hogback Road landfill is listed in New York State's annual report on inactive hazardous waste disposal sites (Reference 4-35). In assessing the impact of past waste disposal at the Hogback Road landfill, Reference 4-35 states "This site is on military property and well patrolled. The chemical waste is buried, therefore volatilization and particulate migration are not likely. Monitoring wells indicate some ground water contamination. However, the nearest drinking water well is more than one half mile away. The site does not pose a significant concern due to its remote location."

Ground water monitoring in the vicinity of other inactive disposal areas, shown on Figure 4-2, is conducted annually. As discussed in Reference 4-4, 1996 data are consistent with historical data collected since 1988, and indicate no apparent impact to local ground water quality.

Ground water monitoring results within the Kesselring Site have shown some elevated parameters in shallow ground water. Elevated inorganic constituents include chloride, sulfate, ammonia, total kjedahl nitrogen, sodium, iron, manganese and magnesium (Reference 4-4). The primary source of these elevated constituents is the application of deicing materials, which include rock salt, calcium chloride and urea. A small number of chlorinated organic compounds have been detected at low (parts per billion) concentrations in three of the Kesselring Site's monitoring wells. These compounds include trichloroethylene, tetrachloroethylene, 1,1,1 trichloroethane, trichlorofluoromethane, and dichlorodifluoromethane (Reference 4-4). The source of the detected chlorinated organic compounds is attributed to the past use of small amounts of chlorinated solvents at the Kesselring Site and associated incidental spills or leaks of these solvents. As discussed in Section 4.3.2, the shallow ground water under the Kesselring Site is hydrogeologically isolated from potable water sources in the surrounding area. Given this isolation and the low concentration of the organic compounds detected, there is no expected impact to these potable water sources.

4.4 Air Resources

4.4.1 Climate and Meteorology

The principal weather recording location for Saratoga County is at the Albany County Airport. The climate of the region is primarily continental in character, but is subject to changes from the maritime climate which prevails in the extreme southeastern portion of New York State. The moderating effect on temperatures is more pronounced during the warmer months than in winter, when bursts of cold air can sweep down from Canada. In the warmer seasons, temperatures can rise rapidly in the daytime, but can also fall rapidly after sunset so that nights are relatively cool. Occasionally, there are extended periods of oppressive heat and humidity up to a week or more in duration.

During the winter months, winds are generally from the west or northwest. During the warmer months, the winds are from the south. Wind velocities are moderate, and generally average less than 16 kilometers (10 miles) per hour.

The mean monthly temperature of the region is approximately 10°C (50°F). Daily extremes can range from approximately -34°C (-30°F) in the winter to approximately 38°C (100°F) in the summer. On an annual basis, the mean daytime relative humidity ranges approximately from 50 to 80 percent. During the summer, relative humidity frequently approaches 100 percent during the night.

Total yearly precipitation averages approximately 91 centimeters (36 inches). The average yearly snowfall is approximately 147 centimeters (58 inches) and the maximum snowfall in 24 hours is approximately 56 centimeters (22 inches).

4.4.2 Severe Weather Phenomena

The area of east central New York is subject to occasional sustained destructive winds associated with severe weather events such as thunderstorms, blizzards and tornadoes. During its almost 50-year history, severe weather effects at the Kesselring Site have been limited mainly to losses of commercial electrical power for short periods of time. During periods of commercial power loss, continuity of electrical power has been maintained at the Kesselring Site using available backup diesel generators.

For the period from 1966 through 1995, the east central area of New York that includes Saratoga County and adjacent counties has been subject to an average of 9 days per year with destructive winds associated with severe weather systems (Reference 4-9). This area is subject to about one tornado per year. Most of the severe weather events resulting in destructive winds have occurred in the months of December and January (blizzards) and in the months of June, July and August (thunderstorms).

4.4.3 Air Quality

The U.S. Environmental Protection Agency designates areas with regard to air quality based on National Ambient Air Quality Standards (Reference 4-10). The Hudson Valley Intrastate Air Quality Control Region, which includes Saratoga County and the Kesselring Site, is in attainment (within established limits) for total suspended particulate matter and sulfur dioxide, and is in marginal nonattainment for ozone. On the basis of available information, the U.S. Environmental Protection Agency has determined that the area is unclassifiable for carbon monoxide, nitrogen dioxide, and lead.

4.4.4 Existing Radiological Conditions - Air Resources

Operations having the potential for the release of airborne particulate radioactivity, such as in air exhausted from the operating prototype reactor plants, are serviced by continuously monitored exhaust systems. The air exhausted from all radiological facilities is continuously sampled for particulate radioactivity, and is regulated under the National Emission Standard for Emissions of Radionuclides Other than Radon from Department of Energy Facilities, 40 CFR Part 61, Subpart H (Reference 3-2). Prior to release, the exhaust air is passed through high efficiency (99.95 percent efficient) particulate air filters to minimize airborne particulate radioactivity.

As reported in Reference 4-4, the radioactivity contained in exhaust air during 1996 consisted of: (1) less than 0.001 curies each of krypton-85 and particulate fission and activation products having half-lives greater than 3 hours; (2) approximately 2.2 curies of noble gases with half-lives of 12 days or less, principally argon-41, xenon-133 and xenon-135; (3) approximately 0.3 curies of tritium; and (4) approximately 1.0 curies of carbon-14. The airborne radioactivity was contained in a total exhaust air volume of 620 billion liters (22 billion cubic feet). The average radioactivity concentration in the effluent air was well below the applicable standards in the U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment. The annual radioactivity concentration at the nearest Federal reservation boundary, allowing for typical diffusion conditions, was less than 0.01 percent of the U.S. Department of Energy derived concentration guideline for effluent released to unrestricted areas (U.S. Department of Energy Order 5400.5) for the mixture of radionuclides present.

Environmental particulate air samplers are operated in the primary upwind and downwind directions from the Kesselring Site to measure normal background airborne radioactivity and to confirm that Site effluents have no measurable effect on normal background levels. As reported in Reference 4-4, there was no significant difference between the average upwind and downwind radioactivity concentrations. Therefore, any resulting radiation exposure from Kesselring Site operations to off-site individuals is too small to measure and must be calculated. Airborne effluent monitoring data and calculated off-site impact are reported as required by the U.S. Department of Energy Order 5400.1, General Environmental Protection Program, and by Reference 3-2. The Naval Reactors Program files annual reports with the U.S. Environmental Protection Agency Region II and the New York State Department of Environmental Conservation.

The New York State Department of Health conducts independent environmental monitoring of radioactivity in air in the vicinity of the Federal reservation. State personnel collect weekly air samples at a location east of the Federal reservation boundary, near Atomic Project Road. The latest report on Environmental Radiation in New York State (Reference 4-29) states that gross beta activity at this location was within the normal range for background levels, and that iodine-131 was below minimum detection levels.

4.4.5 Existing Nonradiological Conditions - Air Resources

The principal sources of industrial airborne emissions from the Kesselring Site are three steam generating boilers used primarily for heating buildings in the winter. Two boilers are each rated at 6.2 megawatts (21 million British thermal units per hour), and one boiler is rated at 8.8 megawatts (30 million British thermal units per hour). Combustion gases from these operating boilers are released through two exhaust stacks. A fourth boiler and its exhaust stack are no longer in service. The remaining three boilers operate under New York State issued permits and comply with the U.S. Environmental Protection Agency's New Source Performance Standards for emissions from stationary combustion installations (Reference 4-12). Compliance with State and U.S. Environmental Protection Agency standards and with State permit conditions is accomplished by utilization of no more than 700,000 gallons of Number 2 fuel oil in any 12-month period and certification by the fuel supplier that the fuel contains no more than 0.5 percent sulfur. Reports documenting sulfur content are provided to the U.S. Environmental Protection Agency Region II on a quarterly basis. A certification of compliance with State permit conditions, which documents fuel use, is submitted to the New York State Department of Environmental Conservation Region 5 on an annual basis.

Other permitted point sources of airborne emissions include three paint spray operations. Emissions from these operations are logged on a monthly basis to ensure compliance with permit conditions. There are no Federal reporting requirements; however, compliance with State permit conditions is included with the certification of compliance submitted annually to the New York State Department of Environmental Conservation Region 5. Other point sources of airborne emissions at the Kesselring Site are from welding operations, carpentry shops, abrasive cleaning, and metal preparation processes, all of which are associated with routine maintenance operations. Airborne emissions from these miscellaneous small point sources meet New York State requirements for exemption from permitting and reporting, as defined in New York State air regulation NYCRR Title 6, Part 201. As discussed in Reference 4-4, all emissions from permitted point sources at the Kesselring Site conform to the applicable State and Federal clean air standards.

Between 1994 and 1996, there were eight unplanned releases from the Kesselring Site to air. These releases were of chlorodifluoromethane (Freon 22) from air conditioning systems. While there is no Federal reportable quantity criterion for this chemical, the releases were of sufficient quantity (greater than 1 pound) to require reporting to the New York State Department of Environmental Conservation per NYCRR Title 6, Part 595.3. Prior to August 1994, reporting to New York State was not required. There were no health or safety impacts to the public as a result of these releases.

4.5 Terrestrial Resources

4.5.1 Topography

The Kesselring Site is located within the undulating transition zone between the Adirondack Mountains and the Hudson-Mohawk Valley lowlands. Ground elevations in the vicinity of the Federal reservation generally range from 120 to 270 meters (400 to 900 feet) above sea level. The terrain surrounding the Kesselring Site forms a partial bowl having a bottom diameter of approximately 610 meters (2,000 feet) and a maximum height of approximately 46 meters (150 feet). The Kesselring Site is essentially flat with ground elevations ranging approximately from 146 to 149 meters (480 to 490 feet) above sea level.

4.5.2 Geology

Borings drilled in the area surrounding the Kesselring Site identified depths to bedrock ranging from 0 to approximately 61 meters (200 feet), with an average depth of approximately 15 meters (50 feet). Bedrock underlying the broader West Milton area is variable and consists of several types of metamorphosed rocks, including gneiss and granite, and sedimentary rocks, including sandstone, dolomite, limestone and shale (Reference 4-13). Successive bedrock formations mapped in the area around the Kesselring Site (upper to lower layers) include Canajoharie shale, more than 150 meters (500 feet) thick; Trenton, Amsterdam and Lowville limestones, approximately 17 meters (55 feet) thick; Gailor dolomite, approximately 46 meters (150 feet) thick; the Galway Formation, approximately 37 meters (120 feet) thick; Potsdam sandstone approximately 15 to 30 meters (50 to 100 feet) thick; and Precambrian age (greater than 600 million years old) granite and gneiss.

The bedrock in the West Milton area is covered by unconsolidated overburden deposits. The overburden deposits consist of several mixtures of clay, sand, gravel and boulders (Reference 4-13). Categories of overburden deposits include: (1) till - a mixture of glacially deposited rock particles ranging in size from clay to boulders; (2) kames - irregularly layered glacial deposits of sand and gravel; (3) flood-plain deposits - generally horizontal, imperfectly stratified layers of stream-deposited clay, silt, and fine sand; (4) lake-bottom deposits - horizontally stratified layers of clay, silt, and fine sand; and (5) deltaic deposits - relatively homogeneous deposits of fine to coarse sand.

Within the Kesselring Site, overburden deposits range approximately from 4.6 to 46 meters (15 to 150 feet) deep and consist of lake-bottom deposits and glacial till. Coarse backfill materials consisting of sand, gravel and crushed stone have also been added during construction activities. There are no known geologic resources on the Kesselring Site having economic value. Additional information on Kesselring Site geology may be found in Reference 4-23.

4.5.3 Seismology

The Kesselring Site is located in a region with several known geologic faults (Reference 4-13). The two most prominent faults in the West Milton area, the East Galway and West Galway faults, are branches of the Hoffman's Ferry fault. The East Galway fault lies approximately 1,100 meters (3,500 feet) northwest of the Kesselring Site. The West Galway fault lies approximately 2.7 kilometers (1.7 miles) west of the Kesselring Site. The Hoffman's Ferry fault has been traced for approximately 64 kilometers (40 miles) between Hoffman's Ferry on the Mohawk River to Fort Ann, north of the Hudson River. Another fault, known as the Rock City Falls fault, begins approximately 3.2 kilometers (2 miles) northeast of the Kesselring Site. All of these faults generally run southwest to northeast. The faults are very old, dating back approximately 200 million years or more to the development of the Appalachian Mountains.

The Kesselring Site is located in an area that is subject to some seismic activity. The area is located in a seismic zone in which moderate damage is possible. However, records dating back to the 1700s indicate that earthquakes capable of causing damage in the vicinity of the Kesselring Site are rare. These records indicate that the maximum intensity earthquake for the region within a 160-kilometer (100-mile) radius of the Kesselring Site had a Modified Mercalli Intensity of VII, which results in negligible damage to buildings of good design and construction, slight to moderate damage in ordinary structures and considerable damage in poorly built or badly designed structures. The most recent earthquake of that intensity occurred at Lake George, New York, on April 30, 1931. Earthquakes of greater intensity have occurred at epicenters greater than 160 kilometers (100 miles) from the Kesselring Site. However, due to attenuation effects, ground motion at the Kesselring Site from these earthquakes fell below a Modified Mercalli Intensity of VI (felt by all, trees and bushes shake, weak plaster and masonry crack). There are no known voids or other subsurface conditions, either natural or man made, beneath the Kesselring Site property which could affect the surface conditions.

Additional information on local and regional seismic characteristics of the West Milton area may be found in reports issued for Kesselring Site evaluations conducted in association with Site construction projects (References 4-23 and 4-27).

4.5.4 Land Condition Reviews and Solid Waste Management

This section describes the processes under which conditions at the Kesselring Site and Federal reservation have been reviewed by regulatory agencies along with the existing status. Current solid waste management practices are also discussed in detail.

4.5.4.1 The CERCLA Review Process

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, required all Federal facilities to complete a review process known as a preliminary assessment. The preliminary assessment required each Federal facility to be evaluated for the presence of environmentally harmful historical releases. Identified areas were ranked in accordance with a National system used to identify facilities requiring prompt remedial action. Facilities requiring prompt remedial action were placed on the National Priorities List.

The preliminary assessment of conditions at the Kesselring Site and Federal reservation, completed in April 1988 (Reference 4-31), was submitted to the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation. This assessment concluded that the Kesselring Site and Federal reservation had a ranking value which was below the criteria for placement on the National Priorities List. As part of a subsequent expanded site investigation, additional information was provided to the U.S. Environmental Protection Agency and New York State Department of Environmental Conservation in support of their review of the preliminary assessment. Based on Reference 4-31 and the supplementary information, the U.S. Environmental Protection Agency has assigned the Kesselring Site and Federal reservation with a recommendation of Site Evaluation Accomplished (Reference 4-8). This means that, based on current information, the Kesselring Site and Federal reservation do not qualify for inclusion on the National Priorities List. No further action is anticipated under CERCLA.

4.5.4.2 New York State RCRA Corrective Action Program

As required by regulations described in Section 2.5.5 and 2.8.4, the Kesselring Site manages hazardous wastes in accordance with a Resource Conservation and Recovery Act (RCRA) hazardous waste management facility permit issued by New York State on June 1, 1995 (Reference 4-16). In addition to regulating current hazardous waste management activities on the Kesselring Site, Module III of the permit (Corrective Action Requirements for Solid Waste Management Units and Areas of Concern) includes a process for evaluating and, if necessary, remediating locations where waste management activities historically occurred. Module III of the Kesselring Site's hazardous waste management facility permit describes 45 historic locations (formally referred to as solid waste management units or areas of concern - see Glossary). After the permit was issued, the Naval Reactors Program identified an additional 7 locations, which are described in References 4-38, 4-39, and 4-42. The first step of the evaluation process specified in the permit is to assess for each location whether or not hazardous constituents were potentially released to the environment (formally referred to as a RCRA facility assessment). As documented in the permit, the New York State Department of Environmental Conservation has concluded from preliminary assessment efforts that hazardous constituents were not released at 28 of the 52 locations and that no further action is required for those locations. The Naval Reactors Program is remediating 3 of the 52 locations through the completion of interim corrective measures, which are identified in the permit and described later in Sections 4.5.6.1 and 4.5.6.2. New York State approved sampling and analysis (formally referred to as a sampling visit) are ongoing to complete the assessment of another 14 locations. After completion of sampling, the Naval Reactors Program will review the results with the New York State Department of Environmental Conservation and reach agreement on any additional actions required to further characterize or to take remedial actions for the 24 locations where the State has not yet concluded that no further action is required. Final remedial actions (or a determination that no further action is required) for each location would be incorporated in a draft revision to the Site's hazardous waste management facility permit which would be published for public review and comment. Refer to Sections 4.5.6.1 and 4.5.6.2 for additional discussion on RCRA corrective actions.

4.5.4.3 General Nonradiological, Nonhazardous Waste Management

Solid waste generated by the Kesselring Site includes office waste, cafeteria wastes and recyclables. Office and cafeteria wastes do not include chemicals, solvents, cleaning solutions or paint. Recyclables include glass, plastic, newspaper, scrap metal, and corrugated cardboard. Kesselring Site and subcontractor personnel are instructed to segregate solid waste into proper waste streams and recyclables. The Kesselring Site office and cafeteria wastes are shipped to an incinerator in Hudson Falls, New York, for disposal. Construction and demolition debris is shipped to commercial landfills. Recyclables are shipped to a local recycling transfer station.

4.5.4.4 Hazardous and Chemical Waste Management

As discussed in Section 4.5.4.2, the Kesselring Site operates under a New York State issued hazardous waste management facility permit that became effective on June 1, 1995 (Reference 4-16). To ensure the safe use of chemicals and disposal of the resulting wastes, the Kesselring Site maintains hazardous substance control and waste minimization programs as detailed in Reference 4-4. As reported in Reference 4-4, the Kesselring Site shipped approximately 138 metric tons (154 tons) of RCRA and New York State hazardous waste off-site during calendar year 1996.

The Kesselring Site has participated in the New York State Hazardous Waste Reduction Plan (see Section 2.8.5) since 1990. The plan requires that 90 percent of the Kesselring Site's hazardous waste streams, including all streams over 5 tons or any acute hazardous waste stream, be included in the plan for reporting purposes. This plan requires reports to be submitted to New York State biennially with annual updates in alternating years. The report discusses 12 different routine waste streams and how the Kesselring Site plans to reduce the generation of these wastes. The Kesselring Site evaluates waste streams for possible recycling, reuse, reduction or elimination. Since the tracking of these waste streams began, 6 of the targeted waste streams have been eliminated.

Where practical, the Kesselring Site recycles materials which are normally considered industrial waste. These materials include waste oil, batteries and lead. The waste oil is shipped off-site to a disposal facility to be recycled or incinerated. Certain types of batteries and some bulk lead products are collected and recycled.

4.5.4.5 Radiological Waste Management

The solid radioactive wastes generated at the Kesselring Site are byproducts of prototype operations and maintenance. These wastes include items such as spent purification process media (such as used filters and ion exchange resin), high efficiency particulate air filters, solidified radioactive liquids, and consumable products such as sheet plastic and rags. The Kesselring Site maintains a vigorous radioactive waste management and waste minimization program. During 1996, approximately 20,000 kilograms (44,000 pounds) of radioactive metals were shipped off-site for recycling and reuse in other radiological applications. As reported in Reference 4-4, the Kesselring Site shipped approximately 133 cubic meters (175 cubic yards) of low-level radioactive waste off-site during calendar year 1996. This volume represented less than 1 percent of the total low-level radioactive waste volume generated at U.S. Department of Energy facilities during 1995 (Reference 4-37). As discussed in Reference 4-4, all radioactive waste shipments complied with applicable Federal and State regulations and were disposed of at government owned disposal sites.

4.5.4.6 Mixed Waste Management

Waste which is both radioactive and chemically hazardous, known as "mixed waste," is regulated under both the Atomic Energy Act of 1954, as amended, and RCRA, as amended. As described in Section 2.5.9, the New York State Department of Environmental Conservation, which has regulatory authority for mixed waste in New York State, approved a Site Treatment Plan for Mixed Wastes Generated at the Kesselring Site and issued an Administrative Consent Order that became effective on October 24, 1995 (Reference 2-2). The Kesselring Site currently operates under interim status in the New York State permitting process for mixed waste. As part of the permitting process for mixed waste, the New York State RCRA Facility Assessment phase, described in Section 4.5.4.2, was repeated with regard to locations at the Kesselring Site and Federal reservation which may contain mixed wastes. These locations were identified in the mixed waste permit application, which was submitted to the New York State Department of Environmental Conservation in August 1997. The permitting process for mixed waste is subject to public reviews separate from this decision making process for S3G and D1G Prototype reactor plant disposal.

Kesselring Site operations endeavor to generate only small amounts of mixed waste. During 1996, 0.21 cubic meters (7.4 cubic feet) of mixed waste were shipped to a commercial facility in the State of Utah. In January 1997, 0.47 cubic meters (16.6 cubic feet) of mixed waste were shipped to the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory. Treatment of mixed waste was consistent with requirements described in the Site Treatment Plan (Reference 2-2). The Site Treatment Plan includes the current estimates for generation and storage of mixed waste at the Kesselring Site. These projections are reviewed annually and updated as necessary.

4.5.5 Existing Radiological Conditions - General

The Kesselring Site maintains a comprehensive environmental monitoring program that covers all radiological aspects of Site operations. Reference 4-4 provides a description of this program and routine monitoring results. In addition to routine monitoring, special monitoring has been conducted in the areas potentially affected by past operations, such as the Kesselring Site drainage ditches and inactive (former) radiological facilities. As discussed in Reference 2-1, there is no detectable radioactivity due to Site operations in the Glowegee Creek sediment. Biological samples (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 operations. None of the alternatives being considered in detail for disposal of the S3G and D1G Prototype reactor plants include activities which would deposit radioactive materials to the soil on the Kesselring Site or Federal reservation.

4.5.5.1 Existing Radiological Conditions on the Kesselring Site Land

As discussed in Reference 2-1, radioactive materials attributable to Kesselring Site operations have never been disposed of on the Site. However, past activities have resulted in the release of small amounts of radioactive material to soil in localized areas of the Kesselring Site. 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 1950's and early 1960's, monitoring in these channels showed a slow build-up 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 site, and a filter and demineralizer were installed to reduce radioactivity in the water being discharged. Subsequently, low levels of radioactivity build-up were found again during channel monitoring, and the radioactivity concentration discharge limits were further reduced to prevent this build-up of radioactivity from recurring. The areas were dredged and the contaminated soil was shipped off-site to an approved disposal site.

As discussed in Section 4.3.3.2, levels of cesium-137 and cobalt-60 are consistently below minimum detection limits in Site ground water samples. This indicates that the isolated soil areas containing detectable radioactivity, have not affected local ground water conditions.

