Exh. AES00070A

Eagle Rock Enrichment Facility

Environmental Report

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1.0 INTRODUCTION TO THE ENVIRONMENTAL REPORT

This Environmental Report (ER) constitutes one portion of an application submitted by AREVA Enrichment Services, LLC (AES) to the Nuclear Regulatory Commission (NRC) for a license to construct and operate a gas centrifuge uranium enrichment facility. The proposed facility, the Eagle Rock Enrichment Facility (EREF), will be located near Idaho Falls, Idaho. The ER for this proposed facility serves two primary purposes. First, it provides information that is specifically required by the NRC to assist it in meeting its obligations under the National Environmental Policy Act (NEPA) of 1969 (Pub. Law 91-190, 83 Stat. 852) (USC, 2008a) and the agency's NEPA-implementing regulations. Second, it demonstrates that the environmental protection measures proposed by AES are adequate to protect both the environment and the health and safety of the public.

AES has prepared this ER to meet the requirements specified in 10 CFR 51, Subpart A, particularly those requirements set forth in 10 CFR 51.45(b)-(e) (CFR, 2008a). The organization of this ER is generally consistent with the format for environmental reports recommended in NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, Final Report August 2003 (NRC, 2003a).

The proposed facility will supply low-enriched uranium (5%) for use in commercial nuclear power plants. The facility will be located approximately 32 kilometers (20 miles) west of Idaho Falls, ID in Bonneville County on a 1,700 hectare (4,200 acre) site. The proposed facility will employ the gas centrifuge enrichment technology originally developed by Urenco, a consortium representing the governments of the United Kingdom, The Netherlands, and Germany. This technology has been used safely and successfully in Urenco's commercial operations for the last 35 years. This is the same technology that will be used at the National Enrichment Facility that was licensed by the NRC in June 2006 and is currently under construction in Lea County, New Mexico. This ER is part of an application for license to construct and then operate the EREF for 30 years.

The following are the key dates and milestones for the project to license, construct, and operate the proposed EREF.

Milestone	Estimated Date
Submit Facility License Application (Rev. 0)	December 2008
Submit Facility License Application (Rev. 1)	April 2009
Requested License Approval	February 2011
Initiate Facility Construction	February 2011
Start First Cascade	February 2014
Complete Construction	February 2022
Achieve Full Nominal Production Output	March 2022
Submit Decommissioning Plan to NRC	February 2030
Complete Construction of D&D Facility	February 2032
D&D Completed	February 2041

A list and discussion of other alternatives to the EREF is provided in Section 1.1 and Chapter 2.

This ER evaluates the environmental impacts of the proposed facility. Accordingly, this document discusses the proposed action, the need for and purposes of the proposed action, and applicable regulatory requirements, permits, and required consultations (ER Chapter 1, Introduction to the Environmental Report); considers reasonable alternatives to the proposed action (Chapter 2, Alternatives); describes the proposed EREF facility and the environment potentially affected by the proposed action (Chapter 3, Description of Affected Environment); presents and compares the potential impacts resulting from the proposed action and its alternatives (Chapter 4, Environmental Impacts); identifies mitigation measures that could eliminate or lessen the potential environmental impacts of the proposed action (Chapter 5, Mitigation Measures); describes environmental measurements and monitoring programs (Chapter 6, Environmental Measurements and Monitoring Programs); provides a cost benefit analysis (Chapter 7, Cost-Benefit Analysis); and summarizes potential environmental consequences (Chapter 8, Summary of Environmental Consequences). A list of references and preparers is also provided in Chapter 9, References, and Chapter 10, List of Preparers, respectively.

The effective date of this ER (Rev. 1) is April 2009.

AREVA Enrichment Services

AREVA Enrichment Services (AES), LLC is a Delaware limited liability corporation. It has been formed solely to provide uranium enrichment services for commercial nuclear power plants. AES is a wholly owned subsidiary of AREVA NC Inc. AREVA NC Inc. is a wholly owned subsidiary of the AREVA NC SA, which is part of AREVA SA.

The AREVA SA is a corporation formed under the laws of France ("AREVA"), is governed by the Executive Board, and its owners are as follows.

• Commissariat à l'Energie Atomique (French Atomic Energy Commission)	78.96%
• French State	5.19%
• Caisse des dépôts and et consignations	4.61%
• ERAP	3.21%
• Electricité d 'France	2.42%
• Investment Certificate Holders	4.03%
• TOTAL	1.58%

AES is a Delaware corporation and is governed by the AES Management Committee. The names and addresses of the members of the AES Management Committee are as follows:

- Mr. Jacques Besnainou
  President and Chief Executive Officer of AREVA NC Inc.
  President of AREVA Inc.
  4800 Hampden Lane, Bethesda MD 20814, USA

  Mr. Besnainou is a citizen of the United States of America and a citizen of France

- Mr. Michael McMurphy
  Senior Executive Vice President
  Mine, Chemistry and Enrichment Sector, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

Mr. McMurphy is a citizen of the United States of America

- Mr. Francoix-Xavier Rouxel, Chairman of the Management Committee
  Executive Vice President, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. Rouxel is a citizen of France

- Mr. Gary Fox
  Executive Vice President, AREVA NC Inc
  4800 Hampden Lane, Bethesda, MD 20814

  Mr. Fox is a citizen of the United States of America and a citizen of Canada

- Mr. Nicolas De Turckheim
  Director, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. De Turckheim is a citizen of France

- Mr. Nicolas Fayet
  Chief Financial Officer, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. Fayet is a citizen of France

The President and Chief Executive Officer of AES is Sam Shakir, a naturalized citizen of the United States of America and a citizen of Canada. Any safety decision related to the operation of the facility will be made by the President of AES.

AES's principal location for business is Bethesda, MD. The facility will be located in Bonneville County near Idaho Falls, Idaho. No other companies will be present or operating on the EREF site other than services specifically contracted by AES.

AES is responsible for the design, quality assurance, construction, operation, and decommissioning of the enrichment facility. The President and CEO of AES report to the AES Management Committee.

Foreign Ownership, Control and Influence (FOCI) of AES is addressed in the AES Standard Practice Procedures Plan, Appendix 1 – FOCI Package. The NRC in its letter to Louisiana Energy Services dated March 24, 2003, has stated "…that while the mere presence of foreign ownership would not preclude grant of the application, any foreign relationship must be examined to determine whether it is inimical to the common defense and security [of the United States]." (NRC, 2003b) The FOCI Package mentioned above provides sufficient information for this examination to be conducted.

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

As set forth in Section 1.2, Proposed Action, the proposed action is the issuance of an U.S. Nuclear Regulatory Commission (NRC) license under 10 CFR 70 (CFR, 2008b), 10 CFR 30 (CFR, 2008c) and 10 CFR 40 (CFR, 2008d) that would authorize AES to possess and use special nuclear material (SNM), source material and byproduct material, and to construct and operate a uranium enrichment facility at a site located in Bonneville County, Idaho. The proposed AES facility would provide enriched Uranium-235 (^{235}U) up to a nominal 5% by the gas centrifuge process, with a nominal production of six million separative work units (SWU) per year. The facility, which will be referred to by its nominal rate, would have a maximum annual enrichment capacity of 6.6 million SWU, which yields 6.4 million SWU per year when operating at a 97% capacity factor. The enriched uranium will be used primarily in commercial nuclear power plants in the United States (U.S.).

Uranium enrichment is critical to the production of fuel for U.S. commercial nuclear power plants, which currently supply approximately 20% of the nation's electricity requirements (EIA, 2008c). However, since the beginning of the decade, domestic uranium enrichment has fallen from a capacity greater than domestic demand to a level that is less than half of domestic requirements (DOE, 2002a). In fact, at present, less than 15% of U.S. enrichment requirements are being met by enrichment plants located in the U.S. (EIA, 2008d). Notwithstanding, forecasts of installed nuclear generating capacity suggest a continuing demand for uranium enrichment services, both in the U.S. and abroad. The current lack of domestic enrichment capacity relative to domestic requirements has prompted concern within the U.S. government. Indeed, in a July 25, 2002 letter to the NRC commenting on general policy issues raised by Louisiana Energy Services (LES) in the course of its pre-application activities, William D. Magwood, IV, then Director of the U.S. Department of Energy (DOE) Office of Nuclear Energy, Science and Technology, stressed the importance of promoting and developing additional domestic enrichment capacity. In this letter, DOE noted that "[i]n interagency discussions, led by the National Security Council, concerning the domestic uranium enrichment industry, there was a clear determination that the U.S. should maintain a viable, competitive, domestic uranium enrichment industry for the foreseeable future." In addition to identifying the policy objective of encouraging private sector investment in new uranium enrichment capacity, DOE has emphasized that "[t]he Department firmly believes that there is sufficient domestic demand to support multiple enrichers and that competition is important to maintain a healthy industry" (DOE, 2002a).

This DOE letter to the NRC is consistent with prior DOE statements concerning the importance from a national energy security perspective of establishing additional reliable and economical uranium enrichment capacity in the U.S. In DOE's annual report, "Effect of U.S./Russia Highly Enriched Uranium Agreement 2001," dated December 31, 2001 (DOE, 2001a), DOE noted that "[w]ith the tightening of world supply and the closure of the Portsmouth Gaseous Diffusion Plant by USEC, in May 2001, the reliability of U.S. supply capability has become an important energy security issue." With respect to national energy security, DOE further stated:

The Department believes that the earlier than anticipated cessation of plant operations at Portsmouth has serious domestic energy security consequences, including the inability of the U.S. enrichment supplier USEC to meet all its enrichment customers' contracted fuel requirements, in the event of a supply disruption from either the Paducah plant production or the Highly Enriched Uranium (HEU) Agreement deliveries. These concerns highlight the importance of identifying and deploying an economically competitive replacement domestic enrichment capability in the near term.

As reflected in DOE's July 25, 2002 letter to the NRC, the Department of State has similarly recognized that "[m]aintaining a reliable and economical U.S. uranium enrichment industry is an important U.S. energy security objective." (Magwood letter, citing unclassified excerpt from U.S. Department of State cable SECSTATE WASHDC 212326Z DEC 01 (NOTAL)). Importantly, the letter emphasized that "the U.S. Government supports the deployment of Urenco gas centrifuge technology in new U.S. commercial enrichment facilities as a means of maintaining a reliable and economical U.S. uranium enrichment industry." Thus, current U.S. energy security concerns and policy objectives establish a clear need for additional domestic uranium enrichment capacity, a need that also has been recognized by Congress for some time. See e.g., S. Rep. No. 101-60, 101st Congress, 1st Session 8, 20 (1989) ("some domestic enrichment capability is essential for maintaining energy security"); H.R. Rep. No. 102-474, pt. 2, at 76 (1992) ("a healthy and strong uranium enrichment program is of vital national interest").

National security concerns and policy objectives also underscore the need for an additional reliable and economical domestic source of enrichment services. Congress has characterized uranium enrichment as a strategically important domestic industry of vital national interest, essential to the national security and energy security of the United States and necessary to avoid dependence on imports. S. Rep No. 101-60, 101st Congress, 1st Session 8, 43 (1989); Energy Policy Act of 1992, 42 U.S.C. Section 2296b-6. National security and defense interests require assurance that "the nuclear energy industry in the United States does not become unduly dependent on foreign sources of uranium or uranium enrichment services." S. Rep. No. 102-72, 102d Congress 1st Session 144-45 (1991). Indeed, in connection with the Claiborne Enrichment Center (CEC) proposed by LES in 1991, the NRC recognized "[t]he fact that USEC already exists to serve national security interests does not entirely obviate a role for LES in helping to ensure a reliable and efficient domestic uranium enrichment industry, particularly when USEC is the only domestic supplier." Louisiana Energy Services (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 96 n. 15 (1998) citing H.R. Rep. No. 102-474, 102d Congress, 2d Session, pt. 1 at 143 (1992) (emphasis in original). Indeed, the NRC stated that "it might fairly be said that national policy establishes a need for a reliable and economical domestic source of enrichment services," and that "congressional and NRC policy statements" articulating such considerations of national policy "bear in [its] view, on any evaluation of the need for the facility and its potential benefits." CLI-98-3, 47 NRC at 95-96.

Increasing the supply of enrichment capacity to ensure a reliable global enrichment supply also supports U.S. non-proliferation objectives reflected in the Global Nuclear Energy Partnership (GNEP). Under GNEP's reliable fuel services program, nations with advanced nuclear technologies would provide fuel to meet the needs of other countries in order to reduce the motivation for countries seeking nuclear power to develop uranium enrichment capabilities. By participating in GNEP, growing economies can enjoy the benefits of clean, safe nuclear power while minimizing proliferation concerns and eliminating the need to invest in the complete fuel cycle (e.g., enrichment). AES's new facility would further the objectives of GNEP by augmenting international enrichment capacity and thereby increasing the reliability of global enrichment supply.

In December 2003 and August 2004, two companies that offer uranium enrichment services worldwide submitted applications to the NRC for licenses to build and operate new centrifuge based uranium enrichment plants in the U.S. In June 2006 and April 2007, respectively, the NRC issued those licenses; and construction is presently underway on both facilities (NRC, 2007a). In 2007, AREVA stated its intent to build a new centrifuge based uranium enrichment plant in the U.S. (AREVA, 2007a).

The AES facility would further attainment of the foregoing energy and national security policy objectives. The enriched uranium supplied by the AES facility would constitute a significant addition to current U.S. enrichment capacity. As noted above, when completed, the AES facility would supply low-enriched uranium at the nominal rate of 6 million SWU per year. This is equivalent to roughly 40 percent of the current U.S. enrichment services requirements.

Operation of the AES facility would foster greater security and reliability with respect to the U.S. low-enriched uranium supply. Of equal importance, it would provide for more diverse domestic suppliers of enrichment services. At present, U.S. enrichment requirements are being met principally through enriched uranium produced by USEC's 50-year old Paducah gaseous diffusion plant (GDP) and at non-U.S. enrichment facilities. Much of the foreign-derived enriched uranium being used in the U.S. comes from the down blending of Russian HEU, pursuant to a 1993 agreement between the U.S. and Russian governments that is administered by USEC. This agreement, however, is currently scheduled to expire in 2013.

In the license application for its proposed American Centrifuge Plant (ACP), USEC, which is currently the only domestic provider of enriched uranium to U.S. purchasers, explicitly recognized that the age of its Paducah facility, coupled with production cost considerations and the expiration of the U.S.-Russia HEU Agreement in 2013, necessitates deployment of more modern, lower-cost domestic enrichment capacity by the end of this decade (USEC, 2005a). The AES facility, which would begin production in 2014 and achieve full nominal production output by 2022, would help meet this need. The presence of multiple enrichment services providers in the U.S., each with the potential capability to increase capacity to meet potential future supply shortfalls, would enhance both diversity and security of supply for generators and end-users of nuclear-generated electricity in the U.S. As discussed in Section 1.1.2, Market Analysis of Enriched Uranium Supply and Requirements, purchasers of enrichment services view diversity and security of supply as vital from a commercial perspective as well.

The reliability and economics of the Enrichment Technology Company Ltd. (ETC) centrifuge technology to be deployed in the AES facility are well-established. This technology has been in use for over 30 years, and is currently deployed at Urenco's three European enrichment facilities. These facilities are located in Gronau, Germany; Almelo, Netherlands; and Capenhurst, United Kingdom (U.K.). These facilities had a combined annual production capability of 11 million SWU at the end of 2008, which when taken together with the Louisiana Energy Services facility that is presently under construction in the U.S. are in total scheduled to increase to 18 million SWU per year by the end of 2015 (Urenco, 2009). The duration of operations at these facilities and their collective SWU output confirms the operational reliability and commercial viability of the centrifuge technology that AREVA will install in the U.S.

Notwithstanding its initial development over three decades ago, the gas centrifuge technology to be deployed by AES remains a state-of-the-art technology. As a result of its longstanding use in Europe, the ETC centrifuge enrichment process has undergone numerous enhancements, which have increased the efficiency of the process, as well as yielded significant safety and environmental benefits. The advantages of the ETC centrifuge technology relative to other existing enrichment technologies are discussed further in Section 2.1.3.1, Alternative Technologies. Chief among these is that the ETC centrifuge enrichment process requires approximately 50 times less energy than the gas diffusion processes still in use in France and the U.S. In this regard, AREVA plans to deploy ETC centrifuge technology in a new enrichment facility to be constructed in France that will replace its old plant that uses the gas diffusion process.

1.1.1 Need for the Proposed Action

Consistent with the guidance contained in NUREG-1520 (NRC, 2002a) concerning the need for and purpose of the proposed action, this section sets forth information on the quantities of enriched uranium used for domestic benefit, domestic and foreign requirements for enrichment services, and potential alternative sources of supply for AES's proposed services for the period 2008 to 2030. Section 1.1.2.1, Forecast of Installed Nuclear Power Generating Capacity, presents a forecast of installed nuclear power generating capacity during the specified period; Section 1.1.2.2, Uranium Enrichment Requirements Forecast, presents a forecast of uranium enrichment requirements; Section 1.1.2.3, Current and Potential Future Sources of Uranium Enrichment Services, discusses current and potential future sources of uranium enrichment services throughout the world; Section 1.1.2.4, Market Analysis of Supply and Requirements, discusses market supply and requirements under alternative scenarios and various commercial considerations and other implications associated with each scenario.

1.1.2 Market Analysis of Enriched Uranium Supply and Requirements

An analysis of the market for uranium enrichment services during the period 2008 through 2030 is presented in the following subsections. The analysis considers several scenarios with and without the proposed introduction of new AES uranium enrichment capacity in the U.S. In the context of this analysis, it is important to recognize that the market for uranium enrichment services is international in nature. At the present time, the owners and operators of commercial uranium enrichment facilities that are located in six countries actively market uranium enrichment services worldwide. In addition, entities in several other countries enrich uranium to supply indigenous commercial requirements. Requirements for uranium enrichment services, which are associated with the operation of commercial nuclear power plants, presently exist in 28 countries. Market related changes that occur in one part of the world impact the supply and requirements situation throughout the world. Accordingly, in order to understand the behavior of the market for uranium enrichment services in the U.S., it is necessary to examine the world market.

1.1.2.1 Forecast of Installed Nuclear Power Generating Capacity

AREVA has prepared both Reference and High Nuclear Power Growth forecasts of installed nuclear power generating capacity by country and categorized the generating capacity in each forecast according to the following five world regions: (i) U.S., (ii) Western Europe, (iii) Commonwealth of Independent States (C.I.S.) and Eastern Europe, (iv) East Asia, and (v) remaining countries, which are grouped as Other.

Eastern Europe consists of the following emerging market economy countries that were in the past classified as Communist Bloc countries and are operating nuclear power plants: Bulgaria, the Czech Republic, Hungary, Lithuania, Romania and Slovakia. Of the 12 C.I.S. countries that were part of the former Soviet Union (F.S.U.), the three with nuclear power plants still operating are Russia, Ukraine and Armenia, and a fourth, Kazakhstan, may revive its nuclear program in the future.

East Asia includes Japan, the People's Republic of China (China), the Republic of Korea (South Korea), Taiwan and Vietnam.

These forecasts were based on AES's country-by-country and unit-by-unit review of current nuclear power programs and plans for the future. The resulting AES forecasts of future world nuclear generation capacity are dependent on the following factors:

- Nuclear generating units currently in operation and retirements among these units that occur during the forecast period;

- Capacity that is created by extending the operating lifetimes of units currently in operation beyond initial expectations through license renewal;
- Units under construction, already ordered, or firmly planned with likely near-term site approval; and
- Additional new capacity that will require site approval and will be ordered in the future.

The Reference Nuclear Power Growth forecast is consistent with current trends. Aggressive expansion plans in East Asia continue to translate into real growth, although public acceptance may impact this, as does the slowdown in growth of electric power demand and the increasing liberalization of the power market. The possibility of new plant construction in Europe has become a reality as Finland begins the first new European nuclear power plant construction since 1991; and as France follows with its own European Power Reactor (EPR). Nuclear moratoriums and phase out plans remain in place in some European countries; however, in many cases these plans are being questioned internally. Plant operating lifetimes extending beyond 40 years are becoming very common, rather than the exception. In the U.S., the prospects for new nuclear plant construction continue to improve. In the meantime, all U.S. plants with operating licenses scheduled to expire by 2025 are expected to pursue license renewal. Additions to plant generating capacities are being made in the form of plant uprates. The U.S. industry continues to make progress in preparation for new nuclear power plant orders, with the NRC expecting up to 22 Combined License (COL) application submittals for a total of 33 units over the 2007 through 2010 period. By the end of 2008, 17 COL application submittals, for a total of 26 units, had been submitted to the NRC (NRC, 2009a).

In the Reference Nuclear Power Growth forecast, AES assumes that world nuclear capacity will be dominated by plants currently in operation (i.e., 435 units and 372.9 GWe at the end of 2007) over the forecast period of this report, accounting for 70% on a GWe basis of the total in 2015 and 24% in 2025, assuming no license renewal. A small but significant contribution of 1% to 2% in 2015 and 2025 is obtained from capacity uprates and restarts of previously shutdown units. The growing importance of license renewal is also highlighted, reaching 17% in 2015 to 43% in 2025. Units currently under construction, firmly planned or proposed will account for 9% in 2015 and 13% in 2025, while additional new capacity will account for 2% in 2015 and 19% in 2025. Cumulative retirements over the period 2008 through 2030 will amount to 71 GWe (110 units) representing 19% of current operating capacity, partially offsetting the new capacity expected to be added in the future.

The High Nuclear Power Growth forecast is generally consistent with announced owner/operator schedules for identified nuclear power plants in the mid term. This forecast projects an average annual growth rate of nuclear capacity consistent with growing world electric generation demand and an increased reliance on nuclear power. In East Asia, renewed public acceptance of nuclear power and strong economic growth is assumed. In the U.S., broad agreement regarding the need for new base load generation capacity, and more stringent environmental controls and associated costs imposed on fossil-fired capacity, including those associated with limits on carbon emissions, are also consistent with the new nuclear power plant orders that are assumed in the High Nuclear Power Growth forecast. Specifically, AES forecasts, prepared by a consultant, are consistent with the most recently published forecasts of installed nuclear generation capacity prepared by the DOE Energy Information Administration (EIA) (EIA, 2008c) (EIA, 2008e) and the World Nuclear Association (WNA) (WNA, 2007a).

In Europe, strong demand for electric power, recognition of nuclear power’s economic and environmental benefits, a decline in the political clout wielded by organizations opposed to nuclear power, and widespread recognition of the inability of renewables to replace nuclear power would enable it to not only maintain, but to enhance its market share. Strong economic performance coupled with the ability to raise the capital necessary for new construction projects is assumed for the High Nuclear Power Growth forecast in the C.I.S. and Eastern Europe. In the High Nuclear Power Growth forecast, most countries are assumed to extend the operating licenses of existing nuclear generating capacity retiring after the year 2015 to 50 years or more, or replace that generating capacity, in order to maintain their portfolio of nuclear power plants.

In the High Nuclear Power Growth forecast, AES assumes that world nuclear capacity over the forecast period will continue to be dominated by plants currently in operation over the forecast period of this report. However, the contribution from plants for which operating licenses have been renewed and in particular new plants is also higher.

Figures 1.1-1 and 1.1-2 present AES's forecast and composition of world nuclear generation capacity in the five categories, discussed above, for the Reference and High Nuclear Power Growth forecasts, respectively.

In the U.S., it is expected that all existing units with operating licenses scheduled to expire by 2025 will find license renewal to be technically, economically and politically feasible. In fact, the NRC granted the first license extension in the U.S. to the two unit Calvert Cliffs Nuclear Station in March 2000. By February 2009 a total of 51 units had been granted license extensions in the U.S. Applications for the renewal of operating licenses for 21 additional units have been submitted to the NRC for review, and the NRC has been notified of operator plans to submit license renewal applications for at least an additional 20 units during the next five years (NRC, 2009b). This accounts for 88.5% of the nuclear generating units currently operating in the U.S. As far back as March 2002, the NRC expected "that virtually the entire operating fleet will ultimately apply" to renew their operating licenses, which appears to have been quite accurate (NRC, 2002b). The transition to a competitive electric generation market has resulted in further plant investment in the form of plant power uprates. These have included more than 78 power uprates, representing approximately 3.4 Gigawatt electric (GWe) that have been approved by the NRC from the year 2000 (through August 2008), six applications for power uprates that are currently under review by the NRC, and an additional 42 applications for power uprates that are expected by the NRC over the next five years (NRC, 2009c).

AREVA's Reference and High Nuclear Power Growth forecasts of installed nuclear power generating capacity are summarized in Table 1.1-1. In the Reference Growth forecast, world installed nuclear power capacity is forecast to rise by 25% on a GWe basis (72 units added net of retirements) from 372.9 GWe (435 units) at the end of 2007 to 465.9 GWe (507 units) by 2020, which is about 1.7% per year during that period, and to rise an additional 16% on a GWe basis (32 units added) to 538.2 GWe (539 units) by 2030, which is about 1.5% per year during the 2020 to 2030 period, for the Reference forecast.

In the High Growth forecast, world installed nuclear power capacity is forecast to rise 48% on a GWe basis (160 units added net of retirements) to 551.4 GWe (595 units) by 2020, which is about 3.1% per year during that period, and to rise an additional 31% on a GWe basis (121 units added) to 725.0 GWe (716 units) by 2030, which is about 2.8% per year during the 2020 to 2030 period.

In the U.S., for the Reference Growth forecast, installed nuclear power capacity is forecast to rise by 9% on a GWe basis (5 units added) from 100.3 GWe (104 units) at the end of 2007 to 109.6 GWe (109 units) by 2020, and to rise an additional 8% on a GWe basis (3 units added net of retirements) to 118.7 GWe (112 units) by 2030 for the Reference forecast, which is about 0.7% per year over the entire period of analysis. In the High Growth forecast, installed U.S. nuclear power capacity is forecast to rise about 12% on a GWe basis (7 units added) to 112.7 GWe (111 units) by 2020, and to rise an additional 15% on a GWe basis (9 units added net of retirements) to 129.5 GWe (120 units) by 2030, which is about 1.1% per year over the entire period of analysis.

The installed nuclear power generating capacity forecasts are also presented as average values over selected time periods in Table 1.1-2 for consistency with the presentation of uranium enrichment requirement forecasts, which appear in Section 1.1.2.2.

As shown in Figures 1.1-3 and 1.1-4 for the world and U.S., respectively, these AES forecasts, which were prepared by Energy Resources International, Inc. (ERI), are consistent with the most recently published forecasts of installed nuclear generation capacity prepared by the DOE Energy Information Administration (EIA) (EIA, 2008c) (EIA, 2008e) and the World Nuclear Association (WNA) (WNA, 2007a), and the International Atomic Energy Agency (IAEA) (IAEA, 2008).

More specifically, as illustrated in Figure 1.1-3, the AES Reference Nuclear Power Growth forecast for the worldis 5.4% higher than the average of the three other forecasts over the period 2015 through 2030 and 1.8% higher than the WNA forecast in 2030. The AES High Nuclear Power Growth forecast for the world is 1.0% higher than the average of the WNA and IAEA High forecasts over the period 2015 through 2030, but by 2030 it is 1.9% lower than the average of the other two forecasts. A corresponding forecast from EIA was not available for comparison.

As illustrated in Figure 1.1-4, the AES Reference Nuclear Power Growth forecast for the U.S. is 1.6% higher than the average of the WNA and EIA forecasts over the period 2015 through 2030. However, the AES High Nuclear Power Growth forecast for the U.S. is 5.2% lower than the average of the other two forecasts over the period 2015 through 2030. IAEA did not provide a forecast for the U.S. alone.

1.1.2.2 Uranium Enrichment Requirements Forecast

Forecasts of uranium enrichment services requirements were prepared by ERI for AES consistent with ERI's nuclear power generation capacity forecasts, which were presented in Section 1.1.2.1. A summary of the nuclear fuel design and management parameters that were used in developing the forecast of uranium enrichment requirements is as follows:

- Country-by-country average capacity factors rising with time from a world average of 79.3% in 2007 to 85% by 2012, where it remains. The average capacity factor for the U.S. remains at 90% through 2030;
- Long term Western world average tails assayof 0.25 $^{w}/_{o}$ ^{235}U in 2008 and beyond. C.I.S. and Eastern Europe tails assays are assumed to remain at 0.11 $^{w}/_{o}$ ^{235}U;
- Individual plant enriched product assays are based on plant design, energy production, design burnup, and fuel type. Actual operating company practices outside the U.S. make use of higher enriched product assays in some Western countries, where a 0.1 to 0.2 $^{w}/_{o}$ ^{235}U design margin is typical; and for fuel used in Russian designed LWRs, where Russian fuel design enrichments are typically 0.3 $^{w}/_{o}$ ^{235}U higher than for otherwise comparable Western fuel designs;
- Current plant specific fuel discharge burnup rates for the U.S., and country and reactor type specific burnup rates elsewhere, will continue to increase; an 7% increase to 49 GWD/MTU is projected by 2013, slowly increasing to 50 GWD/MTU by 2025;
- Country (for some non-U.S. countries) and plant (for the U.S. and other countries) specific fuel cycle lengths, for example, collectively averaging approximately 20 months in the case

of the U.S., and 16 months for all of the world's light water reactors (LWRs), including those in the U.S.;

- Typical enrichment services delivery lead times (from the start of refueling outage) of 18 to 36 months for first cores and 6 to 12 months for reloads; U.S. and European lead times are at the lower end of the range, while lead times in East Asia are at the higher end of the range.

It should be recognized that on a year-to-year basis, there can be both upward and downward annual fluctuations in requirements for enrichment services. This reflects the various combinations of nominal 12 month, 18 month and 24 month operating/refueling cycles that occur at nuclear power plants throughout the world, as well as the timing of initial cores for new nuclear power plants. Therefore, interval averages are used as the basis for subsequent discussion.

Table 1.1-3 provides a forecast of average annual enrichment services requirements by world region for both the Reference and High Nuclear Power Growth forecasts that must be supplied from among the collective sources of uranium enrichment services.

As shown in Table 1.1-3, during the 2011 to 2015 period, world annual enrichment services requirements are forecast to average 52.4 and 58.2 million SWU per year for the Reference and High Nuclear Power Growth forecasts, respectively. The world requirements forecast for this period reflect a 15.7% and 28.5% increase over the estimated 2007 value of 45.3 million SWU for these two forecasts. AES forecasts that world annual enrichment services requirements will rise during the 2016 to 2020 period reaching 58.5 and 70.0 million SWU per year for the Reference and High Nuclear Power Growth cases, respectively. These world requirements forecast for this period reflect a 11.6% and 20.3% increase over the prior period values for these two forecasts. World annual requirements during the 2021 to 2025 period reach 65.2 and 81.3 million SWU per year for the Reference and High Nuclear Power Growth cases, respectively. These requirements reflect a 11.5% and 16.3% increase over the prior period values for these two forecasts. During the 2026 to 2030 period, world annual requirements are 69.6 and 91.2 million SWU per year for the Reference and High Nuclear Power Growth cases, respectively. These requirements reflect a 6.7% and 12.2% increase over the prior period values for these two forecasts.

Figures 1.1-5 and 1.1-6 provide comparisons of the AES forecasts with those published by WNA for world and U.S. requirements, respectively, for both the Reference and High Nuclear Power Growth forecasts. The most recently published WNA forecasts of world and U.S. uranium enrichment requirements (WNA, 2007b) are somewhat higher than the AES forecasts.

Specifically, as illustrated in Figure 1.1-5, the WNA Reference forecast for the world is 3.1% higher than the AES Reference World Nuclear Power Growth forecast in 2015, with the difference increasing to 17.1% by 2030. For the High Nuclear Power Growth forecasts, the WNA forecast is identical to the AES High Nuclear Power Growth forecast in 2015. However, the WNA high world forecast shows requirements growing faster than in the corresponding AES forecast, and by 2030 the WNA forecast is 22.9% higher than the corresponding AES forecast.

For the U.S., as illustrated in Figure 1.1-6, the WNA Reference forecast is 3.2% lower than the AES Reference U.S. Nuclear Power Growth forecast in 2015, with the WNA forecast being 2.5% higher than the corresponding AES forecast by 2020, and the difference between the two forecasts growing to 5.1% by 2030. For the High Nuclear Power Growth forecasts, the WNA U.S. forecast is 2% lower than the AES High U.S. Nuclear Power Growth forecast in 2015, with the WNA forecast being 6.8% higher than the corresponding AES forecast by 2020, and the difference between the two forecasts growing to 28.9% by 2030.

The difference in enrichment requirements forecasts between WNA and AES is due to several factors, including WNA's assumption of higher long term average plant capacity factors, WNA's admitted tendency to overestimate nuclear fuel requirements by up to 3% for operating cycles in current nuclear power plants, and WNA's use of slightly lower tails assays. If the higher WNA forecasts for uranium enrichment requirements for 2020 and beyond were used by AES in this analysis, then an even greater need for newly constructed uranium enrichment capability would be demonstrated.

1.1.2.3 Current and Potential Future Sources of Uranium Enrichment Services

It is of course uncertain how requirements for enrichment services are actually going to develop on a year by year basis as new nuclear power plants are built and come into operation, and where specific increments of supply will come from as new enrichment facilities are completed and begin operation.

Several long term sources of enrichment services, such as the Georges Besse GDP operated by AREVA and the Paducah GDP operated by USEC are expected to be removed from service during the coming years (AREVA, 2006a) (USEC, 2005a). Even though there are published schedules for several sources of future supply that are in various stages of the licensing and construction process, it can not be known with certainty when each will actually become operational; or whether one or more of these new facilities may encounter a problem of such significance that it may never be able to contribute to available supply. There is also the yet to be answered question of whether and, if so, to what extent, each of these new facilities might be further expanded over time to service larger amounts of world requirements.

In addition, there is the question of how other presently operating facilities, such as Urenco's three operating enrichment facilities in Europe, and Rosatom's four operating enrichment plants in Russia may be expanded in the future to meet projected, but as yet uncertain requirements. In addition, the smaller enrichment plants that are located in countries such as Japan, China, and Brazil must also be considered. Also, while they are not expected to be a significant source of supply in the long term, government HEU inventories currently play a role in meeting commercial requirements. Finally, General Electric (GE)-Hitachi Nuclear Energy (GEH) has initiated work that is based on Silex laser enrichment technology. If testing of this technology by GEH, which is presently scheduled to occur during 2009, is successful, then this may lead to commercialization of the GEH Global Laser Enrichment (GLE) Technology as a potential source of between 3.5 and 6 million SWU per year of commercial enrichment services supply at some point in the future (GEH, 2007) (SILEX, 2009).

In addition to the physical supply capacity that may or may not be available, one must be mindful of the extent to which any of the international trade constraints that are presently being imposed, and which may continue to be imposed on selected sources of supply in the future, could impede the market's ability to most effectively utilize physically available increments of supply to meet growing requirements.

Recognizing the national security implications of nuclear fuel supply, as previously discussed in Section 1.1, it is important to consider supply of uranium enrichment services in the context of current and expected future requirements that were described in Section 1.1.2.2.

1.1.2.3.1 Base Supply of Enrichment Services

Table 1.1-4 summarizes current and potential future Base sources and quantities of uranium enrichment services. As available, these sources include production from existing uranium enrichment plants, enrichment services obtained by blending down Russian weapons grade HEU, as well as the base capacity for enrichment plants presently under construction, AES's U.S. plant, and expansions in existing facilities, together with enrichment services that presently being obtained by blending down U.S. HEU. It should be noted in the context of the GDPs that the current annual "economically competitive and physically usable capability," is less than the facility's "nameplate rating." In the case of facilities that are in the process of expanding their capability, the annual production that is available to fill customer requirements during the year is listed, not the end of year capability.

The economically competitive and physically usable capability refers to that portion of the enrichment facility nameplate rating that is capable of producing enrichment services that can be competitively priced and delivered to end users. For instance, the cost of firm power during Summer can be several times higher than the cost of non-firm power that may be purchased under contract during the remainder of the year. In practice this limits the annual enrichment capability of electricity intensive gas diffusion enrichment plants. In addition, from the perspective of an operator of a nuclear power plant in the U.S., physically usable requires that the enriched uranium product be obtained from an enrichment plant that is not subject to international trade restrictions that prevents its use in commercial nuclear power plants in the U.S. In this context the Base supply in this analysis includes the annual amount of Rosatom enrichment services that may be exported to the U.S., consistent with Sections 3112 and 3112A of the USEC Privatization Act, as amended by the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009 (PL, 2008). This Act effectively codified into U.S. law terms of a February 2008 Amendment to the Agreement Suspending the Antidumping Investigation on Uranium from the Russian Federation that may be exported to the U.S. (FR, 2008a). It is for all of the above reasons that it is not appropriate to simply add together the nameplate capacities of all presently operating and potential new enrichment facilities, if the objective is to arrive at a meaningful forecast of total useable world enrichment capability.

As shown in Table 1.1-4, current Base annual supply capability that is economically competitive and not constrained by international trade restrictions amounts to 47.3 million SWU for the Reference Nuclear Power Growth forecast. This is similar to the estimated 2008 total world requirement of 46 million SWU. As will be demonstrated in Section 1.1.2.4, the future does not presently offer any greater sense of security than the present with regard to supply adequacy relative to growing requirements for enrichment services.

This conclusion is generally consistent with other published analyses of the market for uranium enrichment services, unless it is simply assumed that every prospective source of supply will become reality (Lohrey, 2006) (Meade, 2007) (Neely, 2007) (WNA, 2007c).

Each of the sources of supply identified in Table 1.1-4 is discussed in more detail below.

AES believes there are virtually no excess LEU inventories beyond pipeline and strategic reserve that are available for release, and certainly no long term contribution to world supply can be expected from LEU inventories.

Existing AREVA enrichment capability refers to capability from the 10.7 million SWU per year (nameplate rating) Georges Besse I (GB I) GDP that is located near Pierrelatte, France. It should be noted that two to three million SWU per year of the physically available GB I enrichment capability is not economically competitive due to very high electric power costs at that higher operating range (NF, 2007)(NW, 2007)(NF, 2005). As a result of the high power costs, production will be limited to approximately 7.6 million SWU in 2008 and later. According to the schedule announced by AREVA, it is expected that GB I enrichment capability will be split between customer deliveries and pre-production as the new replacement centrifuge plant begins operations. This will enable AREVA to build up a surplus of enrichment services that it can use to supplement centrifuge production following the planned shut down of the GB I GDP while the replacement centrifuge plant capacity is ramping up. Although shutdown of GB I was originally planned for 2012 (AREVA, 2003)(ASN, 2007)(AREVA, 2006b), the exact timing of the shutdown is not yet defined. AREVA has stated that the shutdown will only occur when sufficient capacity from the new centrifuge facility is available and that the decision to extend the GBI operation depends on customer commitments. For the purposes of this analysis, some pre-production from GBI is assumed into 2016.

AREVA is presently building a new enrichment plant near Pierrelatte, France that will result in the replacement of its existing GDP with a new 7.5 million SWU per year enrichment plant that utilizes ETC centrifuge technology. The current schedule brings the new plant, Georges Besse II (GB II), into operation in 2009 with nameplate capacity of 7.5 million SWU per year installed by 2016 (AREVA, 2007b).

AES is also pursuing a license that will allow it to build and operate a nominal 3 million SWU per year centrifuge enrichment plant, using the same technology as will be deployed in GB II, in the U.S. The facility would have a maximum annual enrichment capacity of 6.6 million SWU, which yields 6.4 million SWU per year when operating at a 97% capacity factor. Initial production is expected to occur in 2014 and full capacity is expected to be reached in 2021.

In all figures that display projections of enrichment services supply and requirements, the **Urenco existing and new** centrifuge enrichment capability refers to capability from machines that are presently in operation or expected to be installed at Urenco's three European enrichment plants, which are located in Gronau, Germany; Almelo, Netherlands; and Capenhurst, United Kingdom. These plants had a combined annual production capability of 11 million SWU at the end of 2008 (URENCO, 2009), which after accounting for the expected installation rate of capacity at Urenco's U.S. enrichment facility (see next paragraph), is scheduled to increase to an estimated 12.4 million SWU per year by the end of 2012 (Urenco, 2008a). Urenco is estimated to have produced 10.3 million SWU of enrichment services during 2008.

The Urenco subsidiary, Louisiana Energy Services (LES), is moving forward with construction of a new 5.9 million SWU per year National Enrichment Facility (NEF) in Lea County, New Mexico, using ETC centrifuge technology. An NRC license was issued in June 2006 for a nominal 3 million SWU per year capacity. In November 2008, plans were announced to increase the capacity to 5.9 million SWU per year. This expansion will require a separate NRC approval. The Urenco subsidiary expects to bring the new plant into operation beginning in mid 2009 and to achieve the full 5.9 million SWU per year enrichment capability in 2015 (Urenco, 2008b).

Existing USEC enrichment capability refers to capability from the 8 million SWU per year GDP, which is located in Paducah, Kentucky (USEC, 2007a). A renegotiated power pricing arrangement with the Tennessee Valley Authority (TVA) took effect in June 2006, and power costs are significantly higher as a result. A June 2007 extension of the TVA power contract increased the quantity of power supplied by 25% for three years and extended the contract through May 2012 (USEC, 2007a). While Paducah GDP production ranged between 5 and 5.5 million SWU over the past few years prior to the contract extension (USEC, 2007b) (USEC, 2006) (USEC, 2005b), the additional TVA power supplies will enable production as high as 6.5 million SWU. Approximately 12% of the Paducah GDP's capacity is devoted to underfeeding operations (USEC, 2007c), leaving up to 5.7 million SWU for commercial enrichment sales. The Paducah GDP is expected to shut down in June 2012 (DOE, 2007a), although it could remain open several years longer if required and if further power contract extensions are successfully negotiated (Platts, 2007). State officials hope the life of the Paducah GDP can be extended by processing DOE tails material, but such operations would not contribute the supply needed to meet world nuclear power plant requirements for enrichment services.

USEC plans to replace the Paducah GDP with a new 3.8 million SWU per year centrifuge enrichment plant known as the American Centrifuge Plant (ACP). USEC has been conducting demonstration testing of its AC100 centrifuge machines since the beginning of 2008 and expects the ACP commercial operations to begin at the end of the first quarter 2010 and full nameplate capacity to be reached by the end of 2012 (USEC, 2009). According to USEC, risks and uncertainties associated with the ACP include USEC's success in its demonstration and deployment of the technology, including its ability to meet performance targets and schedule for the ACP, the cost of the ACP, and USEC's ability to secure required external financial support (USEC, 2008) (USEC, 2009).

Rosatom is the new state-owned corporation overseeing both commercial and military nuclear activities in Russia, which were formally handled by the Federal Atomic Energy Agency (also known as Rosatom). Most commercial nuclear activities, including enrichment plants, are consolidated in the subsidiary corporation known as Atomenergoprom. The **Rosatom** uranium enrichment plant production capability refers to the production at four plants in Russia operating at close to a 100% capacity factor. Production is reduced approximately 5% from nameplate capacity due to the low operating tails assay employed (IBR, 2008). Resulting production for 2008 is estimated to be 25.1 million SWU. For 2008, approximately 7.5 million SWU was devoted to C.I.S. and Eastern European requirements at 0.11 $^{w}/_{o}$ ^{235}U operating tails assay, which will be referred to as **Rosatom Internal**.

Rosatom also provides enrichment services to Western customers, primarily in the form of enriched uranium product (EUP) produced at its enrichment plants, which will be referred to as **Rosatom Export** and which totaled 6.1 million SWU in 2008. Of this amount, current U.S. and European trade policies effectively limited the quantity of Russian enrichment services from enrichment plant production that were sold directly to Western customers to approximately 4.1 million SWU. An additional 2.0 million SWU is estimated to have been wholesaled to European enrichment suppliers in 2008, resulting in total Rosatom Exports of 6.1 (= 4.1+2.0) million SWU. The wholesaling arrangement with European suppliers is scheduled to end in 2010, but the direct exports to Western customers are forecast to have the potential to increase to 5.4 million SWU annually by 2015, and 7.4 million SWU by 2025.

Rosatom enrichment plant capacity is also used for additional purposes that do not directly contribute to the world enrichment supply shown in Table 1.1-4. Approximately 5.4 million SWU per year of enrichment services is used to create HEU blend stock from depleted tails material (Bukharin, 2004). Up to 2.3 million SWU per year of Rosatom enrichment capacity is used to recycle tails material (i.e., enrich tails up to natural uranium assay) for European suppliers, Urenco and AREVA. The tails recycling arrangement for European suppliers is scheduled to end around 2010. Since Rosatom's 2008 production capability is estimated at 25.1 million SWU, approximately 3.8 (= 25.1-7.5-6.1-5.4-2.3) million SWU per year of trade policy constrained, but otherwise available, Russian enrichment production remained potentially available. That 3.8 million SWU was used to further process tails from the Western exports to lower feed requirements, and to further process the European suppliers' residual tails material, as well as Russia's own tails material, to create "normal" uranium for internal use or sale.

It should be noted that the Rosatom Internal capacity would be increased to respond to greater requirements for enrichment services and that other applications of Rosatom's enrichment capability would be adjusted accordingly. To account for this, Rosatom Internal enrichment capacity under the High Nuclear Power Growth forecast is assumed to be several million SWU per year higher than under the Reference Nuclear Power Growth forecast. Rosatom Exports are also assumed to increase when the direct sales of at least 3 million SWU per year to the U.S. market begin in 2014, with smaller amounts beginning in 2011, consistent with the terms of current U.S. law (PL, 2008). Application of Rosatom enrichment capacity available for enrichment of tails to create normal uranium is adjusted as necessary to accommodate these changes.

As older centrifuges reach their design lifetimes, Rosatom is replacing them with newer designs that have higher outputs. As a result, total Russian enrichment production is slated to increase to 26.0 million SWU by 2010, 28.4 million SWU by 2015 and 30.0 million SWU by 2020 (IBR, 2008). It is assumed that Rosatom enrichment production continues to increase after 2020, reaching 32.8 million SWU by 2030.

The use of low operating tails assay and tails recycling operations at Russian enrichment plants make economic sense, as they reduce the plants' natural uranium feed requirements, which allows for greater uranium exports. Any transfer of enrichment capacity away from tails recycling and to new commercial enrichment sales will ultimately force Russia to reduce its natural uranium equivalent exports or to purchase natural uranium for eventual resale in the form of EUP. In contrast, operating at approximately 0.11 $^{w}/_{o}$ ^{235}U tails assay makes full use of available enrichment capacity for export and reduces the Russian enrichment complex's natural uranium feed requirements, which allows sales to Western customers in the form of EUP.

The **Russian HEU-derived LEU** mainly originates from the U.S.-Russia Agreement for the down blending of 500 MT HEU. The enrichment content is expected to remain at 5.5 million SWU per year through 2012, dropping to 5.3 million SWU in 2013 when the term of the current agreement concludes. The 5.5 million SWU figure is based on the contractually agreed tails assay of 0.30 $^{w}/_{o}$ ^{235}U. However, it was equivalent to approximately 6.1 million SWU in 2008 when evaluated at the average Western transaction tails assay. AES expects that this arrangement will end in 2013 as scheduled (NF, 2006). It is important to note that in order to create and utilize the SWU contained in the LEU that is derived from the Russian HEU, approximately 5.4 million SWU contained in blend stock is required from Russian enrichment plants, as noted earlier. When the blending of Russian HEU ends, this capacity will become available to Rosatom for use in commercial sales, subject to any trade constraints that may still exist. In addition to the U.S. – Russia Agreement, a small quantity of SWU is derived from Russian HEU (at 15 to 20 $^{w}/_{o}$ ^{235}U) directly blended with European utility reprocessed uranium (RepU). The program has gradually expanded and now provides an estimated 0.7 million SWU per year, but is expected to gradually decline after 2010 and eventually disappear by 2025 as the availability of HEU for mixing with RepU decreases (NF, 2002) (WNN, 2007a)(TVEL, 2007). The direct commercial sales from HEU blended with European RepU are in addition to the sales of production from the Russian enrichment plants.

At present, **U.S. HEU** includes the 61 MT of HEU (approximately 6 million SWU equivalent) that is being used by TVA at a rate ranging between 0.3 and 0.6 million SWU per year over a fifteen year period which began in 2005. The TVA program makes use of off-spec HEU contained in DOE's 1994 and 2005 surplus HEU declarations. An additional small quantity of LEU (totaling up to 0.45 million SWU) resulting from the Reliable Fuel Supply Initiative is assumed to be commercialized between 2009 and 2011 in order to pay for HEU down blending and processing costs. An additional 68 MT of HEU declared to be excess to the U.S. nuclear weapons stockpile might be expected to eventually become available to the commercial nuclear fuel market, but the release would take place over the next 40 years (NNSA, 2008), as discussed in Section 1.1.2.3.2.

The **Other Existing and New** capability is dominated by approximately 1.0 million SWU of annual centrifuge enrichment capability in China, 0.15 million SWU of annual Japanese centrifuge enrichment capability, and 0.1 million SWU of annual capability from other countries. The majority of this capability is used internally. The Chinese enrichment capability uses centrifuges that are imported from Russia. The Chinese centrifuge enrichment capacity is expected to expand to 1.5 million SWU by 2012. China will continue to make use of Russian centrifuge technology for the expansion (Tenex, 2007). The current Japanese capability is declining, and should reach zero in 2009 due to high failure rates that have limited centrifuge operating lifetimes (JNFL, 2008). Development of a next generation centrifuge is under way and is now expected to result in a commercial plant with initial capacity of 0.15 million SWU in 2010 and full capacity of 1.5 million SWU in 2020 (JNFL, 2007). Brazil is beginning operation of a small uranium enrichment facility, which is scheduled to gradually ramp up to 0.2 million SWU by 2012 and will be devoted to internal requirements (INB, 2006)(Brazil, 2006). Despite international efforts against it, Iran could have 0.1 million SWU in operation by 2010 (Iran, 2006)(WNN, 2007b).

Recycle materials contributed about 1.6 million SWU-equivalent to supply in 2008. Mixed Oxide (MOX) fuel is currently used in Europe and supplies 0.9 million SWU equivalent (ESA, 2007). MOX fuel use is expected to expand to Japan starting by 2010, and the disposition of military plutonium in MOX fuel in the U.S. and Russia could start as early as 2015. Russia also blends recycled uranium from VVER-440s, research reactors and submarines to create RBMK fuel containing about 0.7 million SWU equivalent, although the quantity is expected to decrease after 2010 (WNA, 2007e). Recycle materials are projected to supply a total of 2.3 million SWU per year by 2019.

1.1.2.3.2 Potential Supply of Enrichment Services

There are a number of potential sources of enrichment services that could be used to fill any deficits in supply. Potential Supply includes the following sources:

- Enrichment technology that GEH is pursuing separates isotopes by laser excitation, and is referred to as Silex. Silex has been under development for many years by the Australian company, Silex Systems Limited (SSL). In fact, USEC had been funding research on the Silex process under an agreement with SSL between 1996 and April 2003, at which time USEC concluded that it was unlikely that the Silex technology could be utilized to meet USEC's needs and that there were still "numerous technological hurdles that must be overcome" (USEC, 2003). In May 2006, GE and SSL entered into a commercialization and licensing agreement, granting GE exclusive rights to deploy the Silex uranium enrichment technology, which GEH has branded as global laser enrichment (GLE). On January 30, 2009 GLE delivered its environmental report to the NRC with the rest of the license application to be submitted by June 2009 (SILEX, 2009). If GEH ultimately makes the decision to deploy GLE commercially, following results of testing that is scheduled to occur during 2009, GEH then expects to have a commercial Lead Cascade operational by about 2012 or 2013. This facility could be expanded by adding additional modules, with the potential for a base enrichment capacity of 3.5 million SWU per year, which GEH says could be expanded to produce as much as 6 million SWU per year (SILEX, 2009);
- Expansion of the USEC/ACP from 3.8 million SWU per year up to 7.0 million SWU per year;
- Additional supply from Rosatom, if trade constraints are relaxed, reflecting its plans for expanded enrichment capacity, redirection of some of its existing enrichment capacity from

creation of natural uranium equivalent material by the enrichment of tails to the enrichment of natural uranium for reactor fuel; and

- Of the combined 374 MT of HEU that was declared excess to the U.S. nuclear weapons stockpile by DOE in 1994 and 2005, the disposition of 68 MT of HEU still remains undecided, but might be expected to eventually become available to the commercial nuclear fuel market (NNSA, 2008). Upon down blending, the 68 MT HEU would yield not more than 10 million SWU. A little over half (37 MT of HEU) of this material could potentially be blended down and released to the commercial market between 2010 and 2020, while the rest (31 MT of HEU) could possibly be released gradually between 2010 and 2050 as material is rejected by the U.S. Naval Reactor Program. The potential therefore exists for additional U.S. HEU to contribute an average of 0.6 million SWU per year to the commercial nuclear fuel market through 2020, after which it would contribute only 0.1 million SWU per year. However, these enrichment services should be recognized as being highly speculative in any supply forecast that includes their use.

These potential future sources and the associated quantities of uranium enrichment services are summarized in Table 1.1-5 for the Reference Nuclear Power Growth forecast.

While it is possible that further expansion of Urenco's European enrichment capacity beyond 12.5 million SWU per year and AREVA/GBII beyond 7.5 million SWU per year might also occur, no announcements of such potential expansions have been made.

Also, the following additional potential sources of enrichment services are also possible, but not explicitly quantified in this analysis due to their relatively small and/or short-term contribution to meeting the world and U.S. long term enrichment requirements:

- Extended short term operation of the Paducah GDP by USEC;
- More aggressive expansion of new centrifuge capacity in Japan, China and elsewhere; and
- Minor adjustments to transaction and operating tails assays.

Potential sources of additional supply that might be used to close any projected supply deficit would require investment in new enrichment capacity and would also require that decisions be made with appropriate lead time.

As further background for the discussion that follows, it also is important to recognize that the owners and operators of nuclear power plants have two primary objectives in purchasing nuclear fuel, including uranium enrichment services (Rives, 2002) (Culp, 2002) (Malone, 2006) (Malone, 2008). The first objective is security of supply – that is adequacy of supply in the market that is sufficient to mitigate against unanticipated disruptions from one or more sources and the ability of the purchaser to rely on its suppliers to deliver nuclear fuel materials and services on schedule and within technical specifications, according to the terms of the contract, for the contract's entire term. The second objective is to ensure a competitive procurement process – that is the availability of qualified suppliers in the market and the ability of the purchaser to select from among multiple suppliers through a process that is conducive to fostering reasonable prices for the nuclear fuel materials and services that are purchased.

While one can postulate alternative supply scenarios, there are commercial considerations and other implications associated with each such scenario, many of which can have a significant impact on the purchasers' ability to achieve the two primary purchasing objectives just presented.

Nuclear power plants are a significant component of the U.S. electric power supply system, providing 20% of the electricity that is consumed in the U.S. each year. The current U.S. market for uranium enrichment services is characterized by annual requirements of approximately 14.3 million SWU. For the Reference Nuclear Power Growth forecast, enrichment requirements in the U.S. are expected to remain at about this level through 2010, after which they begin to increase. During the ten year period 2021 through 2030 they are forecast to average 16.7 million SWU per year. However, for the High Nuclear Power Growth forecast, during the ten year period of 2021 through 2030, U.S. requirements are expected to average 17.7 million SWU per year. The WNA Reference and High Nuclear Power Growth forecasts indicate U.S. annual average requirements of 18.1 and 21.5 million SWU per year, respectively, during that same ten year period of 2021 through 2030.

Operators of many nuclear power plants in the U.S., who are also the end users of uranium enrichment services in the U.S., view the future supply situation with concern. They see a world supply and requirements situation for economical uranium enrichment services that is presently in balance, but one that has a potential for significant shortfall if plans that have been announced by each of the primary enrichers (i.e., Scenario A, which includes LES, USEC and AES each proceeding to a successful conclusion with their respective plans to build new commercial centrifuge uranium enrichment plants in the U.S.) are not executed.

At the present time, many owners and operators of nuclear power plants in the U.S. view themselves as being largely dependent on a single indigenous enricher, USEC, whose only sources of enrichment services are (i) the Paducah GDP, an aging plant that has very high operating costs, and (ii) Rosatom, which is supplying the enrichment component of the HEU-derived LEU through USEC. These purchasers are concerned that the primary source of enrichment services that USEC delivers for use in their nuclear power plants is obtained from Russia and could be vulnerable to either internal or international political unrest in the future. Also, there is concern that neither the performance nor economics of the updated version of the DOE centrifuge technology that USEC is planning to use has been successfully demonstrated. This is not to say that the technology will not be successful, but there is still more work to be done and the economics remain unproven. Furthermore, while it is apparent that additional enrichment services will be required in the near future, and there are a number of potential sources of such enrichment services, as previously identified in Table 1.1-5, there have been no firm commitments made to deploy new enrichment capacity to meet these future requirements.

1.1.2.4 Market Analysis of Supply and Requirements

1.1.2.4.1 Scenario A – Base Supply of Enrichment Services

Scenario A represents the scenario that is being actively pursued by AREVA/AES, LES and USEC, consistent with schedules that have been announced by each company.

Having summarized the current and expected elements of supply in Section 1.1.2.3, it is useful to examine further the relationship between supply and requirements under this scenario. Figures 1.1-7 and 1.1-8 present the Base supply together with the Reference and High Nuclear Power Growth forecast requirements, respectively. The two requirements forecasts are shown in two different figures to allow for proper characterization of the Rosatom Internal supply, which is assumed to increase as necessary to meet internal C.I.S. and Eastern European requirements that increase under the High Nuclear Power Growth forecast through the diversion of enrichment capacity from other uses such as the enrichment of tails material to uranium with the ^{235}U assay of natural uranium.

As illustrated in Figure 1.1-7 for Scenario A, Base supply and Reference Nuclear Power Growth requirements are in very close balance between 2016 and 2025, although a small supply deficit averaging 1.4 million SWU per year or 2.6% of requirements does exist in 2014 and 2015.

However, during the period 2026 through 2030, the average annual economically competitive and physically usable production capacity that is not constrained by international trade agreements, together with the equivalent enrichment services derived from Russian HEU and other sources reflected in the tables previously provided (Available Supply) is forecast to be 66.9 million SWU. (It should be noted that this and subsequent values of supply and requirements are stated as average values over specified five year time periods. This is in contrast to the values previously presented in Table 1.1-4 which are values of enrichment capacity during individual years.) This is 2.7 million SWU per year (3.9%) less than average annual forecast requirements during this same period of 69.6 million SWU. This emphasizes the need for all of these supply sources, including the proposed AES centrifuge enrichment plant in the U.S. Furthermore, in order to provide for an adequate supply margin to accommodate any unexpected events that could disrupt enrichment of uranium at one or more of the world's enrichment plants, additional enrichment supply capacity would be beneficial from the perspective of nuclear power plant operators.

Under the High Nuclear Power Growth forecast, as illustrated in Figure 1.1-8 for Scenario A, while effectively in balance today, there is a deficit of Base supply relative to requirements beginning in 2013, which continues to grow over time.

During the period 2011 through 2015, the Available Supply is forecast to be 56.2 million SWU. This is 2.0 million SWU per year (3.4%) less than average annual forecast requirements during this same period of 58.2 million SWU for the High Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply of 65.3 million SWU is 4.7 million SWU (6.8%) less than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply of 73.0 million SWU is 8.3 million SWU (10.2%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply of 76.8 million SWU is 14.4 million SWU (15.8%) less than average annual forecast requirements during this same period of 91.2 million SWU.

It is obvious from this comparison that under the Reference Nuclear Power Growth forecast, enrichment capacity from the proposed AES facility is necessary, and that additional enrichment capacity will be required to meet the deficit of supply relative to world requirements - a modest additional amount in 2014 and 2015, and more significant amounts by 2026. Additional capacity would be welcome by nuclear power plant operators as early as 2013 to provide some level of supply margin relative to world requirements. Under the High Nuclear Power Growth forecast, additional enrichment capacity will be required by 2013 to meet the deficit of supply relative to world requirements.

With regard to considerations of national security, if it is assumed that the presently planned AES, LES and USEC facilities are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of 15.4 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. This would be capable of supplying only 95% of an average of 16.3 million SWU per year of annual U.S. requirements during the same period for the Reference Nuclear Power Growth forecast.

This is the scenario that is presently being pursued. It would result in the establishment of three indigenous long-term sources of energy efficient, low cost, reliable uranium enrichment services in the U.S., which is positive with respect to the security of supply objective. In addition, the presence of three indigenous enrichment facilities in the U.S., with potential expansion capability among them, should serve to foster competition and result in a more secure long-term source of indigenous uranium enrichment services. This would also support the objective of ensuring a competitive procurement process for U.S. purchasers of these services. Three indigenous enrichment suppliers would also provide protection against the prospect of severe supply shortfalls if, for example, Rosatom were not to deliver enrichment services into the U.S. beyond 2013. However, even under Scenario A it is apparent that additional enrichment services supply capacity will be required to meet commercial nuclear power plant requirements.

1.1.2.4.2 Scenario B – Base Supply of Enrichment Services Without AES's U.S. Plant

The subsequent sections present alternatives to Scenario A wherein it is postulated that AREVA does not proceed with the construction and operation of its proposed gas centrifuge enrichment plant in the U.S. To provide perspective for these scenarios, Figures 1.1-9 and 1.1-10 illustrate the relationship between forecast uranium enrichment supply and requirements without the nominal 6 million SWU per year AREVA centrifuge enrichment plant in the U.S.

As shown in Figure 1.1-9, beginning in 2014, if the AES facility is not built in the U.S., then a deficit in Available Supply is present and continues to grow each year. Moving forward in time to the period 2016 through 2020, the Available Supply without the AREVA plant located in the U.S. of 55.9 million SWU is 2.6 million SWU (4.5%) less than average annual forecast requirements during this same period of 58.5 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply without the AES facility in the U.S. of 58.8 million SWU is 6.4 million SWU (9.9%) less than average annual forecast requirements during this same period of 65.2 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. of 60.6 million SWU is 9.0 million SWU (13.0%) less than average annual forecast requirements during this same period of 69.6 million SWU.

Under the High Nuclear Power Growth forecast, as illustrated in Figure 1.1-10 for Scenario B without the AES facility in the U.S., while effectively in balance today, there is a deficit in Base supply relative to requirements beginning in 2013, which continues to grow over time.

As shown in Figure 1.1-10, during the period 2011 through 2015, the Available Supply is forecast to be 55.9 million SWU. This is 2.3 million SWU per year (4.0%) less than average annual forecast requirements during this same period of 58.2 million SWU under the High Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply of 61.7 million SWU is 8.3 million SWU (11.9%) less than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply of 66.7 million SWU is 14.6 million SWU (18.0%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. of 70.5 million SWU is 20.7 million SWU (22.7%) less than average annual forecast requirements during the same period of 91.2 million SWU.

With regard to considerations of national security, if it is assumed that the LES NEF and USEC ACP are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of 10.0 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. This would be capable of supplying only 61% of an average of 16.3 million SWU per year of annual U.S. requirements during this same period for the Reference Nuclear Power Growth forecast.

1.1.2.4.3 Scenario C – Base Supply Without AES's U.S. Facility; Plus GEH Deployment of GLE

An alternative scenario is that the nominal 6 million SWU per year AES centrifuge uranium enrichment plant is not built in the U.S. However, since an initial motivating factor for building this plant was to increase the amount of indigenous uranium enrichment capacity in the U.S., the first alternative considered is one that also provides for additional enrichment capacity located in the U.S. Under this Scenario C, it is postulated that testing on the Silex technology is successful during 2009 and the decision is ultimately made by GEH to proceed with commercial deployment of a 6 million SWU of commercial GLE capacity, which is the maximum capacity that GEH has discussed.

Scenario C is illustrated in Figures 1.1-11 and 1.1-12 for the Reference and High Nuclear Power Growth forecasts respectively.

During the period 2011 through 2015, if the AES facility is not built in the U.S. and the GLE facility is built, then the Available Supply is forecast to be 54.5 million SWU. This is 2.1 million SWU per year (4.1%) greater than the average annual forecast requirements during this same period of 52.4 million SWU under the Reference Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply without the AES facility in the U.S. and with the GLE capacity is 61.5 million SWU or 3.0 million SWU (5.1%) greater than the average annual forecast requirements during this same period of 58.5 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply without the AES facility in the U.S. and with the GLE capacity is 64.8 million SWU or 0.4 million SWU (0.7%) less than average annual forecast requirements during this same period of 65.2 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the GLE capacity of 66.6 SWU is 3.0 million SWU (4.4%) less than average annual forecast requirements during this same period of 69.6 million SWU.

As noted above, the 6 million SWU per year GLE maximum capacity is slightly less than the 6.4 million SWU per year of enrichment capacity from the proposed AES facility in the U.S. and also results in a close match to the Reference Nuclear Power Growth forecast requirements. However, there is no margin for unexpected disruptions in supply that may occur.

Under the High Nuclear Power Growth forecast for Scenario C, without the AES facility in the U.S. and with the GLE capacity, during the period 2011 through 2015, the Available Supply is forecast to be 57.5 million SWU. This is 0.7 million SWU per year (1.2%) less than average annual forecast requirements during this same period of 58.2 million SWU under the High Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply of 67.3 million SWU is 2.7 million SWU (3.9%) less than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply of 72.7 million SWU is 8.6 million SWU (10.6%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the GLE capacity of 76.5 million SWU is 14.7 million SWU (16.2%) less than average annual forecast requirements during the same period of 91.2 million SWU.

It is obvious from this comparison that under the Reference Nuclear Power Growth forecast additional enrichment capacity will be required to provide an adequate supply margin relative to requirements in 2014 and 2015, and to meet the deficit in supply relative to requirements by 2024, and by 2014 to meet the deficit in supply relative to requirements under the High Nuclear Power Growth forecast.

With regard to considerations of national security, if it is assumed that the GLE facility, in addition to the LES NEF and USEC ACP, are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of 15.9 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. However, similar to the situation with regard to Scenario A, this enrichment capacity would be capable of supplying 98% of an average of 16.3 million SWU per year of annual U.S. requirements during the same period for the Reference Nuclear Power Growth forecast.

While providing for indigenous U.S. supply, there are several critical concerns associated with this alternative scenario. First, GEH has stated that there remains significant testing to be performed during 2009 before any deployment decision would be made. Therefore, Scenario C, far from being a certain alternative source of enrichment services, is at the present time highly speculative from both a technological and commercial perspective. Ultimately, GEH may decide not to proceed with construction and deployment of GLE. Even if it does make the decision to proceed, there remain uncertainties associated with the schedule and licensing of a new technology, and ultimately financing, building and operating it.