Based on soil sampling and ground water monitoring results, it is estimated that less than 0.05 curies of man-made radioactivity is contained under the Kesselring Site. This is less than 0.1 percent of the naturally occurring radon radioactivity that is released from the Kesselring Site each year and is roughly equal to the naturally occurring radioactivity in the top 1 inch of soil from a local area the size of the Site.

4.5.5.2 Existing Radiological Conditions on the Federal Reservation Land Surrounding the Kesselring Site

As discussed in Reference 2-1, none of the Federal reservation land is used for disposal of radioactive material. However, evaluations of past activities have identified one remote, localized area on the Federal reservation where small amounts of radioactive material were released to the soil. Between 1958 and 1966, a 0.2-hectare (0.5-acre) area located in the northwest portion of the Federal reservation was used to burn oil and sodium containing low levels of radioactivity. The oil and sodium are attributable to past operation of the decommissioned S1G Prototype reactor plant and related past testing operations which were conducted at the Knolls Atomic Power Laboratory Niskayuna Site. The remote area, known as the Silo Area, is located at a former farm site which was abandoned at the time of the establishment of the Federal reservation (see Figure 4-2).

In 1978, numerous soil samples were collected and surveys were performed which resulted in finding localized areas containing low concentrations of radioactivity above natural background levels. Approximately 63 cubic meters (82 cubic yards) of contaminated soil were removed from the Silo Area in 1978 and sent to an approved disposal site. In 1987, additional surveys and sample collections were performed. The highest concentrations of radioactivity found in 1987 were 179 picocuries per gram of cesium-137 and 6 picocuries per gram of cobalt-60. An estimated 115 cubic meters (150 cubic yards) of soil containing radioactivity attributable to past operations remain in this area. The total radioactivity content in this soil is estimated to be about 0.05 curies. Gamma radiation monitoring of the Silo Area indicates natural background radiation levels except for one small area which has twice the natural background levels. Ground water samples from monitoring wells have indicated no detectable radioactivity above background levels. As discussed in Reference 2-1, the total amount of residual radioactivity in the soil of the Silo Area is less than the amount of naturally occurring radioactivity that would be found in the top 4 feet of soil covering a local area of the same size.

4.5.6 Existing Nonradiological Conditions - General

Since the beginning of prototype operations at the Kesselring Site more than 40 years ago, a variety of chemical and hazardous wastes have been generated, some of which were disposed of on Federal reservation land in accordance with normal practices at that time. All identified disposal locations are within the Federal reservation boundary and compose less than 1 percent of the Federal reservation land. Reference 2-1 provides general information on the nonradiological conditions at the Kesselring Site and Federal reservation. As discussed in Section 4.5.4.1 and Reference 4-8, the Kesselring Site and Federal reservation do not qualify for inclusion on the National Priorities List; no further action is anticipated under the Comprehensive Environmental Response, Compensation, and Liability Act.

4.5.6.1 Existing Nonradiological Conditions on the Kesselring Site Land

As discussed in detail in Section 4.5.4.2, an effort is ongoing to evaluate and, if necessary, remediate locations where waste management activities historically occurred. Forty-two (42) of these locations are within the developed area of the Kesselring Site. The locations are generally associated with waste water treatment tanks, waste water and waste oil collection tanks, and solid waste storage facilities. Each location is described in the Kesselring Site's hazardous waste management facility permit (Reference 4-16) or in References 4-38 and 4-39.

Interim corrective measures have been completed in two small areas of the Kesselring Site. These corrective measures involved removal of surface soil containing lead from an approximately 9.3 square meter (100 square foot) area associated with a firing range and an approximately 280 square meter (3,000 square foot) area formerly used for storage of temporary lead shielding. As documented in Reference 4-30, the New York State Department of Environmental Conservation considers remediation efforts in these two areas "were successful in decreasing the lead levels in soil to levels comparable to background levels in the vicinity of these areas" and no further action is required. The remaining locations either require no action or are still undergoing evaluation. Currently, no significant or large scale remedial actions are expected to be required for these remaining locations.

As part of Kesselring Site operations, small inadvertent spills of hazardous materials have occurred. When spills occur, immediate actions are taken to quickly contain and clean up the affected area. Between 1988 and 1996, there were 73 documented spills at the Kesselring Site consisting of a total volume of less than 3,400 liters (900 gallons). The spills contained either petroleum products or ethylene glycol (anti-freeze), as described in detail below. In accordance with regulations which define the minimum reportable quantities of specific hazardous materials, these spills were reported to the appropriate regulatory agencies.

Spills involving petroleum products, which account for 58 of the 73 documented spills, were reported to the New York State Department of Environmental Conservation. The majority of the spilled petroleum products originated from operating equipment and included products such as lubricating oil and hydraulic fluids, gasoline, and diesel fuel. These spills involved a total of approximately 3,300 liters (860 gallons). In the time since the spills occurred, applicable New York State regulations have changed. Under the current implementing regulations, 20 of the spills involving only small quantities would not have required reporting. The largest spill (2,300 liters, or 600 gallons, of diesel fuel) was completely contained in a concrete enclosure and subsequently cleaned up with no effect on Kesselring Site conditions. There was one historic spill of gasoline that was discovered during initiatives to remove an underground storage tank. Cleanup efforts included soil removal; however, residual petroleum products can still be detected in a small area near the southwest corner of the Kesselring Site. Conditions in this area have been reported and agreed to by the New York State Department of Environmental Conservation.

Spills involving ethylene glycol, which account for 15 of the 73 documented spills, were reported to the New York State Department of Environmental Conservation and the U.S. Environmental Protection Agency between 1992 and 1996. These spills involved a total of approximately 87 liters (23 gallons) having an estimated 50 percent mixture concentration. In the time since these spills occurred, applicable regulations have changed. Under the current implementing regulations for the Comprehensive Environmental Response, Compensation, and Liability Act, none of these spills would be reportable to the U.S. Environmental Protection Agency. Spills involving ethylene glycol occurred on paved areas; and after cleanup, conditions at the Kesselring Site were unaffected.

4.5.6.2 Existing Nonradiological Conditions on the Federal Reservation Land Surrounding the Kesselring Site

As discussed in detail in Section 4.5.4.2, an effort is ongoing to evaluate and, if necessary, remediate locations where waste management activities historically occurred. Ten (10) of these locations are on the Federal reservation land surrounding the developed area of the Kesselring Site. The locations are associated with various past waste disposal areas. Nine (9) of the locations are described in the Kesselring Site's hazardous waste management facility permit (Reference 4-16), and the other location is described in Reference 4-42.

Interim corrective measures have been completed in one of the past waste disposal areas, located near the west side of Hogback Road. These corrective measures involved limited sampling of an area used for construction material debris. As documented in Reference 4-40, the New York State Department of Environmental Conservation considers no further action is necessary in this area. The remaining locations either require no action or are still undergoing evaluation. Currently, no significant or large scale remedial actions are expected to be required for these remaining locations.

4.6 Socioeconomics

The population distribution within an 80-kilometer (50-mile) radius of the Kesselring Site, compiled from 1990 Census data, is shown in Figure 4-4. Table 4-1 summarizes the population distribution.

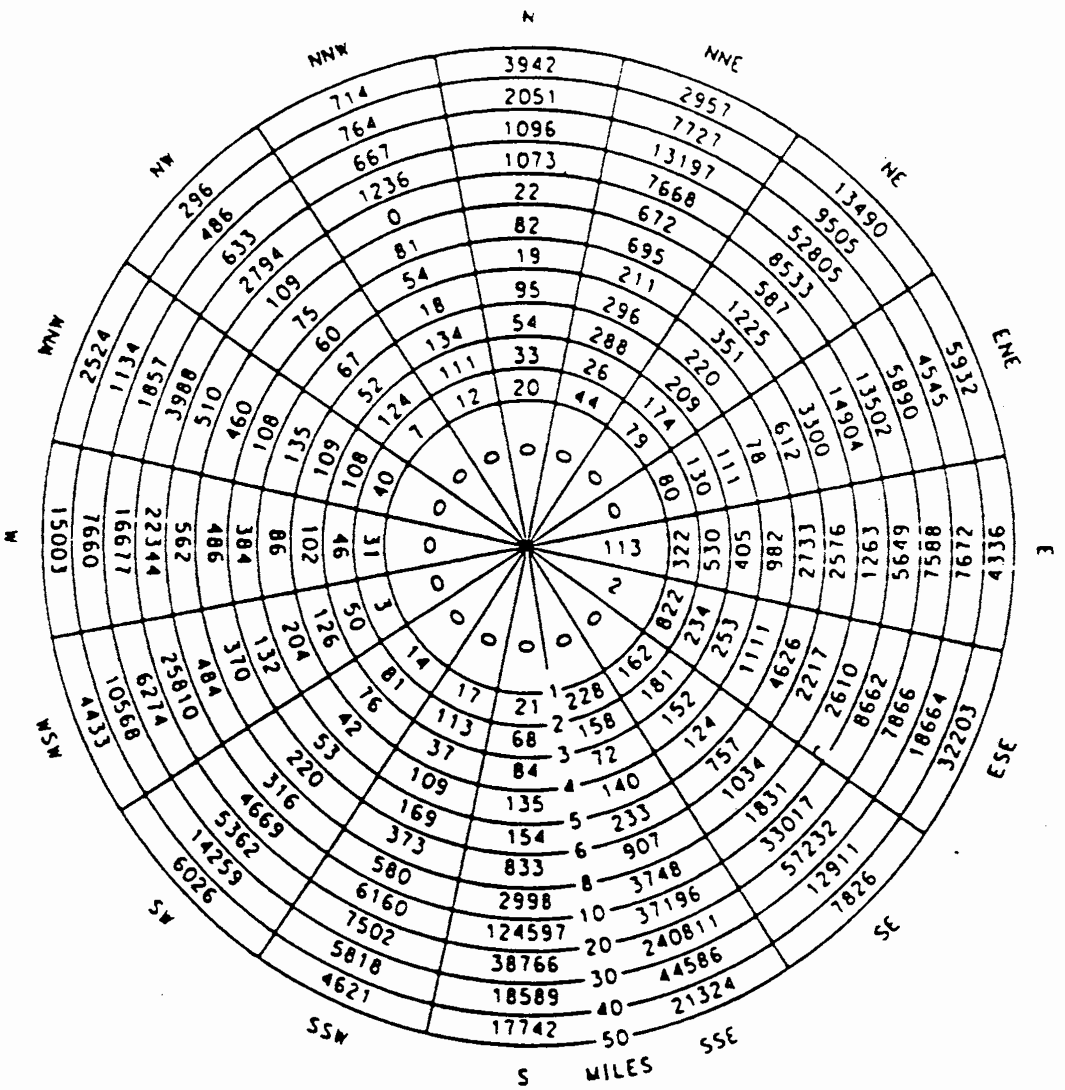

Figure 4-4: 1990 Population Distribution Within an 80-Kilometer (50-Mile) Radius of the Kesselring Site

Table 4-1: Population Distribution Within an 80-Kilometer (50-Mile) Radius of the Kesselring Site

Kilometers	Miles	People	Cumulative People
0 - 8	0 - 5	10,290	10,290
8 - 16	5 - 10	56,786	67,076
16 - 32	10 - 20	306,898	373,974
32 - 48	20 - 30	464,223	838,197
48 - 64	30 - 40	166,939	1,005,136
64 - 80	40 - 50	143,369	1,148,505

Kesselring Site staffing near the end of 1997 is estimated at approximately 700 civilian personnel (including subcontractor) and 1,000 U.S. Navy personnel. More than 75 percent of the labor force employed at the Kesselring Site resides in Saratoga and Schenectady Counties, within 32 kilometers (20 miles) of the Site. Table 4-2 presents socioeconomic data for the immediate vicinity of the Kesselring Site and for the surrounding region based on 1990 Census data compiled by the Capital District Regional Planning Commission and the New York State Data Center, Department of Economic Development.

Table 4-2: Socioeconomic Data for the Immediate Vicinity of the Kesselring Site and for the Surrounding Region

	Immediate Vicinity [a]	Surrounding Region [b]
Population	17,900	436,700
Percent Non - White Population [c]	1	4
Percent Hispanic Population	1	2
Civilian Labor Force	9,500	219,900
Civilian Employment	8,900	207,600
Unemployment Rate (percent)	6	6
Average Household Income	$33,000	$32,000
Percent Living Below Poverty [d]	7	8

a. Includes data for the Towns of Milton and Galway.
b. Includes data for the Counties of Saratoga, Schenectady, Montgomery and Fulton.
c. Includes "Black", "Asian or Pacific Islander", "American Indian, Eskimo or Aleut", and "Other Races".
d. The U.S. Census Bureau characterizes persons living in poverty as those whose income is less than a "statistical poverty threshold." For the 1990 Census, this threshold was based on a 1989 income of $12,500 per household.

4.7 Cultural Resources

Prior to construction of the Kesselring Site, land that is now part of the Federal reservation was used for agricultural purposes. There are three small burial plots on the Federal reservation that are of historical significance. Construction activities at the Kesselring Site have not identified any objects of historical, archaeological or cultural significance in the vicinity of the prototypes. The current National Register of Historic Places (Reference 4-17) does not list any historic sites, buildings, structures, or objects within the Kesselring Site or Federal reservation.

The Hortonsphere, the spherical containment structure in which the D1G Prototype reactor plant is housed at the Kesselring Site, has potential historical significance. When construction was completed in 1953, the Hortonsphere was the largest structural sphere built to date. In 1954, the Hortonsphere became the first operational power reactor pressure containment, establishing a major safety precedent of enclosing power reactors which are located near population centers. In 1986, the D1G Hortonsphere was designated as a Nuclear Historic Landmark by the American Nuclear Society. None of the alternatives would involve dismantling the Hortonsphere.

The Naval Reactors Program does not consider the S3G and D1G Prototypes to have any historical significance. Both prototypes are follow-on developments, and are merely part of the many land-based prototypes that were built and operated by the Naval Reactors Program. Each prototype had an operating follow ship: S3G was the prototype for a single U.S. Navy submarine, the USS Triton (SSN 586), and D1G was the prototype for a single U.S. Navy surface ship, the USS Bainbridge (CGN 25). The U.S. Navy has decommissioned and defueled both of these operating ships.

4.8 Noise, Aesthetic and Scenic Resources

The Kesselring Site is located a minimum of 1.4 kilometers (0.9 miles) from the boundary of the Federal reservation and is fully surrounded by woodlands and low hills. There is very little visibility of the Kesselring Site facilities from public roadways. Like many industrial facilities, there are no resources of scenic or aesthetic value on the Kesselring Site.

Noise is generated by routine Kesselring Site operations, typically equivalent to light industrial activity, such as noise from truck and automobile traffic, and from operating industrial equipment such as diesel or gasoline powered engines and pneumatic tools. Noise is generally not discernible beyond the Federal reservation boundary. However, noise from sirens and loudspeakers at the Kesselring Site may be heard occasionally beyond the Federal reservation boundary. Air operated sirens, similar to a typical firehouse siren, and loudspeakers are most commonly operated at the Kesselring Site in support of routine training exercises to maintain the proficiency of operating plant personnel and support personnel. The sirens are also routinely tested, and the loudspeakers are used for general Kesselring Site announcements. Because the Kesselring Site operates 24 hours a day, year round, the sirens and loudspeakers may occasionally be heard at night and on holidays.

4.9 Traffic and Transportation

No public roads, highways, railways, or navigable waterways traverse the Federal reservation.

Two major interstate highway corridors are located in the vicinity of the Federal reservation. Approximately 16 kilometers (10 miles) to the east, Interstate 87 serves north-south traffic through the Hudson-Champlain corridor. Approximately 24 kilometers (15 miles) to the south, Interstate 90 serves east-west traffic through the Hudson-Mohawk corridor. Secondary roads bounding the Federal reservation are used for local residential traffic, commuting, and delivery routes by a variety of businesses. Secondary roads include State Route 29, approximately 3 kilometers (2 miles) to the north; State Route 67, approximately 6 kilometers (4 miles) to the south; State Route 50, approximately 10 kilometers (6 miles) to the east; and State Route 147, approximately 6 kilometers (4 miles) to the west.

Traffic associated with Kesselring Site operations does not contribute notably to overall traffic conditions in the area. For example, during 1996, there were approximately 850 shipments of materials as a result of routine Kesselring Site operations. Of this total, less than 50 shipments contained radiological materials, such as low-level radiological waste, anti-contamination clothing and radiation monitoring equipment. The approximately 800 remaining shipments were associated with nonradiological materials such as construction debris, recyclable metals, and routine transfers of equipment with other facilities and vendors. The total number of shipments for 1996 is equivalent to an average number of 16 shipments per week.

Kesselring Site employee traffic represents only a small fraction of traffic on local and Saratoga County roads. Since the Kesselring Site operates 24 hours a day, year round, Site employee traffic is distributed over each day. Most traffic (about 900 to 1,000 vehicles) occurs during regular dayshift hours, Monday through Friday. The balance of general Kesselring Site employee traffic occurs on backshifts and on weekends. Both Atomic Project Road and Hogback Road are used for general employee traffic.

Two lines of the Delaware and Hudson Railroad cross the region within 16 kilometers (10 miles) of the Federal reservation. The main north-south line runs through Ballston Spa, approximately 13 kilometers (8 miles) to the southeast, and a branch line runs just over 8 kilometers (5 miles) to the northeast into the central Adirondack area.

Commercial barge traffic occurs on the New York State Erie Canal, southwest of the Federal reservation, and on the less used Champlain Canal, east of the reservation. Docking facilities are available at the Port of Albany and further south at the Port of New York.

Albany County Airport, approximately 35 kilometers (22 miles) south-southeast of the Federal reservation, is the nearest airport with scheduled flights by commercial jet aircraft. Schenectady County Airport, approximately 24 kilometers (15 miles) south of the Federal reservation, is an auxiliary field with a low volume of traffic relative to size. No commercial air carriers provide scheduled service out of Schenectady County Airport. The bulk of Schenectady County Airport's traffic is small corporate and private aircraft, with the rest being mostly military cargo aircraft from the 109th New York Air National Guard. Saratoga County Airport, located approximately 7.2 kilometers (4.5 miles) east of the Federal reservation, is a small airport used mostly by light private aircraft. Data furnished by air traffic control representatives for the three area airports indicate that regular airport traffic patterns for military, commercial, and private aircraft, large and small, do not pass within an 8-kilometer (5-mile) radius of the Kesselring Site (Reference 2-7). The instrument approaches for Albany and Schenectady County Airports, designated by the Federal Aviation Administration, also do not pass within an 8-kilometer (5-mile) radius of the Kesselring Site. Aircraft using the instrument approach to the Saratoga County Airport have the potential for overflying the Kesselring Site.

4.10 Health and Safety

4.10.1 Occupational Health and Safety

The Naval Reactors Program's policy is to maintain a healthful work environment at all of its facilities in accordance with U.S. Department of Energy regulations and consistent with Occupational and Safety Health Administration standards, where appropriate, for all site activities.

4.10.1.1 Radiological Occupational Health and Safety

The Naval Reactors Program's policy is to maintain the external exposure to personnel from ionizing radiation associated with Naval nuclear propulsion plants to levels as low as reasonably achievable. Stringent Naval Reactors Program radiological controls have been successful in minimizing occupational radiation exposure. No personnel at the Naval Reactors Program's facilities have ever exceeded the applicable Federal annual radiation exposure limit. The annual limit was 15 rem per year in 1958 and is currently 5 rem per year. No worker has exceeded the Naval Reactors Program limit of 5 rem per year since this limit was established in 1967, and no worker has received more than 2 rem per year from radiation associated with Naval nuclear propulsion plants since 1979. Since 1958, the average annual occupational exposure per person monitored has been 0.12 rem. The average lifetime accumulated radiation exposure for the 148,000 personnel who have been monitored at the Naval Reactors Program's facilities is about 0.34 rem (Reference 4-22). This corresponds to an average per person risk of developing a latent fatal cancer of 0.00014 (1 chance in about 7,400). Using data from Reference 4-22 specific only to Naval Reactors Program prototypes for the years 1990 through 1996, the average annual occupational exposure per person monitored was 0.074 rem. This value provides a representative measure of current Kesselring Site occupational exposure.

The Naval Reactors Program's policy on occupational exposure from ingested or inhaled radioactivity is to prevent any measurable radiation exposure to personnel from internal radioactivity. The limits invoked to achieve this objective are 10 percent of the levels allowed by Federal regulations for radiation workers. Since 1972, as a result of this policy, no worker has received more than 10 percent of the Federal annual occupational exposure limit from internal radiation exposure caused by radioactivity associated with work at Naval Reactors Program facilities.

4.10.1.2 Nonradiological Occupational Health and Safety

According to the U.S. Department of Labor, injuries in the workplace are most likely to be sprains and strains, bruises and contusions, cuts and lacerations, and fractures. Injuries are most likely to occur from contact with equipment and other objects, falls, and overexertion. Generally, fatalities in the workplace (non-violence related) are most likely to result from contact with equipment and other objects, falls, and exposure to harmful substances or conditions (Reference 4-18).

The Naval Reactors Program's approach to maintaining a safe and healthful work environment emphasizes personal responsibility, technical knowledge, training, and oversight. Engineered systems and administrative controls are the primary means employed for minimizing potential employee exposure to occupational hazards. If hazards cannot be controlled with engineering or administrative controls, personal protective equipment is used to provide additional protection.

Impact of workplace hazards other than radiation is measured by recordable injury/illness and fatality rates in the work force. Injury/illness and fatality rates for construction (demolition) workers are considered separately because of the more hazardous nature of their work. Table 4-3 provides recordable injury/illness and fatality rates for the Naval Reactors Program, averaged over a period of 5 years, as compared to private industry and the U.S. Department of Energy and its contractors. Recordable injury/illness and fatality rates for the Naval Reactors Program have been consistently lower than the rates reported by private industry and the U.S. Department of Energy. For further information on the Naval Reactors Program nonradiological occupational safety and health practices and performance, refer to Reference 4-14.

The evaluations provided by this Environmental Impact Statement involve heavy dismantlement (demolition) work, which represents only a small portion of Naval Reactors Program operations. Therefore, nonradiological occupational health and safety evaluations in this Environmental Impact Statement are based on overall U.S. Department of Energy statistics to provide more representative and conservative impact estimates.

Table 4-3: Average Occupational Injury/Illness and Fatality Rates

	All labor categories		Construction workers	
	Total injuries and illnesses per worker-year	Fatalities per worker-year	Total injuries and illnesses per worker-year	Fatalities per worker-year
Naval Reactors Program [a]	0.022	0	0.044	0
Department of Energy and Contractors [a]	0.036	0.00003	0.066	0.0001
Private Industry [b]	0.089	0.000058	0.12	0.00022

a. 1989-1993 averages (Reference 4-19).
b. 1990-1994 averages (Reference 4-20).