While GLE may eventually offer value as a supplier of enrichment services to the industry in the long term, it is not prudent to substitute (i) a potential source of supply for which the enrichment technology has not yet been commercially tested and a commercial plant deployment decision has not yet been made for (ii) the proposed AES facility in the U.S. that would be using commercially proven centrifuge enrichment technology that would be built and operated by a company that has been providing enrichment services world wide for many decades. The selection of Scenario B would not alleviate concerns among U.S. purchasers of enrichment services regarding long-term security of supply. Therefore, Scenario C is not viewed by AES as a responsible alternative to that of proceeding with the AREVA plant in the U.S.

1.1.2.4.4 Scenario D – Base Supply Without AES's U.S. Facility; Plus USEC Expansion of ACP

An alternative scenario is that the 6 million SWU per year AES centrifuge uranium enrichment plant is not built in the U.S. However, since an initial motivating factor for building this plant was to increase the amount of indigenous uranium enrichment capacity in the U.S., the next alternative considered is one that also provides for additional enrichment capacity located in the U.S. Under this Scenario D, it is postulated that USEC successfully completes the ACP and then, during the period 2013 through 2016, expands the ACP by an additional 3.2 million SWU per year of enrichment capacity, to attain its licensed maximum capacity of 7 million SWU per year.

Scenario D is illustrated in Figures 1.1-13 and 1.1-14 for the Reference and High Nuclear Power Growth forecasts respectively.

During the period 2011 through 2015, if the AES facility is not built in the U.S. and expansion of the ACP takes place, then the Available Supply is forecast to be 53.8 million SWU. This is 1.5 million SWU per year (2.8%) greater than the average annual forecast requirements during this same period of 52.4 million SWU under the Reference Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply without the AES facility in the U.S. and with the expansion of the ACP capacity of 59.1 million SWU is 0.6 million SWU (1.0%) greater than average annual forecast requirements during this same period of 58.5 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply without the AES facility in the U.S. and with the expansion of the ACP of 62.0 million SWU is 3.2 million SWU (5.0%) less than average annual forecast requirements during this same period of 65.2 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the expansion of the ACP capacity of 63.8 million SWU is 5.8 million SWU (8.4%) less than average annual forecast requirements during this same period of 69.6 million SWU.

The 3.2 million SWU per year of ACP expansion capacity is slightly greater than half the capacity of the AES facility and results in a very close match to the Reference Nuclear Power Growth forecast requirements only through 2019 . However, there is still minimal margin for unexpected disruptions in supply that may occur through 2019 and a growing supply deficit thereafter.

Under the High Nuclear Power Growth forecast for Scenario D, without the AES facility in the U.S. and with the expansion of the ACP capacity, during the period 2011 through 2015, the Available Supply is forecast to be 56.8 million SWU. This is 1.3 million SWU per year (2.3%) less than average annual forecast requirements during this same period of 58.2 million SWU under the High Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply of 64.9 million SWU is 5.1 million SWU (7.3%) less than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply of 69.9 million SWU is 11.4 million SWU (14.0%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the expansion of the ACP capacity of 73.7 million SWU is 17.5 million SWU (19.2%) less than average annual forecast requirements during this same period of 91.2 million SWU.

It is obvious from this comparison that under the Reference Nuclear Power Growth forecast that additional enrichment capacity will be required to provide an adequate supply margin relative to requirements by 2013 and to meet the deficit in supply relative to requirements by 2021, and by 2014 to meet the deficit in supply relative to requirements under the High Nuclear Power Growth forecast.

With regard to considerations of national security, if it is assumed that the USEC ACP is completed and then expanded to provide a total of 7 million SWU per year of capacity, then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of 13.2 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. However, as was the situation with regard to Scenario A, this enrichment capacity would be capable of supplying only 81% of an average of 16.3 million SWU per year of annual U.S. requirements during the same period for the Reference Nuclear Power Growth forecast.

However, it should be noted that at the present time, the USEC ACP is not operational and USEC has also not obtained all the financing needed to construct the initial 3.8 million of capacity. In addition, USEC has not publicly stated that a decision has been made to expand enrichment capacity of the ACP immediately upon completion of capacity that is presently under construction, as would be required under this scenario. Ultimately, USEC may decide not to proceed with such an expansion.

While USEC offers value as a long term supplier of enrichment services to the industry, it is not prudent to substitute (i) potential sources of supply for which commercial plant expansion decisions have not yet been made, and in the case of USEC the enrichment technology not yet commercially proven, for (ii) the proposed AES facility in the U.S. using commercially proven centrifuge enrichment technology that would be built and operated by a company that has been providing enrichment services world wide for many decades. The selection of Scenario D would not alleviate concerns among U.S. purchasers of enrichment services regarding long-term security of supply. In addition, it would not result in an additional source of indigenous competitive supply, but just USEC with greater enrichment capacity and LES. Therefore, Scenario D is not viewed by AES as a responsible alternative to that of proceeding with the AES facility in the U.S.

1.1.2.4.5 Scenario E – Base Supply Without AES's U.S. Facility; Plus Potential Rosatom Expansion Capacity

Another alternative scenario is that the 6 million SWU per year AES centrifuge uranium enrichment plant is not built in the U.S. However, under this Scenario E, it is postulated that any additional Rosatom commercial enrichment capacity that is not otherwise being used to meet C.I.S. and Eastern Europe or other Western world enrichment requirements would be made available. Under the Reference Nuclear Power Growth forecast the additional Rosatom commercial annual enrichment capacity is estimated to average 4.7 million SWU per year during the period 2011 to 2015, 4.6 million SWU per year during the period 2016 to 2020, and 3.2 million SWU per year during the period 2021 to 2025, and 2.7 million SWU per year during the period 2026 through 2030. Under the High Nuclear Power Growth forecast, due to increased requirements for enrichment services within the C.I.S. and Eastern Europe, this additional Rosatom enrichment capacity would average an additional 2.6 million SWU per year during the period 2011 to 2015, 0.4 million SWU per year during the period 2016 to 2020, after which it would not be available due to other demands on its enrichment capacity.

Scenario E is illustrated in Figures 1.1-15 and 1.1-16 for the Reference and High Nuclear Power Growth forecasts respectively.

During the period 2011 through 2015, if the AES facility is not built in the U.S. and additional Rosatom commercial enrichment capacity that is not otherwise being used to meet C.I.S. and Eastern Europe or other Western world enrichment requirements would be made available, then the Available Supply is forecast to be 57.5 million SWU. This is 5.2 million SWU per year (9.9%) greater than average annual forecast requirements during this same period of 52.4 million SWU under the Reference Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply without the AES facility in the U.S. and with the potential Rosatom capacity is 60.5 million SWU or 2.0 million SWU (3.4%) more than average annual forecast requirements during this same period of 58.5 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply without the AES facility in the U.S. and with the potential Rosatom capacity is 61.9 million SWU or 3.3 million SWU (5.0%) less than average annual forecast requirements during this same period of 65.2 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the potential Rosatom capacity is 63.3 million SWU or 6.3 million SWU (9.1%) less than average annual forecast requirements during this same period of 69.6 million SWU.

Under this Scenario E, there is a modest excess of supply relative to requirements, declining from about 7% of requirements in 2013 to 0% excess by 2020 after which there is a deficit of supply relative to requirements under the Reference Nuclear Power Growth forecast requirements.

Under the High Nuclear Power Growth forecast for Scenario E, the Available Supply without the AES facility in the U.S. and with the potential Rosatom capacity is forecast to be 58.4 million SWU during the period 2011 through 2015. This is 0.3 million SWU per year (0.5%) greater than average annual forecast requirements during this same period of 58.2 million SWU under the High Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply without the AES facility in the U.S. and with the potential Rosatom expansion is 62.1 million SWU or 7.9 million SWU (11.3%) less than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply without the AES facility in the U.S. and with the potential Rosatom expansion is 66.7 million SWU or 14.6 million SWU (18.0%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply without the AES facility in the U.S. and with the potential Rosatom capacity is 70.5 million SWU or 20.7 million SWU (22.7%) less than average annual forecast requirements during this same period of 91.2 million SWU.

It is obvious from this comparison that under the Reference Nuclear Power Growth forecast that additional enrichment capacity will be required to fill the deficit of supply relative to requirements by 2020, and under the High Nuclear Power Growth forecast by 2014.

With regard to considerations of national security, if it is assumed that the LES NEF and USEC ACP are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of only 10.0 million SWU per year of indigenous enrichment capacity during the 2016 to

2030 period. This would be capable of supplying only 61% of an average of 16.3 million SWU per year of annual U.S. requirements during this same period for the Reference Nuclear Power Growth forecast.

Scenario E would not alleviate the desire on the part of U.S. purchasers for either additional indigenous uranium enrichment capability in the U.S. for security of supply purposes or provide for an additional U.S.-based source of supply competition since it is already assumed that Rosatom will be delivering enrichment services into the U.S. under the Amended Suspension Agreement. There is also the issue of whether such a significant U.S. dependence on Russia for enrichment services could make the U.S. vulnerable to adverse actions as a result of political disagreements and unrelated trade disputes that might arise from time to time between the U.S. and Russia. Consequently, neither the security of supply objective nor the objective of ensuring a long-term competitive procurement process for U.S. purchasers of these services could be assured. Therefore, Scenario E is not viewed by AES as a responsible alternative to that of proceeding with the AES facility in the U.S.

1.1.2.4.6 Scenario F – Base Supply Without AES's U.S. Facility; Plus Build the Equivalent Enrichment Capacity in Europe

Another alternative scenario is that the 6 million SWU per year AES centrifuge uranium enrichment plant is not built in the U.S. Under this Scenario F it is postulated that the equivalent enrichment capacity is built in Europe. From a supply and requirements perspective this would look like Scenario A, except for location of enrichment capacity and associated considerations.

With regard to considerations of national security, if it is assumed that the LES NEF and USEC ACP are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of only 10.0 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. This would be capable of supplying only 61% of an average of 16.3 million SWU per year of annual U.S. requirements during this same period for the Reference Nuclear Power Growth forecast.

While this approach may be physically possible, from a commercial perspective there are several reasons why this would be an unacceptable approach for AES. For example, there are a variety of risks associated with such factors as the uncertain level of European-sourced sales that might be achieved for AES in the U.S. market, significant concentration of its enrichment business in a single market supplied out of France, unpredictable changes in currency exchange rates, transatlantic shipping, and unknown future trade actions that could be undertaken by a protective U.S. government on behalf of its indigenous enrichers.

When these factors are considered collectively, AES presently views the commercial risk of building an additional 6 million SWU per year of enrichment capability in Europe specifically to serve the U.S. market as excessive. Furthermore, its decision in 2007 to pursue the licensing, construction and operation of an enrichment plant in the U.S. confirms that AREVA does not perceive expanding its centrifuge enrichment capability in Europe just to serve the U.S. market as being an attractive alternative to building new centrifuge capability in the U.S.

Furthermore, Scenario F would not alleviate the desire on the part of U.S. purchasers for either additional indigenous uranium enrichment capability in the U.S. or provide for an additional source of supply competition located in the U.S. Consequently, neither the security of supply objective nor the objective of ensuring additional competitive procurement process for U.S. purchasers of these services could be assured. For all of these reasons, Scenario F is not viewed by AES as a responsible alternative to that of proceeding with the AES facility in the U.S.

1.1.2.4.7 Scenario G – Base Supply Without AES's U.S. Facility; Plus Additional U.S. HEU-Derived LEU is Made Available to the Commercial Market

This alternative scenario assumes that the 6 million SWU per year AES centrifuge uranium enrichment plant is not built in the U.S. However, under this scenario, it is postulated that the U.S. government makes available additional HEU-derived LEU to the U.S. commercial market. This material was previously discussed in Section 1.1.2.3. Of the combined 374 MT of HEU that was declared excess to the U.S. nuclear weapons stockpile by DOE in 1994 and 2005, the disposition of 68 MT of HEU still remains undecided but might be expected to eventually become available to the commercial nuclear fuel market (NNSA, 2008). Upon down blending, the 68 MT HEU would yield not more than 10 million SWU. A little over half (37 MT of HEU) of this material could potentially be blended down and released to the commercial market between 2010 and 2020, while the rest (31 MT of HEU) could possibly be released gradually between 2010 and 2050 as material is rejected by the U.S. Naval Reactor Program. The potential therefore exists for additional U.S. HEU to contribute an average of 0.6 million SWU per year to the commercial nuclear fuel market through 2020, after which it would contribute only 0.1 million SWU per year. However, these enrichment services should be recognized as being highly speculative in any supply forecast that includes their use. Furthermore, as shown here there is not sufficient U.S. HEU and equivalent enrichment services to compensate on a long term basis for the 6 million SWU per year of enrichment services that would have been provided by AES under Scenario A.

With regard to considerations of national security, if it is assumed that the LES NEF and USEC ACP are completed and operate successfully in the U.S., then together with these small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of only 10.3 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. This would be capable of supplying only 63% of an average of 16.3 million SWU per year of annual U.S. requirements during this same period for the Reference Nuclear Power Growth forecast.

Furthermore, there has been no clear statement by the U.S. government as to how much of this material will be made available for commercial use, and if it is, then on what schedule. Any forecast that includes use of the enrichment services that may be associated with this material must be recognized as highly speculative. The issue of replacement capacity for the proposed 6 million SWU per year AES enrichment plant in the U.S. is not resolved under Scenario G. Consequently, neither the security of supply objective nor the objective of ensuring a competitive procurement process for U.S. purchasers of these services could be assured.

1.1.2.4.8 Scenario H – Base Supply With GEH Deployment of GLE

Scenario H is included as a variation on Scenario A that recognizes the fact that GEH is currently pursuing uranium enrichment technology, as discussed in Section 1.1.2.3.2, and that it may ultimately decide to deploy GLE on a commercial basis. Under this Scenario H, AES assumes that GEH deploys a base enrichment capacity of 6 million SWU per year and that AES also proceeds with its U.S. enrichment plant.

As illustrated in Figure 1.1-17 for Scenario H, during the period 2011 through 2015, if the GLE facility is added to the Base supply identified in Scenario A, then the Available Supply is forecast to be 54.8 million SWU. This is 2.4 million SWU per year (4.7%) greater than the average annual forecast requirements during this same period of 52.4 million SWU under the Reference Nuclear Power Growth forecast.

Moving forward in time to the period 2016 through 2020, the Available Supply with both AES and GLE facilities in the US is 65.1 million SWU or 6.6 million SWU (11.3%) greater than the average annual forecast requirements during this same period of 58.5 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply with both AES and GLE facilities in the US is 71.1 million SWU or 5.9 million SWU (9.0%) greater than average annual forecast requirements during this same period of 65.2 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply with both AES and GLE facilities in the U.S. is 72.9 million SWU or 3.3 million SWU (4.7%) greater than average annual forecast requirements during this same period of 69.6 million SWU.

Under the High Nuclear Power Growth forecast, as illustrated in Figure 1.1-18 for Scenario H, during the period 2011 through 2015, the Available Supply with both AES and GLE facilities in the US is forecast to be 57.8 million SWU. This is 0.4 million SWU per year (0.7%) less than average annual forecast requirements during this same period of 58.2 million SWU.

Moving forward in time to the period 2016 through 2020, the Available Supply with both AES and GLE facilities in the US is 70.9 million SWU or 0.9 million SWU (1.2%) greater than average annual forecast requirements during this same period of 70.0 million SWU.

Continuing with this scenario to the 2021 through 2025 period, the Available Supply with both AES and GLE facilities in the US is 79.0 million SWU or 2.3 million SWU (2.8%) less than average annual forecast requirements during this same period of 81.3 million SWU.

Finally, during the 2026 through 2030 period, the Available Supply with both AES and GLE facilities in the U.S. is 82.8 million SWU or 8.4 million SWU (9.2%) less than average annual forecast requirements during this same period of 91.2 million SWU.

For Scenario H, under the Reference Nuclear Power Growth forecast, enrichment capacity is adequate to provide a supply margin relative to world requirements that averages 7.4% of requirements during the period 2011 to 2030. In contrast, Scenario H, under the High Nuclear Power Growth forecast demonstrates a growing deficit of supply relative to world requirements beginning in 2021.

With regard to considerations of national security, if it is assumed that the presently planned AES, LES and USEC facilities, together with a GLE plant, are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would provide an average of 21.3 million SWU per year of indigenous enrichment capacity during the 2016 to 2030 period. This would be capable of supplying 131% of an average of 16.3 million SWU per year of annual U.S. requirements during the same period for the Reference Nuclear Power Growth forecast.

The presence of four indigenous enrichment facilities in the U.S. should serve to foster competition and result in a more secure long-term source of indigenous uranium enrichment services. This would also support the objective of ensuring a competitive procurement process for U.S. purchasers of these services. Four indigenous enrichment suppliers would also provide protection against the prospect of severe supply shortfalls if, for example, Rosatom were not to deliver enrichment services into the U.S. beyond 2013 or an industrial accident or natural disaster were to result in the shutdown of one of the other enrichment facilities. However, even under the optimistic supply assumptions of Scenario H it is apparent that additional enrichment services supply capacity will be required to meet commercial nuclear power plant requirements under the High Nuclear Power Growth forecast.

1.1.2.4.10 Summary

Table 1.1-6 summarizes the results of Scenarios A through H for both the Reference and High Nuclear Power Growth forecasts from the perspective of world supply relative to requirements during each of the time periods previously discussed. The periods with supply deficits are highlighted.

In this context, it is evident that under the Reference Nuclear Power Growth forecast, enrichment capacity provided by the proposed AES facility in the U.S. or one of the other alternatives presented will be necessary to help meet requirements for enrichment services that arise from presently operating and yet to be built nuclear power plants. However, by about 2021 it is also evident that neither the AES plant in the U.S. nor any of the alternatives will be adequate by itself to meet enrichment services requirements, which are forecast to continue to grow. Under the High Nuclear Power Growth forecast, by no later then 2014 it is apparent that no individual alternative would be adequate by itself to meet world enrichment requirements. Thus, not only will the AES enrichment facility be required in the U.S., but one or more of the other alternatives will also be required to meet forecast requirements.

With regard to considerations of national security, Table 1.1-7 summarizes the results of Scenarios A through H for both the Reference and High Nuclear Power Growth forecasts from the perspective of U.S. supply relative to U.S. requirements during the 2016 to 2030 time period, as previously discussed.

As shown in Table 1.1-7, there is a deficit of U.S. supply relative to U.S. requirements in each scenario that is an alternative to the proposed AES facility in the U.S. While this is not necessarily unexpected in a world market in which nuclear fuel supply moves both into and out of the U.S., it does highlight the potential advantage of having additional indigenous supply of uranium enrichment services from the perspective of national security.

The need for a new enrichment plant, such as the one proposed by AES, which with a nominal enrichment capacity of 6 million SWU per year, which will represent approximately 10% of world requirements when it is operating at full capacity, becomes even more apparent if even a small supply margin relative to requirements is viewed as desirable by owners and operators of nuclear power plants. This margin would help to assure competition and also help mitigate the impact of potential operational difficulties and/or disruptions at any enrichment plant in the future. If viewed from the perspective of the adequacy of U.S. supply to meet U.S. requirements, then as shown in Table 1.1-7, the additional supply that would be made available by the presence of the AES enrichment facility in the U.S. would only serve to reduce the deficit, but would not eliminate it.

1.1.3 Conclusion

Including Scenario A, a total of eight alternative supply scenarios have been identified and summarized in Section 1.1.2.4 with respect to the available supply of enrichment services and the ability to meet future long term nuclear power plant operating requirements. While variations and/or combinations of these scenarios could be postulated, the shortcomings that have been identified are not resolved.

While it is apparent that sources of enrichment services in addition to those identified in Table 1.1-4 will be required in the near future, and that there are a number of potential sources of such enrichment services, as previously identified in Table 1.1-5, there have been no firm public commitments made to either deploy new commercial enrichment capacity (i.e., GLE – Scenarios C and H), further expand enrichment capacity that is already under construction (i.e., USEC – Scenario D); divert additional production from creation of natural uranium to provide enrichment services for production of LEU (i.e., Rosatom – Scenario E); build the equivalent size facility in Europe to serve the U.S. market (i.e., AES – Scenario F); or to down blend adequate quantities of government controlled HEU and make available the resulting enrichment component of the LEU (i.e., U.S. government – Scenario G) to meet these commercial nuclear power plant requirements. Therefore, the alternatives to building the nominal 6 million SWU per year AES enrichment facility in the U.S., as described in Scenarios C through G, each have a greater degree of inherent uncertainty associated with them than Scenario A. Furthermore, when the critical nuclear fuel procurement objectives, security of supply and a competitive procurement process for U.S. purchasers of these services are considered, it becomes apparent that for long term planning purposes those alternatives, or even combinations thereof, are not acceptable. Accordingly, there is a demonstrated need for AES's proposed nominal 6 million SWU per year enrichment plant in the U.S.

TABLES

Table 1.1-1 Summary of World Nuclear Power Installed Generating Capacity Forecasts (Page 1 of 1)

Year	Forecast	Nuclear Generation Capacity (GWe)					
		U.S.	Western Europe	C.I.S. (a) & E. Europe	East Asia	Other (b)	World
2007	Actual	100.3	124.0	47.1	78.6	22.9	372.9
2010	Reference High	101.6 101.6	120.3 125.1	46.3 49.1	80.7 84.2	27.7 28.8	376.6 388.8
2015	Reference High	104.7 105.8	124.0 127.2	54.5 65.2	99.3 118.1	33.2 39.3	415.7 455.6
2020	Reference High	109.6 112.7	124.7 133.5	66.7 89.8	122.7 157.0	42.2 58.4	465.9 551.4
2025	Reference High	115.4 120.6	117.2 136.1	78.2 108.0	149.5 197.8	48.7 76.1	509.0 638.6
2030	Reference High	118.7 129.5	110.0 138.7	81.6 121.0	172.5 235.7	55.4 100.1	538.2 725.0

(a) C.I.S. includes Armenia, Belarus, Kazakhstan, Russian Federation and Ukraine; Eastern Europe includes Bulgaria, Czech Republic, Hungary, Lithuania, Romania and Slovakia.

(b) Algeria, Argentina, Brazil, Canada, Egypt, India, Indonesia, Iran, Libya, Mexico, Pakistan, South Africa, Turkey and United Arab Emirates (UAE).

Table 1.1-2 Summary of World Period Average Nuclear Power Installed Generating Capacity Forecasts (Page 1 of 1)

Year/Period	Forecast	Nuclear Generation Capacity (GWe)					
		U.S.	Western Europe	C.I.S. (a) & E. Europe	East Asia	Other (b)	World
2007	Actual	100.3	124.0	47.1	78.6	22.9	372.9
2008-2010	Reference High	101.2 101.2	121.8 124.8	46.1 47.8	79.5 81.4	25.6 26.3	374.2 381.5
2011-2015	Reference High	 103.5 103.9	123.3 127.9	50.2 58.2	92.0 101.3	30.4 34.0	399.4 425.3
2016-2020	Reference High	107.6 109.8	123.4 132.2	63.0 80.1	112.8 139.7	37.9 51.7	444.7 513.4
2021-2025	Reference High	112.8 116.8	122.1 136.2	74.1 100.0	138.5 181.8	45.1 71.1	492.5 606.0
2026-2030	Reference High	118.0 127.2	114.1 138.7	81.2 116.4	164.2 221.0	52.8 92.6	530.4 695.9

(a) C.I.S. includes Armenia, Belarus, Kazakhstan, Russian Federation and Ukraine; Eastern Europe includes Bulgaria, Czech Republic, Hungary, Lithuania, Romania, and Slovakia.

(b) Algeria, Argentina, Brazil, Canada, Egypt, India, Indonesia, Iran, Libya, Mexico, Pakistan, South Africa, Turkey and UAE.

Table 1.1-3 Summary of World Period Average Annual Enrichment Requirements Forecasts (Page 1 of 1)

Year/Period	Forecast	Enrichment Requirements (Million SWU)					
		U.S.	Western Europe	C.I.S. (a) & E. Europe	East Asia	Other (b)	World
2007	Actual	14.4	13.2	8.1	8.7	0.9	45.3
2008-2010	Reference High	14.3 14.3	13.5 14.0	8.3 9.0	10.2 10.7	0.9 1.0	47.3 49.0
2011-2015	Reference High	14.9 15.0	14.3 14.9	9.8 11.5	11.9 14.7	1.4 2.1	52.4 58.2
2016-2020	Reference High	15.4 15.9	14.3 15.6	11.8 15.4	14.8 19.2	2.2 3.9	58.5 70.0
2021-2025	Reference High	16.3 16.9	14.5 16.5	13.7 18.6	17.9 23.7	2.8 5.6	65.2 81.3
2026-2030	Reference High	17.1 18.5	13.4 16.5	14.9 20.8	20.9 27.8	3.3 7.5	69.6 91.2

(a) C.I.S. includes Armenia, Belarus, Kazakhstan, Russian Federation and Ukraine; Eastern Europe includes Bulgaria, Czech Republic, Hungary, Lithuania, Romania, and Slovakia.

(b) Algeria, Argentina, Brazil, Canada, Egypt, India, Indonesia, Iran, Libya, Mexico, Pakistan, South Africa, Turkey and UAE.

Table 1.1-4 Base Sources of Uranium Enrichment Services
(Page 1 of 1)

Item		Technology	Base Economically Competitive and Usable Capability (Million SWU)				
			2008	**2015**	**2020**	**2025**	**2030**
1	Urenco (Existing and Planned Expansions)	Centrifuge	10.3	12.4	12.4	12.4	12.4
2	AREVA GB I (Existing)	Diffusion	7.6	1.8	0.0	0.0	0.0
3	AREVA GB II (New)	Centrifuge	0.0	6.0	7.5	7.5	7.5
4	USEC Paducah (Existing)	Diffusion	5.7	0.0	0.0	0.0	0.0
5	Rosatom (Internal – C.I.S. & Eastern Europe – Ref. Case)	Centrifuge	7.5	10.4	12.1	13.3	14.7
6	Rosatom (Exports, but not U.S.)	Centrifuge	6.1	5.4	6.3	7.4	7.6
7	Russian HEU - Derived LEU	Inventory, down blending required	6.8	0.4	0.2	0.0	0.0
8	U.S. HEU	Inventory, down blending required	0.4	0.3	0.0	0.0	0.0
9	Other (Existing/New)	Centrifuge	1.3	2.8	3.4	3.4	3.4
10	LES (New)	Centrifuge	0.0	5.1	5.9	5.9	5.9
11	Recycle	Commercial Reprocessing; Weapons Pu Inv.	1.6	1.7	2.3	2.3	2.3
12	USEC (New)	Centrifuge	0.0	3.8	3.8	3.8	3.8
13	Rosatom (Exports to U.S.)	Centrifuge	0.0	3.1	3.5	3.7	3.9
14	AES US (New)	Centrifuge	0.0	1.2	5.2	6.4	6.1
	Total		47.3	54.3	62.5	66.0	67.5

Table 1.1-5 Potential Sources of Additional Uranium Enrichment Services
(Page 1 of 1)

Item		Technology	Potential Economically Competitive and Usable Capability (Million SWU)				
			2008	**2015**	**2020**	**2025**	**2030**
15	GLE	Laser	0.0	3.5	6.0	6.0	6.0
16	USEC (Expansion)	Centrifuge	0.0	2.9	3.2	3.2	3.2
17	Rosatom – Potential Supply	Centrifuge	0.8	5.3	3.9	2.8	2.4
18	U.S. HEU – Additional	Down Blending	0.0	0.6	0.6	0.1	0.1
	Total		0.8	12.3	13.7	12.1	11.7

Table 1.1-6 Summary of Supply and Requirements Scenarios
(Page 1 of 2)

	Period Scenario	2007	2008-2010	2011-2015	2016-2020	2021-2025	2026-2030
	Reference Requirements	Average Annual Excess or Deficit of Supply Relative to World Requirements Million of SWU (Percent of Annual Requirements)					
A	Base Supply	1.3 (2.8%)	1.7 (3.6%)	0.8 (1.6%)	1.0 (1.7%)	-0.1 (-0.2%)	-2.7 (-3.9%)
B	Base Supply less AES in U.S.	1.3 (2.8%)	1.7 (3.6%)	0.5 (1.00%)	-2.6 (-4.5%)	-6.4 (-9.9%)	-9.0 (-13.0%)
C	Base Supply less AES in U.S. plus GLE	1.3 (2.8%)	1.7 (3.6%)	2.1 (4.1%)	3.0 (5.1%)	-0.4 (-0.7%)	-3.0 (-4.4%)
D	Base Supply less AES in U.S. plus Expanded ACP	1.3 (2.8%)	1.7 (3.6%)	1.5 (2.8%)	0.6 (1.0%)	-3.2 (-5.0%)	-5.8 (-8.4%)
E	Base Supply less AES in U.S. plus Potential Excess Rosatom	1.3 (2.8%)	3.1 (6.5%)	5.2 (9.9%)	2.0 (3.4%)	-3.3 (-5.0%)	-6.3 (-9.1%)
F	Base Supply less AES in U.S. plus Equiv. Capacity in Europe	1.3 (2.8%)	1.7 (3.6%)	0.8 (1.6%)	1.0 (1.7%)	-0.1 (-0.2%)	-2.7 (-3.9%)
G	Base Supply less AES in U.S. plus Additional U.S. HEU	1.3 (2.8%)	1.7 (3.6%)	1.1 (2.2%)	-2.0 (-3.4%)	-6.3 (-9.7%)	-8.9 (-12.8%)
H	Base Supply plus GLE	1.3 (2.8%)	1.7 (3.6%)	2.4 (4.7%)	6.6 (11.3%)	5.9 (9.0%)	3.3 (4.7%)
	High Requirements						
A	Base Supply	0.8 (1.7%)	0.8 (1.7%)	-2.0 (-3.4%)	-4.7 (-6.8%)	-8.3 (-10.2%)	-14.4 (-15.8%)
B	Base Supply less AES in U.S.	0.8 (1.7%)	0.8 (1.7%)	-2.3 (-4.0%)	-8.3 (-11.9%)	-14.6 (-18.0%)	-20.7 (-22.7%)
C	Base Supply less AES in U.S. plus GLE	0.8 (1.7%)	0.8 (1.7%)	-0.7 (-1.2%)	-2.7 (-3.9%)	-8.6 (-10.6%)	-14.7 (-16.2%)
D	Base Supply less AES in U.S. plus Expanded ACP	0.8 (1.7%)	0.8 (1.7%)	-1.3 (-2.3%)	-5.1 (-7.3%)	-11.4 (-14.0%)	-17.5 (-19.2%)
E	Base Supply less AES in U.S. plus Potential Excess Rosatom	0.8 (1.7%)	1.6 (3.3%)	0.3 (0.5%)	-7.9 (-11.3%)	-14.6 (-18.0%)	-20.7 (-22.7%)

Table 1.1-6 Summary of Supply and Requirements Scenarios

(Page 2 of 2)

	Period Scenario	2007	2008-2010	2011-2015	2016-2020	2021-2025	2026-2030
F	Base Supply less AES in U.S. plus Equiv. Capacity in Europe	0.8(1.7%)	0.8 (1.7%)	-2.0 (-3.4%)	-4.7 (-6.8%)	-8.3 (-10.2%)	-14.4 (-15.8%)
G	Base Supply less AES in U.S. plus Additional U.S. HEU	0.8 (1.7%)	0.8 (1.7%)	-1.7 (-2.9%)	-7.7 (-11.1%)	-14.5 (-17.8%)	-20.7 (-22.6%)
H	Base Supply plus GLE	0.8 (1.7%)	0.8 (1.7%)	-0.4 (-0.7%)	0.9 (1.2%)	-2.3 (-2.8%)	-8.4 (-9.2%)

Table 1.1-7 Summary of Supply and Requirements Scenarios for U.S. Only
(Page 1 of 1)

	Scenario	2016-2030
	Reference Requirements	Average Annual Excess or Deficit of U.S. Supply Relative to U.S. Requirements Million of SWU (Percent of Annual U.S. Requirements)
A	Base Supply	-0.8 (-5.0%)
B	Base Supply less AES in U.S.	-6.2 (-38.4%)
C	Base Supply less AES in U.S. plus GLE	-0.4 (-2.3%)
D	Base Supply less AES in U.S. plus Expanded ACP	-3.0 (-18.7%)
E	Base Supply less AES in U.S. plus Potential Excess Rosatom	-2.7 (-16.8%)
F	Base Supply less AES in U.S. plus Equiv. Capacity in Europe	-0.8 (-5.0%)
G	Base Supply less AES in U.S. plus Additional U.S. HEU	-6.0 (-36.7%)
H	Base Supply plus GLE	5.0 (31.0%)
	High Requirements	
A	Base Supply	-1.6 (-9.1%)
B	Base Supply less AES in U.S.	-7.0 (-40.8%)
C	Base Supply less AES in U.S. plus GLE	-1.1 (-6.5%)
D	Base Supply less AES in U.S. plus Expanded ACP	-3.8 (-22.1%)
E	Base Supply less AES in U.S. plus Potential Excess Rosatom	-7.0 (-40.8%)
F	Base Supply less AES in U.S. plus Equiv. Capacity in Europe	-1.6 (-9.1%)
G	Base Supply less AES in U.S. plus Additional U.S. HEU	-6.7 (-39.2%)
H	Base Supply plus GLE	4.3 (25.2%)

FIGURES

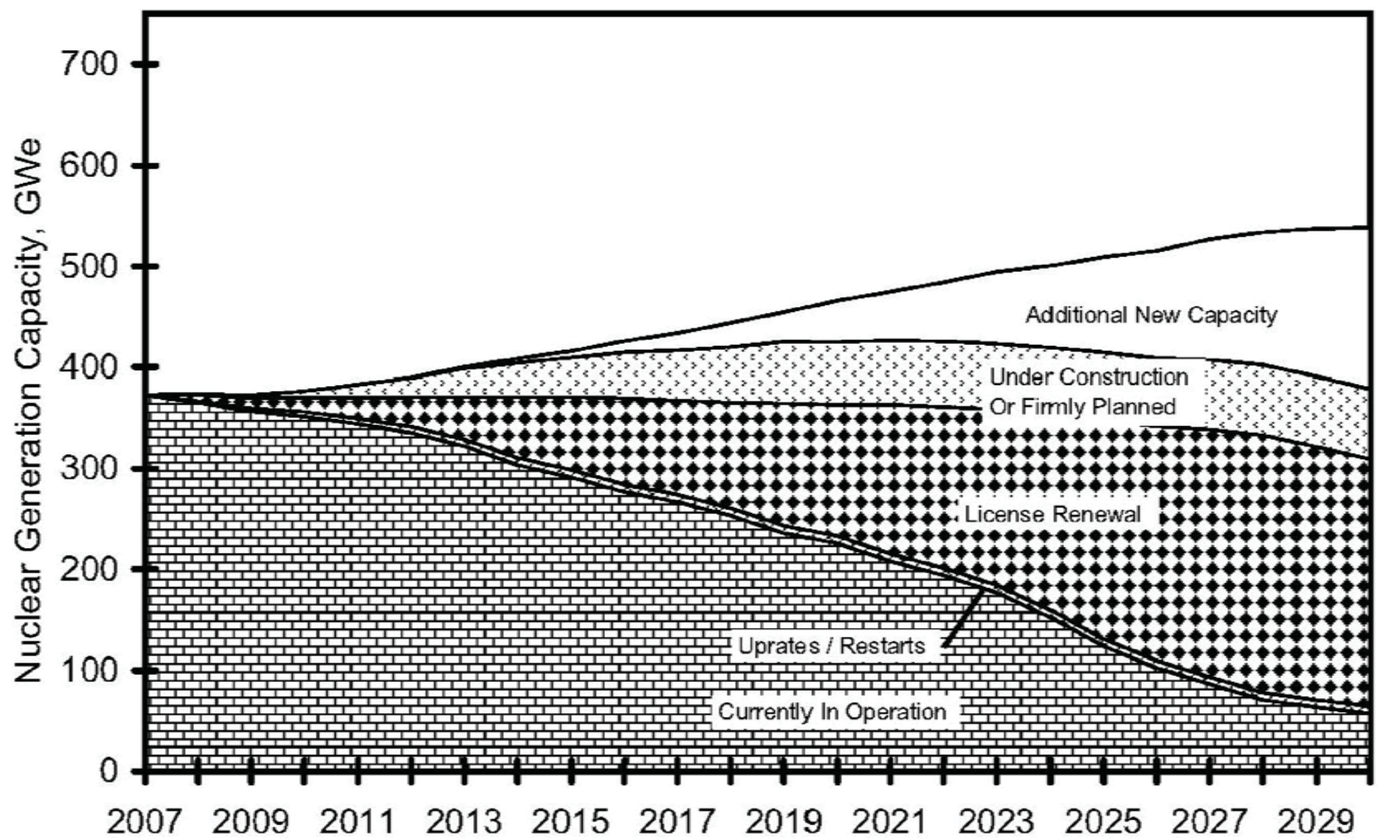

Figure 1.1-1 **Rev. 2**

Composition of World Nuclear Generation Capacity for Reference Forecast

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

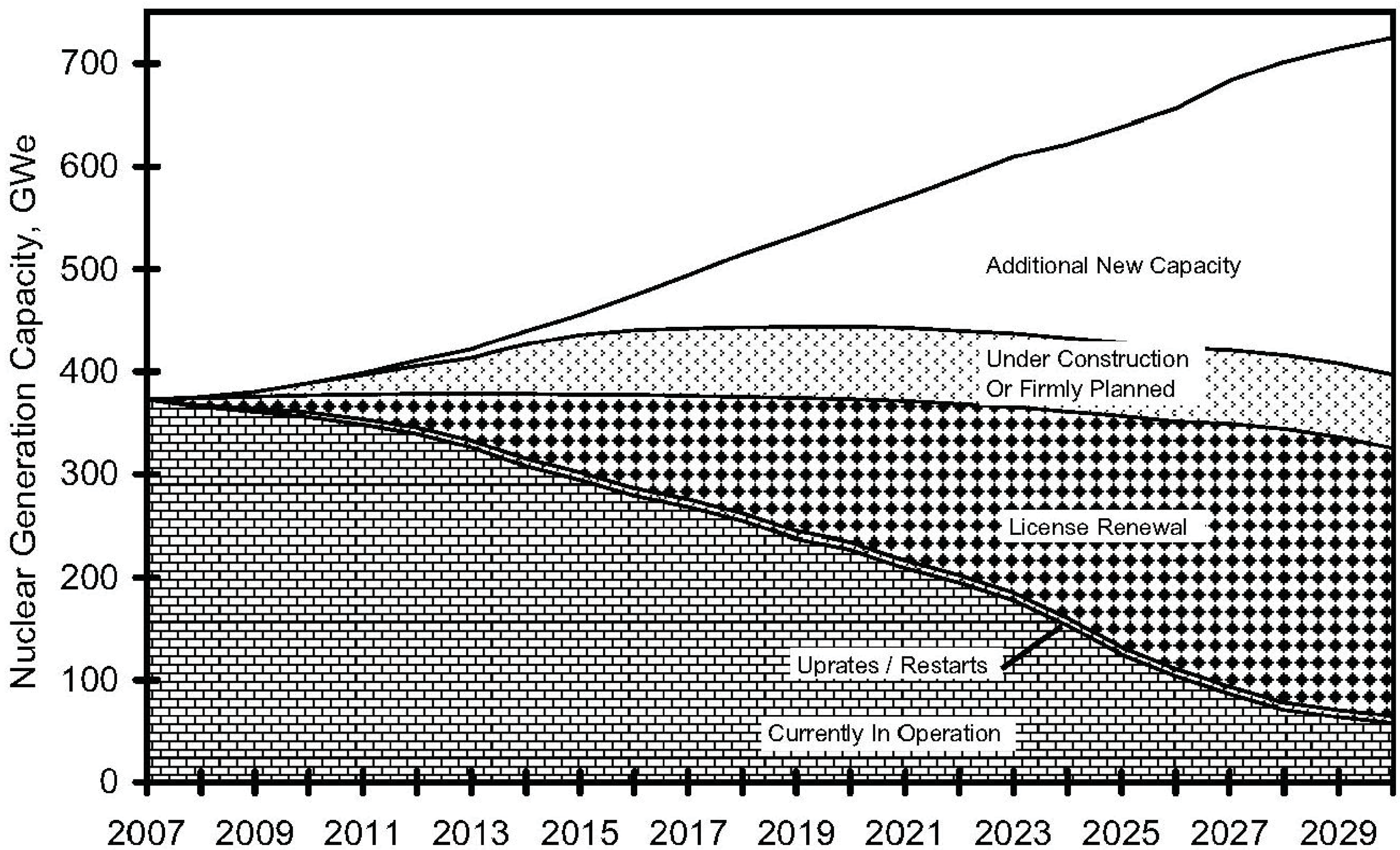

Figure 1.1-2 **Rev. 2**

Composition of World Nuclear Generation Capacity for High Forecast

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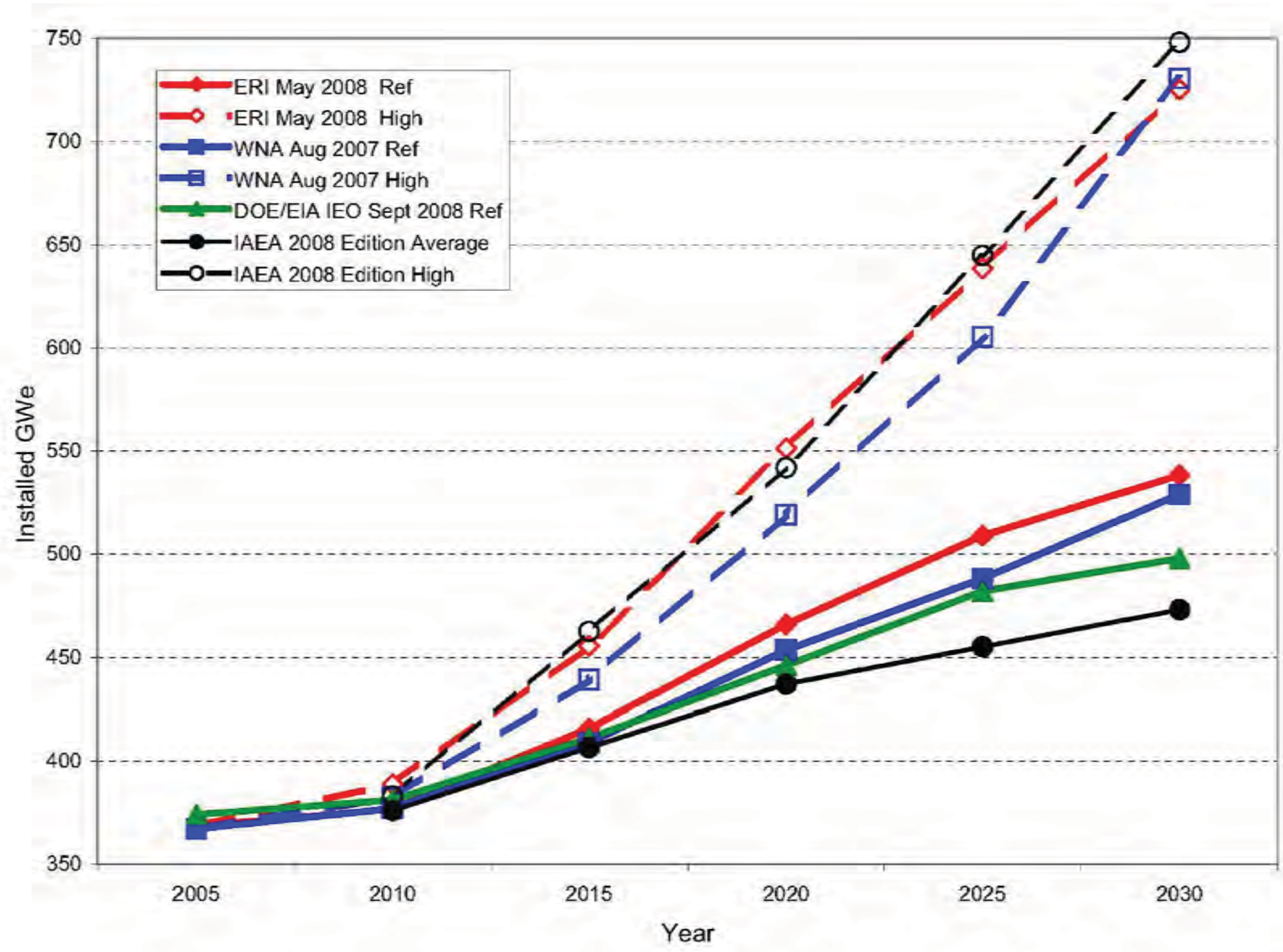

Figure 1.1-3 **Rev. 2**

Comparision of World Nuclear Generation Capacity Forecasts

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

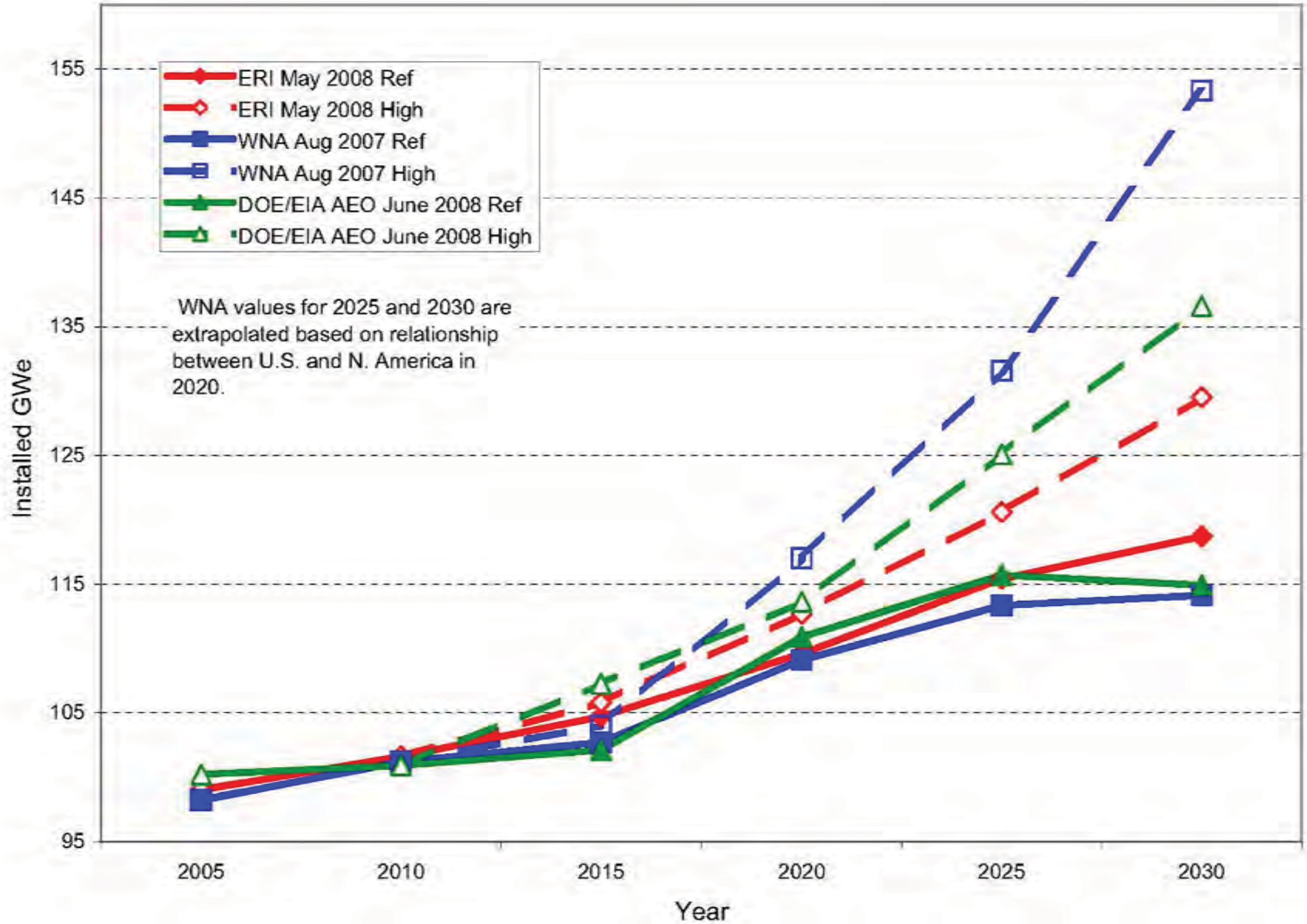

Figure 1.1-4 **Rev. 2**

Comparision of U.S. Nuclear Generation Capacity Forecasts

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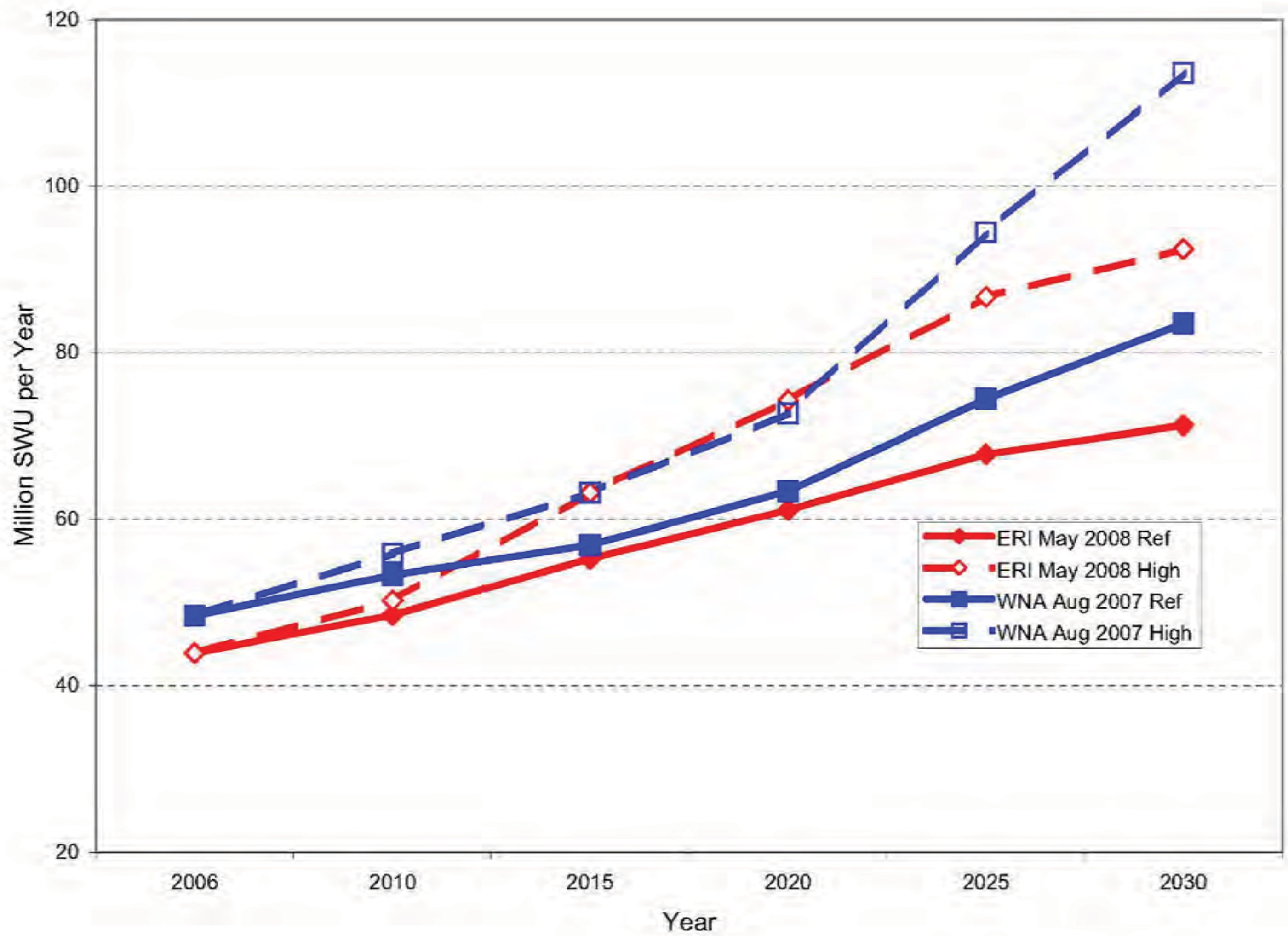

Figure 1.1-5 **Rev. 2**

Comparision of World Annual Enrichment Requirements Forecasts

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

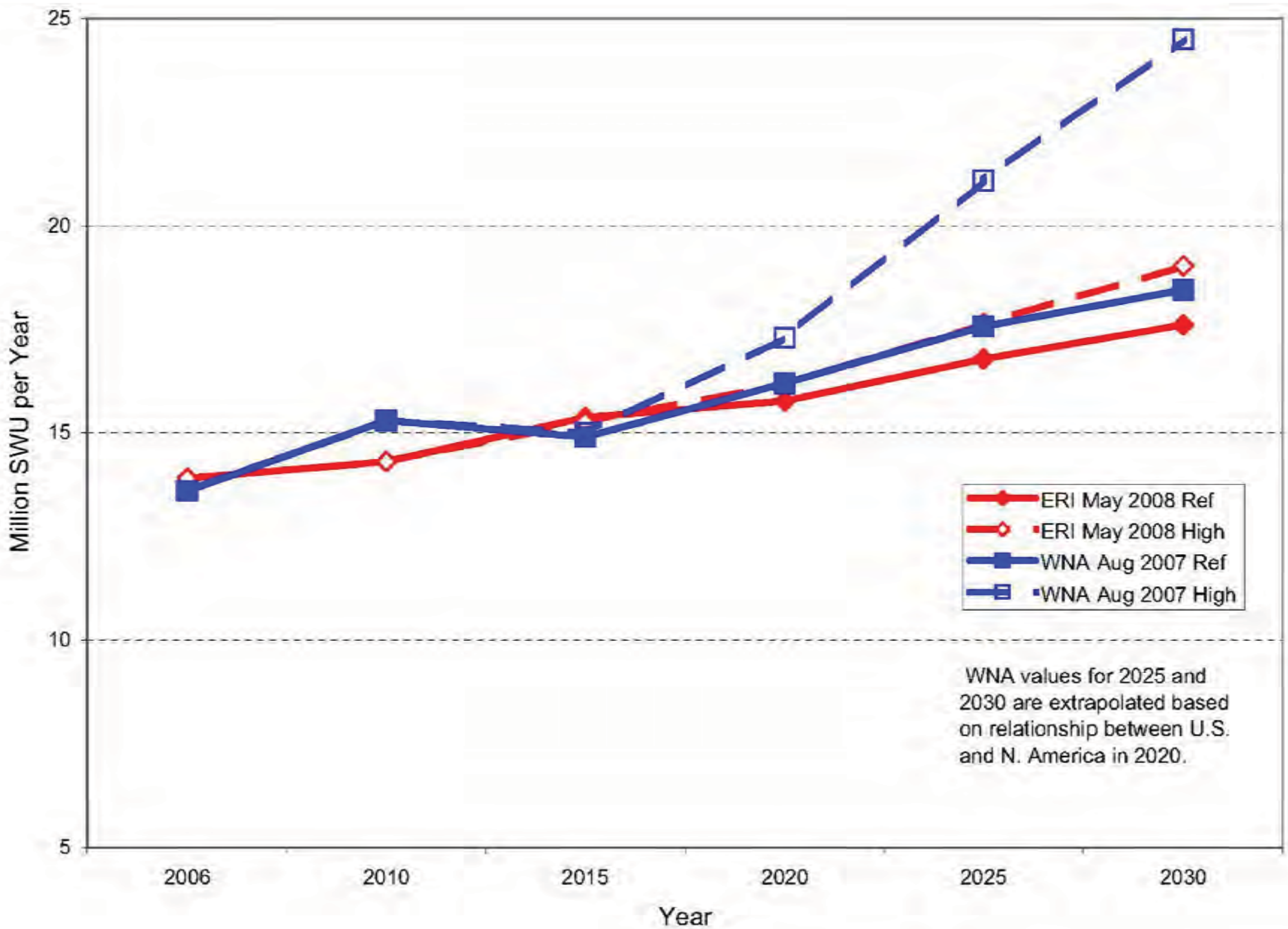

Figure 1.1-6 **Rev. 2**

Comparision of U.S. Annual Enrichment Requirements Forecasts

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

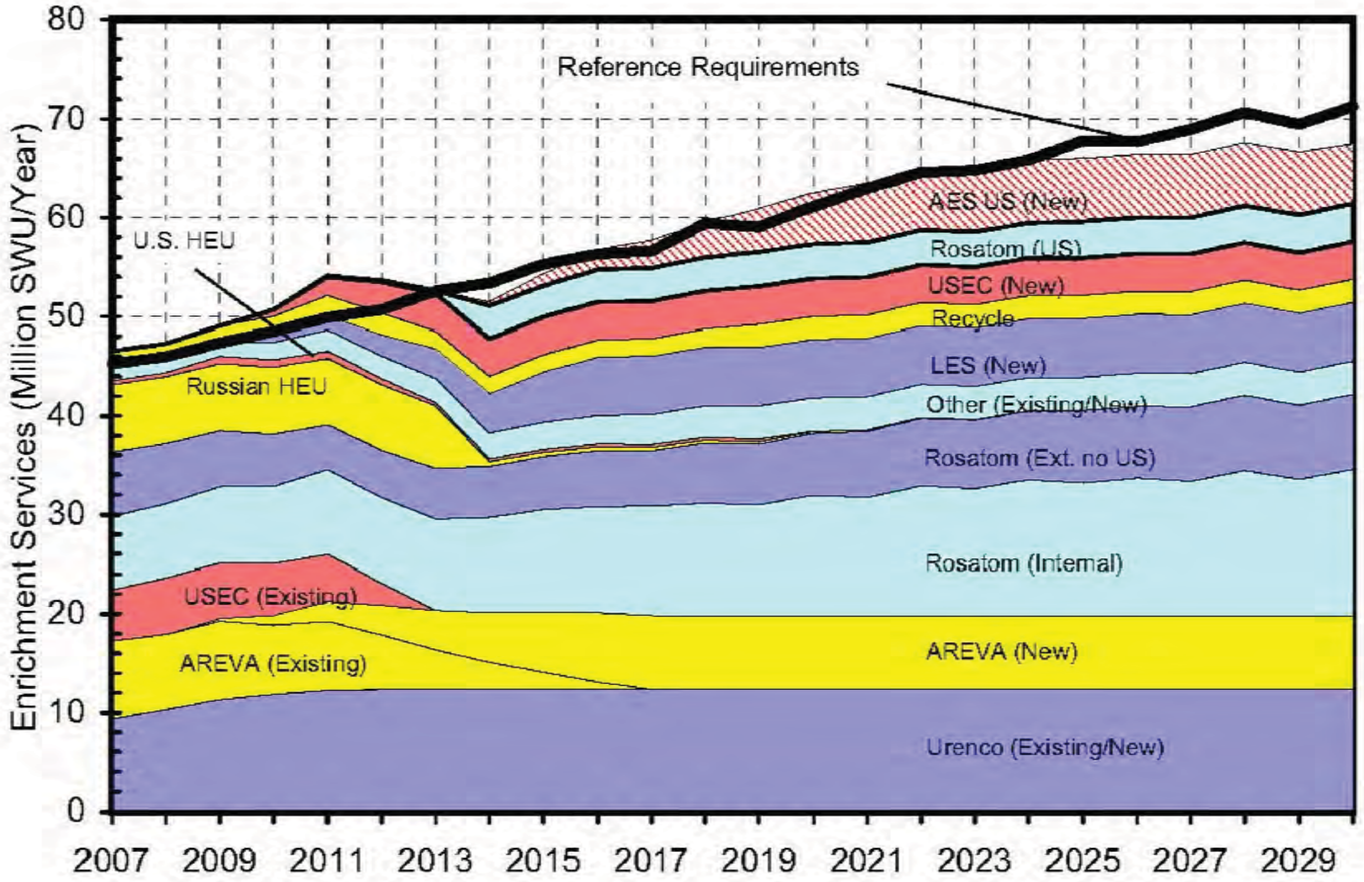

Figure 1.1-7 **Rev. 2**

Scenario A - Base Supply and Reference Nuclear Power Growth Requirements

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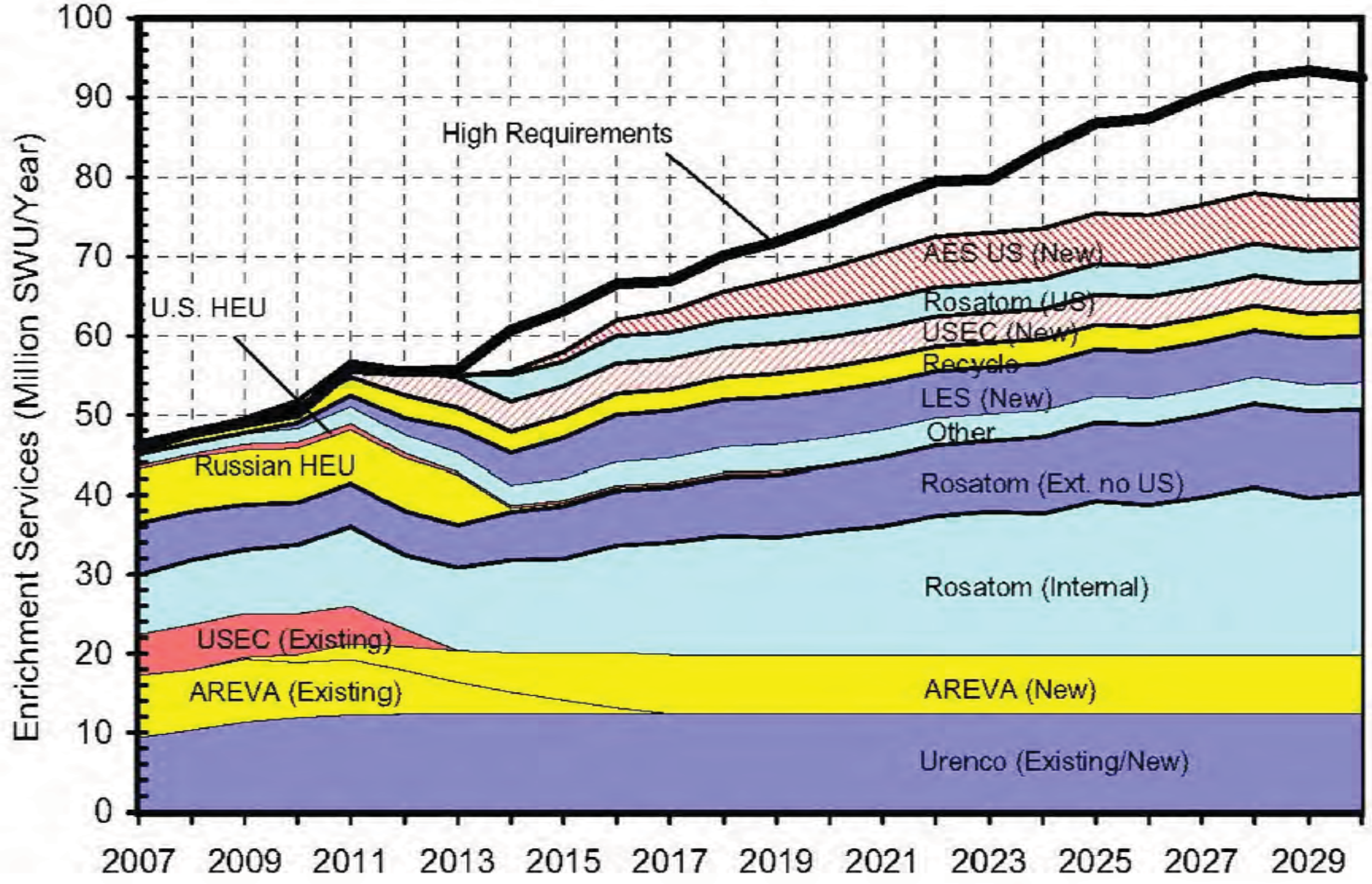

Figure 1.1-8 **Rev. 2**

Scenario A - Base Supply and High Nuclear Power Growth Requirements

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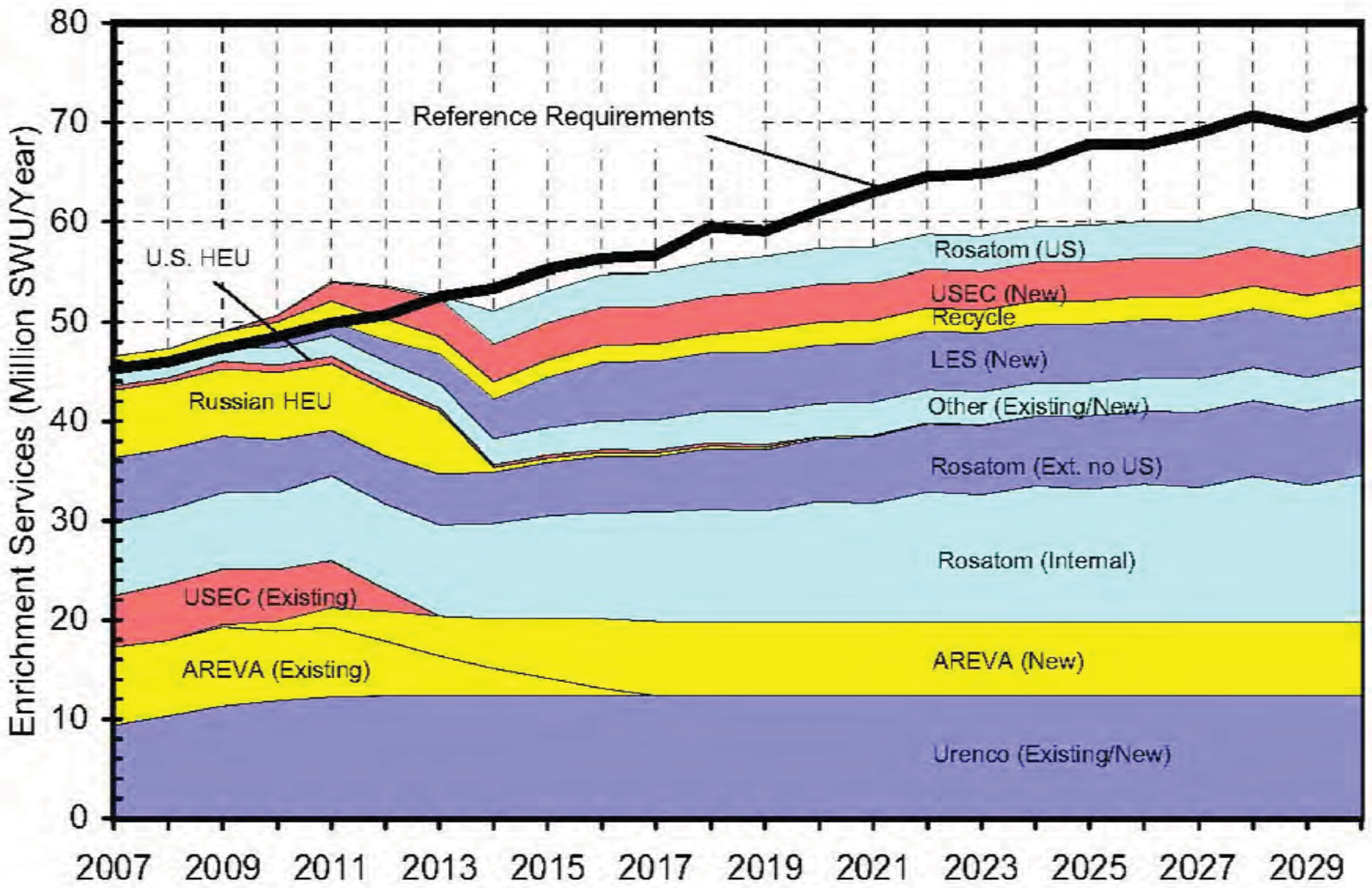