4.10.2 Public Health and Safety

4.10.2.1 Radiological Public Health and Safety

Effluent and environmental monitoring results show that the radioactivity in liquid and gaseous effluents from operations at the Kesselring Site in 1996 had no measurable effect on background radioactivity levels. Therefore, any radiation doses from Kesselring Site operations to off-site individuals were too small to be measured and must be calculated using conservative methods. As reported in Reference 4-4, the following estimates were determined: (1) the radiation dose to the maximally exposed individual in the vicinity of the Kesselring Site was less than 0.1 millirem, (2) the average dose to members of the public residing in the 80-kilometer (50-mile) radius assessment area surrounding the Site was less than 0.001 millirem, and (3) the collective dose to the population residing within 80 kilometers of the Site was less than 0.1 person-rem.

The results show that the estimated doses were less than 0.1 percent of that permitted by the U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment. The results also show that the estimated dose to the population residing within 80 kilometers (50 miles) of the Kesselring Site was less than 0.001 percent of the natural background radiation dose to the same population. In addition, the estimated doses were less than 1 percent of that permitted by the U.S. Nuclear Regulatory Commission numerical guide listed in Reference 4-32 for whole-body dose, demonstrating that doses are as low as reasonably achievable. The dose attributed to radioactive air emissions was less than 1 percent of the U.S. Environmental Protection Agency standard given in Reference 3-2.

The collective radiation dose to the public along travel routes from Kesselring Site shipments of radioactive materials during 1995 was calculated using data given by the U.S. Nuclear Regulatory Commission in Reference 4-33. Based on the type and number of shipments made, the collective annual radiation dose to the public along the travel routes, including transportation workers, was less than 1 person-rem. This is less than 0.001 percent of the dose received by the same population from natural background radiation.

To provide perspective on the above discussion, the collective dose received in 1996 by the population residing within 80 kilometers (50 miles) of the Kesselring Site from natural background radiation is estimated to be 83,000 person-rem (Reference 4-4). This estimate is based on an average cosmic and terrestrial natural background radiation level of approximately 72 millirem measured in the vicinity of the Kesselring Site, which does not include radiation from radon and from radioactivity within the body.

4.10.2.2 Nonradiological Public Health and Safety

Nonradiological public health and safety involves a variety of factors. Details of Kesselring Site operations and existing nonradiological conditions in the environment surrounding the Site are discussed in other sections of this chapter. Related information is covered in Section 4.3 for water resources, Section 4.4 for air resources, and Section 4.5 for terrestrial resources. Based on information provided in References 2-1 and 4-4, Kesselring Site operations meet all applicable Federal, State and local requirements. In addition, Kesselring Site operations and existing nonradiological conditions in the environment surrounding the Site are not impacting public health and safety.

4.11 Utilities and Energy

Kesselring Site electricity is supplied by the Niagara Mohawk Power Company. During 1996, the Kesselring Site used approximately 47,000 megawatt-hours of electricity. Monthly fuel use at the Kesselring Site during 1996 averaged approximately 163,000 liters (43,000 gallons) of fuel oil, 7,000 liters (1,800 gallons) of liquid propane, 3,000 liters (800 gallons) of gasoline, and 800 liters (200 gallons) of diesel fuel.

CHAPTER 5

ENVIRONMENTAL CONSEQUENCES

5.0 Environmental Consequences

This chapter describes the potential environmental consequences associated with the no action, prompt dismantlement, and deferred dismantlement alternatives for S3G and D1G Prototype reactor plant disposal. This chapter also provides a brief description of analysis methodology, results, and conclusions. A basic, overall understanding of the environmental consequences can be gained without reading the appendices. However, those appendices are frequently cited to assist the reader in finding additional information on specific topics. To further assist the reader and decision makers, this chapter is organized by alternatives. All environmental topics of concern are discussed within the section devoted to each alternative.

The environmental consequences are determined by comparing estimated impacts (such as hypothetical health risk) to the baseline environmental conditions described in Chapter 4. All of the environmental consequences would be very small. Detailed analyses of potential impacts on worker and public health are described in Appendix B for facility activities and Appendix C for transportation of materials off-site. In addition, Appendices B and C discuss potential consequences and risks of various accident scenarios. Appendix A provides information on common sources of radiation, radiological controls, risks associated with radiological and nonradiological hazards, potential health effects, and radiological characteristics of the S3G and D1G Prototype reactor plants. Appendix D provides classified information on the operating prototypes, MARF and S8G. Section 5.5 provides an unclassified summary of the safety aspects of reactor plant operations, and covers all potential environmental impacts and conclusions discussed in Appendix D.

Hypothetical radiological health effects are expressed in terms of latent fatal cancers. The most significant potential health effect from environmental and occupational radiation exposure is the inducement of latent fatal cancers. This effect is referred to as latent because cancer may take many years to develop. It is important to emphasize that these latent cancer fatalities are estimated results rather than actual expected fatalities. This is because the expected number of such fatalities is so small as to be unmeasurable and indistinguishable relative to the larger number of such deaths expected from naturally occurring conditions and from other man made effects not related to either Kesselring Site operations or to any of the alternatives discussed in the following sections.

Detailed analyses discussed in the appendices support the conclusion that public radiological exposure resulting from any of the reasonable alternatives for disposal of the S3G and D1G Prototype reactor plants would be very small.

NO ACTION ALTERNATIVE

5.1 No Action Alternative

The no action alternative would include maintaining and monitoring the defueled S3G and D1G Prototype reactor plants in place and in a stable condition for a caretaking period of indefinite duration. This alternative involves no prototype reactor plant dismantlement activities and no waste shipments.

Radiological work on contaminated systems or opening of contaminated systems in the reactor compartments would not be expected during the caretaking period. Periodic inspections and radiological surveys would be conducted each year during the caretaking period to confirm the continued integrity of the reactor plant systems and reactor compartment structures. Periodic monitoring would involve radiological surveys, air samples, and radiation monitoring, inside and outside of the reactor compartments.

For the purposes of comparison to the other alternatives, a 30-year time frame was assumed in analyses that evaluate the environmental effects of this alternative. Environmental impacts are discussed below.

5.1.1 Land Use

The no action alternative would not result in any changes to the present or planned use of the Kesselring Site, Federal reservation or surrounding areas. Caretaking activities would be confined to the Kesselring Site which is an already developed area. No land on the Federal reservation and no additional land outside the Federal reservation would have to be set aside for waste disposal. Impacts to existing agricultural, residential, recreational, or industrial land use in the surrounding area would not be expected.

5.1.2 Ecological Resources

There are no woodlands, State or Federally designated wetlands, or significant biological habitats within the Kesselring Site. There have been no documented sightings of Federal or State designated endangered, threatened, or special concern species on the Kesselring Site (Reference 4-5). Since caretaking activities would be confined to the Kesselring Site, ecological resources located on the Federal reservation would not be impacted.

5.1.3 Water Resources

Caretaking activities over an indefinite period would not change existing ground or surface water conditions on the Kesselring Site and Federal reservation. Independent of caretaking activities, monitoring and reporting of water conditions on the Kesselring Site and Federal reservation would continue as discussed in Section 4.3.

The Kesselring Site is located at elevations above the indicated 100-year flood boundary (Reference 4-6). Because caretaking activities would be confined to the Kesselring Site, floodplains that exist on the Federal reservation would not be affected. Since caretaking activities would not take place in a floodplain and would not affect any designated wetlands, caretaking is not a floodplain/wetlands action and the requirements of 10 CFR 1022 are not applicable.

5.1.3.1 Water Resources - Radiological Consequences

Caretaking activities would not result in any discharges of radioactive liquid effluents to the environment. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would not be expected.

5.1.3.2 Water Resources - Nonradiological Consequences

While water usage and nonradiological waste water discharges would be less due to the lower staffing levels, it would be indistinguishable from existing conditions. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would be not be expected. Nonradiological waste water discharges from the Kesselring Site to the Glowegee Creek would continue to be monitored in accordance with the State Pollutant Discharge Elimination System permit, and results would continue to be reported monthly.

5.1.4 Air Resources

Air discharges from the Kesselring Site would be approximately the same as existing conditions. Air discharges would continue to be monitored as discussed in Section 4.4.

5.1.4.1 Air Resources - Radiological Consequences

Airborne particulate radioactivity emissions associated with the no action alternative were evaluated. The details of the analysis are provided in Appendix B, Section B.2. Table B-4 provides the estimated radioactivity that would be discharged per year. Adding the data from Table B-4 for each radionuclide and for each prototype results in an estimated annual airborne discharge of 3.1×10^{-6} curies. The cumulative discharge of all radionuclides over a 30-year caretaking period would be approximately 9.3×10^{-5} curies.

As discussed in Section 4.4.4 and Reference 4-4, the radioactivity contained in exhaust air during 1996 consisted of: (1) less than 0.001 curies of krypton-85 and particulate fission and activation products having half-lives greater than 3 hours; (2) approximately 2.2 curies of noble gases with half-lives of 12 days or less, principally argon-41, xenon-133, and xenon-135; (3) approximately 0.3 curies of tritium; and (4) approximately 1.0 curies of carbon-14. Compared to these airborne discharges associated with normal Kesselring Site operations, which were well below applicable standards, the amount of airborne radioactivity that would be discharged annually during the no action alternative is small (less than 1 percent of existing conditions). Therefore, impacts to air resources would be indistinguishable from existing conditions.

NO ACTION ALTERNATIVE

5.1.4.2 Air Resources - Nonradiological Consequences

Environmental impacts on air resources from nonradiological emissions were evaluated for several sources, including facility heating and vehicle emissions. The S3G Prototype reactor compartment would be heated by electric heaters and would not result in any nonradiological emissions. The D1G Prototype reactor compartment would continue to be heated by steam from the Kesselring Site boilers. Nonradiological emissions from the heating load due to caretaking activities would be approximately the same as existing Kesselring Site emissions. Overall vehicle emissions would be somewhat reduced due to the lower staffing levels. Therefore, impacts to air resources would be indistinguishable from existing conditions.

5.1.5 Terrestrial Resources

Caretaking activities over an indefinite period would not change existing terrestrial conditions on the Kesselring Site and Federal reservation. Caretaking activities would include periodic inspections of the S3G and D1G Prototype reactor compartments and surrounding areas. Independent of caretaking activities, monitoring, reporting and corrective actions on the Kesselring Site and Federal reservation would continue as discussed in Sections 4.5.4 through 4.5.6.

5.1.5.1 Terrestrial Resources - Radiological Consequences

During the caretaking period, the stringent radiological controls practices used in the Naval Reactors Program would continue. Operations would include periodic radiological surveys of the S3G and D1G Prototype reactor compartments and surrounding areas. Surveys would be performed by trained Kesselring Site radiological controls personnel. Impacts to terrestrial resources would not be expected.

5.1.5.2 Terrestrial Resources - Nonradiological Consequences

During the caretaking period, general upkeep and maintenance inspections would be periodically conducted of the S3G and D1G Prototype reactor compartments and surrounding areas. Impacts to terrestrial resources would not be expected.

5.1.6 Socioeconomics

Kesselring Site staffing near the end of 1997 is estimated at approximately 700 civilian personnel (including subcontractors) and 1,000 U.S. Navy personnel. The labor force needed to support caretaking activities at the Kesselring Site is estimated at 1 equivalent full-time worker. The no action alternative would result in a staff reduction of approximately 200 civilian personnel for the caretaking period. While this would be a noticeable reduction of the civilian work force at the Kesselring Site, it would represent only about 0.1 percent of the employment level in the surrounding region (see Table 4-2). Therefore, the no action alternative would not have any discernible socioeconomic impact.

5.1.7 Cultural Resources

The no action alternative does not involve excavation, construction or demolition activities on the Kesselring Site or on the Federal reservation. Therefore, cultural resources would not be impacted.

5.1.8 Noise, Aesthetic and Scenic Resources

The Kesselring Site is located a minimum of 1.4 kilometers (0.9 miles) from the boundary of the Federal reservation and is fully surrounded by woodlands and low hills. There is very little visibility of the Kesselring Site facilities from public roadways. Like many industrial facilities, there are no resources of scenic or aesthetic value on the Kesselring Site. The no action alternative does not involve excavation, construction or demolition on the Kesselring Site or on the Federal reservation. Noise generation would be indistinguishable from existing levels. Therefore, noise, aesthetic or scenic resources would not be impacted.

5.1.9 Traffic and Transportation

The no action alternative would result in a staff reduction of approximately 200 civilian personnel. As a result, general Kesselring Site employee traffic would be lower. This alternative involves no waste shipments and consequently, no change in the volume of current truck traffic is expected. Therefore, the no action alternative would have a small positive impact on regional and local traffic conditions.

5.1.10 Occupational and Public Health and Safety (Incident-Free)

This section summarizes analytical results for expected incident-free conditions during a nominal 30-year caretaking period for the no action alternative. Detailed analyses of potential impacts on occupational (worker) and public health and safety for facilities activities are presented in Appendix B. There would be no off-site transport of materials associated with this alternative; therefore, the transportation analyses of Appendix C do not apply.

5.1.10.1 Facility Activities - Radiological Consequences

The radiological health risks associated with incident-free facility activities during a 30-year caretaking period were evaluated in Appendix B, Section B.2. Effects from assumed airborne particulate radioactivity releases and exposure to direct radiation were assessed for the worker, maximally exposed off-site individual and the general population. For the workers, analyses were based on radiation survey data from the S3G and D1G Prototype reactor compartments, staffing levels, and time in or near the reactor compartments. For the general population, analyses were based on the cumulative exposure to all members of the general population living within an 80-kilometer (50-mile) radius of the Kesselring Site.

NO ACTION ALTERNATIVE

The details of the analyses are provided in Appendix B, Section B.2. The health risks from radiation exposure, through various pathways, have been summarized in Appendix B, Table B-7. It is conservatively estimated that radiation workers would receive a collective dose of 22 person-rem (0.0088 risk of single additional latent fatal cancer). On an annual basis, the average risk to radiation workers of a single additional latent fatal cancer would be 4.2×10^{-5}. The general population would receive a collective dose of 9.9×10^{-6} person-rem (5.0×10^{-9} risk of single additional latent fatal cancer) from exposure over 30 years during the caretaking period. On an annual basis, the average risk to an individual in the general population of a single additional latent fatal cancer would be 1.4×10^{-16}.

5.1.10.2 Facility Activities - Nonradiological Consequences

Naval Reactors Program policy is to maintain a safe and healthful environment at all facilities, including the Kesselring Site. Caretaking activities would be limited to maintenance, surveillance and security tours by a small number of personnel. As a result, incident-free nonradiological consequences would be very small.

5.1.11 Facility Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3, provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. The results of these analyses are presented in terms of the latent fatal cancers, additional fatalities and health risks to workers and the public. Appendix B, Section B.4, provides analyses of two nonradiological facility accidents, including a diesel fuel fire and a spill of stored chemical products. The results of these analyses are compared to Emergency Response Planning Guideline values for individual workers and the public (maximally exposed off-site individual).

5.1.11.1 Facility Accidents - Radiological Consequences

Several hypothetical accident scenarios that would result in release of radioactivity to the environment were evaluated to determine the long-term health risks. The hypothetical release of airborne radioactivity and exposure to radiation during accident scenarios were assessed for the worker, maximally exposed off-site individual and the general population.

As described in Appendix B, Section B.1.2, accidents were considered if they were expected to contribute substantially to risk. Risk is defined as the product of the probability of occurrence times the consequence of the accident. The four hypothetical accident scenarios evaluated for this Environmental Impact Statement included: (1) a large component drop, (2) mechanical damage of a component due to a wind-driven missile, (3) a high efficiency particulate air filter fire, and (4) a large volume spill of radioactive water. Variables considered in the analyses include airborne particulate radioactivity source terms, population density, meteorological conditions, affected area, and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation).

NO ACTION ALTERNATIVE

For the no action alternative, a high efficiency particulate air filter fire and a large volume spill of radioactive water were evaluated in detail. A component drop accident was not evaluated since lifting or handling of large components would not occur during the caretaking period. A wind-driven missile accident was not evaluated in detail since the D1G Hortonsphere and the steel hull of the S3G Prototype reactor compartment would absorb most of the energy from any wind-driven missiles and would prevent a release of radioactive materials to the environment.

The details of the analyses are provided in Appendix B, Sections B.3.3 and B.3.4. As shown in Appendix B, Table B-26, the accident with the greatest risk during caretaking activities would be a high efficiency particulate air filter fire. The combined S3G and D1G cumulative risk for a member of the general population developing a latent fatal cancer due to a high efficiency particulate air filter fire for a 30-year caretaking period would be 1.4×10^{-9}. This risk is the sum of the products of the probability of the accident occurring times the consequence of the accident times the duration of the caretaking period. On an annual basis, the highest individual risk to a member of the general population of a single additional latent fatal cancer would be 4.2×10^{-17}, as shown in Appendix B, Tables B-20 and B-22. These accident risks would be small compared to incident-free radiological impacts.

5.1.11.2 Facility Accidents - Nonradiological Consequences

Caretaking activities would be limited to maintenance, surveillance and security tours by a small number of personnel. Nonradiological occupational accidents, such as slips and falls, could occur during the caretaking period; however, the rate is not expected to be greater than rates for other Naval Reactors Program activities (see Table 4-3). For conservatism, projections of the number of fatalities and injuries/illnesses were estimated based on the U.S. Department of Energy and Contractors rates for all labor categories (see Table 4-3). The estimated number of fatalities and injuries/illnesses are summarized in Table 5-1 and indicate that the overall nonradiological occupational risks would be small.

NO ACTION ALTERNATIVE

Table 5-1: Estimated Nonradiological, Occupational Impacts for No Action

Estimated Kesselring Site Caretaking Staffing Level (equivalent full-time workers)	1
Estimated Average Number of Injuries/Illnesses per Year [a]	0.036
Estimated Number of Fatalities per Year [a]	0.00003
Total Estimated Number of Injuries/Illnesses [b]	1.1
Total Estimated Number of Fatalities [b]	0.0009

a. Calculated by multiplying Kesselring Site staffing level times the U.S. Department of Energy and Contractors rates provided in Table 4-3.
b. Total values calculated for a 30-year caretaking period.

5.1.12 Utilities and Energy

The use of energy and utility resources would be required to support caretaking activities, such as heating and lighting of the reactor compartments. However, this would be a small portion of the overall use of utility and energy resources that are routinely required to support normal Kesselring Site operations. Since this demand would be indistinguishable from existing demand, impacts to utility and energy resources would not be expected.

5.1.13 Hazardous Materials and Waste Management

Caretaking activities over an indefinite period would generate very small volumes of waste. Waste generated would consist mainly of commercial waste, and disposal would be consistent with State and local regulations. Hazardous materials and waste would be managed in accordance with Federal, State and local regulations and the impacts would be very small.

5.1.14 Irreversible and Irretrievable Commitments of Resources

The no action alternative would not involve any irretrievable or irreversible commitments of environmentally sensitive resources. As discussed previously in this section, this alternative would not contribute to any loss of endangered or threatened species, critical habitats, or areas of archeological, historical or cultural value. Demand on consumable resources such as utilities and energy for caretaking of the S3G and D1G Prototype reactor plants would be very small.

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5.1.15 Impact Summary for the No Action Alternative

The distinguishing environmental consequences of this alternative are: (1) a reduction in the Kesselring Site staffing level of about 200 personnel, and (2) this alternative does not provide for the permanent disposal of the S3G and the D1G Prototype reactor plants. The staffing reduction of about 200 people (see Section 5.1.6) would be a noticeable impact on the total Kesselring Site civilian workforce. However, because this reduction represents only about 0.1 percent of the work force in the surrounding region (see Table 4-2), it would have no discernible impact on the unemployment rate. The no action alternative would include maintaining and monitoring the defueled S3G and D1G Prototype reactor plants in place and in a stable condition for an indefinite duration. Due to long half-life radionuclides and hazardous materials remaining in the reactor plants, a permanent disposal decision would be required sometime in the future.

5.2 Prompt Dismantlement (Preferred) Alternative

This alternative would dismantle the S3G and D1G Prototype reactor plants and would recycle or dispose of waste materials. Dismantlement of the defueled S3G and D1G Prototype reactor plants would begin shortly after the Record of Decision is issued.

Dismantlement activities would involve disassembly of all S3G and D1G Prototype reactor plant systems and the reactor compartment structures. Dismantlement activities are estimated to take approximately 2 years for S3G and approximately 3 years for D1G. Dismantlement activities would be conducted in series. However, preliminary sequencing plans indicate that some overlap in S3G and D1G Prototype dismantlement activities schedules would be possible. As a result, dismantlement activities would occur over an estimated 3 to 4-year period. Environmental impacts are discussed below.

5.2.1 Land Use

The prompt dismantlement alternative would not result in any changes to the present or planned use of the Kesselring Site, Federal reservation or surrounding area. Dismantlement activities would be confined to the Kesselring Site which is an already developed area. The areas currently occupied by the S3G and D1G Prototype reactor compartments would continue to be used for Naval Reactors Program work following dismantlement. The D1G Hortonsphere, which houses the D1G Prototype, would remain intact for possible future Naval Reactors Program use, although no future use is planned at this time. No land on the Federal reservation and no additional land outside the Federal reservation would have to be set aside for waste disposal. Impacts to existing agricultural, residential, recreational, or industrial land use in the surrounding area would not be expected.

5.2.2 Ecological Resources

There are no woodlands, State or Federally designated wetlands, or significant biological habitats within the Kesselring Site. There have been no documented sightings of Federal or State designated endangered, threatened, or special concern species on the Kesselring Site (Reference 4-5). Since the dismantlement activities would be confined to the Kesselring Site, ecological resources located on the Federal reservation would not be impacted.

5.2.3 Water Resources

Dismantlement activities would not change existing ground or surface water conditions on the Kesselring Site and Federal reservation. Independent of dismantlement activities, monitoring and reporting of water conditions on the Kesselring Site and Federal reservation would continue as discussed in Section 4.3.

The Kesselring Site is located at elevations above the indicated 100-year flood boundary (Reference 4-6). Because dismantlement activities would be confined to the Kesselring Site, floodplains that exist on the Federal reservation would not be affected. Since dismantlement activities would not take place in a floodplain and would not affect any designated wetlands, dismantlement is not a floodplain/wetlands action and the requirements of 10 CFR 1022 are not applicable.

5.2.3.1 Water Resources - Radiological Consequences

Prompt dismantlement activities would not result in any discharges of radioactive liquid effluents to the environment. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would not be expected.

5.2.3.2 Water Resources - Nonradiological Consequences

Water usage and nonradiological waste water discharges during dismantlement activities would be approximately the same as existing conditions. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would not be expected. Nonradiological waste water discharges from the Kesselring Site to the Glowegee Creek would continue to be monitored in accordance with the State Pollutant Discharge Elimination System permit, and results would continue to be reported monthly. New permits or modifications to existing permits are not expected to be required. After completion of dismantlement activities, water usage would be less due to lower staffing levels.