Figure 1.1-9 **Rev. 2**
Scenario B - Base Supply and Reference Nuclear Power Growth Requirements Without AES's U.S. Plant
EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

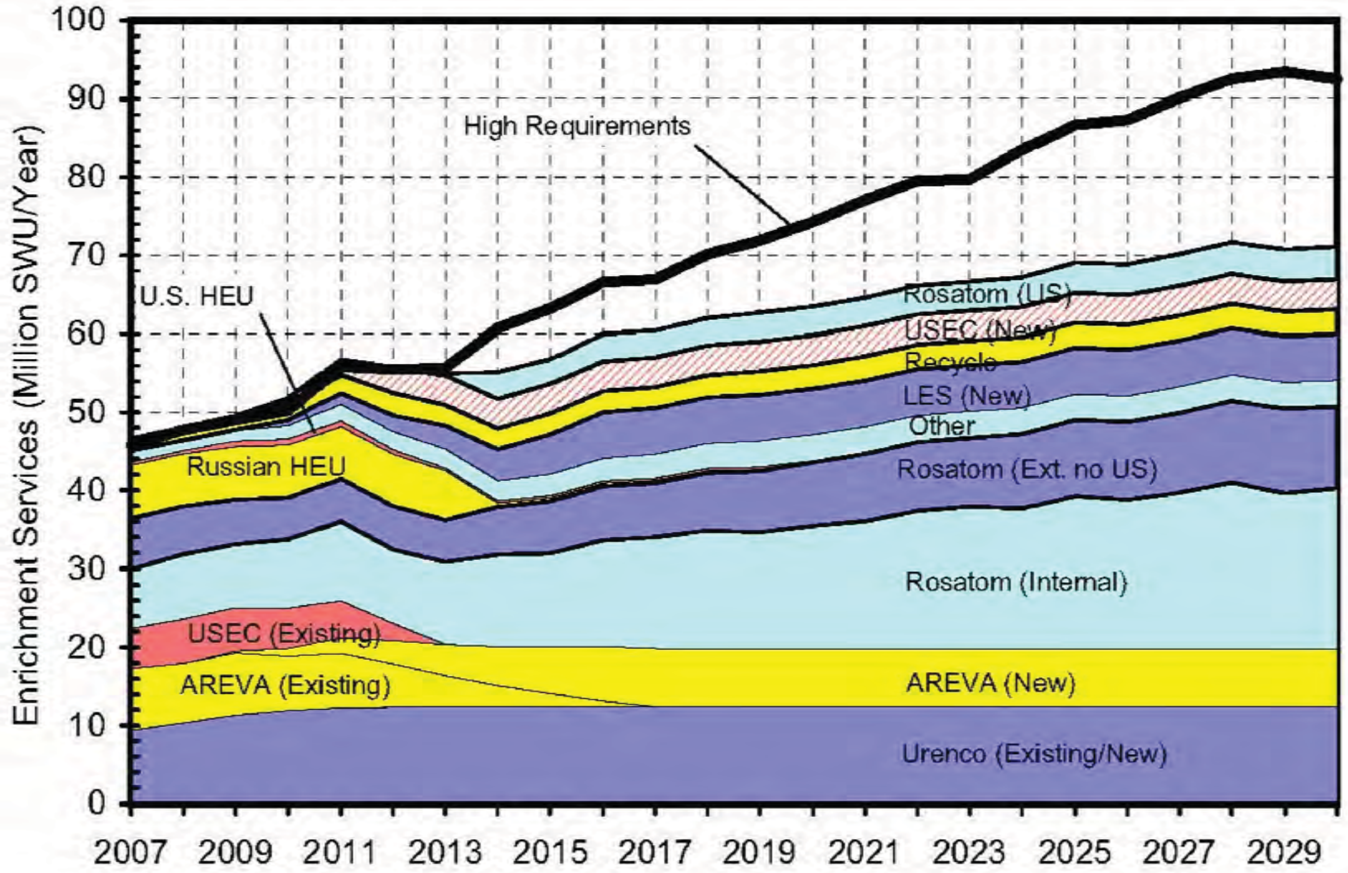

Figure 1.1-10 **Rev. 2**

Scenario B - Base Supply and High Nuclear Power Growth Requirements Without AES's U.S. Plant

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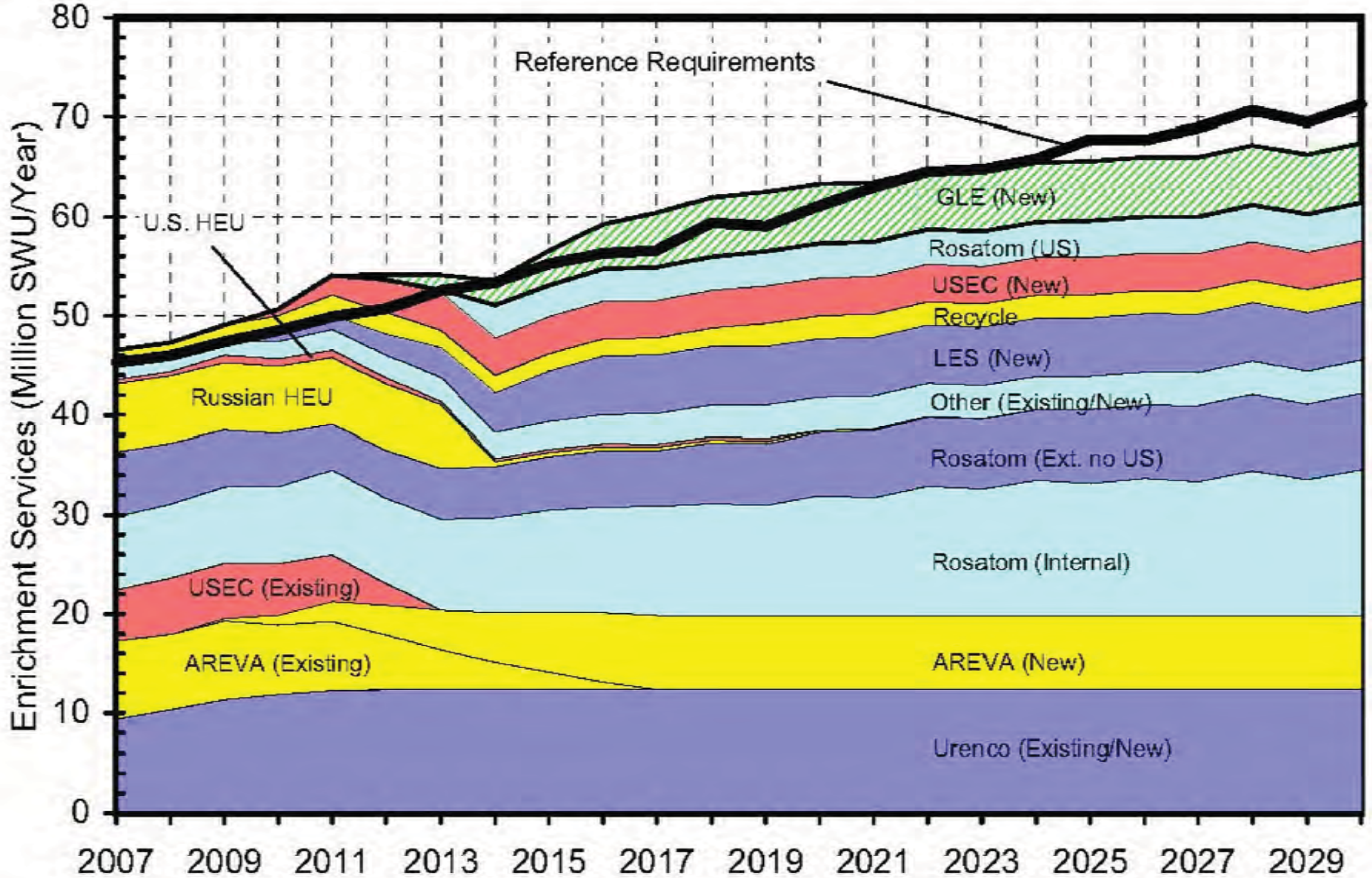

Figure 1.1-11 **Rev. 2**

Scenario C - Base Supply and Reference Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus GEH Deployment of GLE

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

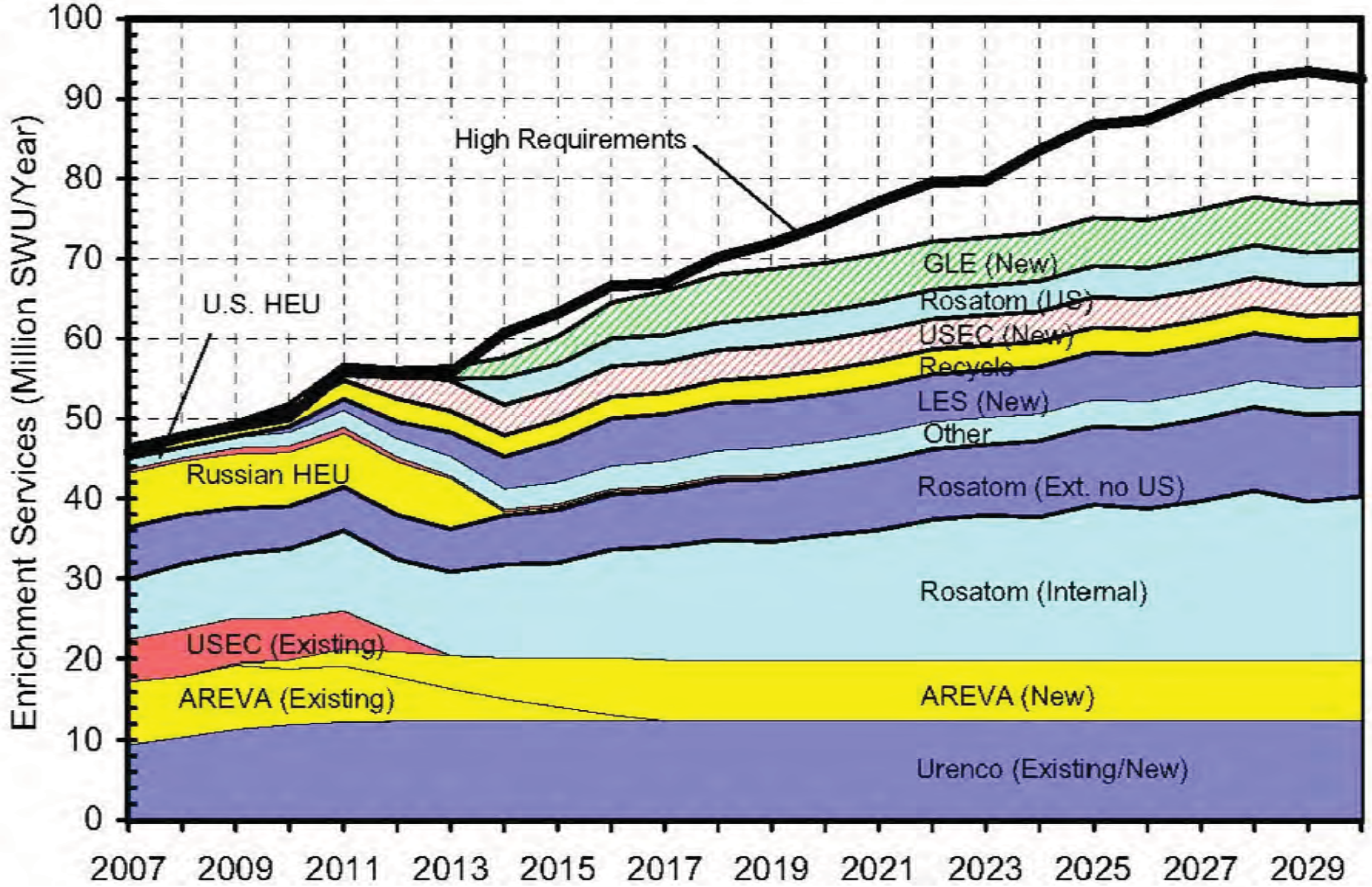

Figure 1.1-12 **Rev. 2**

Scenario C - Base Supply and High Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus GEH Deployment of GLE

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ENVIRONMENTAL REPORT

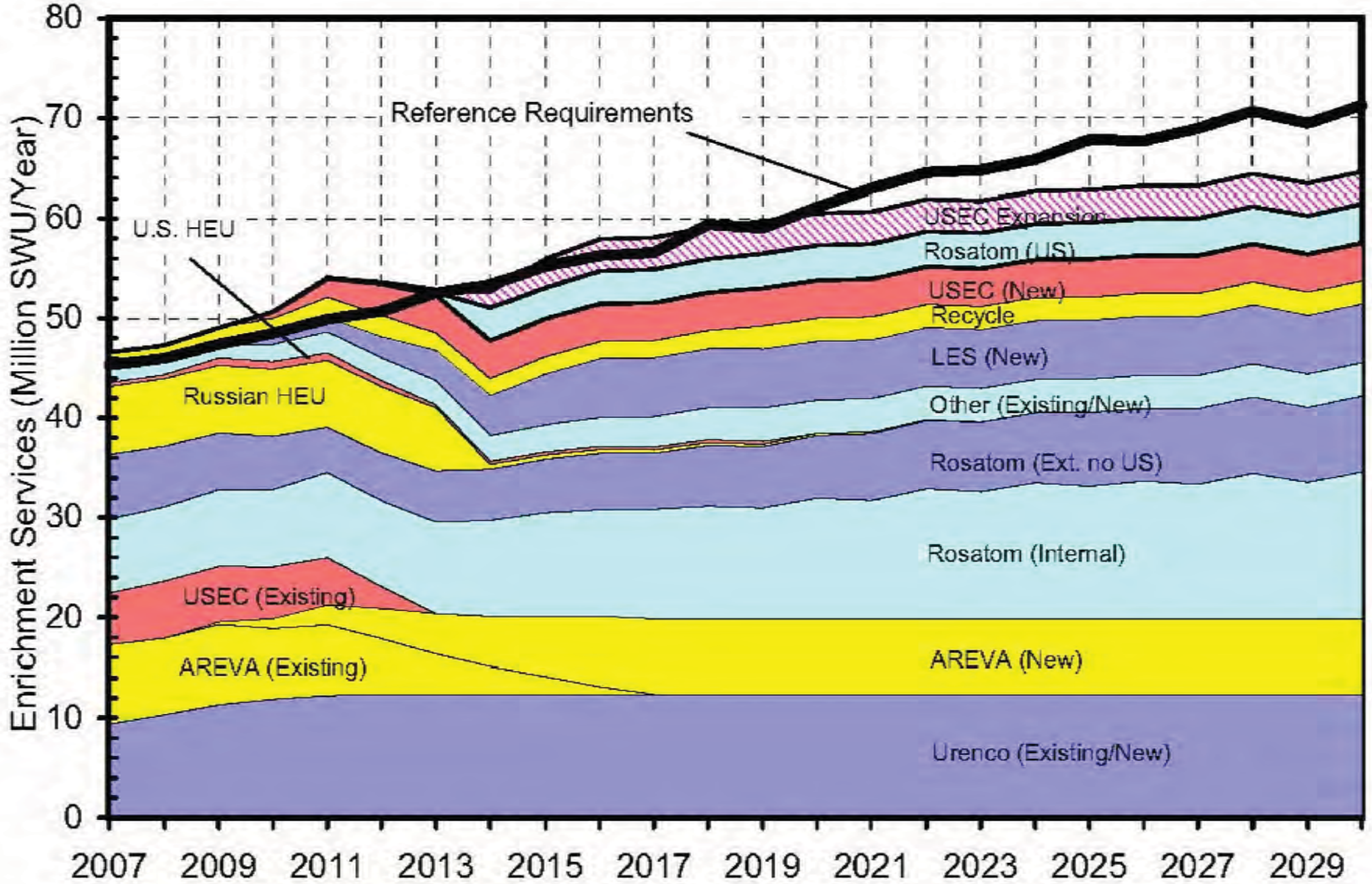

Figure 1.1-13 **Rev. 2**

Scenario D - Base Supply and Reference Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus USEC Expansion of ACP

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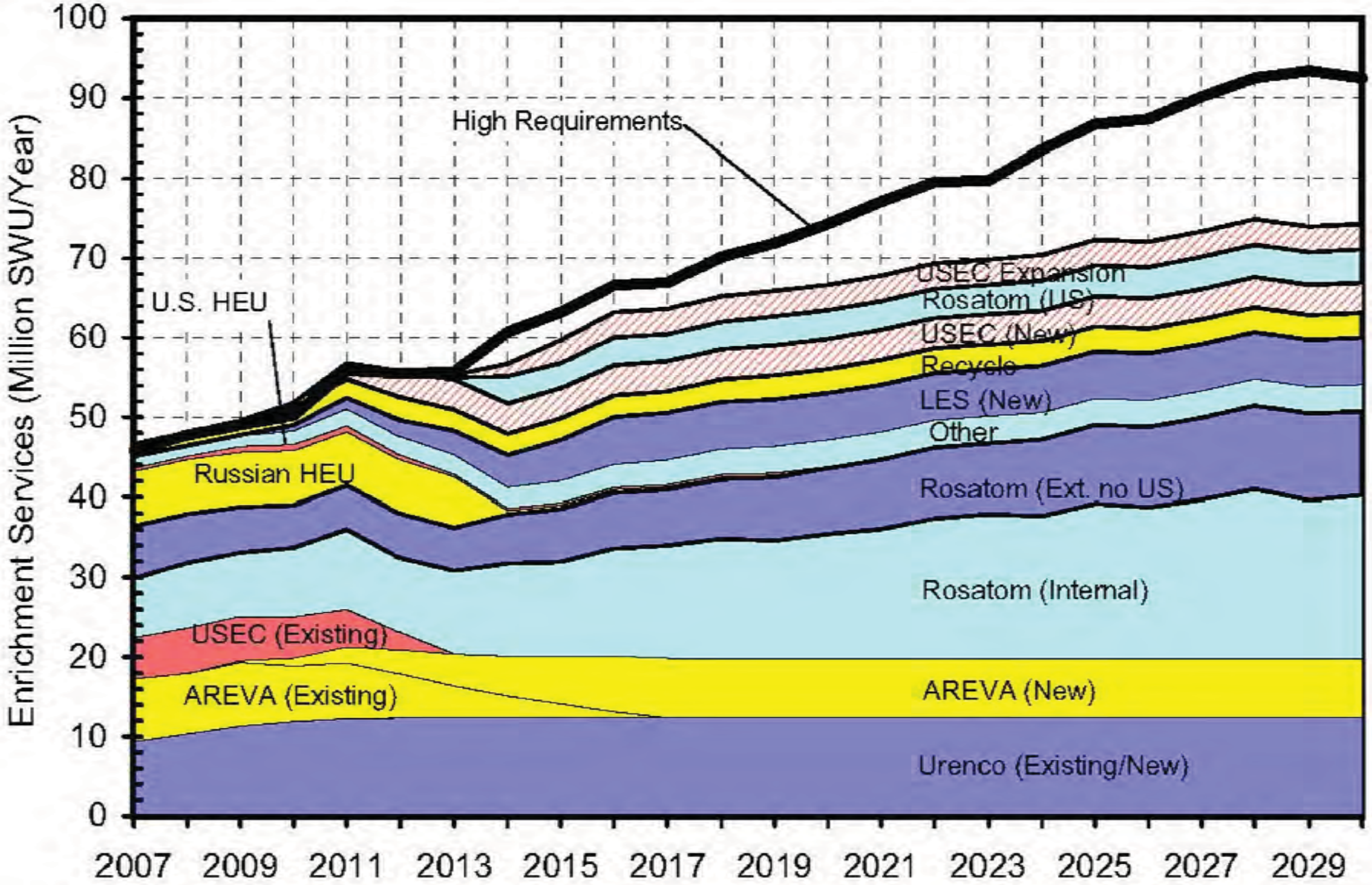


Figure 1.1-14 **Rev. 2**
Scenario D - Base Supply and High Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus USEC Expansion of ACP

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

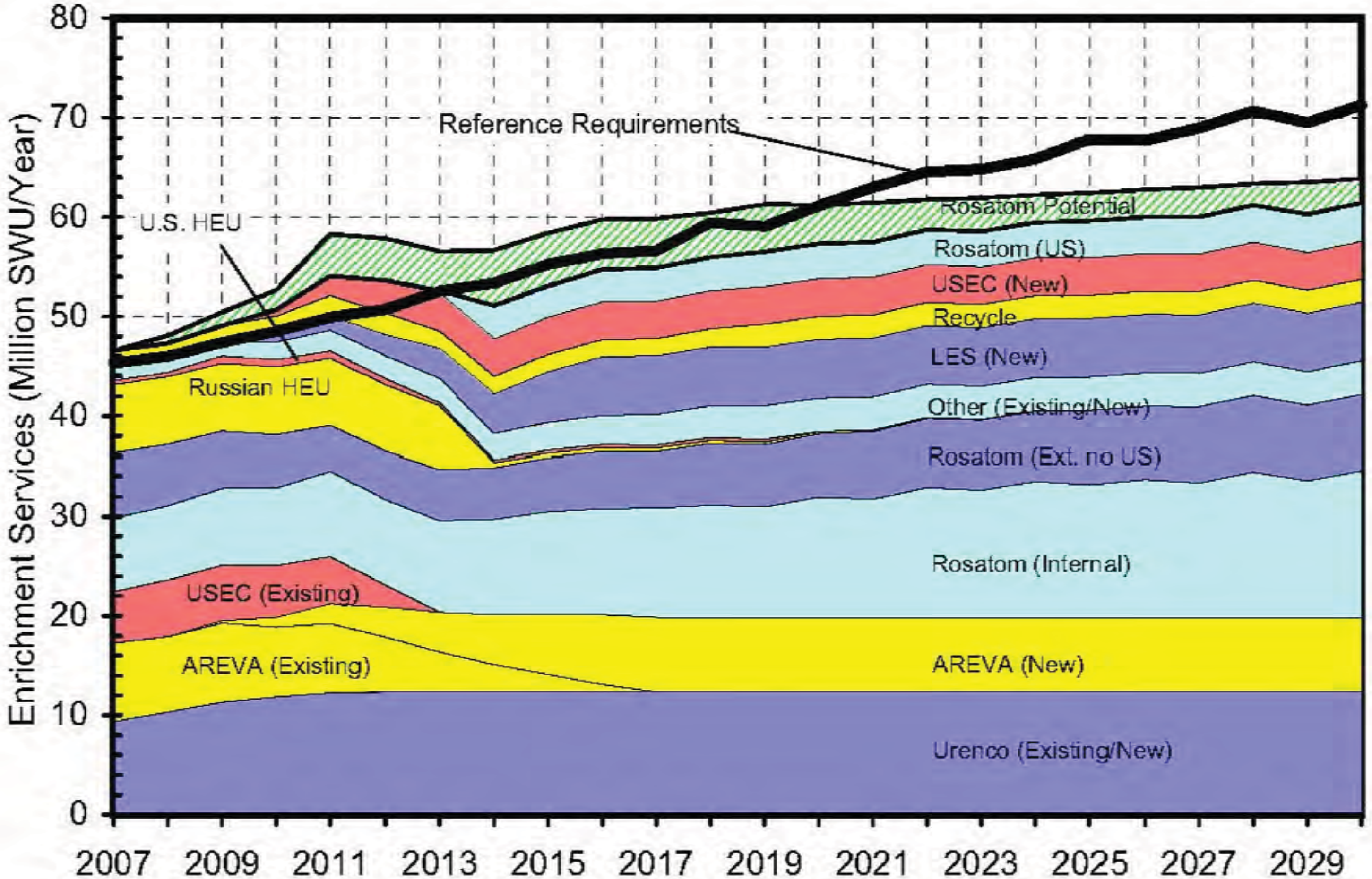


Figure 1.1-15 **Rev. 2**

Scenario E - Base Supply and Reference Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus Potential Rosatom Expansion Capability

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

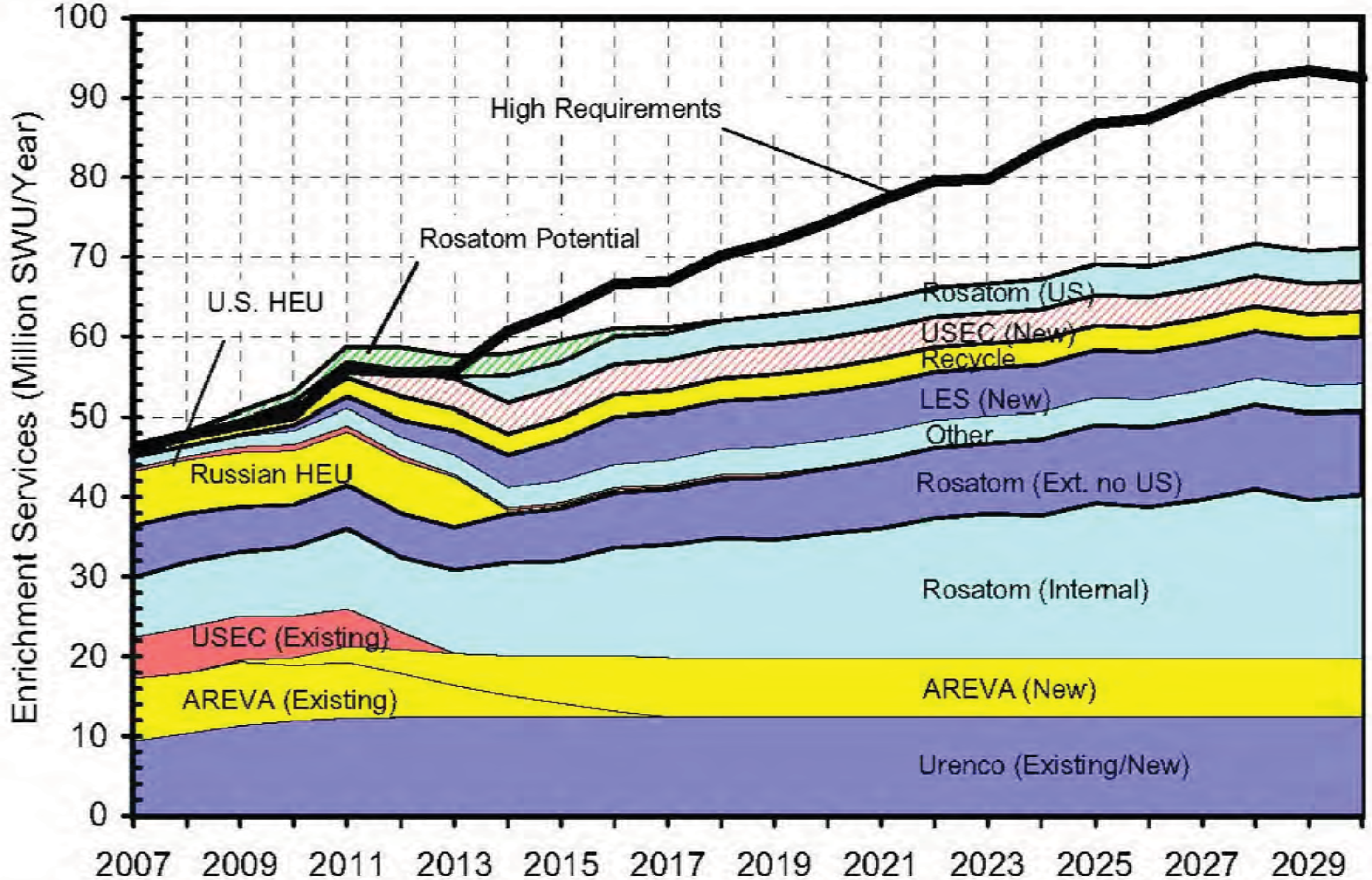


Figure 1.1-16 **Rev. 2**

Scenario E - Base Supply and High Nuclear Power Growth Requirements Without AES's U.S. Plant; Plus Potential Rosatom Expansion Capability

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

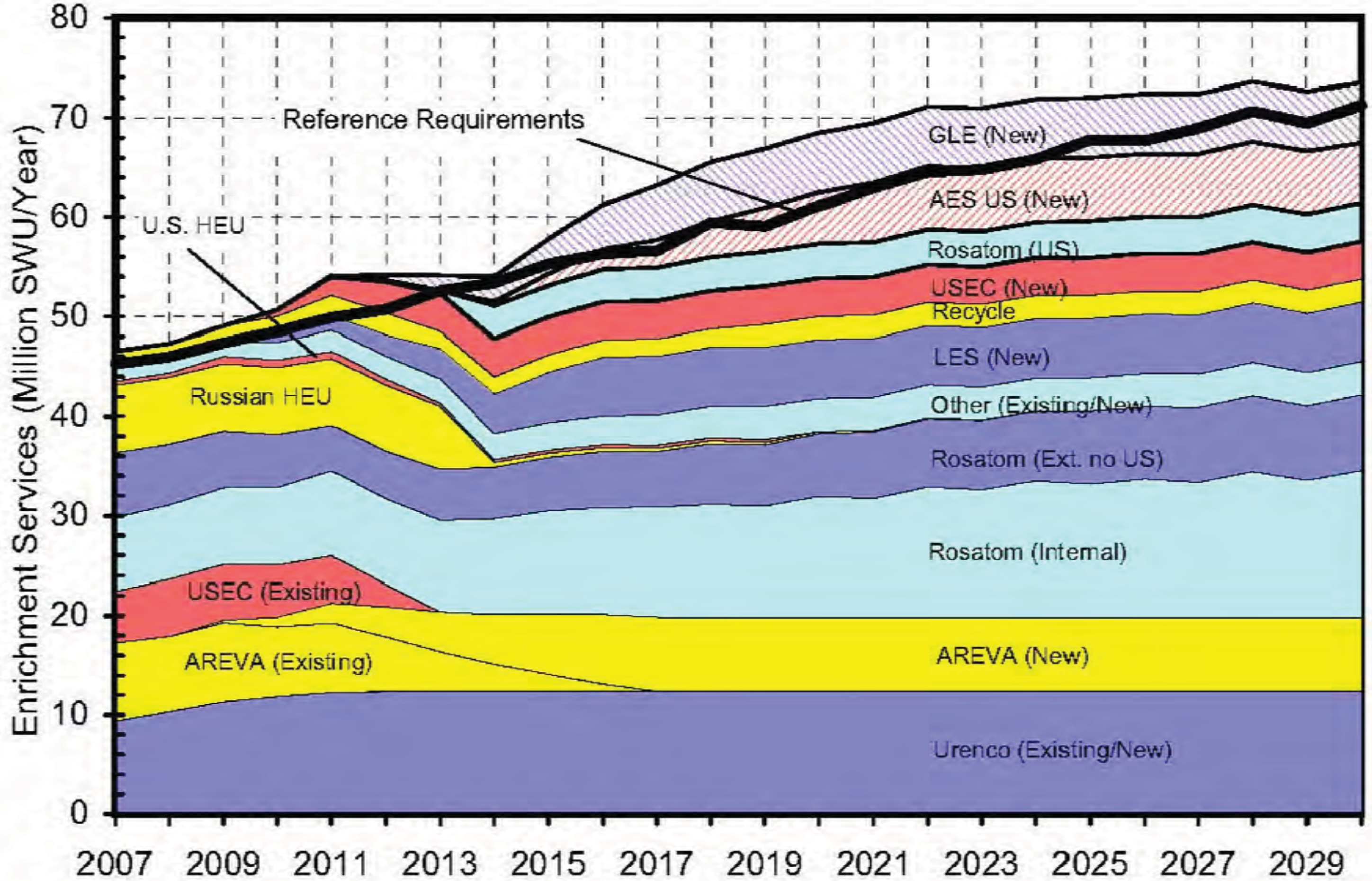


Figure 1.1-17 **Rev. 2**

Scenario H - Base Supply and Reference Nuclear Power Growth Requirements; Plus GEH Deployment of GLE

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

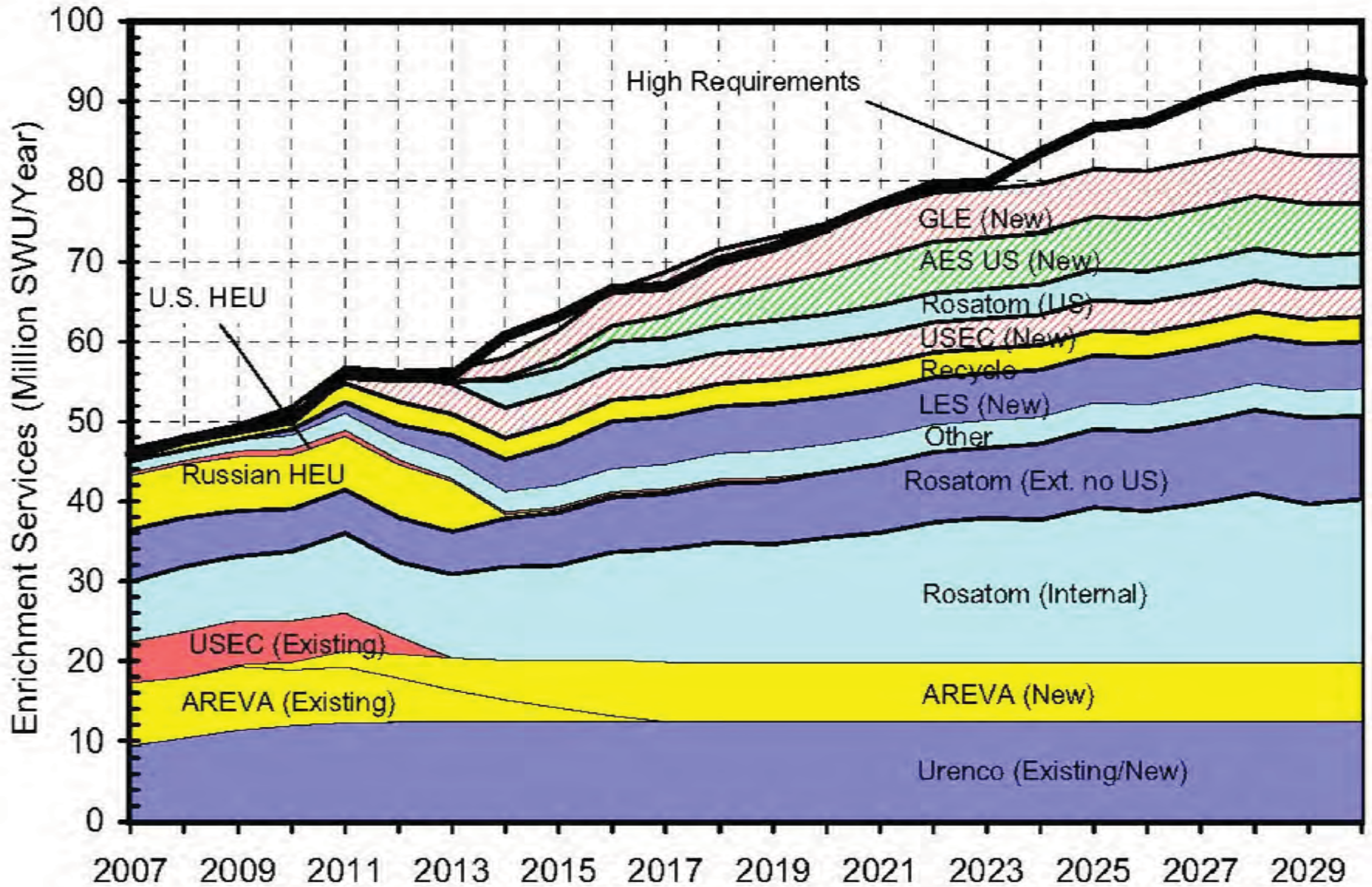


Figure 1.1-18 **Rev. 2**

Scenario H - Base Supply and High Nuclear Power Growth Requirements; Plus GEH Deployment of GLE

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

1.2 PROPOSED ACTION

The proposed action is the issuance of an NRC license under 10 CFR 70 (CFR, 2008b) for the construction and operation of a uranium enrichment facility at a site located In Bonneville County, Idaho. The Eagle Rock Enrichment Facility (EREF) will use the gas centrifuge process to separate natural uranium hexafluoride feed material containing approximately 0.71 Uranium-235 (^{235}U) into a product stream enriched up to 5.0 $^{w}/_{o}$ ^{235}U and a depleted UF_6 stream containing approximately 0.15 to 0.30 $^{w}/_{o}$ ^{235}U. Production capacity at design throughput is approximately a nominal 6.0 million Separative Work Units (SWU) per year. Facility construction is expected to require eleven (11) years, including four years of assemblage and testing. Construction will be conducted in eight phases associated with each of the eight Cascade Halls. Operation will commence after the completion of the first cascade in the first Cascade Hall. The facility is licensed for 30 years of operation. Decommissioning and Decontamination (D&D) is projected to take nine (9) years. AREVA Enrichment Services, LLC (AES) estimates the cost of the plant to be approximately $4.1 billion (in 2007 dollars) excluding escalation, contingency, interest, tails disposition, decommissioning, and any replacement equipment required during the operational life of the facility.

1.2.1 The Proposed Site

The proposed site is situated in Bonneville County, Idaho, on the north side of U.S. Highway 20, about 113 km (70 mi) west of the Idaho/Wyoming state line. Portions of Bonneville, Jefferson, and Bingham counties are within 8 km (5 mi) of the proposed site. The approximately 1,700 ha (4,200 ac) property is currently under private ownership by a single landowner. There is a 16-ha (40-ac) parcel within the proposed site, which is administered by the U. S. Bureau of Land Management (BLM). There are two, 16-ha (40-ac) parcels located within the proposed site for which the Federal government did reserve for itself certain mineral rights which were not subject to claim or patent by anyone under the General Mining Act of 1872 (USC, 2008f). These reservations were released, remised and quitclaimed to the person to whom the land was patented pursuant to Section 64.b of the Atomic Energy Act of 1954, as amended, and are no longer valid. The privately held land will be purchased by AES. The approximate center of the EREF is located at latitude 43 degrees, 35 minutes, 7.37 seconds North and longitude 112 degrees, 25 minutes, 28.71 seconds West. Refer to Figure 1.2-1, Location of Proposed Site, and Figure 1.2-2, EREF Location Relative to Population Centers Within 80 Kilometers (50 Miles).

There are no right-of-ways on the property with the exception of the right-of-way for U.S. Highway 20, which forms part of the southern boundary of the proposed site. A dirt road provides site access from U.S. Highway 20, while other dirt roads provide access throughout the proposed site. The proposed site is comprised mostly of relatively flat and gently sloping surfaces with small ridges and areas of rock outcrop. Most of the site is semi-arid steppe covered by eolian soils of variable thickness that incompletely cover broad areas of volcanic lava flows. Elevations at the site range from about 1,556 m (5,106 ft) to about 1,600 m (5,250 ft). Many of the areas with thickest soils and gentle slopes with a minimum of rock outcrop are currently used for crops.

The proposed site is in native rangeland, non-irrigated seeded pasture, and irrigated cropland. The proposed site is seasonally grazed. Wheat, barley, and potatoes are grown on 389 ha (962 ac) of irrigated land on the proposed site. One potato storage facility is located at the south end of the site.

Grazing and cropping are the main land uses within 8 km (5 mi) of the proposed site. State land immediately west of the proposed site and BLM land immediately east of the site are grazed. The nearest off-site croplands are within 0.8 km (0.5 mi) of the southeast corner of the proposed site. The nearest feedlot and dairy operations are approximately 16 km (10 mi) east of the proposed site. The Department of Energy's Idaho National Laboratory (INL) eastern boundary is 1.6 km (1 mi) west of the proposed site. The INL property near the site is undeveloped rangeland. The closest facility on the INL property is the Materials and Fuels Complex (MFC), located approximately 16 km (10 mi) west of the proposed site boundary. The lands north, east, and south of the site are a mixture of private-, State-, and Federal-owned parcels.

The city of Idaho Falls, the nearest large population center, is located approximately 32 km (20 mi) east southeast of the site. Idaho Falls has the closest commercial airport. The towns of Rigby and Rexburg are located approximately 23 km (14 mi) and 42 km (26 mi) north of Idaho Falls, respectively. Atomic City is approximately 32 km (20 mi) west of the site. The towns of Blackfoot , Fort Hall, and Pocatello are located approximately 40 km (25 mi), 60 km (37 mi), and 76 km (47 mi) south of the proposed site, respectively. The Fort Hall Indian Reservation comprises approximately 220,150 ha (544,000 ac) and also lies to the south. The nearest boundary of the Fort Hall Indian Reservation is about 44 km (27 mi) from the proposed site.

The nearest residence is approximately 7.7 km (4.8 mi) east of the proposed site. Temporarily occupied structures in the 8 km (5 mi) radius include a transformer station adjacent to the proposed site to the east, and potato storage facilities, one approximately 3.2 km (2 mi) west of the proposed site, and one approximately 7.7 km (4.8 mi) to the east. Public use areas include a hiking trail south of the proposed site in Hell's Half Acre Wilderness Study Area (WSA) and a small lava tube cave located approximately 8 km (5 mi) east and south. The Wasden Complex, consisting of caves formed by collapsed lava tubes, is located approximately 3.2 km (2 mi) northeast from the footprint of the EREF.

Refer to Figure 1.2-3, EREF Location Relative to Transportation Routes, for the site location relative to other important landmarks, transportation routes, including active railroad lines.

1.2.2 Description of EREF Operations and Systems

The EREF is designed to separate a feed stream containing the naturally occurring proportions of uranium isotopes into a product stream enriched in ^{235}U and a stream depleted in the ^{235}U isotope. The feed material for the enrichment process is uranium hexafluoride (UF_6) with a natural composition of isotopes ^{234}U, ^{235}U, and ^{238}U. The enrichment process involves the mechanical separation of isotopes using a fast-rotating cylinder (centrifuge) which is based on a difference in centrifugal forces due to differences in molecular weight of the uranic isotopes. No chemical or nuclear reactions take place. The feed, product, and depleted UF_6 streams are all in the form of UF_6.

The UF_6 is delivered to the plant in standard Type 48Y international transit cylinders, which are connected to the plant in feed stations joined to a common manifold. Heat is then applied electrically to sublime UF_6 from solid to vapor. The gas is flow controlled through a pressure control system for distribution to individual cascades at sub-atmospheric pressure.

Individual centrifuges are not able to produce the desired product and depleted ^{235}U concentration in a single step. They are therefore grouped together in series and parallel to form arrays known as cascades. A typical cascade hall comprises many thousands of centrifuges. A cascade hall is made up of twelve cascades. UF_6 is drawn through cascades with vacuum pumps and moved to the transport cylinders located in product and tails take-off stations where it can desublime. Highly reliable UF_6 resistant pumps have been developed for transferring the process gas.

Depleted uranium material is desublimed at the Tails Low-Temperature Take-Off Station into chilled Type 48Y cylinders. The product is desublimed into Type 30B cylinders for shipping or Type 48Y cylinders for internal use.

The entire plant process gas system operates at sub-atmospheric pressure. This provides a high degree of safety but also means that the system is susceptible to in-leakage of air. Any in-leakage of air passes through the cascades and is preferentially directed into the product stream. A vent system is provided to remove hazardous contaminants from low levels of light gas (any gas lighter than UF_6) that arise on a regular basis from background in-leakage, routine venting of UF_6 cylinders, and purging of UF_6 lines.

Each Plant Module - consisting of two Cascade Halls - is provided with a cooling water system to remove excess heat at key positions on the centrifuges in order to maintain optimum temperatures within the centrifuges.

The centrifuges are driven by a medium frequency Alternating Current (AC) supply system. A converter produces the medium frequency supply from the AC main supply using high efficiency switching devices for both run-up and continuous operation.

1.2.3 Comparison of the EREF Design to the LES Claiborne Enrichment Center Design and the LES National Enrichment Facility Design

While the design of the EREF is fundamentally the same as the Claiborne Enrichment Center design reviewed and approved by the NRC staff in the 1990s (NRC, 1994), a number of improvements or enhancements have been made in the current design from an environmental and safety perspective. In addition to these changes is the increase from seven cascades per Assay Unit to twelve cascades per Assay Unit. Maximum Assay Unit capacity has been increased from 280,000 SWU/yr to 825,000 SWU/yr.

There are two important differences in the UF_6 Feed System for the EREF as compared to the Claiborne Enrichment Center. First, the liquid UF_6 phase above atmospheric pressure has been eliminated. Sublimation from the solid phase directly to the gaseous phase below atmospheric pressure is the process to be used in the EREF. A sealed autoclave is replaced with a Solid Feed Station enclosure for heating the feed cylinder. A second major difference is the use of chilled air, rather than chilled water, to cool the feed purification cylinder. The EREF UF_6 Feed System is the same as used at the NEF.

In addition to operating the process at sub-atmospheric pressure, the other primary difference between the Louisiana Energy Services, Claiborne Enrichment Center, and the EREF cascade systems is that all assay units are now identical, whereas in the Claiborne Enrichment Center, one assay unit was designed to produce low assays - in the region of 2.5%. An additional change is the increase from seven cascades per Cascade Hall to twelve cascades per Cascade Hall. Maximum Cascade Hall capacity has been increased to 825,000 SWU/yr. Louisiana Energy Services' National Enrichment Facility (NEF) has eight cascades per Cascade Hall with a Cascade Hall capacity of 545,000 SWU/yr.

The EREF "Product Take-Off System" uses a process similar to the Claiborne Enrichment Center, but there are certain differences. In the current system proposed for the EREF, there is only one product pumping stage, whereas the proposed Claiborne Enrichment Center system used two pumping stages to transport the product for desublimation. In the EREF system, pressures are controlled such that desublimation cannot occur in the piping, eliminating the need for heat tracing and valve hot boxes. In the Claiborne Enrichment Center, the product cylinder stations relied on common chillers to cool the stations, the current system; however, the EREF uses a dedicated chiller for each station. The cold traps used to desublime any UF_6 in the vent gases are smaller than those of the Claiborne Enrichment Center design and each is situated on load cells to allow continuous monitoring of accumulation (LES, 1991). The EREF UF_6 product Take-Off System is essentially the same as the one used at the NEF.

The EREF “Product Liquid Sampling System” uses a process very similar to the Claiborne Enrichment Center, but will have the following differences and enhancements from the Claiborne Enrichment Center design:

- The Process Vent System is a permanent vent system rather than a mobile unit as used at the Claiborne Enrichment Center (LES, 1991).
- The Liquid Product Sampling Autoclaves (autoclaves) will consist of eleven autoclaves to process 30B cylinders and two combined autoclaves that may be used to sample either 30B or 48Y cylinders. The Claiborne Enrichment Center design uses only the five autoclaves to process 30B cylinders.
- Each autoclave uses an internal heat exchanger to cool the autoclave rather than external cooling coils which cool the autoclave walls for the Claiborne Enrichment Center design.
- The internal autoclave circulation fan’s motor is located outside the autoclave rather than being internal for the Claiborne Enrichment Center design.
- The sampling manifold inside the autoclave is normally not removed after each liquid sample but goes through a cleaning process using liquid UF_6 which is removed through the Process Vent System as part of the autoclave liquid process. For the Claiborne Enrichment Center design, the sampling manifold is replaced each time a liquid sample is taken and cleaned in the Decontamination System.

A more detailed discussion of the EREF Product Liquid Sampling System that can be compared to the NEF Product Liquid Sampling System is provided in the Integrated Safety Analysis Summary, Section 3.4, “Process Descriptions.”

The EREF "Product Blending System," like the NEF, uses a process similar to the proposed Claiborne Enrichment Center. One major difference, however, is the use of Solid Feed Stations to heat the donor cylinders in the EREF. The Claiborne Enrichment Center design required the use of autoclaves to heat the donor cylinders in the Claiborne Enrichment Center. EREF utilizes two Product Blending Subsystems. One subsystem has two donor stations and two receiver stations. The second subsystem has one donor station and one receiver station. Another difference between the two designs includes the use of a dedicated vacuum pump/trap set in the EREF design versus a mobile set in the Claiborne Enrichment Center (LES, 1991). The NEF design was based on four receiver stations (LES, 2005)..

The EREF "Tails Take-Off System," like the NEF, uses a process similar to that proposed for the Claiborne Enrichment Center, but there are certain differences. In the EREF system there is only one tails pumping stage, whereas the Claiborne Enrichment Center would have used two pumping stages to transport the tails for desublimation. UF_6 tails are desublimed in cylinders cooled with chilled air in the current system, whereas the Claiborne Enrichment Center would have used chilled water to cool the cylinders. The Claiborne Enrichment Center design called for a total of ten tails cylinders in five double cooling stations for each Separation Plant Module (two Cascade Halls), but the EREF system uses eleven cylinders in single cooling stations for each Cascade Hall. Finally, the EREF system has a dedicated vacuum pump/trap set for venting and does not use the Feed Purification System like the Claiborne Enrichment Center

(LES, 1991). The NEF design uses ten cylinders in single cooling stations (LES, 2005). Other than this difference, the EREF and NEF designs are the same.

The EREF “Cylinder Preparation System” uses a process similar to the Claiborne Enrichment Center design in conditioning empty, clean or used (i.e., with heel) 30B or 48Y cylinders except the EREF has six conditioning stations rather than the four the Claiborne Enrichment Center design has. The EREF also has a Cylinder Evacuation System which is used to reduce the heel in used 30B and 48Y cylinders and the Claiborne Enrichment Center and NEF designs does not. This system uses six donor stations, two receiver stations and two large capacity cold traps arranged in two subsystems.

The major structures and areas of the EREF are described below and shown in Figure 1.2-4, EREF Buildings. A more detailed discussion of these structures and areas, which are different than the corresponding structures and areas for the Claiborne Enrichment Center and the NEF, is provided in the Integrated Safety Analysis Summary, Section 3.3, “Facility Description.”

The Security and Secure Administration Building serves as the primary access control point for the facility. It also contains the necessary space and provisions for an alternate Emergency Operations Center (EOC) should the primary facility become unusable.

The Separations Building Modules (SBM) house two, essentially identical, plant process units. Each SBM is comprised of a UF_6 Handling Area, two Cascade Halls, and a Process Services Corridor. The EREF has four SBMs. UF_6 is fed into the Cascade Halls and enriched UF_6 and depleted UF_6 are removed.

The Centrifuge Assembly Building (CAB) is used to assemble centrifuges before the centrifuges are moved to the Separations Building Modules and installed in the cascades.

The Technical Support Building (TSB) contains various laboratories and maintenance facilities necessary to safely operate and maintain the facility. The Operation Support Building (OSB) contains a Medical Room and the Control Room. In an emergency, the Control Room serves as the primary Emergency Operations Center (EOC) for the facility. Most site infrastructure facilities (i.e., laboratories for sample analysis) are located in the TSB and the OSB.

The Electrical Services Building (ESB) houses four standby diesel generators (DGs) that provide power to protect selected equipment in the unlikely event of loss of off-site supplied power. The ESB also contains electrical equipment. The ESB for the CAB houses four transformers and switchgear, and control and lighting panels which provide the CAB and the adjacent long term warehouse with power. The Mechanical Services Buildings (MSBs) house air compressors, the demineralized water system and portions of the centrifuge cooling water system.

The Gasoline and Diesel Fueling Station (GDFS) will be used for vehicle repair and maintenance and for fuel dispensing from an adjacent pump island.

The Cylinder Receipt and Shipping Building (CRSB) is used to receive, inspect, and weigh cylinders of natural UF_6 sent to the facility and ship cylinders of enriched UF_6 to customers.

The Cylinder Storage Pads are a series of concrete pads designed to temporarily store empty and full feed, product, and tails cylinders. The Full Tails Cylinder Storage Pads would need to accommodate a total of 25,718 cylinders generated over the lifetime of the facility. Two single-lined Cylinder Storage Pads Stormwater Retention Basins will be used specifically to retain runoff from the Cylinder Storage Pads during heavy rainfalls. These basins will also receive treated effluent from the packaged domestic sanitary sewage treatment plant. The unlined Site Stormwater Detention Basin will receive rainfall runoff from the balance of the developed plant site. No other liquid effluent will be discharged from the facility.

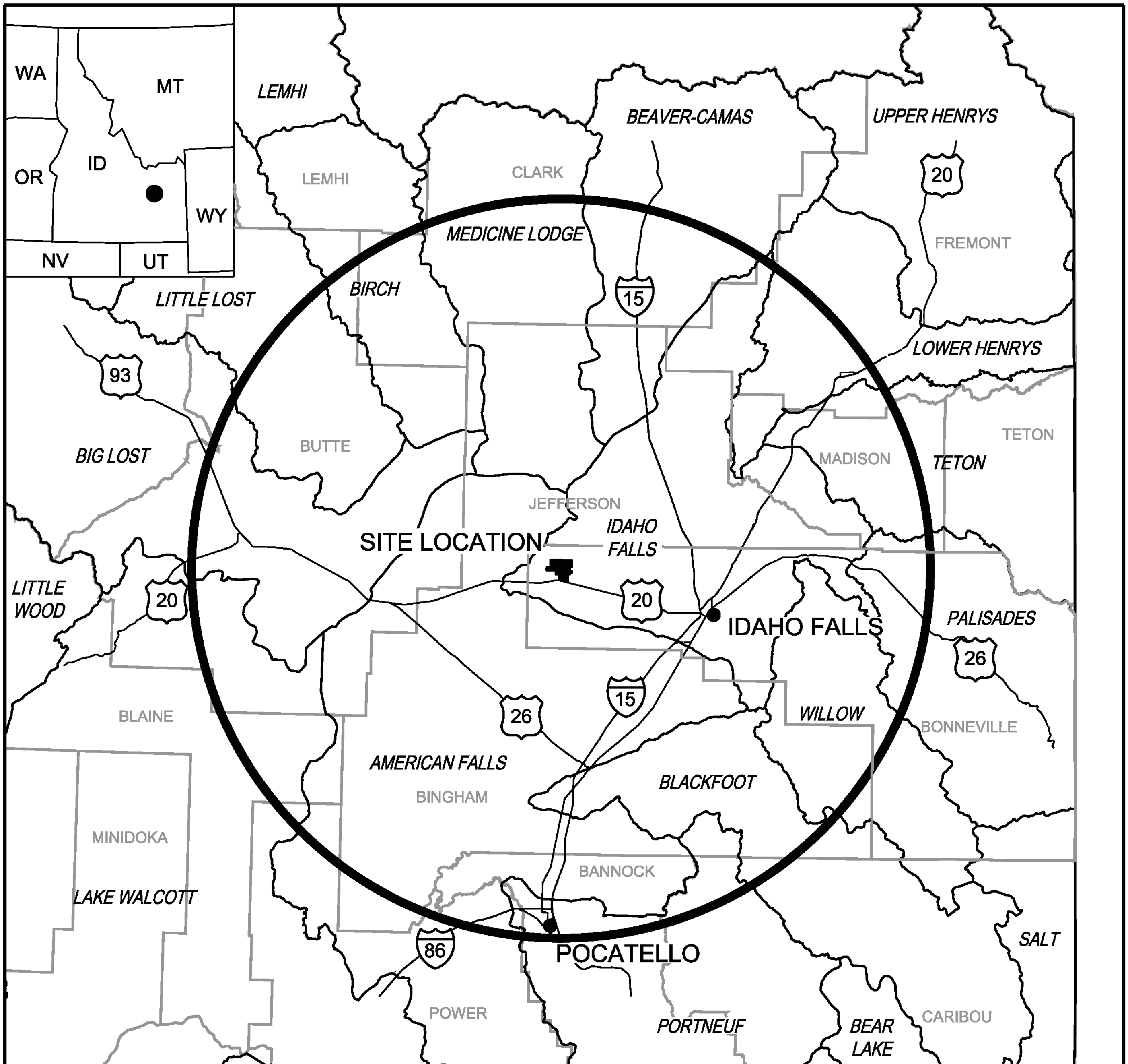
1.2.4 Schedule of Major Steps Associated with the Proposed Action

The EREF will be constructed in eight phases corresponding to the successive completion of eight centrifuge Cascade Halls. All construction will be completed in 2022. Each phase will result in an additional 825,000 SWU, with the first unit beginning operation prior to the completion of the remaining phases. Like the Claiborne Enrichment Center (LES, 1991) and the NEF (LES, 2005), the EREF is designed for at least 30 years of operation. A review of the centrifuge replacement options will be conducted late in the second decade of 2000. Decommissioning is expected to take approximately nine (9) years.

The anticipated schedule for licensing, construction, operation and decommissioning is as follows:

Milestone	Estimated Date
Submit Facility License Application (Rev. 0)	December 2008
Submit Facility License Application (Rev. 1)	April 2009
Initiate Facility Construction	February 2011
Start First Cascade	February 2014
Achieve Full Nominal Production Output	March 2022
Submit Decommissioning Plan to NRC	February 2030
Complete Construction of D&D Facility	February 2032
D&D Completed	February 2041

FIGURES



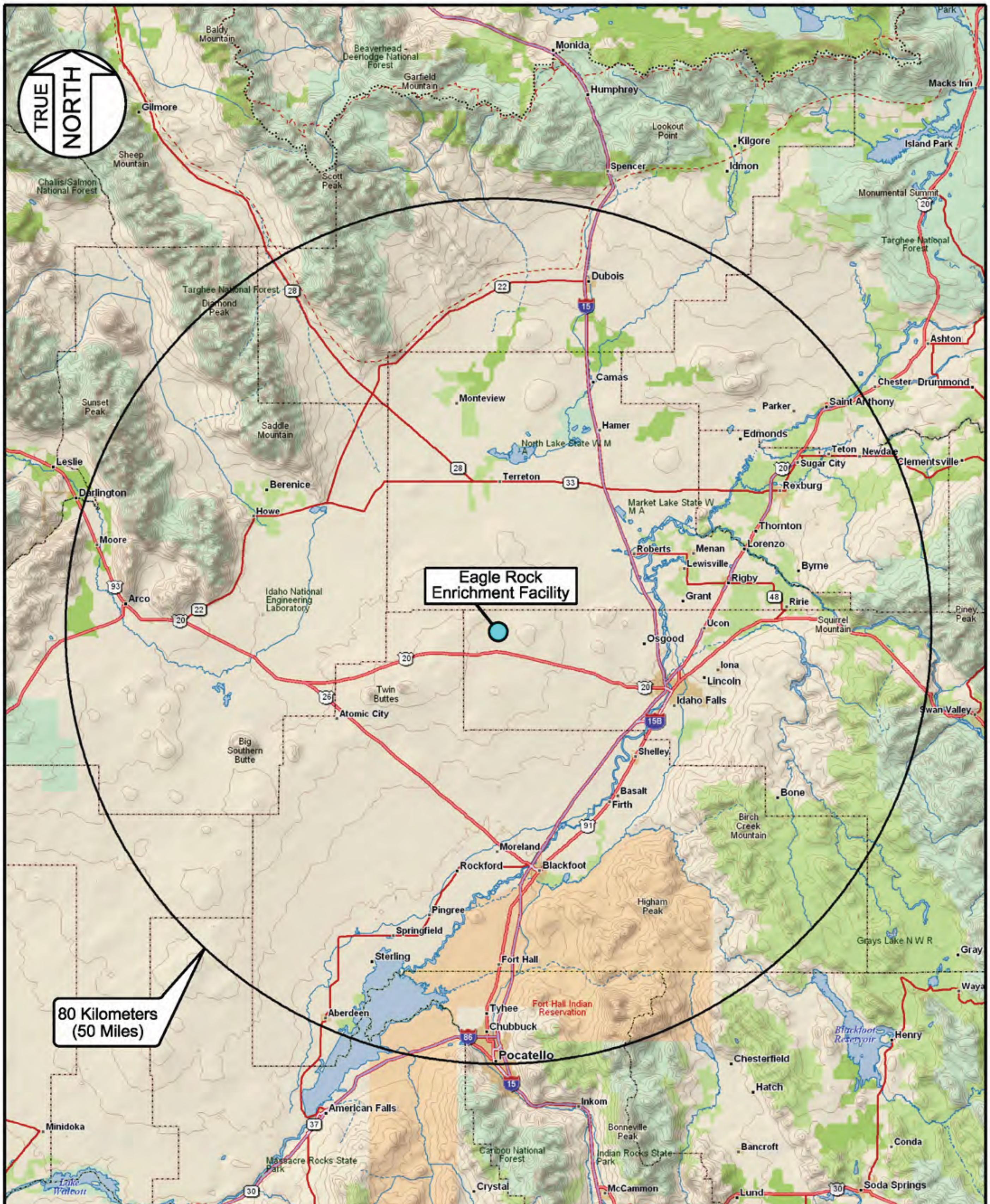
LEGEND:

80 km (50 mi) RADIUS

Figure 1.2-1 **Rev. 2**

Location of Proposed Site

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT



0 5 10 15 20 25

SCALE: MILES

0 5 10 15 20 25 30 35 40

SCALE: KILOMETERS

Figure 1.2-2 **Rev. 2**

EREF Location Relative to Population Centers Within 80-Kilometers (50-Miles)

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

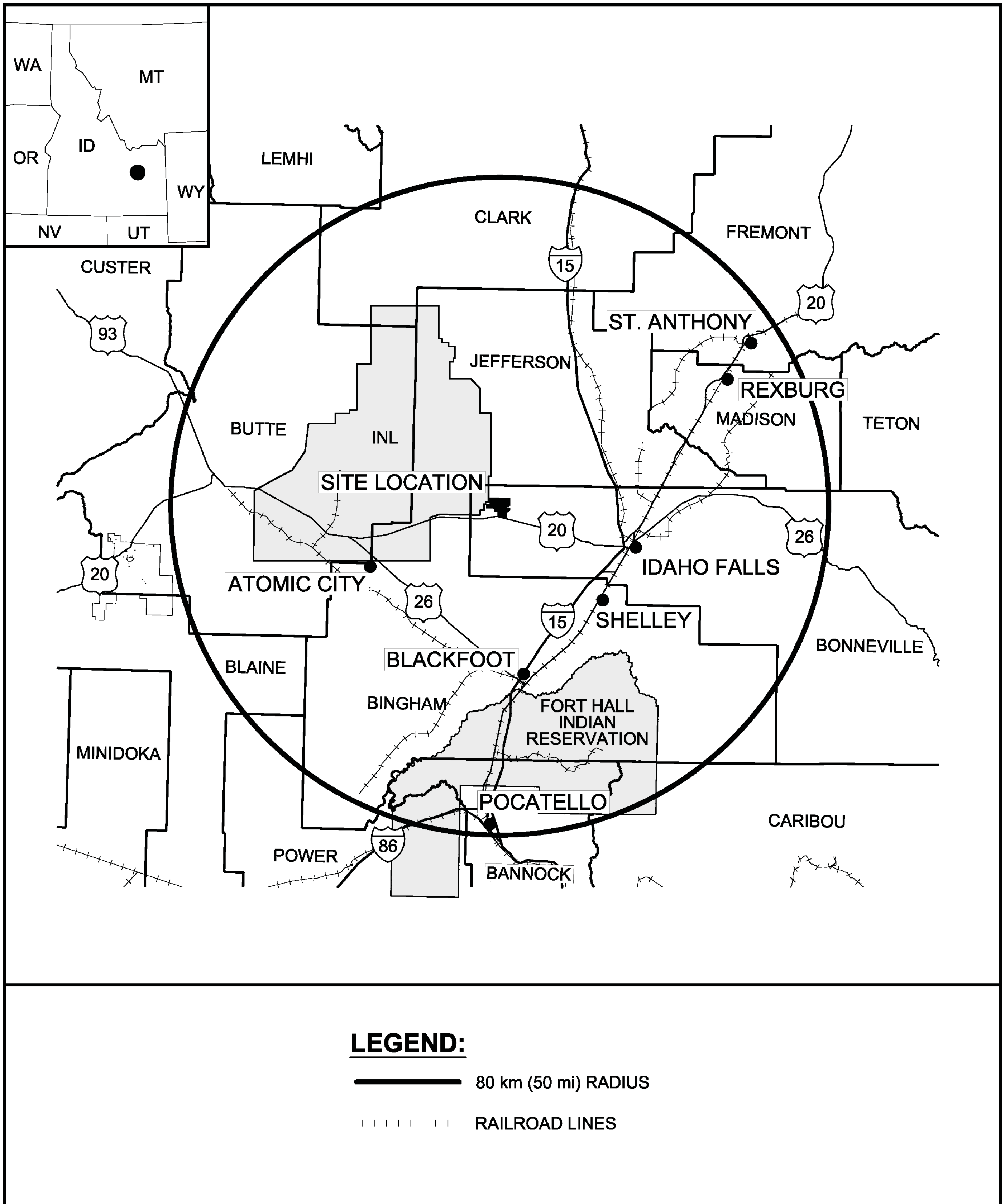


Figure 1.2-3 **Rev. 2**

EREF Location Relative to Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

Figure 1.2-4, EREF Buildings, contains Security-Related Information Withheld from Disclosure under 10 CFR 2.390

1.3 APPLICABLE REGULATORY REQUIREMENTS, PERMITS AND REQUIRED CONSULTATIONS

In addition to the Nuclear Regulatory Commission (NRC) licensing and regulatory requirements, a variety of environmental regulations apply to the Eagle Rock Enrichment Facility (EREF) during the site characterization, construction, and operation phases. Some of these regulations require permits from, consultations with, or approvals by other governing or regulatory agencies. Some apply only during certain phases of the plant development, rather than over the entire life of the facility. Federal, state and local statutes and regulations (non-nuclear) have been reviewed to determine their applicability to the site characterization, construction, and operation phases of the proposed site.