5.2.4 Air Resources

Air discharges from the Kesselring Site would be approximately the same as existing conditions. Air discharges would continue to be monitored as discussed in Section 4.4.

5.2.4.1 Air Resources - Radiological Consequences

Dismantlement activities on radiologically contaminated piping and components would be performed using: (1) existing radiological ventilation facilities, and (2) environmental protection measures to minimize the emission of particulate radioactivity to air as discussed in Appendix A, Section A.3.3. High efficiency particulate air filters, which have a greater than 99.95 percent efficiency for removal of airborne particulate radioactivity, would be used. The resulting airborne particulate radioactivity emissions associated with incident-free prompt dismantlement activities were evaluated. The details of the analysis are provided in Appendix B, Section B.2. Table B-4 provides the estimated radioactivity that would be discharged per year. Adding the data from Table B-4 for each radionuclide and for each prototype results in an estimated annual airborne discharge of 1.9×10^{-5} curies. Based on dismantlement periods of 2 years for S3G and 2¾ years for D1G, the cumulative discharge of all radionuclides during dismantlement activities would be approximately 4.6×10^{-5} curies.

As discussed in Section 4.4.4 and Reference 4-4, the radioactivity contained in exhaust air during 1996 consisted of: (1) less than 0.001 curies of krypton-85 and particulate fission and activation products having half-lives greater than 3 hours; (2) approximately 2.2 curies of noble gases with half-lives of 12 days or less, principally argon-41, xenon-133, and

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xenon-135; (3) approximately 0.3 curies of tritium; and (4) approximately 1.0 curies of carbon-14. Compared to these airborne discharges associated with normal Kesselring Site operations, which were well below applicable standards, the amount of airborne radioactivity that would be discharged annually during the prompt dismantlement alternative is small (less than 1 percent of existing conditions). Therefore, impacts to air resources would be indistinguishable from existing conditions.

Airborne emissions from dismantlement activities have been further evaluated as a modification to an existing source of airborne radionuclides in accordance with U.S. Environmental Protection Agency (EPA) regulations contained in 40 CFR Part 61, Subparts A (General Provisions) and H (National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities). Using the conservative EPA calculation methods and based on existing dismantlement work methods, no application submittals to the EPA are required. However, since it is anticipated that plasma arc cutting of radiologically contaminated materials would be introduced as a prompt dismantlement work method, a modification to the National Emission Standards for Hazardous Air Pollutants radionuclide emissions from the Kesselring Site would be required. This modification would require EPA approval. Evaluation of the plasma arc work method at other sites indicates that there would be no significant environmental impacts from additional radioactivity emissions due to plasma arc cutting.

5.2.4.2 Air Resources - Nonradiological Consequences

Environmental impacts on air resources from nonradiological emissions were evaluated for several sources, including facility heating and vehicle emissions. The S3G Prototype reactor compartment would be heated by electric heaters and would not result in any nonradiological air emissions. The D1G Prototype reactor compartment would continue to be heated by steam from the Kesselring Site boilers. Nonradiological emissions from the heating load due to dismantlement activities would be approximately the same as existing Site emissions.

As discussed in Section 4.4.3, the Hudson Valley Intrastate Air Quality Control Region, which includes Saratoga County and the Kesselring Site, is in a marginal nonattainment area for ozone (due to volatile organic compounds or nitrogen oxides). Nonattainment areas exist where sources of pollution lead to air quality that fails to meet State and Federal ambient air quality standards. The analysis of impacts on air quality associated with dismantlement activities evaluated the conformity requirements of the State Implementation Plan that apply to volatile organic compounds and nitrogen oxides in the nonattainment area. Analyses indicate that dismantlement activities would result in an estimated emission of 1.8 metric tons (2 tons) per year of volatile organic compounds and 8.2 metric tons (9 tons) per year of nitrogen oxides. These estimates fall below the criteria that would require a conformity determination in a nonattainment area, 45 metric tons (50 tons) per year for volatile organic compounds and 91 metric tons (100 tons) per year for nitrogen oxides. Therefore, no additional limitations on air emissions would be expected.

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Prompt dismantlement activities would include cutting, handling and removal of systems and structures. The presence of materials such as asbestos insulation, lead shielding, and paint containing lead, chromium or polychlorinated biphenyls introduce the potential for small emissions of regulated air pollutants from these activities. Such emissions would be maintained below State and Federal limits through the use of engineered controls. Furthermore, these emissions would be transitory and, based on Naval Reactors Program experience, are not expected to result in the classification of the Kesselring Site under the Clean Air Act as a major source of air pollutants.

Nonradiological consequences of vehicle emissions from transport of dismantlement wastes and recyclable materials off-site is discussed in Sections 5.2.10 and 5.2.11. The overall discharge of nonradiological air pollutants from prompt dismantlement activities would be very small and impacts on air resources would be indistinguishable from existing conditions. New permits or modifications to existing permits are not expected to be required.

5.2.5 Terrestrial Resources

Prompt dismantlement of the S3G and D1G Prototype reactor plants would not change existing terrestrial conditions on the Kesselring Site or on the surrounding Federal reservation. Excavation work in support of reactor plant dismantlement activities would be confined to the Kesselring Site. Excavation work would be in small localized areas and limited in depth to a few feet. No liquids or solids would be disposed of on the Kesselring Site or on the Federal reservation. Independent of dismantlement activities, monitoring, reporting and corrective actions would continue, as discussed in Sections 4.5.4 through 4.5.6.

5.2.5.1 Terrestrial Resources - Radiological Consequences

Dismantlement activities would be conducted in accordance with the stringent radiological control practices used in the Naval Reactors Program (see Appendix A, Section A.3.3, and Reference 4-22). All radioactive materials would be recycled or disposed of off-site. Following dismantlement activities, radiological surveys would be conducted of the areas surrounding the former S3G and D1G Prototype reactor compartments. Surveys would be performed by trained Kesselring Site radiological controls personnel. Impacts to terrestrial resources would not be expected.

5.2.5.2 Terrestrial Resources - Nonradiological Consequences

Dismantlement activities would be conducted using proven methods such as machine cutting of piping, grinding, sawing, flame cutting and plasma arc cutting. All materials would be recycled or disposed of off-site. Following dismantlement activities, hazardous material surveys would be conducted, as necessary, of the areas surrounding the former S3G and D1G Prototype reactor compartments. Dismantlement of the S3G and D1G Prototype reactor plants is not expected to result in the identification of additional RCRA solid waste management units (see Section 4.5.4.2 for a discussion of existing solid waste management units). Impacts to terrestrial resources would not be expected.

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5.2.6 Socioeconomics

Kesselring Site staffing near the end of 1997 is estimated at approximately 700 civilian personnel (including subcontractors) and 1,000 U.S. Navy personnel. Approximately 200 personnel would be required for about 3 to 4 years to accomplish S3G and D1G Prototype reactor plant dismantlements. Under this alternative, no change in Kesselring Site staffing would be required until the completion of dismantlement activities, at which time a reduction in work force of approximately 200 civilian personnel would occur. While this would be a noticeable reduction of the civilian work force at the Kesselring Site, it would represent only about 0.1 percent of the employment level in the surrounding region (see Table 4-2). Therefore, the prompt dismantlement alternative would not have any discernible socioeconomic impact.

5.2.7 Cultural Resources

Based on past construction activities, no objects or structures of historic, archaeological or cultural significance have been identified on the Kesselring Site. The Naval Reactors Program does not consider the S3G and D1G Prototypes to have any historical significance. Neither prototype was the first land-based prototype; both prototypes are merely part of the many land-based prototypes that were built and operated by the Naval Reactors Program. Each prototype had an operating follow ship: S3G was the prototype for a single U.S. Navy submarine, the USS Triton (SSN 586), and D1G was the prototype for a single U.S. Navy surface ship, the USS Bainbridge (CGN 25). The U.S. Navy has decommissioned and defueled both of these operating ships.

The D1G Hortonsphere, which houses the D1G Prototype and has potential historical significance, would remain intact and would not be impacted by any of the D1G Prototype dismantlement activities. After completion of D1G Prototype reactor plant dismantlement, the Hortonsphere would be available for possible future Naval Reactors Program use, although no future use is planned at this time.

The Naval Reactors Program has reviewed with State, county, and local historians effects of actions associated with the alternatives under evaluation on historical, archaeological, or cultural resources in the area. The New York State Historic Preservation Field Service Bureau has concluded that these actions would have no effect upon cultural resources eligible for inclusion in the National Register of Historic Places (Reference 5-2). The Saratoga County Historian and the Town of Galway Historian have also concluded that these actions would not have any impact on historical, archeological or cultural resources in the area (References 5-3 and 5-4). The Town of Milton Historian considers the area of the Federal reservation to be of historical significance based on the development of the Kesselring Site, the presence of three small burial plots located on the reservation, and the likely presence of Native American and pioneer artifacts within the reservation. Additionally, the Town of Milton Historian requested a continuing dialogue during the decision making process for the dismantlement of the S3G and D1G Prototype reactor plants (Reference 5-7). The Naval Reactors Program will coordinate with the Town of Milton Historian as the process proceeds.

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Based on the reviews by the historians and because dismantlement activities would be confined to only the S3G and D1G Prototypes on the developed area of the Kesselring Site as discussed above, cultural resources would not be impacted.

5.2.8 Noise, Aesthetic and Scenic Resources

Dismantlement activities would be confined to the Kesselring Site. The Kesselring Site is located a minimum of 1.4 kilometers (0.9 miles) from the boundary of the Federal reservation and is fully surrounded by woodlands and low hills. There is very little visibility of the Kesselring Site facilities from public roadways. Like many industrial facilities, there are no resources of scenic or aesthetic value on the Kesselring Site.

As an industrial facility, the Kesselring Site is characterized by noise from truck and automobile traffic, operating industrial equipment such as diesel-powered engines, air-operated jackhammers, and other similar equipment. This noise is generally not discernible beyond the Federal reservation boundary. Dismantlement activities would not result in a noticeable increase in existing noise levels in occupied areas surrounding the Federal reservation. Therefore, noise, aesthetic or scenic resources would be not be impacted.

5.2.9 Traffic and Transportation

Traffic related to dismantlement activities would include commuting personnel, equipment mobilization and recyclable material and waste shipments. During dismantlement activities, staff levels, and consequently general Kesselring Site employee traffic, would remain at current levels. After completion of the dismantlement activities, employee traffic would be lower and this would have a small positive impact on regional and local traffic conditions.

Truck shipments associated with dismantlement activities have been estimated and analyzed in Appendix C. Truck shipments annually represent less than 5 percent of existing radiological and nonradiological shipments and would not be noticeably greater than that which currently exists in support of normal Kesselring Site operations. The largest shipments by weight and radioactive content would be the two reactor pressure vessels. Transport of each reactor pressure vessel package from the Kesselring Site to the Delaware and Hudson railroad terminus, approximately 13 kilometers (8 miles) southeast of the Kesselring Site, would affect local traffic for a short period during one day, principally on less traveled secondary roads. Transport of each of the reactor pressure vessel packages by heavy hauler would be planned for times that minimize such impacts. Highway shipments of packages of similar size to the reactor pressure vessel packages have occurred between the Kesselring Site and the Delaware and Hudson railroad terminus in the past. Based on past experience with these shipments, local police escorts would direct traffic to minimize congestion. The reactor pressure vessel packages would then be transported by railroad to the U.S. Department of Energy Savannah River Site in South Carolina for disposal.

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In addition to the two reactor pressure vessels, the S3G Prototype reactor plant primary shield tank may be shipped by rail as a single large package. Other components, such as steam generators and pressurizers, and miscellaneous recyclable material and waste would be shipped by truck to the Savannah River Site or to a commercial recycling facility to reduce the volume of disposed waste.

Prompt dismantlement of the S3G and D1G Prototype reactor plants would have no discernible impact on existing regional and local traffic conditions.

5.2.10 Occupational and Public Health and Safety (Incident-Free)

This section summarizes analysis results for expected incident-free conditions during prompt dismantlement. Detailed analyses of potential impacts from facility and transportation activities are presented in Appendices B and C, respectively.

5.2.10.1 Facility Activities - Radiological Consequences

The radiological health risks associated with incident-free facility activities during prompt dismantlement are evaluated in Appendix B, Section B.2. Effects from assumed airborne particulate radioactivity releases and direct radiation exposure were assessed for the worker, maximally exposed off-site individual, and the general population. Gamma radiation from cobalt-60 contained within the reactor plant systems is the primary source of direct radiation exposure. For the workers, analyses were based on radiation survey data from the S3G and D1G Prototype reactor compartments, staffing levels, and time in or near the reactor compartments. For the general population, analyses were based on the cumulative exposure to all members of the general population living within an 80-kilometer (50-mile) radius of the Kesselring Site.

The health risks from radiation exposure, through various pathways, have been summarized in Table B-7. It is estimated that the radiation workers would receive a total of 205 to 460 person-rem (0.082 risk of a single additional latent fatal cancer) during prompt dismantlement. The larger value of the range represents an estimate based on preliminary plans. The lower value of the range reflects experience that detailed work planning typically results in additional exposure reductions. The annual occupational radiation exposure from prompt dismantlement would be comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval nuclear reactor plants. In addition, each individual worker's exposure would be limited to 2 rem per year even though Federal limits allow exposure up to 5 rem per year. On an annual basis, the average risk to radiation workers of a single additional latent fatal cancer would be 0.00058. The general population would receive an estimated total of 8.6×10^{-6} person-rem (4.4×10^{-9} risk of single additional latent fatal cancer) from radiation exposure during prompt dismantlement. On an annual basis, the average risk to an individual in the general population of a single additional latent fatal cancer would be 1.6×10^{-15}.

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5.2.10.2 Facility Activities - Nonradiological Consequences

Naval Reactors Program policy is to maintain a safe and healthful environment at all facilities, including the Kesselring Site. Work practices are designed to minimize exposure to physical and chemical hazards. Employees are routinely monitored during work for exposure to such hazards and, when appropriate, are placed into medical surveillance programs. Dismantlement evolutions requiring the use of specialized equipment or the handling of hazardous materials would only be performed by trained personnel. Personnel exposure to hazardous materials would be minimized through the use of engineered controls, protective clothing, respiratory protection, enclosed containment tents and filtered ventilation. These controls would also ensure protection of the environment within applicable limits. Occupational nonradiological effects from reactor plant dismantlement work would be very small.

5.2.10.3 Transportation Analyses

Transportation evaluations in Appendix C assumed all shipments originate at the Kesselring Site. The analyses assumed that 50 shipments of nonradioactive materials would be recycled or disposed of at facilities located within New York State. The analyses assumed that 60 radioactive material shipments would be made from the Kesselring Site. The reactor pressure vessels would be shipped by heavy hauler to the Delaware and Hudson railroad terminus in Ballston Spa, and the rest of the trip to the disposal site would be made by rail. The S3G primary shield tank may also be shipped by rail. Although estimated impacts from both truck and rail shipments of the S3G Prototype primary shield tank are very small, rail shipments have lower impacts than truck shipments. Therefore, for the purposes of conservatism, the analysis results provided include the S3G Prototype primary shield tank as a truck shipment. Analyses assumed that the remaining shipments would be made by truck.

In the transportation analyses, two U.S. Department of Energy destinations were analyzed for shipments of low-level radioactive materials: the Savannah River Site in South Carolina and the Hanford Site in Washington State. The analyses included additional general assumptions to keep the meaning of the results simple and conservative. For example, the Savannah River Site and the Hanford Site were examined individually as the destination for all radioactive shipments. The Savannah River Site represents a reasonable close location for transportation analyses, and the Hanford Site represents a reasonable but more distant location. Combinations of shipping destinations, including available recycling facility locations for radioactive materials, are not examined. This is a conservative simplification because the total mileage of any combination of available destinations would be less than the total mileage of all shipments going cross-country to the Hanford Site. As a result, the estimated risks that are presented in this chapter are for the Hanford Site.

For certain large quantities of low-level radioactive materials, such as highway route-controlled quantities defined in 49 CFR §173.403, U.S. Department of Transportation regulations require the carrier to operate only on preferred routes. These include routes that have been designated by the appropriate state routing agency, as discussed in 49 CFR

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§397.101. Due to their radioactivity content, the two reactor pressure vessel shipments would be considered highway route controlled and would require the use of a New York State preferred route. Because of their oversize dimensions and weight, which would require New York State Department of Transportation issued permits, the two reactor pressure vessel packages would likely be transported over the same route between the Kesselring Site and the railroad terminus in Ballston Spa that has been used for past shipments of similar size and weight. For all other shipments with smaller quantities of low-level radioactive materials, the regulations do not designate which routes the carrier should follow. Other than the reactor pressure vessels, all other shipments of low-level radioactive materials from S3G and D1G Prototype reactor plant dismantlement would be less than highway route controlled quantities, and the carrier would determine the specific routing of the shipments. Because there are no specific regulations governing the routing for low-level radioactive material shipments made by rail, the rail carrier would select the routing for rail shipments from the railroad terminus.

Actual disposal of dismantlement materials would utilize multiple shipping destinations with emphasis on recycling as much material as practical. The topic of waste management and recycling is discussed in more detail in Section 5.2.13.

5.2.10.3.1 Transportation - Radiological Consequences

Gamma radiation from cobalt-60 contained within reactor components is the primary source of direct radiation exposure from the low-level radioactive recyclable material and waste shipments. All low-level radioactive recyclable material and waste shipments would be packaged to meet U.S. Department of Transportation standards for packaging integrity and dose rate limits.

The potential radiological health risks associated with incident-free transportation of reactor plant components were evaluated using the RADTRAN 4 computer code, an accepted industry predictive tool. Health effects were assessed for the general population, transportation crew, maximally exposed individual in the general population, and the maximally exposed individual in the transportation crew. Details on the technical approach for assessing incident-free radioactive shipments are provided in Appendix C, Section C.3. Computer model variables and assumptions are provided in Appendix C, Section C.4.

The health risks for shipments to the Hanford Site are summarized in Appendix C, Table C-13. However, the radiological health risks would still be very small. For shipment of low-level radiological waste from the Kesselring Site to the Hanford Site, analyses indicate the transportation crew would receive 6.8 person-rem (0.0027 risk of a single additional latent fatal cancer). On an annual basis, the average per person dose to the transportation crew would be 1.7 rem (0.00068 risk of a single additional latent fatal cancer). The general population would receive 5.4 person-rem (0.0027 risk of a single additional latent fatal cancer). On an annual basis, the average per person dose to the general population would be 2.9×10^{-6} rem (1.5×10^{-9} risk of a single additional latent fatal cancer).

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These results represent conservative estimates of the radiological consequences of incident-free transportation. Based on past experiences, the estimated radiation exposures are higher than actual radiation exposures from typical Naval Reactors Program low-level radioactive waste shipments.

5.2.10.3.2 Transportation - Nonradiological Consequences

The nonradiological health risks associated with incident-free transportation of recyclable material and waste were evaluated based on methods developed at Sandia National Laboratory. Nonradiological health risks for incident-free transportation would result from vehicle exhaust emissions (air pollutants). Health effects were assessed for the general population. The radiological shipment evaluations considered shipment to the U.S. Department of Energy Savannah River and Hanford disposal sites. For nonradiological shipments, the final destination can vary depending on the waste hauler. For the purposes of analyses, the nonradiological shipment evaluations conservatively assumed shipment to the southern part of New York State because of the higher population density.

Incident-free transportation analyses of nonradiological risks are discussed in detail in Appendix C, Section C.2. The nonradiological health risks (due primarily to vehicle exhaust emissions) are presented in Appendix C, Tables C-3 and C-13. Adding the nonradiological health risks for all waste shipments from the Kesselring Site results in a fatality risk to the general population of 0.0018. On an annual basis, the average per person fatality risk to a member of the general population would be 8.1×10^{-10} (the sum of 6.4×10^{-10} from Table C-3 and 1.7×10^{-10} from Table C-13). These risks would be small and would be within a factor of two of the radiological health risks discussed in Section 5.2.10.3.1 for radiological consequences.

5.2.11 Facility and Transportation Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3, provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. Appendix C, Section C.5, describes the technical approach for assessing radioactive shipment accidents. The results of these analyses are presented in terms of latent fatal cancers and health risks to dismantlement workers and the public. Appendix B, Section B.4, provides analyses of two nonradiological facility accidents, including a diesel fuel fire and a spill of stored chemical products. The results of these analyses are compared to Emergency Response Planning Guideline values for individual workers and the public (maximally exposed off-site individual).

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5.2.11.1 Facility Accidents - Radiological Consequences

Several hypothetical accident scenarios that would result in release of radioactivity to the environment were evaluated to determine the long-term health risks. The hypothetical release of airborne particulate radioactivity and exposure to radiation during accident scenarios were assessed for the worker, maximally exposed off-site individual and the general population.

As described in Appendix B, Section B.1.2, accidents were considered if they were expected to contribute substantially to risk. Risk is defined as the product of the probability of occurrence times the consequence of the accident. The four hypothetical accident scenarios evaluated for the dismantlement activities included: (1) a large component drop, (2) mechanical damage of a component due to a wind-driven missile, (3) a high efficiency particulate air filter fire, and (4) a large volume spill of radioactive water. Variables considered in the analyses include airborne particulate radioactivity source terms, population density, meteorological conditions, affected area, and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation).

The details of the analyses are provided in Appendix B, Section B.3. As shown in Appendix B, Table B-26, the accident with the greatest risk during dismantlement activities would be a component drop accident. The combined S3G and D1G cumulative risk for a member of the general population developing a latent fatal cancer due to a component drop accident over the duration of prompt dismantlement would be 1.9×10^{-7}. This risk is the sum of the products of the probability of the accident occurring times the consequence of the accident times the duration of the dismantlement period (2 years and 2¾ years for S3G and D1G, respectively). On an annual basis, the highest individual risk to a member of the general population of a single additional latent fatal cancer would be 5.2×10^{-14}, as shown in Appendix B, Tables B-10 and B-12. These accident risks would be small compared to incident-free radiological impacts due to the low probability of a component drop accident occurring.

5.2.11.2 Facility Accidents - Nonradiological Consequences

For the purpose of comparison with other risks associated with dismantlement and caretaking activities, Appendix B, Section B.4, provides analysis of two nonradiological facility accidents. These accident scenarios include a spill of approximately 750 liters (200 gallons) of stored chemical products, and a fire involving approximately 1,040 liters (275 gallons) of diesel fuel. Typical products that would be stored to support dismantlement activities include various adhesives, strippers, solvents, and lubricants. A hypothetical accident scenario involving a fire in a temporary hazardous waste container storage area was considered but eliminated from detailed analysis since the volume of stored hazardous waste from dismantlement activities is expected to be small.