Following is a list of federal, state, and local agencies with whom consultations have been or will be conducted. Table 1.3-1, Regulatory Compliance Status, summarizes the status of the permits and approvals required to construct and operate the proposed facility.

1.3.1 Federal Agencies

Nuclear Regulatory Commission

The Atomic Energy Act of 1954, as amended, gives the NRC regulatory jurisdiction over the design, construction, operation, and decommissioning of the proposed facility specifically with regard to assurance of public health and safety in 10 CFR 70, 40, and 30 (CFR, 2008b) (CFR, 2008d) (CFR, 2008c) which are applicable to uranium enrichment facilities. The NRC performs periodic inspections of construction, operation, and maintenance of the facility. The NRC, in accordance with 10 CFR 51 (CFR, 2008a), also assesses the potential environmental impacts of the proposed facility.

The NRC establishes standards for protection against radiation hazards arising out of licensed activities. NRC licenses are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Organization Act of 1974. The regulations apply to all persons who receive, possess, use, or transfer licensed materials.

Domestic Licensing of Special Nuclear Material (10 CFR 70) (CFR, 2008b) establishes the procedures and criteria for the issuance of licenses to receive title to, own, acquire, deliver, receive, possess, use, and transfer special nuclear material; and establishes and provides for the terms and conditions upon which the Commission will issue such licenses.

Domestic Licensing of Source Material (10 CFR 40) (CFR, 2008d) establishes the procedures and criteria for the issuance of licenses to receive, possess, use, transfer, or deliver source material.

Rule of General Applicability to Domestic Licensing of Byproduct Material (10 CFR 30) (CFR, 2008c) establishes the procedure and criteria for the issuance of licenses to receive, possess, use, transfer, or deliver byproduct material.

Packaging and Transportation of Radioactive Material (10 CFR 71) (CFR, 2008e) regulates shipping containers and the safe packaging and transportation of radioactive materials under authority of the NRC and the U.S. Department of Transportation (DOT).

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) has primary authority relating to compliance with the Clean Air Act (CAA) (USC, 2008b), Clean Water Act (CWA) (USC, 2008c), Safe Drinking Water Act (SDWA) (USC, 2008d), and Resource Conservation and Recovery Act

(RCRA) (USC, 2008e). EPA Region 10 has not delegated regulatory jurisdiction to the State of Idaho for CWA and SDWA enforcement permitting, monitoring, and reporting activities relating to these statutes and associated programs. However, the State of Idaho has water quality requirements that are required to be met. EPA Region 10 has delegated regulatory jurisdiction to the state of Idaho for CAA and RCRA enforcement permitting, monitoring, and reporting activities relating to these statutes and associated programs. Applicable state requirements, permits, and approvals are described in Section 1.3.2, State Agencies.

Environmental Standards for the Uranium Fuel Cycle (40 CFR 190 Subpart B) (CFR, 2008f) establishes the maximum doses to the body organs resulting from operational normal releases and received by members of the public.

The CAA (USC 2008b) establishes regulations to ensure air quality and authorizes individual states to manage permits. The CAA requires (1) the EPA to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant; (2) establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants; (3) specific emission increases to be evaluated to prevent a significant deterioration in air quality; and (4) specific standards for releases of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each state with EPA approval. The CAA requires sources to meet air-quality standards and obtain permits to satisfy those standards.

The SDWA was enacted in 1974 to establish minimum national standards for public water supply systems (USC, 2008d). The SDWA requires protection of sole source aquifers (SSA). The proposed EREP will use site groundwater for potable water. The Eastern Snake River Plain (ESRP) SSA map was reviewed to determine the spatial relationship between the proposed site and the SSA.

The SDWA authorizes EPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. EPA and states then work together to make sure that these standards are met (EPA, 2004). Idaho has been authorized by the EPA to implement the SDWA requirements in Idaho. EPA sets national standards for drinking water; provides guidance, assistance, and public information about drinking water; collects drinking water data; and oversees state drinking water programs. Primary drinking water regulations and regulations applicable to drinking water systems are promulgated in 40 CFR 141 through 143 (CFR 2008q) (CFR 2008r) (CFR 2008s). 40 CFR 141 specifies siting requirements for construction of a new drinking water system at a site that is subject to significant risk from earthquakes, floods, fires, or other disasters or that is within the floodplain of a 100-year flood. In addition, regulations pertaining to the maximum permissible level of a contaminant in water and monitoring and analytical requirements are published in 40 CFR 141 and are implemented and enforced in 40 CFR 142. The National Secondary Drinking Water Regulations control contaminants in drinking water primarily affected by aesthetic qualities relating to the public acceptance of drinking water and are promulgated in 40 CFR 143.

The SDWA applies to every public drinking water system in the U.S. (EPA, 2004). A public drinking water system is defined as one that has 15 or more service connections or serves 25 or more persons per day for at least 60 days per year. Therefore, drinking water provided at the proposed facility will be governed by the SDWA as a public drinking water system. Rules governing quality and safety of drinking water in Idaho have been promulgated in Idaho Administrative Code (IDAPA) 58.01.08 (IDAPA, 2008b).

In 1987, Congress amended the CWA (USC, 2008c) and added Section 402(p). This section requires a comprehensive program for addressing stormwater discharges through the National Pollutant Discharge Elimination System (NPDES) program. The CWA requires states to set water quality standards for all bodies of water within their boundaries and directs EPA and the states to regulate and issue permits for point-source discharges as part of the NPDES permitting program. Under the CWA, EPA has established a program whereby the EPA or individual states can issue permits for stormwater discharges related to industrial activity, including construction activities that could disturb 20,500 or more square meters (220,660 or more square feet) (CFR, 2008p) (IDEQ, 2008c). The CWA recognizes but does not regulate problems posed by nonpoint source pollution.

As authorized by the CWA, the EPA NPDES permit program controls water pollution by regulating point sources that discharge pollutants into surface waters of the United States. In Idaho, the NPDES permit program is administered by the EPA, Region 10. An applicant may apply for either an individual or a general NPDES permit. An individual permit is specifically tailored to an individual facility, and a general permit covers multiple facilities with a specific category, such as stormwater discharges (IDEQ, 2008a). Permits specify the control technology applicable to each pollutant, the effluent limitations a discharger must meet, and the deadline for compliance. The permit incorporates numerical effluent limitations issued by the EPA. Permittees are required to maintain records and carry out effluent monitoring activities. Permits are issued for 5-year periods and must be renewed thereafter to allow continued discharge (CFR, 2008p).

Wastewater is spent or used water that contains enough harmful material, such as oil, dirt, human waste, and chemicals, to damage the water's quality. Any structure or facility that generates wastewater must dispose of it through a wastewater treatment and disposal system (IDEQ, 2008d). Some industries may discharge their wastewater directly to a sanitary sewer, where it is conveyed to a wastewater treatment plant. This wastewater may be subject to pretreatment requirements under the wastewater treatment plant's NPDES permit (IDEQ, 2008c). Sites not served by public sewer systems depend on decentralized, on-site septic systems to treat and dispose of wastewater (IDEQ, 2008d). Industrial point sources of pollution that discharge wastewater directly to surface waters are required to obtain NPDES permits that limit the amount of pollution that may be discharged into surface waters (IDEQ, 2008c).

The NPDES permit program includes an industrial stormwater permitting component adopted under Section 402 of the CWA (USC, 2008c). The NPDES Stormwater Program regulates discharges of stormwater from construction and industrial activities to waters of the United States. Since construction of the proposed EREF would be greater than 0.4 ha (1.0 ac), AES will obtain a NPDES Construction General Permit to establish the provisions for meeting stormwater regulations at the EREF. In addition, during operations, AES will obtain a NPDES Multi-Sector General Permit for storm water discharges. Design, construction, and operational details of facility stormwater systems and stormwater pollution prevention plans will be provided to EPA and IDEQ for review and issuance of the permits for construction and operation of the EREF.

The RCRA (USC, 2008e) requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 of the RCRA allows states to establish and administer these permit programs with EPA approval. EPA Region 10 has delegated regulatory jurisdiction to the Idaho Department of Environment Quality (Waste Management and Remediation Division) for nearly all aspects of permitting as required by the Hazardous Waste Management Act of 1983 (IDAPA, 2008f). The EPA regulations implementing the RCRA are found in 40 CFR Parts 260 through 282 (CFR, 2008t). Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements. The proposed EREF would generate small quantities of hazardous waste that are expected to be not greater than 1,000 kg (2,200 lb) per month. There would be no plans to store these wastes in excess of 180 days; thus, the proposed EREF would qualify as a small quantity hazardous waste generator in accordance with Section 006.01 of the Idaho Rules and Standards for Hazardous Waste (IDAPA, 2008f) and RCRA requirements.

The Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S. Code 116) (USC, 2008g) establishes the requirements for federal, state and local governments, Indian Tribes, and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment. AES will provide the State Emergency Planning Committee and the local fire department information on the storage and use of chemicals that meet the threshold quantity reporting thresholds required by the Community Right to Know provisions of the Act. In addition, to the extent the EREF exceeds thresholds for chemical emissions reporting, AES will submit the required annual toxic chemical release inventory information. Should EREF experience an inadvertent release of a Reportable Quantity (RQ) of a chemical listed as hazardous under provisions of the Emergency Release Notification requirements, AES will provide immediate notification to local and state emergency planning committees.

U.S. Department of Transportation (DOT)

Transport of the proposed facility UF_6 cylinders, radioactive waste, and hazardous waste requires compliance with the following DOT enabling regulations:

- 49 CFR 107, Hazardous Materials Program Procedures, Subpart G: Registration and Fee to DOT as a Person Who Offers or Transports Hazardous Materials (CFR, 2008i).
- 49 CFR 171, General Information, Regulations and Definitions (CFR, 2008j).
- 49 CFR 173, Shippers - General Requirements for Shipments and Packages, Subpart I: Radioactive Materials (CFR, 2008k).
- 49 CFR 177, Carriage by Public Highway (CFR, 2008l).
- 49 CFR 178, Specification for Packagings (CFR, 2008m).

All provisions of these enabling regulations will be met prior to the transport of UF_6 cylinders, radioactive waste, and hazardous waste. AES will be transporting UF_6 cylinders and wastes from the proposed facility on interstate highways.

U.S. Department of Agriculture

The U.S. Natural Resources Conservation Service (NRCS) branch of the U.S. Department of Agriculture (USDA) is responsible for the preservation of prime or unique farmlands as outlined in the Farmland Protection Policy Act (FPPA) (USC, 2008l). Although the proposed site occupies land designated as Prime Farmland, FPPA does not apply because the action is on private land and the Federal action is a licensing action. Federal licensing and permitting actions are not required to follow FPPA. Therefore, no NRCS formal land evaluation and site assessment will be required for the proposed facility.

The Noise Control Act of 1972 (42 USC 4901) (USC, 2008h)

The Noise Control Act transfers the responsibility of noise control to state and local governments. Commercial facilities are required to comply with federal, state, interstate, and local requirements regarding noise control. The proposed facility is located in a county (Bonneville) that does not have a noise control ordinance.

National Historic Preservation Act of 1966 (16 USC 470) (USC, 2008i)

The National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their actions (including permits) on historic properties. Historic properties are defined as “Any district, site, building, structure or object included in or eligible for inclusion in the National Register of Historic Places.” Such consideration includes but is not limited to the identification and management of historic properties under an agency’s responsibility and taking into account the effects of their actions on historic properties. The Advisory Council on Historic Preservation (ACHP) Regulations, 36 CFR Part 800 (CFR, 2008u), Protection of Historic Properties, are the implementing regulations for Section 106 of NHPA which identify the roles and functions of federal and state agencies as well as describing the process by which historic properties are identified, evaluated, and effects assessed.

An archaeological survey of the proposed site resulted in the recording of 11 sites and 17 isolated occurrences (finds). The sites include three prehistoric, four historic, and four multi-component sites. The prehistoric components at three sites (MW002, MW012, and MW015) required further investigation to determine their National Register of Historic Places (NRHP) eligibility. Subsequent testing of these sites resulted in a recommendation of not eligible. The historic component of one site (MW004) is recommended as eligible. The remaining seven sites (MW003, MW006, MW007, MW009, MW011, MW013, and MW014) are recommended not eligible for inclusion in the NRHP. The potentially eligible site is within the proposed plant footprint. A treatment/mitigation plan for MW004 will be developed by AES in consultation with the Idaho SHPO to recover significant information.

Hazardous Materials Transportation Act (49 USC 1801, Title 49 CFR 106-179) (USC, 2008j)

The Hazardous Materials Transportation Act (HMTA) regulates transportation of hazardous material (including radioactive material) in and between states. According to HMTA, states may regulate the transport of hazardous material as long as they are consistent with HMTA or the DOT regulations in Title 49 CFR 171-177 (CFR, 2008g). Other regulations regarding packaging for transportation of radionuclides are contained in Title 49 CFR 173 (CFR, 2008k), Subpart I. AES will be transporting UF_6 cylinders, radioactive waste, and hazardous waste from the proposed facility on interstate highways.

U.S. Army Corps of Engineers

The Clean Water Act (USC, 2008c) established a permit program under Section 404 to be administered by the U.S. Army Corps of Engineers (USACE) to regulate the discharge of dredged or fill material into "the waters of the U.S." The USACE also evaluates wetlands, floodplains, dam inspections, and dredging of waterways. The proposed facility will not impact or involve any wetlands, surface waters, dams, or other waterways. By letter dated October 10, 2008, the USACE notified AES of its determination that there are no Department of the Army jurisdictional waters at the proposed site (USACE, 2008). Therefore, a Section 404 permit will not be required.

Occupational Safety and Health Administration

The Occupational Safety and Health Act of 1970 (OSHA) is designed to increase the safety of workers in the workplace. It provides that the Department of Labor is expected to recognize the dangers that may exist in workplaces and establish employee safety and health standards. The identification, classification, and regulation of potential occupational carcinogens are found at 29 CFR 1910.101 (CFR, 2008n), while the standards pertaining to hazardous materials are listed in 29 CFR 1910.120 (CFR, 2008n). OSHA regulates mitigation requirements and mandates proper training and equipment for workers. Facility employees and management are subject to the requirements of 29 CFR 1910 (CFR, 2008n).

U.S. Department of Interior

The U.S. Fish and Wildlife Service (USFWS) is responsible for the protection and recovery of threatened and endangered species under the Endangered Species Act (USC, 2008n).

AES conducted a rare, threatened and endangered species survey for both plants and animals. No threatened or endangered species or habitat is present on the proposed site. The site provides potential habitat for the pygmy rabbit and greater sage grouse. USFWS initiated status reviews in January 2008 for the pygmy rabbit (FR, 2008b) and in February 2008 for the greater sage grouse (FR, 2008c) (FR, 2008d) to determine if listing of either species is warranted. However, neither species is listed as a candidate, threatened, or endangered species as of September 2008. By letter dated June 30, 2008, the USFWS notified AES of its determination that Endangered Species Act consultation is not needed (USFWS, 2008a).

The USFWS is responsible for the protection of migratory bird species under the Migratory Bird Treaty Act of 1918 (MBTA) (USC, 2008k). The facility occupies land that is potential habitat for several migratory species protected under the MBTA. AES will minimize the impacts to migratory birds by taking a number of actions as described in Sections 4.5.9 and 5.2.5.

1.3.2 State Agencies

Several state agencies are responsible for the protection and management of the environment and public health in the state of Idaho. State departments include divisions of the Idaho Department of Environmental Quality (IDEQ), Idaho Department of Water Resources (IDWR), Idaho Department of Lands, Idaho Department of Fish and Game (IDFG), Idaho Department of Health and Welfare (IDHW), Idaho State Historic Preservation Office (IDSHPO), Idaho Transportation Department (ITD), and the Division of Building Safety. AES has consulted with these State agencies regarding permit and consultation requirements. The general and specific consultations, permits and requirements are discussed below by the agency that has responsibility for consultations and permitting actions.

Idaho Air Quality Division

The Air Quality Division (AQD) Permitting Section processes permit applications for any business or industry (source) in Idaho that emits, or has the potential to emit, pollutants into the air. Permits are issued when new sources begin operation and when existing sources modify their facilities.

The AQD issues several different types of permits based on the emissions from the facility and/or emitting source. Permits require sources to comply with all health- and technology-based standards established by the EPA and Idaho’s Rules for Control of Air Pollution in Idaho (IDAPA, 2008i).

Construction Permits are required for constructing or modifying a stationary source which has a potential emission rate equal to 91 MT per year (100 tons per year) of any regulated air contaminant for which there is an Idaho Air Quality Standard. If the specified threshold is exceeded for any one regulated air contaminant, all regulated air contaminants emitted are subject to permit review. The threshold emission rate for nitrogen dioxide shall be based on total oxides of nitrogen.

Operating Permits (under Title V) are required for major sources that have a potential to emit more than 4.5 kg (10 lbs) per hour or 91 MT (100 tons) per year for criteria pollutants, or for landfills greater than 2.5 million m^3 (88 million ft^3). In addition, major sources also include facilities that have the potential to emit greater than 9.1 MT (10 tons) per year of a single Hazardous Air Pollutant, or 22.7 MT (25 tons) per year of any combination of Hazardous Air Pollutants. Air emissions for the proposed EREF during operations will be less than the limits identified by the standards; therefore, a permit is not required. Similarly, the proposed EREF would not require a National Emissions Standards for Hazardous Air Pollutants (NESHAPS) permit since it would not be a major source of criteria air pollutants and would not be a source of hazardous air pollutants.

For this facility, the potential applicable state permit is the permit to construct (PTC) which is issued by the IDEQ. Specifically, an air quality PTC is required prior to construction or modification of stationary sources, such as buildings, structures, and other installations that emit, or may emit, pollutants into the air. A PTC is also required for certain portable equipment such as generators. The State of Idaho uses a self-exemption process for air quality permits (IDAPA, 2008i). The Rules for Control of Air Pollution in Idaho provide for exemptions to the PTC. These conditions are as follows:

1. Idaho Administrative Code (IDAPA) 58.01.01.220 (IDAPA, 2008i) states the general exemption criteria to be used by owners or operators to exempt certain sources from the requirement to obtain a permit to construct. No permit to construct is required for a source that satisfies the following criteria in subparts (01.a and 01.b):

    a. (01.a) Maximum capacity of a source to emit an air pollutant under its physical and operational design without consideration of limitations on emissions such as air pollutant control equipment, restriction on hours of operation and restrictions on the type and amount of material combusted, stored or processed would not (i.) equal or exceed one hundred (100) tons per year of any regulated air pollutant and (ii.) cause an increase in the emissions of a major facility that equals or exceeds the significant emission rates set out in the definition of significant at Section 006.

    b. (01.b) The source is not part of a proposed new major facility or part of a proposed major modification.

2. IDAPA 58.01.01.222.01(d) (IDAPA, 2008i) states that a source is exempt if it satisfies the criteria set forth in section 220 and if stationary internal combustion engines are used exclusively for emergency purposes, which are operated less than or equal to aggregate of five hundred (500) hours total per year and are fueled by natural gas, propane gas, liquefied petroleum gas, distillate fuel oils, residual fuel oils, and diesel fuel.

    Another exemption in IDAPA 58.01.01.222.02(c) (IDAPA, 2008i) is for fuel burning equipment used for indirect heating and for reheating furnaces using natural gas, propane gas, liquefied petroleum gas, or biogas (gas produced by the anaerobic decomposition of organic material through a controlled process) with hydrogen sulfide concentrations less than two hundred (200) parts per million by volume (ppmv) exclusively with a capacity of less than (50) million (British thermal units) BTUs per hour input.

    IDAPA 58.01.01.223.02.a (IDAPA, 2008i) states that no permit to construct for toxic air pollutants is required for a source where the uncontrolled emission rate for all toxic air pollutants shall be less than or equal to all applicable screening emission levels listed in Sections 585 and 586.

IDAPA 58.01.01.223.02.b (IDAPA, 2008i) states that no permit to construct for toxic air pollutants is required for a source where the uncontrolled ambient concentration for all toxic air pollutants at the point of compliance shall be less than or equal to all applicable acceptable ambient concentrations listed in Sections 585 and 586.

3. Record Retention (IDAPA 58.01.01.220.02) (IDAPA, 2008i) states that the owner or operator shall maintain documentation on-site which shall identify the exemption determined to apply to the source and verify that the source qualifies for the identified exemption. The records and documentation shall be kept for a period of time not less than five (5) years from the date of when the exemption determination has been made or for the life of the source for which the exemption has been determined to apply, which ever is greater, or until such time as a permit to construct or an operating permit is issued which covers the operation of the source. The owner or operator shall submit the documentation to the Department upon request.

   IDAPA 58.01.01.223.05 (IDAPA, 2008i) states that an annual certified report for the toxic pollutant exemption will be submitted to the Idaho DEQ.

The proposed facility qualifies for these exemptions and, therefore, a permit is not required for the following reasons:

1. The six diesel generators (standby (4), security, and fire pump), will be used exclusively for emergency purposes and for the purpose of testing these generators, the generators will be meet the hours of operation for testing specified in the IDAPA 58.01.01.222.01(d) (IDAPA, 2008i). Records will be maintained to document the hours of operation for each diesel generator.
2. The six (6) diesel generators have the potential to emit less than 25 tons per year of critical air pollutants (oxides of nitrogen (NOx), carbon monoxide (CO), oxides of sulfur dioxide (SO_2), particulate matter (PM_{10}), and volatile organic compounds (VOC)).
3. The estimated emission rates of hydrogen fluoride and ethanol from operations are less than the applicable screening levels for toxic air pollutants and the estimated ambient air concentration of methylene chloride from operations and toxic air pollutants (specifically benzene) from the on-site fueling facility are less than the acceptable ambient concentrations for a carcinogen (AACC).

IDAPA 58.01.01 650 and 651 (IDAPA, 2008i) are the Idaho State air quality regulations associated with control of fugitive dusts. Those regulations state that all reasonable precautions shall be taken to prevent particulate matter from becoming airborne. Examples of reasonable precautions listed in the regulations include, use of water or chemicals, application of dust suppressants, use of control equipment, covering of trucks, paving and removal of materials from streets.

AES will comply with IDAPA 58.01.01 Part 650 for the prevention of the generation of fugitive dusts and will prepare and implement a Dust Prevention and Control Plan in accordance with Idaho Department of Environmental Quality (IDEQ) guidance. Fugitive dust control measures will be implemented during construction of the facility to comply with these regulations.

<u>Idaho Water Quality Division</u>

To implement the Safe Drinking Water Act (SDWA) requirements on a state level, the Idaho Environmental Protection and Health Act (Idaho Code Chapter 1, Title 39) (IDAHO Code, 2008c) gives the Idaho Department of Environmental Quality (IDEQ) the authority to promulgate rules governing quality and safety of drinking water (IDAPA, 2008b). The Water Quality Division (WQD) is delegated responsibility to implement the SDWA. The state 1) ensures that water systems are tested for contaminants, 2) reviews plans for water system improvements, 3) conducts on-site inspections and sanitary surveys, 4) provides training and technical assistance, and 5) takes action against water systems not meeting standards (EPA, 2004). In addition, a state has primary enforcement responsibility for drinking water systems in the state (CFR, 2008q).

Therefore, drinking water provided at the proposed facility will be governed by the SDWA as a public drinking water system. Rules governing quality and safety of drinking water in Idaho have been promulgated in IDAPA 58.01.08 (IDAPA, 2008b). No person may construct a drinking water system until it is demonstrated to the WQD that the water system will have adequate technical, financial, and managerial capacity (IDAPA, 2008b). Although there is not a permit required for a drinking water system, AES must have a drinking water facility plan that includes sufficient detail to demonstrate that the proposed project meets applicable criteria. The facility plan generally addresses the overall system-wide plan. The facility plan shall identify and evaluate problems related to the drinking water system, assemble basic information, present criteria and assumptions, examine alternative solutions with preliminary layouts and cost estimates, describe financing methods, set forth anticipated charges for users, and review organizational and staffing requirements.

The WQD requires facility owners of drinking water systems to place the direct supervision and operation of their systems under a properly licensed operator. All drinking water systems are also required to have a licensed backup or substitute operator. Operators are licensed by the Idaho State Board of Drinking Water and Wastewater Professionals.

Water systems serving fewer than 10,000 persons are considered to be small systems. IDAPA 58.01.08.005(02)(b) (IDAPA, 2008b) and 40 CFR 142 (CFR, 2008r) provide authorization for obtaining variances from the requirement to comply with Maximum Contaminant Level (MCL) or treatment techniques to systems serving fewer than 10,000 persons. Although a permit is not required for a drinking system serving fewer than 10,000 persons, the IDEQ requires a comprehensive treatment plan and licensed plant operator. The drinking water plan for the proposed EREF will include sufficient detail to demonstrate that the proposed project meets applicable criteria.

An on-site domestic sanitary sewage treatment plant will treat sanitary sewage. Liquid effluents would be discharged into the lined Cylinder Storage Pads Stormwater Retention Basin. Because this basin is lined, the system is considered a zero-discharge system. Therefore, a sanitary sewage system permit is not required.

As previously stated, industrial point sources of pollution that discharge wastewater directly to surface waters are required to obtain NPDES permits that limit the amount of pollution that may be discharged into surface waters (IDEQ, 2008c).

In Idaho, the NPDES permit program is administered by the EPA, which means that EPA is responsible for issuing and enforcing all NPDES permits in Idaho. The state of Idaho's role in this process is to certify that NPDES-permitted projects comply with state water quality standards (IDEQ, 2008b) in accordance with Section 401 of the CWA (USC, 2008c), which is implemented in 40 CFR 121 (CFR, 2008o). IDEQ is the state agency responsible for implementing the Section 401 certification process (IDEQ, 2008b).

Section 401 of the Clean Water Act certification is required for any permit or license issued by a federal agency for any activity that may result in a discharge into waters of the state to ensure that the proposed project will not violate state water quality standards. IDEQ is responsible for issuing Section 401 certifications in Idaho.

After the EPA issues a draft permit and provides public notice, the agency provides the proposed final permit to the IDEQ for certification. The IDEQ must grant, deny, or waive Section 401 certification for a project before a federal permit or license can be issued. AES will apply for the NPDES permits with the EPA, and the EPA would request the Section 401 certification from IDEQ. IDEQ must act on a request for certification within a reasonable period of time, which cannot exceed one year, after which the certification requirement will be waived. IDEQ can waive certification (either expressly or by taking no action), deny the certification, grant the certification, or grant the certification with conditions.

Since construction of the proposed EREF would be greater than 0.4 ha (1.0 ac), AES will obtain a NPDES General Permit for Storm Water Discharges Associated with Construction Activities. In addition, during operations, AES will obtain a NPDES Multi-Sector General Permit for Storm Water Discharges Associated With Industrial Activities. Design, construction, and operational details of facility stormwater systems and stormwater pollution prevention plans are required to be provided to EPA as part of the Notice of Intent to obtain both permits.

Idaho Waste Management & Remediation Division

The Idaho Waste Management & Remediation Division (WMRD) mission is to provide regulatory oversight and technical guidance to Idaho hazardous waste generators and treatment, storage, and disposal facilities as required by the Idaho Hazardous Waste Management Act (HWMA; Chapter 44, Title 39 1983) (IDAHO Code, 2008d) and regulations promulgated under the Act. The bureau issues hazardous waste permits for all phases, quantities, and degrees of hazardous waste management, including treating, storing and disposing of listed or hazardous materials.

Hazardous waste permits are required for the treating, storing or disposing of hazardous wastes. The level of permit and associated monitoring requirements depend on the volume and type of waste generated and whether or not the waste is treated or just stored for off-site disposal. Any person owning or operating a new or existing facility that treats, stores, or disposes of hazardous waste must obtain a hazardous waste permit from the Idaho Waste Management & Remediation Division. It is anticipated that small volumes of hazardous waste will be temporarily stored at the facility for eventual off-site disposal. The facility will generate small quantities of hazardous waste that are not expected to be greater than 1,000 kg (2,200 lbs) per month and is not planning to store these wastes in excess of 180 days (see ER Section 3.12, Waste Management). As a result, the facility will not require a hazardous waste Treatment, Storage, and Disposal Permit (40 CFR Part 262) (CFR, 2008h), but will file for a US EPA Hazardous Waste Identification Number as a Small Quantity Generator with the Idaho Department of Environmental Quality under Administrative Code 58.01.05 (IDAPA, 2008f).

The facility is committed to pollution prevention and waste minimization practices and will incorporate RCRA pollution prevention goals, as identified in 40 CFR 261 (CFR, 2008v). A Pollution Prevention Waste Minimization Plan will be developed to meet the waste minimization criteria of NCR, EPA, and state regulations. The Pollution Prevention Waste Minimization Plan will describe how the facility design procedures for operation will minimize (to the extent practicable) the generation of radioactive, mixed, hazardous, and non-hazardous solid waste.

Idaho Department of Water Resources

The Idaho Department of Water Resources (IDWR) is responsible for guiding, controlling, and planning the use and conservation of Idaho's water and energy resources. It is responsible for water allocation, water rights adjudication, surface water protection, and groundwater protection. IDWR also is responsible for water well permitting

The use of groundwater will be covered by a 1961 water right appropriation that will be transferred to the property for use as industrial water. The water transfer will occur concurrently with the purchase of the property by AES and will change the original water use from agriculture to industrial use. The primary point of diversion is expected to be from the existing agricultural well, Lava Well 3, near the center of Section 13, or a replacement well. The water will be assigned to other points of diversion to allow for the use of water from another well if the primary well should happen to fail. The original 1961 appropriation will decrease to approximately 1,713 m^3/d (452,500 gal/d) for industrial use and 147 m^3/d (38,800 gal/d) for seasonal irrigation use.

The predicted daily water consumption of the EREF is anticipated to be approximately 68,200 L/d (18,000 gal/d) and the peak water consumption rate is anticipated to be 42 L/s (664 gal/min) (i.e., equivalent to the normal and peak water usage rates given in m^3/min (gal/min) in Table 3.4-2, Anticipated Normal Plant Water Consumption, and Table 3.4-3, Anticipated Peak Plant Water Consumption. The peak water usage is developed based on the conservative assumption that all water users are operating at maximum demand simultaneously. This peak water usage is used to size the piping system and pumps. The normal annual water usage rate will be 24,870,000 L/y (6,570,000 gal/yr), which is a small fraction (i.e., about 4%) of the water appropriation value of 625,000,000 L/yr (165,000,000 gal/yr) for industrial use. Given that the normal annual water usage rate for the EREF is a small fraction of the appropriation value, momentary usages of water beyond the expected normal water usage rate is expected to be well within the water appropriation value for the EREF.

The IDWR has statutory responsibility for all water wells. A drilling permit must be obtained from the IDWR before the construction of any well greater than 5.5 m (18 ft) in depth. The drilling permit is valid for two months from the approval date for the start of construction. The well is required to be constructed by a driller currently licensed in the State of Idaho, who must maintain a copy of the drilling permit at the drilling site. Wells must also comply with Idaho’s well construction standards found at IDAPA 37.03.09 (IDAPA, 2008h). AES will apply for drilling permits for a proposed water production well and for additional groundwater monitoring wells.

The State Board of Land Commissioners and the Idaho Department of Lands

The Idaho Department of Lands manages endowment trust lands to maximize long-term financial returns and provide protection to Idaho's natural resources (Idaho Code, 2008a). Article IX of the Idaho Constitution established the State Board of Land Commissioners to act in the capacity of trustees to manage endowment lands, given in trust by the Federal government in 1890 (endowment lands). Idaho Code 57-715 (Idaho Code, 2008b) created the Endowment Fund Investment Board, which formulates policy for, and manages the investment of, the financial assets (IDL, 2008a). The Department of Lands was created in 1895 to manage these lands under the Land Board’s direction. Land immediately to the west of the proposed site is managed by the Department of Lands. However, no access or easement is needed, and therefore no permits or approvals are required (IDAPA, 2008j).

Idaho Department of Fish and Game

The Idaho Department of Fish and Game (IDFG) mission is to preserve, protect, perpetuate, and manage all species with in the state of Idaho. Although the primary responsibility for species classified as federally endangered or threatened (Endangered Species Act (ESA)) (USC, 2008n) rests with the USFWS, the Secretary of the Interior does negotiate cooperative agreements to provide financial assistance to states for the conservation of endangered and threatened species. Idaho administrative codes also identify and afford protection to species listed by the state as threatened or endangered (IDAPA, 2008g). AES conducted a rare, threatened and endangered (RTE) species survey for both plants and animals. No listed RTE species or habitat were observed on the proposed site. However, USFWS initiated status reviews in January 2008 for the pygmy rabbit (FR, 2008b) and in February 2008 for the greater sage grouse (FR, 2008c) (FR, 2008d) to determine if listing of either species is warranted. However, neither species are listed as a candidate, threatened, or endangered species as of September 2008. Habitat is present on the proposed site for both species and is isolated to the northwestern one-third of the proposed site. By letter dated June 30, 2008, the USFWS notified AES of its determination that Endangered Species Act consultation is not needed (USFWS, 2008a).

<u>Idaho Department of Health and Welfare</u>

The Radiation Control Agency of the Idaho Department of Health and Welfare (IDHW) regulates the radiation machines and their usage in accordance with the requirements of the Idaho Radiation Control Rules (IDAPA, 2008a). A radiation machine is defined by the Idaho Administrative Codes as any device capable of producing radiation except those which produce radiation only from radioactive material. Examples include medical x-ray machines, particle accelerators, and x-ray radiography machines used for non-destructive testing of materials. The Radiation Control Agency of the IDHW regulates the machines and their usage in accordance with the requirements of the Idaho Radiation Control Rules (IDAPA, 2008a). AES plans to use non-destructive (x-ray) inspection systems for package security requirements. AES has notified the IDHW and will submit a permit request to register the facility x-ray equipment prior to use when the equipment specifications become available.