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The airborne concentrations from the chemical spill and the combustion products resulting from the diesel fuel fire were evaluated with respect to the maximally exposed off-site individual and the on-site individual worker. The toxic chemicals that were assumed for the chemical spill include acetone, ethyl alcohol, formic acid, methyl alcohol, methyl ethyl ketone, mineral spirits, n-butyl alcohol, and toluene. The toxic chemicals that would be generated from combustion of diesel fuel include carbon monoxide, oxides of nitrogen (90 percent nitric oxide and 10 percent nitrogen dioxide), and sulfur dioxide.

The estimated airborne chemical concentrations were compared against the Emergency Response Planning Guidelines (ERPG) level 1, 2, and 3 concentration limits or alternates to determine the health impacts (References 5-5 and B-16). The analysis results indicate that all toxic chemical concentrations were at or below ERPG level 1 values for the maximally exposed off-site individual (Tables B-27 and B-28). For the on-site individual worker, toxic chemical concentrations may exceed the ERPG level 2 and ERPG level 3 values. However, in the event of a chemical spill or an accidental fire, actual toxic chemical exposures would be much less due to the mitigative measures that would be implemented as part of Kesselring Site safety procedures.

Nonradiological occupational accidents, such as slips and falls, could occur during the dismantlement activities; however, the rate is not expected to be greater than rates for other Naval Reactors Program activities (see Table 4-3). For conservatism, projections of the number of fatalities and injuries/illnesses were estimated based on the U.S. Department of Energy and Contractors rates for all labor categories (see Table 4-3). The estimated number of fatalities and injuries/illnesses are summarized in Table 5-2 and indicate that the overall nonradiological occupational risks would be small.

Table 5-2: Estimated Nonradiological, Occupational Impacts for Prompt Dismantlement

Estimated Kesselring Site Dismantlement Staffing Level (equivalent full-time workers)	200
Estimated Average Number of Injuries/Illnesses per Year [a]	7.2
Estimated Number of Fatalities per Year [a]	0.006
Total Estimated Number of Injuries/Illnesses [b]	25
Total Estimated Number of Fatalities [b]	0.021

a. Calculated by multiplying Kesselring Site dismantlement staffing level times the U.S. Department of Energy and Contractors rates provided in Table 4-3.
b. Total values calculated for a 3½-year duration of prompt dismantlement.

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5.2.11.3 Transportation Accidents

There has never been a major accident nor measurable release of radioactivity to the environment during shipment of Naval Reactors Program waste or materials. However, hypothetical transportation accidents were evaluated to determine potential environmental effects.

5.2.11.3.1 Transportation Accidents - Radiological Consequences

Appendix C, Section C.5, provides the technical approach used for assessing the consequences of hypothetical radioactive shipment accidents. Health effects were assessed for the general population and the maximally exposed individual. Analyses assumed that the transportation workers would evacuate the scene of an accident within a relatively short time after the accident occurred. Therefore, the risks associated with transportation accidents for transportation workers are included in the results for the general population. Risk calculations conservatively assume that the general population would not be evacuated.

Radiological health risks from releases of radioactivity to the environment and direct radiation exposure from damaged packages were evaluated using the RADTRAN 4 and RISKIND computer codes, both accepted industry predictive tools. Variables considered in the analyses include affected areas, pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation), weather conditions, and package release fractions. The major contributor to radiation exposure would be from the ground contamination pathway (more than 90 percent of total exposure).

The health risks associated with transportation accidents for shipments from the Kesselring Site to the Hanford Site for prompt dismantlement are summarized in Appendix C, Table C-17. Analyses indicate that the general population would receive 0.0027 person-rem (1.4×10^{-6} risk of single additional latent fatal cancer) in this scenario. On an annual basis, the per person risk to the general population of a single additional latent fatal cancer would be 3.1×10^{-12}.

When compared to the radiological health risks associated with incident-free radioactive waste shipments (see Section 5.2.10.3.1) the risks of hypothetical accidents are less. This is due to the very low probability of a severe accident occurring.

5.2.11.3.2 Transportation Accidents - Nonradiological Consequences

There would be no long-term environmental consequences from an accident in which a waste package containing hazardous or toxic materials is breached. Hazardous or toxic constituents such as polychlorinated biphenyls, lead, and chromium would be in a solid (insoluble) state. Asbestos, if present, could be disturbed in an accident. The Naval Reactors Program would ensure recovery, as necessary, of any spilled hazardous or toxic materials as part of the accident recovery action.

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The nonradiological health risks associated with transportation accidents resulting from the shipment of nonradiological and radiological materials are summarized in Appendix C, Tables C-4 and C-17. Analyses indicate that the estimated risk of an additional fatality from nonradiological and radiological shipments would be 0.0014 and 0.03, respectively. While these nonradiological health risks would be small, the risks would be higher than the radiological health risks from transportation accidents associated with the shipment of radiological materials (see Section 5.2.11.3.1).

5.2.12 Utilities and Energy

The use of energy and utility resources would be required to support dismantlement activities, such as heating, lighting, ventilation and dismantlement of the reactor compartments. However, this would be a small portion of the overall use of utility and energy resources that are routinely required to support normal Kesselring Site operations. Since this demand would be indistinguishable from existing conditions, impacts to utility and energy resources would not be expected.

5.2.13 Hazardous Materials and Waste Management

The S3G and D1G Prototype reactor plants are small in comparison to commercial reactor plants. The total volume and weight of both intact reactor compartments are approximately 1,200 cubic meters (41,000 cubic feet) and 1,400 metric tons (1,540 tons). Even though the S3G and D1G Prototype reactor plants are small, emphasis would still be placed on recycling as much material as practical. The following sections describe the various waste streams that would be generated as a result of dismantlement activities. Dismantlement of the S3G and D1G Prototype reactor plants is not expected to result in the identification of additional RCRA solid waste management units (see Section 4.5.4.2 for a discussion of existing solid waste management units). The amounts of hazardous materials and waste generated as a result of dismantlement activities are expected to be small and are not expected to have any significant impact on the environment.

5.2.13.1 Hazardous Materials Contained in the S3G and D1G Prototype Reactor Plants

The S3G and D1G Prototype reactor plants contain several types of hazardous materials, such as lead, chromium, cadmium, and silver. The hazardous material with the largest volume is lead. Most of the lead is encased within welded steel sheets. The encased lead is permanently installed as radiation shielding in the form of panels. The lead is encased in the panels either as layered sheets, bricks or poured in place. The S3G and D1G Prototype reactor plant dismantlement would generate approximately 45 cubic meters (1,600 cubic feet) of elemental lead weighing more than 450 metric tons (500 tons) that would require recycling or disposal. Lead that can be released from radiological controls would be recycled; other lead, containing radioactive impurities or surface contamination, would be treated in accordance with the Site Treatment Plan (see Section 5.2.13.2.3 and Reference 2-2).

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Typical of piping systems constructed before the mid-1970s, some items in the D1G Prototype reactor plant remain insulated with asbestos-containing materials. Thermal insulation that contains asbestos is installed on the steam generators, pressurizers and some piping. Essentially all of the asbestos-containing insulation has been removed from the S3G Prototype reactor plant. Miscellaneous items in the S3G and D1G Prototype reactor plants may also include asbestos-containing materials, such as electrical cable insulation, small components in electrical equipment, and gaskets in mechanical systems. In addition, PCBs are regulated as hazardous by New York State and are discussed in Section 5.2.13.2.4.

5.2.13.2 Waste Streams and Recycling

In order to minimize the volume of wastes generated from dismantlement activities and to minimize the costs associated with waste disposal, segregation of materials would occur. Segregation is a process of identifying and separating materials into different disposal categories, known as waste streams. To ensure the proper segregation and management of waste streams generated, preplanning would include the identification of hazardous materials through review of design and material specifications. Where necessary, sampling and analysis prior to dismantlement would also be done. Dismantlement activities would generate the following segregated waste streams:

- recyclable materials and volume reduction,
- low-level radioactive wastes,
- low-level radioactive and hazardous (mixed) wastes,
- polychlorinated biphenyl (PCB)-containing wastes,
- hazardous wastes, and
- nonhazardous and nonradioactive wastes.

5.2.13.2.1 Recyclable Materials and Volume Reduction

Waste minimization would be achieved through recycling and volume reduction services (such as metal smelting and compacting). Emphasis would be placed on recycling as much material as practical. Segregating radioactive and hazardous or toxic materials increases the options for recycling. Most of the recyclable materials generated from dismantlement activities would be metals such as carbon steel from the hull and deckplate structures, corrosion resisting metals from reactor plant systems, and lead shielding. These materials would be recycled using various commercial vendors. One existing business in Tennessee recycles low-level radioactive metals by melting them into shield blocks which are then provided to the U.S. Department of Energy for reuse in high energy physics applications. Other commercial enterprises are also starting to enter the radioactive metal recycling field with alternate recycling uses.

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Low-level radioactive materials from the S3G and D1G Prototype reactor plants that could be recycled include piping, valves, components and carbon steel structural materials. Low-level radioactive materials would be candidates for recycling if the radioactivity concentration is less than 0.002 microcuries per gram. In general, components with radiation levels that measure less than 0.02 rem per hour on contact would meet the radioactivity concentration criteria for recycling.

Radioactive components that exceed the criteria for recycling could still be candidates for volume reduction if their radiation levels measure less than 0.2 rem per hour on contact. Similar to recycling, S3G and D1G Prototype reactor plant materials that would be candidates for volume reduction include piping, valves and large components. Volume reduction savings vary widely depending on component and material construction.

5.2.13.2.2 Low-Level Radioactive Wastes

Other than recyclable materials, the largest waste stream, based on weight and volume, would be low-level radioactive wastes. Low-level radioactive wastes, consisting only of solid, nonhazardous material, would be disposed of at a U.S. Department of Energy disposal facility. The U.S. Department of Energy Savannah River Site in Aiken, South Carolina currently receives low-level radioactive wastes from Naval Reactors Program sites in the eastern United States. The U.S. Department of Energy Hanford Site in Washington State is also available for disposal of low-level radioactive wastes generated by Naval Reactors Program activities.

Compared to commercial reactor plants, the S3G and D1G Prototype reactor plants are small. The volume of the intact S3G Prototype reactor plant is approximately 680 cubic meters (24,000 cubic feet) and the volume of the intact D1G Prototype reactor plant is approximately 480 cubic meters (17,000 cubic feet). The combined volume of the intact reactor plants is approximately 1,200 cubic meters (41,000 cubic feet). Dismantlement of the S3G and D1G Prototype reactor plants would result in approximately 60 shipments of low-level radioactive materials. Based on the package volumes defined in Appendix C, Table C-6, the volume of low-level radioactive materials to be shipped from the Kesselring Site would be approximately 1,500 cubic meters (53,000 cubic feet). This is a highly conservative estimate that represents more than the combined volume of the intact reactor plants. After completion of all segregation, recycling, volume reduction processing, and efficient packaging of materials, S3G and D1G Prototype reactor plant dismantlement would generate approximately 450 cubic meters (16,000 cubic feet) of low-level radioactive wastes that would require disposal at a U.S. Department of Energy disposal site. In comparison, decommissioning of the Shippingport pressurized water reactor plant (a small plant by commercial standards) produced approximately 6,100 cubic meters (220,000 cubic feet) of low-level radioactive wastes that weighed approximately 3,800 metric tons (4,200 tons).

About 20 percent of the low-level radioactive waste volume, is due to the two reactor pressure vessels. Other low-level radioactive wastes would include the reactor coolant pumps, residuals from recycled material, volume reduced nonrecycled materials, and miscellaneous low-level wastes unsuitable for recycling or volume reduction.

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Some items in the S3G and D1G Prototype reactor plants contain asbestos bearing materials. Examples of these materials include thermal insulation installed before the mid-1970s, electrical cable insulation, small components in electrical equipment and gaskets in mechanical systems and components. Asbestos-bearing materials that cannot be released from radiological controls would be encapsulated and disposed of as low-level radioactive waste.

The U.S. Department of Energy Savannah River Site has established radioactivity concentration limits for acceptance of waste based upon site specific analysis. In addition, the Savannah River Site Waste Acceptance Criteria prohibits acceptance of waste exceeding the U.S. Nuclear Regulatory Commission Class C limits as defined by 10 CFR Part 61 (Licensing Requirements for Land Disposal of Radioactive Waste). Of the total radioactivity remaining in the S3G and D1G Prototype reactor plants listed in Appendix A, Tables A-2 and A-3, respectively, more than 95 percent would be in the two packages that contain the reactor pressure vessels and their internal structures. These packages would be within the limits of the Savannah River Site Waste Acceptance Criteria and would be within the U.S. Nuclear Regulatory Commission limits for Class C. The other low-level waste packages would have lower radioactivity concentrations. The volume of the S3G and D1G low-level radioactive wastes falls within the projection of Naval Reactors Program wastes previously provided to the Savannah River Site. The impacts of these waste disposal activities at the Savannah River Site are analyzed in the recent Savannah River Site Waste Management Final Environmental Impact Statement (Reference 5-1).

5.2.13.2.3 Low-Level Radioactive and Hazardous (Mixed) Wastes

The management, processing and treatment of mixed wastes generated by dismantlement activities would be in accordance with the Kesselring Site Treatment Plan, which was approved by the New York State Department of Environmental Conservation on October 24, 1995, for mixed wastes generated at the Kesselring Site (Reference 2-2). The Kesselring Site Treatment Plan includes volume projections for mixed wastes to be generated from dismantlement activities. Information in the Site Treatment Plan is updated annually, and is approved by the New York State Department of Environmental Conservation.

Mixed wastes are radioactive materials that include hazardous constituents, such as lead. Typically, mixed wastes generated from dismantlement activities would be homogeneous solids (such as radiologically activated or surface contaminated lead) or nonhomogeneous solids (such as radiologically activated composite shielding made of carbon steel and lead, or items coated with polychlorinated biphenyl-containing paint). Mixed wastes are regulated by the Resource Conservation and Recovery Act (40 CFR Parts 260 through 271), Codes, Rules and Regulations of the State of New York (NYCRR Title 6, Parts 370 through 376), Toxic Substances Control Act (40 CFR Part 761), Federal Facility Compliance Act (42 USC §6921 et seq.), as well as the Atomic Energy Act (42 USC §2011 et seq.).

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The potential for mixed waste results from the lead used in shielding the reactor plants (see Appendix A, Figure A-2). Although the lead used for permanently installed shielding is highly refined, the lead typically contains a small amount of impurities such as silver and cobalt. The lead closest to the reactors was exposed to a neutron flux, which caused the impurities in the lead to become activated (see Appendix A, Section A.3). Decontamination of lead containing radioactive impurities may not be practical because the impurity concentrations are very low and essentially inseparable. To reduce the volume of mixed wastes, the Naval Reactors Program is evaluating recycling options to reuse lead containing low levels of radioactive impurities in shielding applications at other U.S. Department of Energy facilities. Decontamination of lead with surface contamination is practical with commercially available technology which would further reduce the volume of mixed wastes. S3G and D1G Prototype reactor plant dismantlement would result in the generation of approximately 9,100 kilograms (20,000 pounds) of elemental lead containing radioactive impurities. This weight equals a volume of approximately 0.8 cubic meters (28 cubic feet), which is within the latest Kesselring Site Treatment Plan forecast for the elemental lead mixed waste stream. All other mixed wastes would be temporarily stored and disposed of in accordance with the Site Treatment Plan (Reference 2-2).

Removed paint containing PCBs at or above 50 parts per million and radioactivity would be managed and stored as mixed waste. Currently, there is no available treatment or disposal facility for this waste stream. The projected volume included in the 1997 update to the Kesselring Site Treatment Plan is 13.4 cubic meters (470 cubic feet) for the PCB-containing mixed waste stream which could be amenable to disposal by incineration. Paint removal processes that would minimize generation of PCB-containing mixed waste are under evaluation, including mechanical removal using media such as dry ice (solid carbon dioxide), sponge, and steel shot. The amounts of mixed waste that would be generated during paint removal activities vary with the process. Currently, it is conservatively estimated that reactor compartment dismantlement work will result in the generation of approximately 26 cubic meters (940 cubic feet or 7,000 gallons) of mixed waste, which primarily includes PCB-containing mixed waste.

In August 1997, the Naval Reactors Program submitted a mixed waste permit application to the New York State Department of Environmental Conservation. The permit application included a clause for increasing the mixed waste storage capacity in Kesselring Site Building 91 to cover the increased generation of mixed waste from sources apart from the S3G and D1G Prototype reactor plants. The impacts from increasing the Kesselring Site mixed waste storage capacity were evaluated in a separate environmental assessment (Reference 5-9). Based on this environmental assessment, the Naval Reactors Program issued a finding of no significant impact (Reference 5-10). The environmental impacts from storing an additional 7,000 gallons of mixed waste from reactor plant dismantlement paint removal operations would be small. The need for a second permit modification, to allow storing the additional waste from S3G and D1G Prototype reactor plant dismantlement, would be coordinated with the New York State Department of Environmental Conservation in accordance with NYCRR Title 6, Part 373-1.7(c).

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5.2.13.2.4 Polychlorinated Biphenyl (PCB)-Containing Wastes

Some S3G and D1G Prototype reactor plant components may contain regulated concentrations (greater than or equal to 50 parts per million) of polychlorinated biphenyls (PCBs). Examples of materials that could contain PCBs as a constituent include paint, adhesives, electrical cable coverings and rubber items manufactured before the mid-1970s. In these examples, PCBs are usually tightly bound in the composition of the solid material. While the amount of PCBs is small by weight, its use as a constituent in paint affects a large number of components. Painted surfaces in the S3G and D1G Prototype reactor plants include the hulls, large components such as the steam generators and pressurizers, decking support structures, pipe hangers, equipment foundations and thermal insulation.

PCB wastes are regulated by the Toxic Substances Control Act (40 CFR Part 761). The State of New York also regulates PCBs as hazardous waste (6 NYCRR §371.4(e)). Additionally, the Federal Facility Compliance Agreement on Storage of Radioactive and PCB Wastes between the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the Naval Nuclear Propulsion Program, dated August 8, 1996, contains special provisions for the management and storage of radioactive and PCB wastes. Mixed radioactive and PCB-containing wastes are discussed in Section 5.2.13.2.3. Paint containing PCBs at or above the regulatory limit of 50 parts per million would be removed when practical from all materials not releasable from radiological controls. Removal of the paint would be in accordance with U.S. Environmental Protection Agency Alternate Method of Disposal Approval (40 CFR §761.60(e)).

5.2.13.2.5 Hazardous Wastes

Chemical products required for dismantlement operations would include small amounts of isopropyl alcohol in radiological control applications, building maintenance cleaning products, and miscellaneous petroleum products for routine vehicle and equipment maintenance. Small amounts of paint removal products (paint softeners) may be used in conjunction with mechanical paint removal processes (using abrasive media) to enhance efficiency. Consistent with pollution prevention initiatives, emphasis would be placed on using non-toxic paint removal products as much as practicable. Compared to the volume of other chemical products required for dismantlement operations, diesel fuel would constitute the largest volume. However, the amount of diesel fuel that would be stored in support of dismantlement operations would be small, less than 1,100 liters (300 gallons). Evaluation of a diesel fuel fire accident is provided in Appendix B, Section B.4.1 and summarized in Section 5.2.11.2. Even though dismantlement operations would not require any significant increase in the quantities or types of chemicals used at the Kesselring Site, a detailed chemical risk analysis was performed for substances other than diesel fuel for a hypothetical fire in a chemical storage locker. The results of this analysis are provided in Appendix B, Section B.4.2.

Only small amounts of hazardous waste would be expected as a result of dismantlement operations and the majority of these wastes would be in solid form. Dismantlement operations

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would not involve large bulk storage of toxic chemicals. Elemental lead is potentially the largest hazardous waste stream. Most of the lead is encased within welded steel sheets and is permanently installed as radiation shielding in the form of panels. Lead that can be released from radiological controls, more than 95 percent of the total, would be recycled and would not require disposal. Other elemental lead, less than 5 percent, containing radioactive impurities or surface radioactive contamination, would be treated as discussed in Section 5.2.13.2.3. Lead is also present as an alloy with other metals, such as in bronze, brass, and electrical solder, and as a constituent in paint. There are other hazardous materials that may be present in small quantities, such as chromates as a constituent of paint, and cadmium as a coating on electrical items. Because mercury can cause metals such as stainless steel to crack under stress, and can become a poisonous vapor when heated, the Naval Reactors Program has strictly controlled mercury concentrations in reactor plant components and materials to very low levels since the 1950s. Therefore, mercury is present only at incidental levels in the S3G and D1G Prototype reactor plants. The total volume of all hazardous wastes is expected to be small. In addition, PCBs are regulated as hazardous by New York State and are discussed in Section 5.2.13.2.4.

5.2.13.2.6 Nonhazardous and Nonradioactive Wastes

Commercial solid wastes, nonradioactive hazardous materials, and nonradioactive nonhazardous demolition debris from S3G and D1G Prototype reactor plant dismantlement would be recycled or disposed of off-site at permitted facilities using licensed haulers. Emphasis would be placed on recycling as much nonradioactive material as practical. Reusable materials, such as carbon steel and other metals, would be recycled through various commercial vendors. Nonradioactive, nonhazardous demolition debris which is generated from dismantlement activities and which is not recyclable would be disposed of in accordance with all applicable Federal, State and local regulations. The quantities of nonradioactive wastes and recyclable materials from reactor plant dismantlement (approximately 50 shipments) would be small compared to the quantities normally handled by the appropriate disposal or recycling vendors.

5.2.14 Irreversible and Irretrievable Commitments of Resources

The prompt dismantlement alternative would not involve any irretrievable or irreversible commitment of environmentally sensitive resources. As discussed previously in this section, this alternative would not contribute to any loss of endangered or threatened species, critical habitat, or areas of archeological, historical or cultural value. Demand on consumable resources such as utilities and energy for dismantlement activities would be very small. No additional disposal sites would be required to dispose of dismantlement wastes.

5.2.15 Impact Summary for the Prompt Dismantlement Alternative

The distinguishing environmental consequences of this alternative are: (1) the retention of about 200 personnel for approximately 3 to 4 years to accomplish dismantlement, followed by a staff reduction, (2) occupational radiation exposure from incident-free activities,

(3) radiation exposure to the general public from incident-free transportation activities, and (4) the number of material shipments resulting from dismantlement.

The retention of 200 personnel for approximately 3 to 4 years to accomplish dismantlement would be a positive impact on the Kesselring Site work force. However, this benefit would be temporary and would still require a Kesselring Site staff reduction once the dismantlement activities are completed. Because this reduction represents only about 0.1 percent of the work force in the surrounding region (see Table 4-2), it would have no discernible impact on the unemployment rate.

The occupational radiation exposure for incident-free activities is estimated at 205 to 460 person-rem (0.082 risk of a single additional latent fatal cancer; see Appendix B, Table B-7). On an annual basis, however, the average individual risk to radiation workers of a single additional latent fatal cancer would be 0.00058. This corresponds to 1 chance in about 1,700 that the average radiation worker might develop a latent fatal cancer sometime in his or her lifetime due to dismantlement work. Each member of the general population has 1 chance in 5 of developing a fatal cancer due to all causes (see Appendix A, Section A.4.1); thus, the increased risk for the most exposed worker would be very small. Therefore, the risk associated with the occupational radiation exposure is considered commensurate with the risks associated with everyday life.

Radiation exposure to the general public from incident-free transportation activities for radioactive material shipments is estimated at 5.4 person-rem (see Appendix C, Table C-13, Kesselring Site to Hanford Site). This corresponds to a latent fatal cancer risk of 0.0027. The 5.4 person-rem to the general public is for approximately 1 million people (see Appendix C, Section C.6). Therefore, the estimated average dose to a member of the public would be 5.4×10^{-6} rem, which is approximately the radiation exposure an individual receives in 8 minutes from natural background sources of radiation. The risks associated with the transportation related radiation exposure to the general public are considered much lower than the risks associated with everyday life.

Dismantlement activities would result in approximately 110 radiological and nonradiological shipments from the Kesselring Site over the dismantlement period (see Section 5.2.10). On an annual basis these shipments represent less than 5 percent of the total radiological and nonradiological shipments as a result of normal Kesselring Site operations. The largest shipments by weight and radioactive content would be the two reactor pressure vessels. Transport of each of these packages from the Kesselring Site to the Delaware and Hudson railroad terminus would affect local traffic for a short period during one day each, principally on the less traveled secondary roads. Highway shipments of packages of similar size to the reactor pressure vessel packages have successfully occurred between the Kesselring Site and the Delaware and Hudson terminus in the past. Based on past experience with these shipments, local police escorts would direct traffic to minimize congestion. Therefore, the shipments resulting from dismantlement activities would be commensurate with normal Kesselring Site operations in recent years.

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5.3 Deferred Dismantlement Alternative

This alternative would dismantle the S3G and D1G Prototype reactor plants after a 30-year caretaking period. Deferred dismantlement would allow the radioactivity in reactor plant materials to decay to a lower amount. Caretaking activities for the deferred dismantlement alternative would be identical to caretaking activities described for the no action alternative in Section 5.1. The only difference would be a defined end date for this alternative.

Following the 30-year caretaking period, reactor plant dismantlement would commence. For the purposes of comparison, deferred dismantlement activities are assumed to be identical to dismantlement activities described for the prompt dismantlement alternative in Section 5.2. Environmental impacts are discussed below.

5.3.1 Land Use

The deferred dismantlement alternative would not result in any changes to the present or planned use of the Kesselring Site, Federal reservation or surrounding areas. Caretaking and dismantlement activities would be confined to the Kesselring Site which is an already developed area. The areas currently occupied by the S3G and D1G Prototype reactor compartments would continue to be used for Naval Reactors Program work following the deferred dismantlement. The D1G Hortonsphere, which houses the D1G Prototype, would remain intact for possible future Naval Reactors Program use, although no future use is planned at this time. No land on the Federal reservation and no additional land outside the Federal reservation would have to be set aside for waste disposal. Impacts to existing agricultural, residential, recreational, or industrial land use in the surrounding area would not be expected.

5.3.2 Ecological Resources

There are no woodlands, State or Federally designated wetlands, or significant biological habitats within the Kesselring Site. There have been no documented sightings of Federal or State designated endangered, threatened, or special concern species on the Kesselring Site (Reference 4-5). Since the caretaking and dismantlement activities would be confined to the Kesselring Site, ecological resources located on the Federal reservation would not be impacted.

5.3.3 Water Resources

Caretaking and dismantlement activities of the S3G and D1G Prototype reactor plants would not change the existing ground water or surface water conditions on the Kesselring Site and Federal reservation. Independent of caretaking and dismantlement activities, monitoring and reporting of water conditions on the Kesselring Site and Federal reservation would continue as discussed in Section 4.3.

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The Kesselring Site is located at elevations above the indicated 100-year flood boundary (Reference 4-6). Because caretaking and dismantlement activities would be confined to the Kesselring Site, floodplains that exist on the Federal reservation would not be affected. Since caretaking and dismantlement activities would not take place in a floodplain and would not affect any designated wetlands, caretaking and dismantlement are not floodplain/wetlands actions and the requirements of 10 CFR 1022 are not applicable.

5.3.3.1 Water Resources - Radiological Consequences

Caretaking and deferred dismantlement activities would not result in any discharge of radioactive liquid effluents to the environment. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would not be expected.

5.3.3.2 Water Resources - Nonradiological Consequences

When compared to existing conditions, water usage and nonradiological waste water discharges would be less during the caretaking period and approximately the same during deferred dismantlement activities. Therefore, impacts to ground water and surface water resources on the Kesselring Site and Federal reservation would not be expected. Nonradiological waste water discharges from the Kesselring Site to the Glowegee Creek would continue to be monitored per the State Pollutant Discharge Elimination System permit, and results would continue to be reported monthly.

5.3.4 Air Resources

Air discharges from the Kesselring Site would be approximately the same as existing conditions. Air discharges would continue to be monitored as discussed in Section 4.4.

5.3.4.1 Air Resources - Radiological Consequences

Airborne particulate radioactivity emissions associated with incident-free deferred dismantlement activities were evaluated. Airborne radioactivity discharges during the caretaking period would be the same as the no action alternative, as discussed in Section 5.1.4.1. During deferred dismantlement activities, existing radiological ventilation facilities would be used. High efficiency particulate air filters would also be used, which have a greater than 99.95 percent efficiency for removal of airborne particulate radioactivity. The details of the analysis are provided in Appendix B, Section B.2. Table B-4 provides the estimated radioactivity that would be discharged per year. Adding the data from Table B-4 for each radionuclide and for each prototype results in an estimated annual airborne discharge of 1.8×10^{-5} curies during deferred dismantlement activities. Based on dismantlement periods of 2 years for S3G and 2¾ years for D1G, the cumulative discharge of all radionuclides during deferred dismantlement activities would be approximately 4.2×10^{-5} curies. The cumulative discharge for the entire duration of this alternative (30-year caretaking period plus deferred dismantlement activities) would be approximately 0.00014 curies.

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As discussed in Section 4.4.4 and Reference 4-4, the radioactivity contained in exhaust air during 1996 consisted of: (1) less than 0.001 curies of krypton-85 and particulate fission and activation products having half-lives greater than 3 hours; (2) approximately 2.2 curies of noble gases with half-lives of 12 days or less, principally argon-41, xenon-133, and xenon-135; (3) approximately 0.3 curies of tritium; and (4) approximately 1.0 curies of carbon-14. Compared to these airborne discharges associated with normal Kesselring Site operations, which were well below applicable standards, the amount of airborne radioactivity that would be discharged annually during the deferred dismantlement alternative is small (less than 1 percent of existing conditions). Therefore, impacts to air resources would be indistinguishable from existing conditions.

5.3.4.2 Air Resources - Nonradiological Consequences

The discussion of nonradiological consequences of caretaking in Section 5.1.4.2 and for prompt dismantlement in Section 5.2.4.2 apply to the deferred dismantlement alternative. Impacts to air resources would not be expected.

5.3.5 Terrestrial Resources

Caretaking and dismantlement activities of the S3G and D1G Prototype reactor plants would not change the existing terrestrial conditions on the Kesselring Site or on the surrounding Federal reservation as presented in Section 4.5. Caretaking activities for the deferred dismantlement alternative would be identical to caretaking activities described for the no action alternative in Section 5.1.5. Deferred dismantlement activities are assumed to be identical to dismantlement activities described for the prompt dismantlement alternative in Section 5.2.5. Impacts to terrestrial resources would not be expected.

5.3.6 Socioeconomics

Kesselring Site staffing near the end of 1997 is estimated at approximately 700 civilian personnel (including subcontractors) and 1,000 U.S. Navy personnel. The labor force needed to support caretaking activities at the Kesselring Site is estimated at 1 equivalent full-time worker. This alternative results in a staff reduction of approximately 200 personnel for the 30-year caretaking period. At the beginning of the deferred dismantlement activities, staffing levels would be expected to be similar to the prompt dismantlement and increase by 200 personnel for an approximately 3 to 4-year period. While staff fluctuations associated with deferred dismantlement would be a noticeable portion of the civilian work force at the Kesselring Site, it would represent only about 0.1 percent of the employment level in the surrounding region (see Table 4-2). Therefore, the deferred dismantlement alternative would not have any discernible socioeconomic impact.

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5.3.7 Cultural Resources

Based on the discussions in Section 5.1.7 for the no action alternative and Section 5.2.7 for the prompt dismantlement alternative, caretaking and deferred dismantlement of the S3G and D1G Prototype reactor plants would not impact any cultural resources.

5.3.8 Noise, Aesthetic and Scenic Resources

Based on the discussions in Section 5.1.8 for the no action alternative and Section 5.2.8 for the prompt dismantlement alternative, caretaking and deferred dismantlement of the S3G and D1G Prototype reactor plants would not impact noise, aesthetic or scenic resources.

5.3.9 Traffic and Transportation

Based on the discussions in Section 5.1.9 for the no action alternative and Section 5.2.9 for the prompt dismantlement alternative, caretaking and deferred dismantlement of the S3G and D1G Prototype reactor plants would not have a discernible impact regional and local traffic conditions.

5.3.10 Occupational and Public Health and Safety (Incident-Free)

This section summarizes analysis results for expected incident-free conditions during a 30-year caretaking period followed by an approximately 3 to 4-year deferred dismantlement period. Detailed analyses of potential impacts for facility and transportation activities are presented in Appendices B and C, respectively.

5.3.10.1 Facility Activities - Radiological Consequences

The radiological health risks associated with incident-free facility activities during a 30-year caretaking period and deferred dismantlement of the S3G and D1G Prototype reactor plants were evaluated in Appendix B, Section B.2. Effects from assumed airborne particulate radioactivity releases and direct radiation exposure were assessed for the worker, maximally exposed off-site individual, and the general population. Gamma radiation from cobalt-60 contained within the reactor plant systems is the primary source of direct radiation exposure. During a 30-year caretaking period, much of the short half-life radionuclides, primarily cobalt-60, would decay. The decay of cobalt-60 would result in less than 2 percent of direct radiation exposure to workers compared to the prompt dismantlement alternative. For the workers, analyses were based on radiation survey data from the S3G and D1G Prototype reactor compartments, staffing levels, and time in or near the reactor compartments. For the general population, analyses were based on the exposure to all members of the general population living within an 80-kilometer (50-mile) radius of the Kesselring Site.

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Analyses for radiological exposure during the caretaking period and deferred dismantlement were made using an approach consistent with the analyses for the no action and prompt dismantlement alternatives, discussed in Sections 5.1.10.1 and 5.2.10.1. Occupational exposure over the course of 30 years of caretaking activities would be approximately 22 person-rem. This occupational exposure would be the same as the 30-year caretaking period of the no action alternative. Occupational exposure from deferred dismantlement activities would be approximately 4 person-rem.

The health risks from radiation exposure, through various pathways, have been summarized in Appendix B, Table B-7. It is conservatively estimated that the caretaking and dismantlement workers would receive a total of 26 person-rem (0.01 risk of a single additional latent fatal cancer). On an annual basis, the average individual risk to radiation workers of a single additional latent fatal cancer would be 4.0×10^{-5}. The general population would receive 1.3×10^{-5} person-rem (6.9×10^{-9} risk of a single additional latent fatal cancer) from exposure during caretaking and deferred dismantlement. On an annual basis, the average risk to an individual in the general population of a single additional latent fatal cancer would be 1.9×10^{-16}.

5.3.10.2 Facility Activities - Nonradiological Consequences

Naval Reactors Program policy is to maintain a safe and healthful environment at all facilities, including the Kesselring Site. Caretaking activities would be limited to maintenance, surveillance and security tours by a small number of personnel. As a result, incident-free nonradiological consequences would be very small. During deferred dismantlement activities, the nonradiological consequences during incident-free facility activities would be the same as the prompt dismantlement alternative, discussed in Section 5.2.10.2.

5.3.10.3 Transportation Analyses

The discussion in Section 5.2.10.3 for shipment destinations and transportation analysis assumptions applies equally to the deferred dismantlement alternative.

5.3.10.3.1 Transportation - Radiological Consequences

The radiological consequences associated with incident-free shipment of low-level radiological recyclable material and waste from deferred dismantlement were analyzed using the same approach described in Section 5.2.10.3.1.

Packaging for the reactor pressure vessel shipments would be designed to meet the same transport index for both the deferred and prompt dismantlement alternatives. Transport index values represent the radiation levels at 1 meter from the package surface of radiological shipments in millirem per hour (see Appendix C, Section C.4.2). Analysis results for these shipments are identical for both the deferred and prompt dismantlement alternatives. The radiological risks for shipment of all other radioactive recyclable materials and waste under the deferred dismantlement alternative would be lower due to cobalt-60 radioactive decay.

However, the amount of materials handled as low-level radioactive waste would not be expected to change, due to the presence of other longer-lived radionuclides.

The health risks for shipments to the Hanford Site are summarized in Appendix C, Table C-15. For shipments of low-level radiological waste from the Kesselring Site to the Hanford Site, analyses indicate the transportation crew would receive 0.24 person-rem (9.6×10^{-5} risk of a single additional latent fatal cancer). On an annual basis, the average per person dose to the transportation crew would be 0.065 rem (2.6×10^{-5} risk of a single additional latent fatal cancer). The general population would receive 0.15 person-rem (7.4×10^{-5} risk of a single additional latent fatal cancer). On an annual basis, the average per person dose to the general population would be 8.2×10^{-8} rem (4.1×10^{-11} risk of a single additional latent fatal cancer).

5.3.10.3.2 Transportation - Nonradiological Consequences

The nonradiological consequences associated with incident-free transportation of recyclable material and waste are assumed to be identical for the prompt and deferred dismantlement alternatives. The discussion in Section 5.2.10.3.2 is equally applicable for the deferred dismantlement.

5.3.11 Facility and Transportation Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3, provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. Appendix C, Section C.5, describes the technical approach for assessing radioactive shipment accidents. The results of these analyses are presented in terms of latent fatal cancers and health risks to dismantlement workers and the public. Appendix B, Section B.4, provides analyses of two nonradiological facility accidents, including a diesel fuel fire and a spill of stored chemical products. The results of these analyses are compared to Emergency Response Planning Guideline values for individual workers and the public (maximally exposed off-site individual).

5.3.11.1 Facility Accidents - Radiological Consequences

Several hypothetical accident scenarios that would result in release of radioactivity to the environment were evaluated to determine the long term health risk. The hypothetical release of airborne particulate radioactivity and exposure to radiation during accident scenarios were assessed for the worker, maximally exposed off-site individual and the general population. The discussion in Section 5.1.11.1 for the no action alternative is applicable for the caretaking period, and the discussion in Section 5.2.11.1 for the prompt dismantlement alternative is applicable for the deferred dismantlement activities.

DEFERRED DISMANTLEMENT ALTERNATIVE

The details of the analyses are provided in Appendix B, Section B.3. As shown in Appendix B, Table B-26, the combined S3G and D1G cumulative risk of a member of the general population developing a latent fatal cancer due to a high efficiency particulate air filter fire for a 30-year caretaking period would be 1.4×10^{-9}.

During deferred dismantlement activities, the accident with the greatest risk would be a component drop accident. The combined S3G and D1G cumulative risk of a member of the general population developing a latent fatal cancer due to a component drop accident would be 5.1×10^{-9}. This risk is the sum of the products of the probability of the accident occurring times the consequence of the accident times the duration of the dismantlement period (2 years and 2¾ years for S3G and D1G, respectively). On an annual basis, the highest risk to an individual in the general population of a single additional latent fatal cancer due to this accident would be 1.4×10^{-15}, as shown in Appendix B, Tables B-10 and B-12. These accident risks during the caretaking and deferred dismantlement activities would be small compared to incident-free radiological impacts due to the low probability of the accidents occurring.

5.3.11.2 Facility Accidents - Nonradiological Consequences

The nonradiological consequences associated with the caretaking and dismantlement activities would be the same as for the no action and the prompt dismantlement alternatives. The discussions in Sections 5.1.11.2 and 5.2.11.2 are applicable for the deferred dismantlement alternative.

Nonradiological occupational accidents, such as slips and falls, could occur during the caretaking period and deferred reactor plant dismantlement; however, the rate is not expected to be greater than rates for other Naval Reactors Program activities (see Table 4-3). For conservatism, projections of the number of fatalities and injuries/illnesses were estimated based on the U.S. Department of Energy and Contractors rates for all labor categories (see Table 4-3). The estimated number of fatalities and injuries/illnesses are summarized in Table 5-3 and indicate that the overall nonradiological occupational risks would be small.

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Table 5-3: Estimated Nonradiological, Occupational Impacts for Deferred Dismantlement

	Caretaking	Dismantlement
Estimated Kesselring Site Caretaking and Dismantlement Staffing Level (equivalent full-time workers)	1	200
Estimated Average Number of Injuries/Illnesses per Year [a]	0.036	7.2
Estimated Number of Fatalities per Year [a]	0.00003	0.006
Total Estimated Number of Injuries/Illnesses [b]	1.1	25
Combined Totals	26	
Total Estimated Number of Fatalities [b]	0.0009	0.021
Combined Totals	0.022	

a. Calculated by multiplying Kesselring Site staffing levels times the U.S. Department of Energy and Contractors rates provided in Table 4-3.

b. Total values calculated for a 30-year caretaking period and 3½-year dismantlement period.

5.3.11.3 Transportation Accidents

There has never been a major accident nor measurable release of radioactivity to the environment during shipment of Naval Reactors Program waste or materials. However, hypothetical transportation accidents were evaluated to determine potential environmental effects.

5.3.11.3.1 Transportation Accidents - Radiological Consequences

The discussion in Section 5.2.11.3.1 for the prompt dismantlement applies to this section. Because of radioactive decay, the risks would be lower.

The health risks associated with transportation accidents for shipments from the Kesselring Site to the Hanford Site for deferred dismantlement are summarized in Appendix C, Table C-19. Analyses indicate that the general population would receive 5.8×10^{-5} person-rem (2.9×10^{-8} risk of single additional latent fatal cancer) in this scenario. On an annual basis, the per person risk to the general population of a single additional latent fatal cancer would be 6.3×10^{-14}.

When compared to the radiological health risks associated with incident-free radioactive waste shipments (see Section 5.3.10.3) the risks of hypothetical accidents would be less. This is due to the very low probability of a severe accident occurring.

DEFERRED DISMANTLEMENT ALTERNATIVE

5.3.11.3.2 Transportation Accidents - Nonradiological Consequences

The nonradiological consequences associated with the transportation accidents for the prompt dismantlement alternative (see Section 5.2.11.3.2) would be the same for the deferred dismantlement alternative.

5.3.12 Utilities and Energy

The use of energy and utility resources would be required to support caretaking and dismantlement activities. This would include maintenance activities during the 30-year caretaking period and dismantlement activities associated with the removal of the reactor compartments. However, this would be a small portion of the overall use of utility and energy resources that are routinely required to support normal Kesselring Site operations. Since this demand would be indistinguishable from existing conditions, impacts to utility and energy resources would not be expected.

5.3.13 Hazardous Materials and Waste Management

Caretaking activities would generate very small volumes of waste. Waste generated would consist mainly of commercial waste, and disposal would be consistent with State and local regulations. Hazardous materials would continue to be managed in accordance with Federal, State and local regulations.

Deferred dismantlement activities would be similar to prompt dismantlement activities. Although cobalt-60 would decay to less than 2 percent of the levels at the start of a 30-year caretaking period, the amount of materials handled as low-level radioactive waste would not be expected to change, due to the presence of other longer-lived radionuclides.

Deferred dismantlement would result in the same number of shipments of recyclable materials and waste as the prompt dismantlement alternative. Low-level radioactive waste from deferred dismantlement would meet the same disposal site requirements as discussed in Section 5.2.13. Decay of radioactivity in the S3G and D1G Prototype reactor plants could allow for a greater percentage of radioactive metals to be candidates for recycling or volume reduction than the percentages discussed in Section 5.2.13. However, considering that the estimated volume of low-level radioactive waste associated with prompt dismantlement falls within the range currently experienced within the U.S. Department of Energy, deferred dismantlement would have an even lower environmental effect. The volume of mixed waste resulting from deferred dismantlement is estimated to be the same as discussed in Section 5.2.13.

DEFERRED DISMANTLEMENT ALTERNATIVE

5.3.14 Irreversible and Irretrievable Commitments of Resources

The deferred dismantlement alternative would not involve any irretrievable or irreversible commitment of environmentally sensitive resources. As discussed previously in this section, this alternative would not contribute to any loss of endangered or threatened species, critical habitat, or areas of archeological, historical or cultural value. Demand on consumable resources such as utilities and energy for caretaking and deferred dismantlement activities would be very small. No additional disposal sites would be required to dispose of dismantlement wastes.

5.3.15 Impact Summary for the Deferred Dismantlement Alternative

The distinguishing features of this alternative are: (1) fluctuation of Kesselring Site staffing levels for the caretaking and dismantlement activities, (2) occupational radiation exposure from incident-free activities, and (3) the number of waste shipments resulting from dismantlement.

This alternative would dismantle the reactor plants after a 30-year caretaking period. While the reactor plants would require maintenance and monitoring during the caretaking period, a staff reduction of 200 personnel at the Kesselring Site would still be required. After the caretaking period, an increase of 200 personnel at the Kesselring Site would occur to support the deferred dismantlement activities. This increase in staffing levels would be temporary (for approximately 3 to 4 years) since a subsequent staff reduction would occur once the dismantlement activities are completed. While this fluctuation in the staffing levels would have a noticeable impact on the Kesselring Site work force, it only represents about 0.1 percent of the work force in the surrounding region (see Table 4-2) and would have no discernible impact on the unemployment rate.

The occupational radiation exposure for incident-free activities is estimated to be 26 person-rem (see Appendix B, Table B-7). A comparison shows that the occupational radiation exposure for the deferred dismantlement alternative would be less than 15 percent of direct radiation exposure from the prompt dismantlement alternative. The occupational radiation exposure for deferred dismantlement reflects the radioactive decay of cobalt-60.

The discussion on the number of waste shipments for the prompt dismantlement alternative in Section 5.2.15 would also apply to this section. During the caretaking period, the radioactivity in reactor plant materials would decay to a lower amount when compared to the prompt dismantlement alterative. However, the amount of materials handled as low-level radioactive waste during deferred dismantlement activities would not be expected to change, due to the presence of long-lived radionuclides.

5.4 Environmental Justice

5.4.1 Introduction

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (see Section 2.6.8), directs Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies and activities on minority or low-income populations. A disproportionately high and adverse human health or environmental effect occurs when there is a significant and adverse effect that occurs for minority or low-income populations at an appreciably higher rate than for the general population.

5.4.2 Community Characteristics

Definitions, figures and data for minority and low-income populations used in this environmental justice analysis were obtained from the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7). The data and figures are based on the 1990 Census and include 304 census tracts within 80 kilometers (50 miles) of the Kesselring Site. The total population within this area is approximately 1,149,000. Distribution of the population in this area is shown in Figure 4-4.

Figure 5-1 shows the locations of populations within 80 kilometers of the Kesselring Site for which minority membership exceeds the average (6 percent). Figure 5-1 also shows the location of populations within this area for which minority membership exceeds 50 percent; these populations are difficult to distinguish in the figure due to their small size. The figure shows that none of these populations are located within 8 kilometers (5 miles) of the Kesselring Site.

The U.S. Census Bureau characterizes persons living in poverty as those whose income is less than a "statistical poverty threshold." For the 1990 Census, this threshold was based on a 1989 income of $12,500 per household. Figure 5-2 shows the locations of populations within 80 kilometers of the Kesselring Site for which the percent of the population living in poverty exceeds 25 percent (average is approximately 9 percent); these populations are difficult to distinguish in the figure due to their small size. The figure shows that none of these populations are located within 8 kilometers (5 miles) of the Kesselring Site.

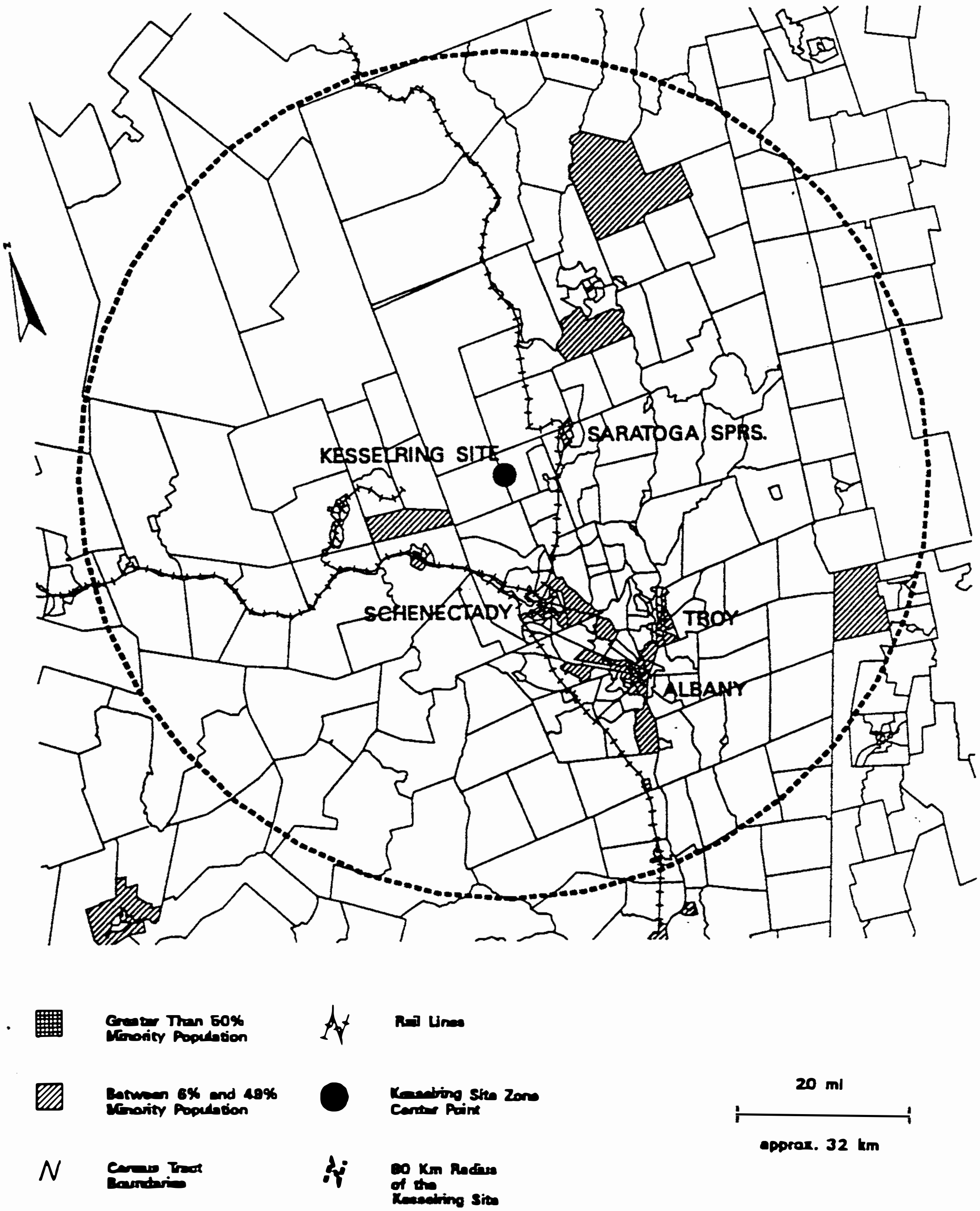

Figure 5-1: Minority Population Distribution Within an 80-Kilometer (50-Mile) Radius of the Kesselring Site

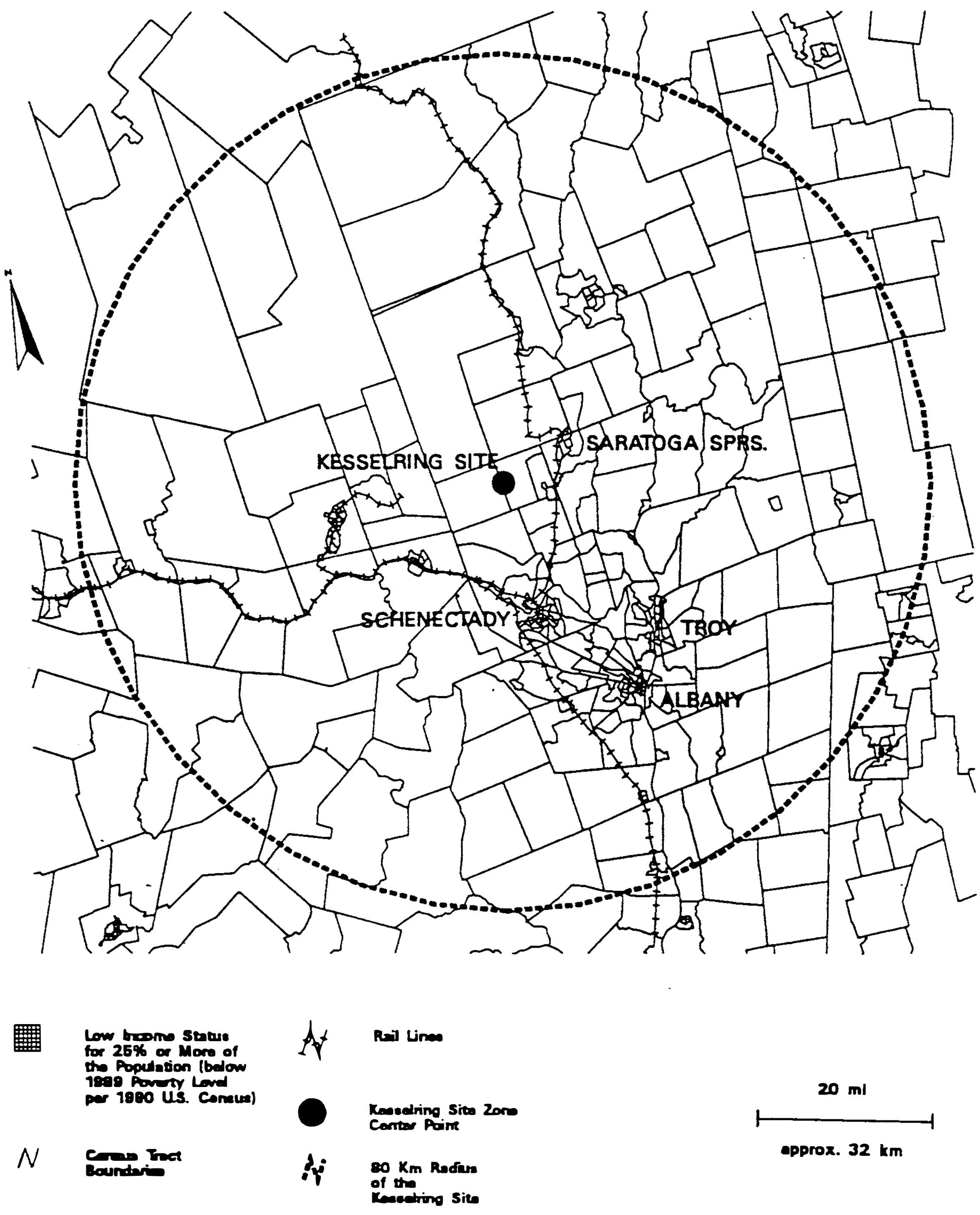

Figure 5-2: Low-Income Population Distribution Within an 80-Kilometer (50-Mile) Radius of the Kesselring Site

5.4.3 Environmental Justice Assessment

In the preceding sections of this chapter, a review was made of human health effects and environmental impacts associated with the three alternatives under evaluation. Caretaking and dismantlement activities present very small health effects and do not constitute reasonably foreseeable adverse impacts to the regional population.

The number of potential injuries and fatalities as a result of transportation and/or occupational accidents is very small for any of the alternatives. The latent fatal cancer risk to the public resulting from incident-free caretaking and/or dismantlement activities and from the incident-free transportation of recyclable materials and waste off-site would be very small. The number of potential injuries and fatalities as a result of occupational accidents is also very small. The risks to workers from any of the alternatives are small and comparable to risks commonly accepted in the workplace.

Transportation-related accidents could occur at any location along the transportation routes; however, the assumptions and parameters used in the transportation accident analyses in Appendix C of this Environmental Impact Statement make the results applicable to all segments of the population along the routes, including minority and low-income populations. Results of these accident analyses show that the potential impacts on the population along the transportation routes due to an accident would be very small. It is reasonable to state that the potential impacts would be very small for any particular segment of the general population, including minority and low-income populations.

All three alternatives under evaluation result in job reductions, although the timing would differ. These job reductions would represent a small fraction of the regional employment level. In addition, minority and low-income communities do not largely rely on the Kesselring Site for employment.

The character of the Federal reservation and the surrounding area would remain unchanged. None of the alternatives would result in the disturbance of undeveloped land or the addition of land to the Federal reservation. Liquid and gaseous discharges resulting from caretaking and dismantlement activities would be controlled to maintain water quality and air quality, consistent with present practice. Caretaking and dismantlement activities would be confined within the Kesselring Site and would not adversely impact any subsistence consumption of fish, game, or native plants in the region.

5.4.4 Conclusion

None of the alternatives analyzed would result in disproportionately high and adverse environmental or health effects on any particular segment of the population, including minority and low-income populations. Accordingly, none of the alternatives for disposal of the S3G and D1G Prototype reactor plants present an environmental justice concern.

5.5 Cumulative Impacts and Effects

Cumulative impacts are those effects resulting from implementation of one of the proposed alternatives considered in combination or association with other actions that are either directly or indirectly related. For the alternatives considered, the cumulative effects of the alternatives are discussed in the context of ongoing Kesselring Site operations which include the continued operations of the MARF and S8G Prototypes. A discussion of potential cumulative impacts associated with the three reasonable alternatives is provided in the following sections. There would be no discernible cumulative impacts specifically associated with any of the alternatives for disposal of the S3G and D1G Prototype reactor plants.

5.5.1 Land Use

The approximately 26 hectares (65 acres) of land comprising the Kesselring Site have already been developed from their previous agricultural use (see Section 4.1). None of the S3G and D1G disposal alternatives would change the existing character on any land on the Federal reservation. No land would have to be set aside for disposal of dismantlement waste materials. Therefore, there would be no cumulative land use impacts associated with any of the alternatives considered.

5.5.2 Water Resources

There would be no cumulative water resource impacts associated with any of the S3G and D1G Prototype reactor plants disposal alternatives. An overview of historical impacts from liquid effluents discharged at the Kesselring Site is discussed in detail in Section 4.3.

There has been no measurable impact on the environment or adverse effect on the community or the public associated with radiological discharges from Kesselring Site operations (Reference 4-4). None of the S3G and D1G Prototype reactor plants disposal alternatives would result in the discharge of radiological liquid effluents to the environment.

Nonradiological waste water discharges have included treated water from the sanitary system and storm water runoff. As discussed in Reference 4-4, the analytical results for the chemical constituents present in the Kesselring Site liquid effluents have been within applicable standards. Changes in Kesselring Site water usage or discharges as a result of the alternatives would be very small when compared to existing conditions and discharges would be expected to meet all discharge limits.

5.5.3 Air Resources

There would be no cumulative air resource impacts associated with any of the alternatives. Existing operations which have a potential for release of airborne particulate radioactivity are serviced by monitored exhaust systems. Prior to release, the exhaust air is passed through high efficiency particulate air filters to minimize radioactivity content. As discussed in Section 4.4.4 and Reference 4-4, the radioactivity contained in exhaust air during 1996 consisted of: (1) less than 0.001 curies of krypton-85 and particulate fission and activation products having half-lives greater than 3 hours; (2) approximately 2.2 curies of noble gases with half-lives of 12 days or less, principally argon-41, xenon-133, and xenon-135; (3) approximately 0.3 curies of tritium; and (4) approximately 1.0 curies of carbon-14. The average radioactivity concentration in the effluent air was well below the applicable standards in the U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment.

Based on data discussed in Sections 5.1.4.1, 5.2.4.1 and 5.3.4.1, and Appendix B, Section B.2, annual radiological airborne emissions associated with the three disposal alternatives would be less than 1 percent of the existing air emissions for normal Kesselring Site operations and would not cause a discernible change. Therefore, radiological airborne emissions would not have a cumulative impact.

Based on data discussed in Sections 5.1.4.2, 5.2.4.2 and 5.3.4.2, and Appendix C, the effects of nonradiological air emissions would be very small and would not be expected to impact air resources. Sources of nonradiological air emissions, such as vehicle emissions and dismantlement operations, would be transitory. All nonradiological air emissions would be controlled in accordance with State and Federal regulations. No change in classification of the Kesselring Site under the Clean Air Act would be expected. Consequently, nonradiological air emissions would not have a cumulative impact.

5.5.4 Terrestrial Resources

No dismantlement materials would be disposed of on the Kesselring Site or on the Federal reservation. All of the monitoring and corrective actions discussed in Section 4.5 would continue independent of dismantlement activities. Therefore, there would be no cumulative impacts to terrestrial resources associated with any of the alternatives considered.

5.5.5 Transportation

The cumulative transportation impacts associated with the dismantlement activities of the prompt and deferred dismantlement alternatives would be small. The dismantlement activities would result in approximately 110 radiological and nonradiological shipments from the Kesselring Site over the dismantlement period (see Section 5.2.10.3). On an annual basis these shipments represent less than 5 percent of the total nonradiological and radiological shipments as a result of normal Kesselring Site operations. The largest shipments by weight and radioactive content would be the two reactor pressure vessels. Transport of each of these packages from the Kesselring Site to the Delaware and Hudson railroad terminus would affect local traffic for a short period during one day each, principally on the lesser traveled secondary roads. Highway shipments of packages of similar size to the reactor pressure vessel packages have successfully occurred between the Kesselring Site and the Delaware and Hudson terminus in the past. Based on past experience with these shipments, local police escorts would direct traffic to minimize congestion. Therefore, the shipments resulting from dismantlement activities would be commensurate with normal Kesselring Site operations in recent years. Since deferred dismantlement would not reduce the volume of radioactive waste generated compared to prompt dismantlement (see Section 5.3.13), due to long-lived radionuclides, the cumulative transportation impacts would be the same for both alternatives.

5.5.6 Occupational and Public Health and Safety

As discussed in Section 5.1.10, the impacts from the no action alternative on occupational health and safety from radiation exposure would be small. The cumulative impact of the no action alternative on public health and safety would not be discernible from the effects of existing Kesselring Site activities, including the operating prototypes, as reported in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-4).

As discussed in Section 5.2.10, the most notable impact from the prompt dismantlement alternative on occupational health and safety results from additional radiation exposure. Since individual worker exposure would be limited to 2 rem per year, and since the occupational radiation exposure would be comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval nuclear reactor plants, the cumulative impact on the Kesselring Site work force would be small. The cumulative impact of the prompt dismantlement alternative on public health and safety would not be discernible from the effects of existing Kesselring Site activities, including the operating prototypes, as reported in Reference 4-4.

Occupational and public health and safety impacts from deferred dismantlement would be within the range of impacts for the no action and prompt dismantlement alternatives. Since the no action and prompt dismantlement alternatives would have no discernible cumulative impact, deferred dismantlement would also be expected to have no discernible cumulative impact.

5.5.7 Hazardous Materials and Waste Management

Waste volumes generated at the Kesselring Site vary from year-to-year. Between 1988 and 1994, low-level radioactive waste volume has been as high as 215 cubic meters (281 cubic yards). Compared to these previous years, the volume of low-level radioactive waste generated at the Kesselring Site during 1996, approximately 133 cubic meters (175 cubic yards), was small. From a cumulative impact perspective, prompt S3G and D1G Prototype dismantlement activities would noticeably add to the volume of low-level radioactive waste generated at the Kesselring Site for about a 3-year period. However, on an annual basis, the expected cumulative volumes would continue to fall within historical ranges generated at the Kesselring Site. On a broader scale, as discussed in Section 5.2.13, the end of the Cold War may result in some increases in radioactive wastes, such as from dismantlement of the S3G and D1G Prototype reactor plants. However, there has also been a larger decrease in radioactive waste generation due to the earlier-than-projected inactivation of Naval nuclear-powered warships and prototype reactor plants. As a result, the volume of the S3G and D1G low-level radioactive waste would be within the projection of Naval Reactors Program waste previously provided to the Savannah River Site, which in turn is included in existing Savannah River Site analyses (Reference 5-1).

S3G and D1G Prototype dismantlement activities would generate small amounts of hazardous waste, as discussed in Section 5.2.13. Between 1992 and 1996, the annual quantity of hazardous and chemical waste generated at the Kesselring Site ranged between 19.2 and 138 metric tons (21.2 and 154 tons). The high end of the range represents the quantity of hazardous and chemical waste generated during 1996. From a cumulative impact perspective, the quantity of hazardous and chemical waste shipped from the Kesselring Site during prompt dismantlement would continue to be within the historical ranges generated at the Kesselring Site.

As discussed in Section 4.5.4.6, the volume of mixed waste generated and stored at the Kesselring Site has been small. Prompt S3G and D1G Prototype dismantlement activities would add to the inventory of mixed waste stored at the Kesselring Site. The projected volume of elemental lead mixed waste is within existing forecasts in the Site Treatment Plan (Reference 2-2). The projected volume of PCB-containing mixed waste from paint removal operations and small miscellaneous rubber components could be above the existing forecast in the Site Treatment Plan. As discussed in the Site Treatment Plan, the inventory of mixed waste stored at the Kesselring Site will tend to increase over the next 5 years, pending the availability of off-site treatment and storage facilities. As part of a recent proposed modification to the New York State Department of Environmental Conservation (NYSDEC) issued Kesselring Site Part 373 Hazardous Waste Management Permit (Reference 4-16), Naval Reactors has requested NYSDEC approval to allow transfer of small quantities of mixed waste between the Knolls Site in Schenectady and the Kesselring Site. The purpose of this provision is to consolidate like forms of mixed waste to facilitate shipment out of the State for treatment and disposal. The cumulative impact of projected mixed waste from all site activities and mixed waste from prompt dismantlement activities, 76 cubic meters (2,700 cubic feet or 20,000 gallons), would be small and is not expected to result in any significant impacts on the environment. The projected amounts of mixed waste at the Kesselring Site represent less than 0.1 percent of the total amount of mixed waste stored and generated at U.S. Department of Energy facilities.

Since caretaking activities would generate very small quantities of waste, there would be no discernible cumulative impact on Kesselring Site waste generation under the no action alternative. Deferred dismantlement activities would generate approximately the same quantities of wastes as the prompt dismantlement alternative. Since Kesselring Site activities 30 years in the future are not established at this time, the cumulative impacts of deferred dismantlement waste generation cannot be fully determined. However, since the cumulative impacts of prompt dismantlement would be small with regard to waste generation, the cumulative impacts of deferred dismantlement are also estimated to be small.

5.5.8 Operating Reactors/Reactor Safety

This section provides background on Naval nuclear power plant design and operation and evaluates the cumulative impacts of the operating S8G and MARF Prototype reactor plants at the Kesselring site. This section has been developed making full use of the extensive body of unclassified environmental information available on Naval nuclear propulsion matters. This information includes detailed annual reports published over three decades, independent environmental surveys performed by the U.S. Environmental Protection Agency and by states in which Naval nuclear propulsion facilities are located, and a thorough independent review performed by the General Accounting Office in 1991 (Reference 2-6). Because nuclear propulsion technology is among the most sensitive military technologies possessed by the United States, Congress has placed stringent limitations on foreign access under the Atomic Energy Act of 1954 (amended) and other Federal statutes. Appendix D, which is classified, contains Naval reactor design information and evaluation of postulated accidents. However, all potential environmental impacts and conclusions discussed in Appendix D are covered in the following unclassified sections.

5.5.8.1 Naval Nuclear Power Plant Design

The source of energy for Naval nuclear power plants is heat which originates from fissioning uranium atoms contained within pressurized water reactor cores. Since the fission process also produces radiation, shielding is placed around the reactor to protect the crew. United States Naval nuclear propulsion plants, including the S8G and MARF Prototype reactor plants, use a pressurized water reactor design which has two basic systems: the primary system and the secondary system. The arrangement is shown schematically in Appendix A, Figure A-2. The primary system circulates ordinary demineralized water in an all-welded, closed loop consisting of the reactor pressure vessel, piping, pumps, and steam generators. The heat produced in the reactor core is transferred to the water, which is kept under pressure to prevent boiling. The heated water passes through the steam generators where it transfers its energy. The primary system water is then pumped back to the reactor to be heated again.

Inside the steam generators, the heat from the primary system is transferred across a water-tight boundary to the water in the secondary system, also a closed loop. The secondary system water, which is at a relatively low pressure, boils to create steam. Isolation of the secondary system from the primary system prevents water in the two systems from intermixing, keeping radioactivity out of the secondary system water.

In the secondary system, steam flows from the steam generators to drive the main propulsion turbines, which turn the ship's propellers, and the turbine generators, which supply the ship with electricity. After passing through the turbines, the steam is condensed back into water in a condenser cooled by seawater, and feed pumps return it to the steam generators for reuse. Thus, the primary and secondary systems are separate, closed systems in which constantly circulating water transforms energy produced in the nuclear chain reaction into useful work.

The reactor core is installed in a heavy-walled reactor pressure vessel within a primary shield. This shield limits exposure from gamma and neutron radiation produced when the reactor is operating. Reactor plant piping systems are installed primarily inside a reactor compartment, which is surrounded by a secondary shield. Because of these two shields, the resulting radiation levels outside the propulsion plant spaces during reactor plant operation are indistinguishable from background radiation levels. Fleet personnel operating nuclear-powered submarines receive less total annual exposure than they would if they were stationed on shore performing work not involving occupational radiation exposure. The exposure is less, because of the low natural background radiation in a steel hull submerged in the ocean, compared to natural background radiation from sources on shore (References 2-3 and 4-22).

5.5.8.2 Reactor Design and Operation

As stated in Section 2.4, Naval nuclear propulsion reactors have an outstanding safety record. In over 4,800 reactor-years of operation and over 110 million miles steamed by nuclear-powered U.S. Navy warships, there has never been a nuclear reactor accident or any incident having a large effect on the environment. A nuclear reactor accident is defined as an event which results in a significant release of fission products from the reactor fuel. The features which are built into Naval nuclear propulsion plants to make them battle worthy also enhance reactor reliability and safety. These features include inherent self-regulation for stability, ability to accommodate rapid power level changes repeatedly to meet changes in ship speed, equipment redundancy, and rugged design for battle shock with the nuclear plant contained within the confines of the hull. Further, prototype propulsion plants are operated and maintained by highly trained crews to the same stringent requirements, exacting standards, and explicit procedures applicable to all Naval nuclear propulsion plants.

The nuclear fuel in Naval nuclear propulsion reactor cores uses highly corrosion-resistant and highly radiation-resistant materials. Since the corrosion rate of the protective cladding on the fuel elements is very slow, the reactor could remain submerged in seawater indefinitely without releasing fission products while the radioactivity decays. As a result, the fuel is very strong and has very high integrity. The fuel is designed, built, and tested to ensure that the fuel construction will contain the radioactive fission products during normal reactor operations and other extreme conditions such as battle shock. In contrast, typical commercial nuclear power plants differ from Naval nuclear propulsion plants in fuel design. Commercial fuel may release some fission products within regulatory limits under normal operations. Naval nuclear fuel can withstand combat shock loads that are well in excess of 50 times the seismic loads a commercial plant might experience in a severe earthquake. Naval nuclear fuel routinely operates with rapid changes in power level since Naval warships must be able to change speed quickly in operational situations. Naval nuclear fuel consists of solid components which are nonexplosive, nonflammable, and noncorrosive.

Strict adherence to conservative principles of design and operation of Naval reactors was discussed on May 24, 1979, by the Director of Naval Nuclear Propulsion (then, Admiral H. G. Rickover) in congressional testimony following the accident at Three Mile Island. Admiral Rickover emphasized that ensuring reactor safety is the responsibility of all personnel who work on Naval nuclear propulsion plants and that each Naval Reactors Program element from training, to design, to construction, and to operation must be properly carried out in a coordinated fashion to achieve the goal of safe performance. A more thorough discussion of this topic can be found in Rickover and the Nuclear Navy: The Discipline of Technology (Reference 2-5).

The MARF and S8G Prototype reactor plants have pressurizable steel containment structures and engineered safety systems. Even though the Atomic Energy Act does not require the MARF and S8G Prototype reactor plant designs to be licensed by the U.S. Nuclear Regulatory Commission, the Naval Reactors Program has provided the designs to the U.S. Nuclear Regulatory Commission and the Advisory Committee on Reactor Safeguards for independent review. These reviews concluded that the S8G and MARF Prototype reactor plants could be operated without undue risk to the health and safety of the public.

5.5.8.3 Cumulative Impacts of Accidents for Reactor Operations and Dismantlement Activities

Notwithstanding the remote possibility of occurrence, the consequences of postulated nuclear accidents have been analyzed and are addressed in Appendix D. A range of hypothetical accident scenarios considering plant-specific design features, operational attributes, procedures, site physical characteristics, and population distribution have been evaluated to examine their resulting impacts on the surrounding environment and population. Those evaluations confirm that the S8G and MARF Prototype reactor plants are designed to withstand a wide variety of accident conditions without damage to the reactor core or release of large amounts of radioactivity.

In the unlikely event of an accident at either the S8G or MARF Prototype reactor plants, the impact on dismantlement work would be small. Virtually all dismantlement work can be stopped or interrupted without compounding the risks associated with the work. If a reactor accident required dismantlement workers to immediately leave the job and relocate to another area on or off the Kesselring Site, the dismantlement activities would remain in a stable condition since this work does not require special conditions or uninterrupted operator intervention to prevent loss of containment or shielding. Therefore, reactor accident consequences would not unduly impact dismantlement activities.

Similarly, if a dismantlement accident were to occur, the impact on reactor operations at the Kesselring Site would be small. Dismantlement activities would take place in locations which are several hundreds of feet away from the operating reactor plants and there would be no loads or lifts of large components near the operating reactor plants or near any of the prototype reactor plant systems which support operation of the plants. As shown in Appendix B, the consequences associated with hypothetical dismantlement accidents would be very small. Therefore, dismantlement accidents do not increase the likelihood or consequence of a reactor plant accident.

5.5.9 Other Resources

Since none of the alternatives would have any impact on environmental resources such as ecological resources, critical habitats, endangered species, cultural resources, or aesthetic resources, no cumulative impact would occur. With regard to resources such as noise, socioeconomics, and utility and energy usage, the potential impacts from all three alternatives would be so small that there would be no discernible cumulative impact.

5.5.10 Conclusion

The evaluation of the activities associated with the dismantlement alternatives combined with ongoing Kesselring Site operations does not result in any discernible cumulative impact or effect on health and the environment.

5.6 Unavoidable Adverse Effects

Each alternative includes small impacts which would be unavoidable. However, none of the alternatives would result in a discernible adverse effect on the environment or human health and safety. Compared to the deferred dismantlement and no action alternatives, the prompt dismantlement alternative would result in greater occupational radiation exposure. Occupational radiation exposure would still be comparable to the radiation exposure routinely received during ongoing operations and maintenance of Naval nuclear reactor plants. Radiation worker doses would be limited to 2 rem per year which is well below the Federal limit of 5 rem per year. Prompt dismantlement would also result in a slightly higher public exposure to radiation from transportation of recyclable materials and waste compared to the other alternatives. The exposure to individuals would be a small fraction of the radiation exposure received from other sources associated with everyday life, such as background radiation. Overall, the health effects associated with any of the alternatives would be very low and would not discernibly add to the incidence of cancer in the general population or the work force.

Dismantlement activities would consume some nonrenewable resources (energy and various materials) and would result in some emissions and wastes. New materials would be needed to ensure adequate isolation of radioactive components from the environment and as shielding to reduce external radiation dose to regulatory levels. Emphasis would be placed on recycling as much dismantled material as practical. Radioactive components that exceed the criteria for recycling could still be candidates for volume reduction including methods such as compaction and metal smelting. Emissions, direct radiation exposure and waste disposal would comply with existing regulations. Under the no action alternative, impacts of material and energy use, direct radiation exposure, and emissions and waste generation would be minimal since caretaking activities would be limited to surveillance and security tours.

Except for the transportation of materials under the prompt and deferred dismantlement alternatives, activities associated with each alternative would be confined to already developed areas of the Kesselring Site. Therefore, none of the alternatives would have any impact on ecological, cultural, geological, or aesthetic resources.

5.7 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity

This section provides the relationship between short-term impacts versus long-term effects on the environment. With regard to short-term environmental impacts (within a 5-year period), there is little distinction between the alternatives because all environmental impacts would be small. However, the prompt dismantlement alternative is the only alternative that would result in a permanent disposal solution in the short-term. Prompt dismantlement activities would be completed within approximately 3 to 4 years. Wastes that would be generated from dismantlement activities fall within existing estimated forecasts and disposal sites have sufficient capacity at this time.

None of the alternatives would have a discernible long-term effect on the environment. However, there are some long-term considerations that factor into comparisons. For example, while the no action alternative would not have a long-term effect on the environment, it also does not provide for permanent disposal of the S3G and D1G Prototype reactor plants. Although there are no plans to close existing disposal facilities, such as the U.S. Department of Energy Savannah River Site, deferring dismantlement activities would introduce some uncertainty with regard to future waste disposal options.

Since there are no plans to shut down the other operating prototypes or to release the Kesselring Site or Federal reservation lands for other uses in the foreseeable future, none of the alternatives would have any impact on the long-term productivity of the environment. However, the prompt dismantlement would make the eventual release of the Kesselring Site more readily achievable since dismantlement and disposal of two of the four prototype reactor plants would be completed. None of the alternatives involve construction of new structures or development of undisturbed lands.

In terms of socioeconomic effects, each alternative would impact Kesselring Site employment with a reduction of approximately 200 personnel in the short-term. Under the no action and deferred dismantlement alternatives, Kesselring Site employment would be reduced and then a limited work force would place the defueled reactor plants in a condition suitable for long-term caretaking. In comparison, the prompt dismantlement alternative maintains the approximately 200 staff positions at the Kesselring Site for the dismantlement duration, and productivity is enhanced by use of currently available and experienced personnel. In a regional context, changes in Kesselring Site employment do not have any discernible impact on short-term or long-term socioeconomic trends. None of the alternatives involve any environmental justice concerns because all impacts would be small.

5.8 Impact Avoidance and Mitigative Measures

The strictly controlled conduct of activities at Naval Reactors Program facilities are mitigation measures integral to all three alternatives considered in detail for disposal of the S3G and D1G Prototype reactor plants. The Naval Reactors Program has directives and regulations for the conduct of operations at its facilities and has adopted stringent controls for minimizing occupational and public radiation exposure. The policy of these programs is to reduce radiation exposures to as low as reasonably achievable. Singly and collectively, these measures avoid, reduce, or eliminate any potentially adverse environmental impacts from activities at Naval Reactors Program facilities, including those associated with the alternatives considered. The following sections provide measures which are used at the Kesselring Site. The Naval Reactors Program has not identified a need for additional mitigative measures.

5.8.1 Pollution Prevention

Under Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, the Kesselring Site is required to eliminate or reduce the unnecessary acquisition of products containing extremely hazardous substances or toxic chemicals. Although the prototype reactor plants would contain lead and other hazardous materials, these substances would be managed in accordance with stringent safety procedures further discussed in Section 5.8.2. Therefore, current technologies for pollution prevention would be used and would meet pollution prevention standards for the dismantlement alternatives.

Consistent with normal Kesselring Site practice, emphasis during dismantlement would be placed on recycling as much material as practical. As discussed in Section 5.2.13, segregating radioactive and hazardous or toxic materials increases the options for recycling. Most of the recyclable materials generated from dismantlement activities would be metals such as carbon steel from the hull and deckplate structures, corrosion-resisting metals from reactor plant systems, and lead shielding. These materials would be recycled using various commercial vendors.

While the radioactive decay of cobalt-60 would substantially reduce occupational exposure associated with deferred dismantlement activities, many of the materials from reactor systems would still be radioactive due to the longer-lived radionuclides which remain even after 30 years. For the purposes of comparison, the number and types of radioactive shipments associated with deferred dismantlement were assumed to be the same as for the prompt dismantlement alternative. Methods for packaging, transport, disposal and recycling were also assumed to be the same for the deferred and prompt dismantlement alternatives.

Pollution prevention at the Kesselring Site includes two management plans which outline actions for storage requirements and spill management. The Best Management Practices and Spill Prevention Plan outlines proper management of several hazardous substances stored and used at the Kesselring Site. Proper management of these substances prevents accidental spills or releases. The Best Management Practices and Spill Prevention Plan specifically addresses actions for New York State registered Hazardous Substance Bulk Storage Tanks. This plan outlines proper storage, inspection and emergency spill procedures, and is required by the Kesselring Site's New York State Pollutant Discharge Elimination System permit. Additionally, the Spill Prevention Control and Countermeasures Plan outlines proper storage, inspection and emergency spill procedures for all petroleum storage locations at the Kesselring Site. This plan is required by 40 CFR Part 112.5.

5.8.2 Normal Facility Activities

Work on radiologically contaminated components is part of routine operations at the Kesselring Site. This work is pre-engineered and performed using appropriate measures to prevent the spread of radioactivity and to protect human health and the environment. The protective measures during dismantlement would adhere to the same standards and practices that were used to successfully control maintenance evolutions during plant operations. These protective measures include, but are not limited to:

- preliminary planning;
- preparation and use of detailed engineering work procedures;
- pre-engineering of processes and special tooling to minimize exposure to radiation and radioactive contamination;
- checkout of equipment and procedures, and training of personnel on mockups;
- engineered containment enclosures;
- nuclear grade high efficiency particulate air filtered ventilation systems;
- radiation shielding;
- isolation and sealing of component openings upon disassembly;
- controlled work areas with all personnel and materials evaluated and monitored for radiation and radioactive contamination at the exit; and
- monitoring and sampling within and adjacent to the controlled work areas.

5.8.3 Accidents

There has never been an accident in the history of the Naval Reactors Program that resulted in a significant release of radioactivity to the environment or that resulted in radiation exposure to workers in excess of specified limits. Appendix B provides a description of nontransportation related accidents which could occur during dismantlement of the reactor plants and loading of disposal containers at the Kesselring Site. Appendix C provides a description of the transportation related accidents that could occur. The results of these analyses are presented in terms of latent fatal cancer risk to caretaking and dismantlement workers and the public. The risks are based on hypothetical occurrences of the accidents and do not reflect the very low probabilities of the accidents actually occurring. Calculations of the latent fatal cancers which might occur as a result of all postulated accidents are provided in Appendices B and C. A comparison of the accident consequences for all alternatives is provided in Section 3.5.

Although a serious accident involving radioactive or other hazardous materials is highly unlikely, emergency plans are in place at all Naval nuclear facilities to mitigate the impacts of a facility or transportation accident. These plans include activation of emergency control organizations throughout the Naval Reactors Program to provide on-scene response as well as support for the on-scene response team. Emergency plans for the Kesselring Site have been provided to the New York State Emergency Management Office and local Saratoga County officials (Reference 5-8). Realistic training exercises are conducted periodically to ensure that the response organizations maintain a high level of readiness, and to ensure that coordination and communication lines with local authorities and other Federal and State agencies are effective.

Emergency response measures include provisions for immediate response to any emergency at any Naval Reactors Program site, identification of accident conditions, and communications with other authorities to provide radiological data and recommendations for any appropriate corrective actions. Periodic training and evaluation of the emergency response personnel is conducted to ensure that corrective actions are taken properly during an actual casualty. In the event of a facility accident involving radioactive or other hazardous materials, workers in the vicinity of the accident would promptly evacuate the immediate area. This evacuation can typically be accomplished within minutes of the accident and would reduce the hazard to workers. Other individuals who work at the Kesselring Site, or delivery personnel in transit within the Federal reservation boundary, would be evacuated from the affected area within a short time. Kesselring Site emergency response and security personnel would oversee any evacuation to ensure completion of actions in a safe and efficient manner.

For emergencies that impact areas beyond the Kesselring Site and Federal reservation property boundary, local community emergency services are responsible for providing initial response and on-scene command. The Naval Reactors Program would assist local response agencies, beginning with notification and initial assessment, and recommendations for public evacuation, if necessary.

As a result of the emergency plans and coordinated efforts described above, exposure of residents, workers and travelers to any hazard would be limited to the extent possible. Actions would be taken, if needed, to prevent the public from exceeding limits for exposure to radiation or other hazards. Following stabilization of accident conditions, recovery and remediation actions would be implemented.

5.9 Summary of Analysis Uncertainties

The calculations in this Environmental Impact Statement have generally been performed in such a way that the estimates of risk provided are conservatively high and are unlikely to be exceeded during transportation, dismantlement activities, caretaking activities, or in the event of an accident. The results of radiation surveys and monitoring of similar operations provide clearly realistic source terms for incident-free activities, which, when combined with conservative estimates of the effects of radiation, produce estimates of risk which are very unlikely to be exceeded.

The analyses of hypothetical accidents provide more opportunities of uncertainty, primarily because the calculations must be based on sequences of events and models of effects that have not occurred. The models have attempted to provide estimates of the probabilities, source terms, pathways for dispersion and exposure, and the effects on human health and the environment that are as realistic as possible. However, in many cases, the very low probability of the accidents postulated has required the use of models or values for input. These inputs produce estimates of consequences and risks which are higher than would actually occur. The risks presented in this Environmental Impact Statement are believed to be at least 10 to 100 times larger than what would actually occur. Even with the use of conservative analytical methods, the risks of all the alternatives would be very small. Since the resulting risks would be so small, the significance of any uncertainty in analysis parameters is greatly reduced.

The use of conservative analyses does not create a bias in this Environmental Impact Statement since all of the alternatives have been evaluated using the same methods and data, the potential impacts of each alternative can be fairly compared on the same basis. An extensive discussion of uncertainty relative to this Environmental Impact Statement can be found in Volume 1, Appendix D, Part B, Attachment F, Section F.1.5, of the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 2-7).

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GLOSSARY

100-Year flood	A flood event of such magnitude that it occurs, on average, every 100 years (equates to a 1 percent probability of occurring in any given year).
Activation	The process of making a material radioactive by exposing the material to neutrons, protons, or other nuclear particles.
Alpha radiation	Energy released in the form of large positively-charged particles emitted from the nuclei of some radioactive elements during radioactive decay.
Area of Concern	A location that is not known to be a Solid Waste Management Unit but where hazardous waste and/or constituents are present, or are suspected to be present, as a result of a release. Refer to "Solid Waste Management Unit."
Beta radiation	Energy released in the form of small charged particles emitted from the nuclei of some radioactive elements during radioactive decay. A beta particle may be either negatively-charged or positively-charged.
Cladding	A metal casing that surrounds nuclear fuel.
Corrosion products	The substances produced by the corrosion of a metal. Rust is a corrosion product resulting from the corrosion of iron.
Curie	The curie is the common unit used for expressing the magnitude of radioactive decay in a sample containing radioactive material. Specifically, the curie is that amount of radioactivity equal to 3.7×10^{10} (37 billion) disintegrations per second. This unit does not give any indication of the radiological hazard associated with the disintegration.
Defueling	The complete removal of all nuclear fuel from the reactor plant.
Fission products	The series of intermediate weight atoms left after the fission (splitting) of a heavy atom such as uranium. Because of the nature of the fission process, many fission products are unstable and, therefore, radioactive.

Gamma radiation	High energy, short wavelength electromagnetic radiation emitted from the nuclei of some radioactive elements during radioactive decay. Gamma rays are essentially similar to x-rays but are usually more energetic.
Half-life	The time required for a radioactive substance to lose 50 percent of its activity by decay.
Hazardous waste	The Resource Conservation and Recovery Act (40 CFR Part 261) defines Hazardous Waste as a waste that is listed on one of the U.S. Environmental Protection Agency's hazardous waste lists or meets one of four hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity.
Latent fatal cancer	The unit for the health detriment of fatal cancer, after a period of time, for an individual as a result of radiation dose. The product of dose in rem and the health effects conversion factor for fatal cancer for an individual (general public or worker).
Mixed waste	Waste that is radioactive and also hazardous as defined in the Resource Conservation and Recovery Act.
Naval Reactors Program	A joint program of the U.S. Department of Energy and the U.S. Department of the Navy which has as its objective the design and development of improved Naval nuclear propulsion plants having high reliability, maximum simplicity, and optimum fuel life for installation in ships ranging in size from small submarines to large combatant surface ships. The program is also referred to as the Naval Nuclear Propulsion Program.
Particulate	Pertaining to a very small piece or part of material.
Pathway	The route or course along which radionuclides could reach man.
Person-rem	A unit used to measure the radiation dose to an entire group of people over a specific period of time or during a specified work effort. It is obtained by multiplying the average dose (measured in rem) to the whole body by the number of persons in the group of interest.

Polychlorinated Biphenyls	A class of chemical substances, formerly manufactured as an insulating fluid in electrical equipment, that is highly toxic to aquatic life. Polychlorinated biphenyls (PCBs) persist in the environment for a long time and tend to accumulate in animals, with possible adverse effects.
Radioactive decay	The process of spontaneous transformation of a radioactive nuclide to a different nuclide or different energy state of the same nuclide. Radioactive decay involves the emission of alpha particles, beta particles, or gamma rays from the nuclei of the atoms. If a radioactive nuclide is transformed to a stable nuclide, the process results in a decrease in the number of original radioactive atoms. Radioactive decay is also referred to as radioactive disintegration.
Radiation	Energy in the form of waves (rays) or particles emitted from the nuclei of unstable atoms during decay (disintegration).
Radiation dose	The amount of radiation received (in rem or millirem). Radiation dose is also referred to as radiation exposure.
Radiation dose rate	The radiation dose per unit time (in rem per hour or millirem per hour).
Radiation shielding	Materials placed around a radioactive source to reduce radiation levels and protect personnel; usually concrete, water, or lead.
Radiation survey	The evaluation of an area or object with instruments to detect, identify, and quantify radioactive materials and radiation fields which may be present.
Radioactivation	Refer to "Activation."
Radioactivity	The process of spontaneous decay or disintegration of an unstable nucleus of an atom; usually accompanied by the emission of ionizing radiation.
Radionuclide	Atoms that exhibit radioactive properties. Standard practice for naming radionuclides is to use the name or atomic symbol of an element followed by its atomic weight (for example, cobalt-60, a radionuclide of cobalt).

Record of Decision	A public document that records the final decision(s) concerning a proposed action. The Record of Decision is based on information and technical analyses generated during the decision- making process, which takes into consideration public comments and community concerns.
Rem	Rem (Roentgen Equivalent Man) is a unit of radiation that relates energy deposited to biological damage. (1 rem = 1,000 millirem).
Scientific Notation	Expressing numbers in terms of powers of ten to simplify mathematical operations or results involving very large or very small numbers. For example: $1 \times 10^{9} = 1,000,000,000$ $1 \times 10^{6} = 1,000,000$ $1 \times 10^{3} = 1,000$ $1 \times 10^{1} = 10$ $1 \times 10^{-1} = 0.1$ $1 \times 10^{-3} = 0.001$ $1 \times 10^{-6} = 0.000001$ $1 \times 10^{-9} = 0.000000001$
Solid Waste Management Unit	A known waste management location at which solid wastes have been placed at any time, regardless of whether the location was intended for the management of hazardous waste.
Type B shipping container	A container designed to retain its containment and shielding integrity under both normal transportation conditions and the hypothetical accident test conditions of 10 CFR Part 71 (Packaging and Transportation of Radioactive Material).
X-rays	Penetrating electromagnetic radiations with wavelengths shorter than those of visible light. X-rays are usually produced (as in medical diagnostic x-ray machines) by irradiating a metallic target with large numbers of high energy electrons. X-rays are essentially similar to gamma rays but are usually less energetic and originate outside the nucleus.

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