<u>Idaho State Historic Preservation Office</u>

The Idaho State Historic Preservation Office (IDSHPO) participates with federal agencies in the consultation process during the planning of federal actions which may affect historic properties. The IDSHPO requires that cultural resource studies within the state use the various guidance and documentation forms. The NHPA Section 106 Review Process Guidance (USC, 2008m) establishes standards for cultural resource fieldwork and reporting as well as protocols for the actual Section 106 consultation process.

The State Historical Society code (Idaho Statutes, 2008a) provides for the designation of historic sites and penalties for damage to archaeological or historical sites, requires permits for excavation, establishes requirements for and duties of Board of Trustees for Historical Society, specifies powers and duties of Board and Director, establishes historical society account, and designates Pioneer Relic Hall.

The Preservation of Historic Sites code (Idaho Statutes, 2008b) authorizes city and county governments to enact local historic preservation ordinances and establish preservation commissions, outlines duties of commissions, allows for design review authority in locally designated historic districts, provides for historic easements and designation as historic property, provides for penalties, and provides exemption from health or building codes.

The Protection of Graves code (Idaho Statutes, 2008c) prohibits the willful disturbance or destruction of human burials, prohibits possession of artifacts or human remains taken from a grave other than as authorized, and provides for professional archaeological excavation.

Trespass and Malicious Injuries to Property code (Idaho Statutes, 2008d) specifies that damaging caves or caverns is unlawful and prohibits willful damage to archaeological sites associated with caves or caverns.

AES retained a subcontractor who obtained a permit to conduct an archaeological survey. A Cultural Resource Inventory was conducted on the site from April through July, 2008. The survey for the cultural resources (archaeological and historical) consisted of: (1) file search and records check; (2) field inventory; and (3) inventory report for the project. The tasks described in this scope are those necessary to complete SHPO standards for a cultural resource inventory which includes NRHP evaluations of all cultural resources within the project area and subsequent review and acceptance by federal and state agencies. Results of the survey are provided in ER Section 3.8, Historic and Cultural Resources, and Section 4.8, Historic and Cultural Resource Impacts.

Idaho Transportation Department

The Idaho Transportation Department (ITD) is responsible for design, construction, and maintenance of the state transportation system. The state transportation system includes a road network, bridges, rail lines, and public airports. ITD has jurisdictional responsibility for almost 8,046 km (5,000 mi) of highway, more than 1,700 bridges, and 30 recreational and emergency airstrips. ITD also oversees federal grants to 15 rural and urban public transportation systems, provides state rail planning and rail-project development, and supports bicycle and pedestrian projects. They are responsible for reviewing and permitting new access to state highways, including U.S. Highway 20. AES has initiated discussions with ITD on design and construction of access points on to U.S. Highway 20 (IDAPA, 2008k). AES will submit a permit application and receive a permit prior to construction.

Division of Building Safety

Construction permits will need to be obtained and inspections performed for electrical, plumbing, and HVAC systems for the proposed plant (IDAPA, 2008c) (IDAPA, 2008d) (IDAPA, 2008e).

Bonneville County has the authority to inspect and permit new buildings (Phillmore, 2008). County inspections and permits will be needed for the structure (including fire and safety permits) and mechanical systems. The county follows the 2006 International Building Code (ICC, 2006).

1.3.3 Local Agencies

Plans for construction and operation of the proposed facility are being communicated to and coordinated with local organizations. Officials in Bonneville County have been contacted regarding the project and county requirements. The county does not have any noise ordinances or visual resource protection requirements.

Emergency support services have been coordinated with the state and local agencies. When contacted, the Central Dispatch in the Idaho Falls Police Department will dispatch fire, Emergency Medical Services (EMS) and local law enforcement personnel. Mutual aid agreements exist between the Idaho Falls Police Department, Bonneville County Sheriff’s Department, and Idaho State Police, which are activated if additional police support is needed. Mutual aid agreements also exist between other counties and cities (e.g., Atomic City, Fort Hall) for additional fire and medical services. If emergency fire and medical services personnel in Bonneville County are not available, the mutual aid agreements are activated; and the Idaho Falls Central Dispatch will contact the appropriate agencies for the services requested at the facility.

AES is in discussions with local, county, and State agencies and parties to develop agreements for emergency services cooperation.

1.3.4 Permit and Approval Status

Several permits associated with construction activities have been drafted and will be formally submitted to the appropriate agency prior to the commencement of construction. Construction and operational permit applications will be prepared and submitted, and regulator approval and/or permits will be received prior to construction or facility operation as appropriate.

Initial consultations have been made with the cognizant agencies. Some permits (including notices of intent) have been submitted to the state of Idaho. More specific discussions will be held, as appropriate, as the project progresses. See Table 1.3-1, Regulatory Compliance Status, for a summary listing of the required federal, state and local permits and their current status.

TABLES

Table 1.3-1 Regulatory Compliance Status
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Requirement	Agency	Status	Comments
Federal			
10 CFR 70, 10 CFR 71, 10 CFR 40, 10 CFR 30	NRC	Application submitted	Facility License
NPDES Industrial Stormwater Permit	EPA Region 10	Application to be submitted	IDEQ/WQD has authority to promulgate rules governing quality and safety of drinking water.
NPDES Construction General Permit	EPA Region 10	Application to be submitted	IDEQ/WQD has authority to promulgate rules governing quality and safety of drinking water.
Section 404 permit	USACE	Not Required	
Endangered Species Act consultation	USFWS	Not required (Discussions ongoing)	No currently listed species or habitat on-site.
State			
Air Construction Permit	IDEQ/AQD	Not required	
Air Operating Permit	IDEQ/AQD	Not required	
NESHAPS Permit	IDEQ/AQD	Not required	
Hazardous Waste Permit	IDEQ/WMRD	Not required	
NPDES Permit Certification	IDEQ/WQD	Application to be submitted	See NPDES Permits under Federal Requirement of this Table 1.3-1

Table 1.3-1 Regulatory Compliance Status
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Requirement	Agency	Status	Comments
Well drilling permit	IDWR	Application to be submitted for additional monitoring or production wells	
Easement on State Owned Land	Department of Lands	Not required	
SDWA Drinking Water System	IDEQ/WQD	Prepare comprehensive treatment plan	AES will place operations under a licensed operator
Sanitary system permit	IDEQ/WQD	Not required	No permit required for a zero discharge system.
Section 401 Certification	IDEQ	Not required	
Access permit	ITD	Application to be submitted.	
Construction Permits (structural and mechanical	Bonneville County	Application to be submitted	
Construction Permits (electrical, plumbing, HVAC)	ID Division of Building Safety	Application to be submitted	
Machine-Produced Radiation-Registration	IDHW/RCB	Application to be submitted	

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2.0 ALTERNATIVES

This chapter describes the alternatives to the proposed action described in ER Section 1.2, Proposed Action. The range of alternatives considered in detail is consistent with the underlying need for and purposes of the proposed action, as set forth in ER Section 1.1, Purpose and Need for the Proposed Action. Accordingly, the range of alternatives considered is based on the underlying need for additional reliable and economical uranium enrichment capacity in the United States – as would be provided by the proposed Eagle Rock Enrichment Facility (EREF) – as well as related commercial considerations concerning the security of supply of enriched uranium. The alternatives considered in detail include (1) the “no-action” alternative under which the proposed EREF would not be built, (2) the proposed action to issue a Nuclear Regulatory Commission (NRC) license to AREVA Enrichment Services, LLC (AES) for the construction and operation of the EREF, (3) alternative technologies available for an operational uranium enrichment facility, (4) design alternatives and (5) alternative sites for the proposed enrichment facility.

This chapter also addresses the alternatives that were considered, but ultimately eliminated, as well as the potential cumulative impacts of the proposed action. Finally, this chapter presents, in tabular form, a comparison of the potential environmental impacts associated with the proposed action and various scenarios possibly arising under the no-action alternative.

2.1 DETAILED DESCRIPTION OF THE ALTERNATIVES

This section identifies the no action alternative, the proposed action, and reasonable alternatives to the proposed action. Included are the technical design requirements for the proposed action and its reasonable alternatives.

2.1.1 No-Action Alternative

The no-action alternative for the Eagle Rock Enrichment Facility (EREF) would be to not build the proposed EREF. Under the no-action alternative, the NRC would not approve the license application to construct and operate the proposed facility. Accordingly, the current owners of the private property upon which the proposed facility would be sited would be free to continue the current uses of the property or pursue alternative uses of the property. In the absence of NRC approval of the EREF license, utility customers would be required to meet their uranium enrichment service needs through existing suppliers. In the United States, this would mean that the one remaining operating enrichment facility, the gaseous diffusion facility operated by the United States Enrichment Corporation (USEC) at Paducah, Kentucky, would be the only domestic facility currently available to serve this purpose. Therefore, USEC would remain the sole current domestic supplier of low-enriched uranium. As discussed in ER Section 1.1.2.3, Current and Potential Future Sources of Uranium Enrichment Services, the Paducah Gaseous Diffusion Plant (GDP) operated by USEC is expected to be shutdown in June 2012.

In December 2003 and August 2004, two companies (Louisiana Energy Services (LES) and USEC) that offer uranium enrichment services worldwide, submitted applications to the NRC for licenses to build and operate new centrifuge based uranium enrichment plants in the United States. In June 2006 and April 2007, respectively, the NRC issued those licenses; and construction is presently underway on both facilities (National Enrichment Facility (NEF) and the American Centrifuge Plant (ACP)) (NRC, 2007a).

As discussed in ER Section 1.1.2.4.2, Scenario B – Base Supply of Enrichment Services Without AES's U.S. Plant, if it is assumed that the LES NEF (using proven Enrichment Technology Company Ltd. (ETC) technology) and the USEC ACP are completed and operate successfully in the U.S., then together with small contributions of equivalent supply from down blended U.S. HEU and limited recycle, they would be capable of supplying only 61% of the U.S. requirements during the period of AES's Reference Nuclear Power Growth forecast.

In addition to the potential LES and USEC future sources of enrichment services, General Electric (GE)-Hitachi Nuclear Energy (GEH) has initiated work that is based on Silex laser enrichment technology (GLE). On January 30, 2009, GEH delivered its environmental report to the NRC with the rest of the license application to be submitted by June 2009 (SILEX, 2009). If GEH ultimately makes the decision to deploy GLE commercially, following results of testing that is scheduled to occur during 2009, GEH then expects to have a commercial Lead Cascade operational by 2012 or 2013.

The above potential enrichment services alone would be inconsistent with the clear federal policy of fostering the development of additional, secure, reliable, and economical domestic enrichment capacity to promote both U.S. energy security and national security. The Department of Energy (DOE) believes that the earlier than anticipated cessation of plant operations at Portsmouth has serious domestic energy security consequences, including the inability of the U.S. enrichment supplier USEC to meet all its enrichment customers' contracted fuel requirements, in the event of a supply disruption from either the Paducah plant production or the Highly Enriched Uranium (HEU) Agreement deliveries. As the DOE has further recognized, these energy security concerns are due, in large part, to the lack of available replacement for the inefficient and noncompetitive gaseous diffusion enrichment plants. In its application for the ACP, USEC noted the Portsmouth facility "is over 50 years old and the power costs to product SWU are significant." Although USEC is pursuing development and deployment of its own advanced centrifuge technology, this technology has yet to be proven commercially viable.

Even if USEC were able to bring the proposed facility online successfully, as well as LES bring their facility online, their operation alone would not guarantee security of supply, particularly in view of forecasted installed nuclear generating capacity and uranium enrichment requirements discussed in ER Section 1.1.2, Market Analysis of Enriched Uranium Supply and Requirements.

As discussed in ER Section 1.1, Purpose and Need for the Proposed Action, the U.S.-Russian HEU agreement (for which USEC is the U.S. executive agent) is currently scheduled to expire in 2013, and like other arrangements for the importation of foreign-enriched uranium, it may be subject to disruptions caused by both political and commercial factors. These circumstances have raised concerns among U.S. purchasers of enrichment services with respect to the security of their supplies. The past contract dispute between Russia's Techsnabexport (Tenex) and its former affiliate Globe Nuclear Services & Supply provides one example of the concerns raised by potential supply disruptions. As noted in a trade press article, even though this dispute was not expected to impact the US-Russian HEU Agreement or other sales by Tenex, "some utilities may now come to view those supplies as less certain and take steps to line up alternate sources of supply or to ask for price discounts to account for perceived increased delivery risk." (NW, 2003)

Under the no-action alternative, a decision by the NRC not to approve the EREF license application would reduce the projected domestic enrichment capacity and therefore limit the diversity and security of the U.S. enrichment supply. This alternative, therefore, would not serve the recognized need of the U.S. government to promote energy and national security through the development of additional, secure, reliable, and economical domestic enrichment capacity; nor would it serve the need of utility customers to ensure secure supplies and diverse suppliers of enrichment services.

2.1.2 Proposed Action

The proposed action, as described in ER Section 1.2, Proposed Action, is the issuance of an NRC license under 10 CFR 30, 40 and 70 (CFR, 2008c; CFR, 2008d; CFR, 2008b) that would authorize AES to possess and use byproduct material, source material and special nuclear material (SNM) and to construct and operate a uranium enrichment facility at a site located in Bonneville County, Idaho. ER Section 1.2 contains a detailed description of the proposed action, including relevant general background information, organization sharing ownership, and project schedule.

2.1.2.1 Description of the Proposed Site

The proposed site is situated in Bonneville County, Idaho, on the north side of U.S. Highway 20, about 113 km (70 mi) west of the Idaho/Wyoming state line. Portions of Bonneville, Jefferson, and Bingham counties are within 8 km (5 mi) of the proposed site. The approximately 1,700 ha (4,200 ac) property is currently under private ownership by a single landowner. There is a 16-ha (40-ac) parcel within the proposed site, which is administered by the U. S. Bureau of Land Management (BLM). Also, there are two, 16-ha (40-ac) parcels located within the proposed site that the Federal government did reserve for itself certain mineral rights which were not subject to claim or patent by anyone under the General Mining Act of 1872 (USC, 2008f). These reservations were released, remised and quitclaimed to the person to whom the land was patented pursuant to Section 64.b of the Atomic Energy Act of 1954, as amended, and are no longer valid. The privately held land will be purchased by AES. The approximate center of the Eagle Rock Enrichment Facility is located at latitude 43 degrees, 35 minutes, 7.37 seconds North and longitude 112 degrees, 25 minutes, 28.71 seconds West. Refer to Figure 2.1-1, 80-Kilometer (50-Mile) Radius With Cities and Roads.

There are no right-of-ways on the property with the exception of the right-of-way for U.S. Highway 20, which forms part of the southern boundary of the proposed site. Otherwise, the site is in native rangeland, non-irrigated seeded pasture, and irrigated cropland. A dirt road provides site access from U.S. Highway 20, while other dirt roads provide access throughout the proposed site. The proposed site is comprised mostly of relatively flat and gently sloping surfaces with small ridges and areas of rock outcrop. Most of the site is semi-arid steppe covered by eolian soils of variable thickness that incompletely cover broad areas of volcanic lava flows. Elevations at the site range from about 1,556 m (5,106 ft) to about 1,600 m (5,250 ft). Many of the areas with thickest soils and gentle slopes with a minimum of rock outcrop are currently used for crops.

The proposed site is in native rangeland, non-irrigated seeded pasture, and irrigated cropland. The proposed site is seasonally grazed. Wheat, barley, and potatoes are grown on 389 ha (962 ac) of irrigated land on the proposed site. One potato storage facility is located at the south end of the site.

Grazing and cropping are the main land uses within 8 km (5 mi) of the proposed site. State land immediately west of the proposed site and BLM land immediately east of the site are grazed. The nearest offsite croplands are within 0.8 km (0.5 mi) of the southeast corner of the proposed site. The nearest feedlot and dairy operations are about 16 km (10 mi) east of the proposed site. The Department of Energy’s Idaho National Laboratory (INL) eastern boundary is 1.6 km (1 mi) west of the proposed site. The INL property near the site is undeveloped rangeland. The closest facility on the INL property is the Materials and Fuels Complex (MFC), located approximately 16 km (10 mi) west of the proposed site boundary. The lands north, east, and south of the site are a mixture of private-, State-, and Federal-owned parcels.

The city of Idaho Falls, the nearest major city, is located about 32 km (20 mi) east southeast from the site. The towns of Rigby and Rexburg are located approximately 23 km (14 mi) and 42 km (26 mi) north of Idaho Falls, respectively. Atomic City is about 32 km (20 mi) west of the site. South of the proposed site are the towns of Blackfoot at 40 km (25 mi) and Pocatello at 76 km (47 mi). The Fort Hall Indian Reservation comprises about 220,150 ha (544,000 ac) and also lies to the south. The nearest boundary of the reservation is about 44 km (27 mi) from the proposed site. The town of Fort Hall is located a distance of approximately 60 km (37 mi).

The nearest residence is 7.7 km (4.8 mi) east of the proposed site. Temporarily occupied structures in the 8-km (5-mi) radius include a transformer station adjacent to the proposed site to the east, and potato cellars, one 3.2 km (2 mi) west of the proposed site, and one 7.7 km (4.8 mi) to the east. Public use areas include a hiking trail south of the proposed site in Hell's Half Acre Wilderness Study Area (WSA) and a small lava tube cave located approximately 8 km (5 mi) east and south. The Wasden Complex, consisting of caves formed by collapsed lava tubes, is located approximately 3.2 km (2 mi) northeast from the footprint of the EREF.

Figure 2.1-2, Site Area and Facility Layout Map 1.6-Kilometer (1-Mile) Radius, Figure 2.1-3, Existing Conditions Site Aerial Photograph, and Figure 2.1-4, EREF Buildings show the site property boundary and the general layout of the buildings on the EREF site.

Refer to ER Figure 1.2-3, EREF Location Relative to Transportation Routes, for the location of highways and railroad lines relative to the proposed site.

2.1.2.2 Applicant for the Proposed Action

AREVA Enrichment Services (AES), LLC is a Delaware limited liability corporation. It has been formed solely to provide uranium enrichment services for commercial nuclear power plants. AES is a wholly owned subsidiary of AREVA, NC Inc. AREVA, NC Inc. is a wholly owned subsidiary of the AREVA NC SA, which is part of AREVA SA.

The AREVA SA is a corporation formed under the laws of France (“AREVA”), is governed by the Executive Board, and its principal owners are as follows.

- Commissariat à l’Energie Atomique (French Atomic Energy Commission) 78.96%
- French State 5.19%
- Caisse des dépôts and et consignations 4.61%
- ERAP 3.21%
- Electricité de ’France 2.42%
- Investment Certificate Holders 4.03%
- TOTAL 1.58%

AES is a Delaware corporation and is governed by the AES Management Committee. The names and addresses of the AES Management Committee are as follows.

- Mr. Jacques Besnainou
  President and Chief Executive Officer of AREVA NC Inc.
  President of AREVA Inc.
  4800 Hampden Lane, Bethesda MD 20817, USA

  Mr. Besnainou is a citizen of France and a citizen of the United States of America

- Mr. Michael McMurphy
  Senior Executive Vice President
  Mine, Chemistry and Enrichment Sector, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. McMurphy is a citizen of the United States of America

- Mr. Francoix-Xavier Rouxel
  Executive Vice President, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. Rouxel is a citizen of France

- Mr. Gary Fox
  Executive Vice President, AREVA NC Inc
  4800 Hampden Lane, Bethesda, MD 20814

  Mr. Fox is a citizen of the United States of America

- Mr. Nicolas De Turckhiem
  Director, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. De Turckhiem is a citizen of France

- Mr. Nicolas Fayet
  Chief Financial Officer, Enrichment Business Unit, AREVA NC SA
  33 rue Lafayette, 75009 Paris, France

  Mr. Fayet is a citizen of France

The President and Chief Executive Officer of AES is Sam Shakir, a citizen of Canada and a naturalized citizen of the United States of America. Any safety decision related to the operation of the facility will be made by the President of AES.

AES's principal location for business is Bethesda, MD. The facility will be located in Bonneville County near Idaho Falls, Idaho. No other companies will be present or operating on the EREF site other than services specifically contracted by AES.

AES is responsible for the design, quality assurance, construction, operation, and decommissioning of the enrichment facility. The President and CEO of AES report to the AES Management Committee.

Foreign Ownership, Control and Influence (FOCI) of AES is addressed in the AES Standard Practice Procedures Plan, Appendix 1 - FOCI Package. The NRC in its letter to Louisiana Energy Services dated, March 24, 2003, has stated "...that while the mere presence of foreign ownership would not preclude grant of the application, any foreign relationship must be examined to determine whether it is inimical to the common defense and security [of the United States]." (NRC, 2003b) The FOCI Package mentioned above provides sufficient information for this examination to be conducted.

2.1.2.3 Facility Description

The EREF is designed to separate a feed stream containing the naturally occurring proportions of uranium isotopes into a product stream enriched in ^{235}U and a uranium stream depleted in the ^{235}U isotope. Following is a summary description of the EREF process, buildings and related operation. The EREF ISA Summary contains a detailed description of facility characteristics, including plant design and operating parameters.

The feed material for the enrichment process is uranium hexafluoride (UF_6), with a natural composition of isotopes ^{234}U, ^{235}U, ^{236}U, and ^{238}U. The enrichment process involves the mechanical separation of isotopes using a fast rotating cylinder (centrifuge) and is based on a difference in centrifugal forces due to differences in the molecular weight of the uranic isotopes. No chemical or nuclear reactions take place. The feed, product, and depleted uranium streams are all in the form of UF_6.

The UF_6 feed arrives from conversion facilities as a solid under partial vacuum in 122-cm (48-in) diameter transportation cylinders. Product material is collected in 76-cm (30-in) diameter containers and transported to a fuel fabricator. The depleted UF_6 material is collected in 122-cm (48-in) diameter containers and removed for temporary storage onsite.

The plant design capacity is 6.6 million separative work units (SWU) per year i.e., a nominal 6 MSWU per year production rate. At full production in a given year, the plant will receive approximately 17,518 MT (19,310 tons) of UF_6 feed, supply 2,252 MT (2,482 tons) of low enriched UF_6, and yield 15,270 MT (16,832 tons) of depleted UF_6. The principal EREF operational structures are shown on Figure 2.1-4, EREF Buildings, and include the following:

- Separations Building Modules (includes UF_6 Handing Area, Cascade Halls, Process Service Corridor)
- Blending, Sampling and Preparation Building (BSPB)
- Technical Support Building (TSB)
- Operation Support Building (OSB)
- Centrifuge Assembly Building (CAB)
- Cylinder Receipt and Shipping Building (CRSB)
- Electrical Services Building (ESB)
- ESB for the CAB
- Mechanical Services Buildings (MSBs) – 2 Buildings
- Cylinder Storage Pads
- Administration Building
- Security and Secure Administration Building
- Guard House
- Visitor Center
- Gasoline and Diesel Fueling Station (GDFS)

Information on items used, consumed, or stored at the site during construction and operation is provided in ER Section 3.12.4, Resources and Materials Used, Consumed or Stored During Construction and Operation.

2.1.2.3.1 Separations Building Modules (SBM)

The facility includes four identical Separations Building Modules. Each module consists of two Cascade Halls. Each Cascade Hall houses twelve cascades, each of which consists of hundreds of centrifuges connected in series and parallel producing a single product concentration at any one time. Each Cascade Hall is capable of producing a maximum of 825,000 SWU per year. In addition to the Cascade Halls, each Separations Building Module houses a UF_6 Handling Area and a Process Service Corridor.

An assay unit consists of twelve cascades. The centrifuges are mounted on precast concrete floor-mounted elements (flomels). Each Cascade Hall is enclosed by a structural steel frame that supports insulated sandwich panels. This enclosure surrounds each Cascade Hall to aid in maintaining a constant temperature within the cascade enclosure.

The UF_6 Handling Area contains the Feed System, Product and Tails Take-off Systems. The Process Service Corridor contains the gas transport equipment, which connects the cascades to the Product Take-off System and Tails Take-off Systems and the Cascade Systems. The Process Service Corridor also contains key electrical and cooling water systems. Each SBM will have its own Gaseous Effluent Ventilation System (GEVS). The SBM GEVS for Module 1 serves the Blending, Sampling, and Preparation Building (BSPB).

2.1.2.3.2 Blending, Sampling and Preparation Building (BSPB)

The Blending, Sampling and Preparation Building is adjacent to the UF_6 Handling Areas, Technical Support Building and the Operation Support Building. The primary function of the BSPB is to provide means to fill 30B cylinders with UF_6 at a required ^{235}U concentration level and sample the product cylinders for ^{235}U concentration and UF_6 purity. In addition, cylinder activities including testing, weighing, conditioning, defrosting and inspection are performed in the BSPB.

Cylinder preparation activities include testing and inspecting new or cleaned 30B and 48Y cylinders and conditioning and evacuation of used (i.e., with heels) 30B and 48Y cylinders for use in the plant. Equipment is available within the room to fit plugs and valves to new empty or cleaned empty cylinders to internally visually inspect the cylinders and to pressure test the cylinders, condition cylinders and remove cylinder heels if required.

The Ventilated Room is also located within the BSPB. This room provides space for the maintenance of cylinders. The activities carried out within the Ventilated Room include contaminated cylinder pressure testing, cylinder pump out and valve maintenance. The Ventilated Room is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

2.1.2.3.3 Technical Support Building (TSB)

The TSB is adjacent to the Separation Building Modules (SBMs), the Blending, Sampling and Preparation Building (BSBP) and the Operation Support Building (OSB). The TSB contains radiological support areas for the facility. The TSB acts as a secure point of entry to the SBMs and the BSPB. Entry into the TSB is typically made by first entering into the OSB through a lobby and then passing through the OSB into the TSB itself.

The TSB contains the following functional areas located on the first floor:

Solid Waste Collection Room

The Solid Waste Collection Room processes both wet and dry low-level solid waste. Wet waste is categorized as radioactive, hazardous or industrial waste and includes assorted materials, oil recovery sludge, oil filters and miscellaneous hazardous wastes. Dry waste is also categorized as radioactive, hazardous or industrial waste and includes assorted materials, activated carbon, aluminum oxide (also referred to as alumina), sodium fluoride, HEPA filters, scrap metal and other miscellaneous plant equipment.

TSB Gaseous Effluent Ventilation System (GEVS)

The GEVS removes uranyl fluoride (UO_2F_2), i.e., uranium compounds particulates containing uranium and hydrogen fluoride (HF) from potentially contaminated process gas streams. Pre-filters and absolute high efficiency particulate air (HEPA) filters remove particulates, including uranium particles, and activated charcoal filters remove HF. The TSB GEVS serves the TSB.

Technical Support Building Contaminated Area Heating, Ventilation and Air Conditioning (HVAC) System

The Technical Support Building Contaminated Area HVAC System maintains the room temperature in various areas of the TSB, including some potentially contaminated areas. For the potentially contaminated areas, the TSB Contaminated Area HVAC System maintains a negative pressure in these rooms and discharges the room air to an exhaust vent on the TSB roof. The system provides for continuous alpha and HF monitoring.

Liquid Effluent Collection and Treatment Room

The Liquid Effluent Collection and Treatment Room is used to collect potentially contaminated liquid effluents produced onsite, which are monitored for contamination prior to processing. These liquid effluents are stored in tanks prior to processing. The contaminated liquids are processed for uranium removal. Liquid effluents produced by the plant include hydrolyzed uranium hexafluoride, degreaser water, citric acid, floor wash water, and miscellaneous effluent.

These liquid effluents are processed through several precipitation units, filtration units, microfiltration units and evaporation units.

Laundry Sorting Room

The Laundry Sorting Room provides an area to sort potentially contaminated and soiled clothing and other articles that have been used throughout the plant. Lightly contaminated articles will be shipped off-site to be laundered; heavily contaminated articles are inspected first and if too difficult to clean are sent to the Solid Waste Collection System, otherwise they will be shipped off-site to be laundered as well.

Radiation Monitoring Room

The Radiation Monitoring Room is the point of demarcation between non-contaminated areas and potentially contaminated areas of the plant. It includes space for personnel contamination monitoring equipment (e.g., hand and foot monitors or portal monitors), hand washing facilities, safety showers, and access controls for preventing the spread of contamination (e.g., a step-off pad).

Truck Bay/Shipping and Receiving Area

The Truck Bay is used as a place to load packaged low-level radioactive wastes and hazardous wastes onto trucks for transportation offsite to a licensed processing facility and/or licensed disposal facility. It is also used for miscellaneous shipping and receiving.

Ancillary Areas

The following ancillary areas are located on the first floor: electrical room, offices, stairs, corridors, and elevators.

The TSB contains the following areas located on the second floor: HVAC rooms, Electrical rooms, stairs, corridors and elevators:

The TSB contains the following functional areas located on the third floor:

Chemical Trap Workshop

The Chemical Trap Workshop provides space for the maintenance of chemical traps, the temporary storage of full and empty traps and for the contaminated chemicals used in the traps. The activities carried out within the Chemical Trap Workshop include receipt and storage of saturated chemical traps, chemical removal and temporary storage.

The Chemical Trap Workshop is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

Mobile Unit Disassembly and Reassembly Workshop

This workshop provides space for the maintenance of mobile vacuum pump skids and the temporary storage of vacuum pump skid components.

The Mobile Unit Disassembly and Reassembly Workshop is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

Valve and Pump Dismantling Workshop

This workshop provides space for the dismantling and maintenance of valves and pumps and for the temporary storage of valve and pump components prior to decontamination. It is also used for the temporary storage and subsequent dismantling of failed pumps. The activities carried out within this workshop include receipt and storage of contaminated pumps, out-gassing, Perfluoropolyether (PFPE) oil removal and storage, pump stripping, and the dismantling and maintenance of valves.

The Valve and Pump Dismantling Workshop is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

Decontamination Workshop

The Decontamination Workshop provides a facility for the removal of radioactive contamination from contaminated materials and equipment. The decontamination system consists of a series of steps including equipment disassembly, degreasing, decontamination, drying and inspection. Components commonly decontaminated include pumps, valves, piping, instruments, sample bottles, tools and scrap metal.

The Decontamination Workshop is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

Maintenance Facility

The Maintenance Facility provides space for the normal maintenance of contaminated plant equipment. The facility also deals with faults associated with the pump motors, all instrument and control equipment, lighting, power, and associated process and services pipe work. It also provides space for the temporary storage of minor plant equipment.

The Maintenance Facility is under negative pressure. Therefore, any equipment or personnel entering this room must go through an air-lock.

Laboratory Areas

The laboratory areas provide space for various rooms and laboratories that receive, prepare, and store various samples including:

- Mass Spectrometry Laboratory - for the process of uranium isotope measurement
- Analytical Chemistry Laboratory - for the process of UF_6 quality assurance
- Sample Preparation Room
- Sample Bottle Storage Room
- Uranium Analysis Room
- Physical Analysis Room
- Alpha/Beta/Gamma Counting
- Gas Fourier Transfer Infrared Spectrometry (G-FTR) Room
- Inductively Coupled Plasma Atomic Emission Spectroscopy/Inductive Coupled Plasma Mass Spectrometry (ICPAES/ICPMS) Room
- Sub-Sampling Unit Room

Ancillary Areas

The following ancillary areas are located on the third floor: archive storage, offices, conference rooms, stairs, corridors, and elevators.

2.1.2.3.4 Operation Support Building (OSB)

The OSB is adjacent to the Technical Support Building (TSB) and the Blending, Sampling and Preparation Building (BSBP). The OSB contains non-radiological support areas for the facility.

The OSB contains the following functional areas located on the first floor:

Vacuum Pump Rebuild Workshop

The Vacuum Pump Rebuild Workshop provides space for the maintenance and re-building of plant equipment, mainly pumps that have been decontaminated in the Decontamination Workshop, and other miscellaneous plant equipment.

Mechanical, Electrical and Instrumentation (ME&I) Workshop

The ME&I Workshop provides space for the normal maintenance of non-contaminated plant equipment. The facility also deals with faults associated with the pump motors, all instrument and control equipment, lighting, power, and associated process and services pipe work. It also provides space for the temporary storage of rebuilt and minor plant equipment.

Medical Room

The Medical Room provides space for a nurse's station.

Locker Rooms

The Locker Rooms provide change areas, showers, and toilets.

Lobby

The Lobby is the entry point to the plant.

Ancillary Areas

The following ancillary areas are located on the first floor: storage areas, heating, ventilation, and air conditioning (HVAC) and electrical rooms, offices, stairs, and corridors.

The OSB contains the following functional areas located on the second floor:

Control Room

The Control Room is the main monitoring point for the entire plant and provides all of the facilities for the control of the plant, operational requirements and personnel comfort. It is a permanently staffed area that contains the following equipment:

- Overview screen
- Control desk
- Fire alarm system
- Storage facilities
- Communication systems.

In an emergency, the Control Room serves as the primary Emergency Operations Center (EOC) for the facility.

Training Room and Operation Support

The Training Room and Operation Support is used for Control Room training and provides some plant operation support functions. It has visual and personnel access to the Control Room and contains the following:

- Plant Control System Training System
- Centrifuge Monitoring System Training System
- Central Control System switches and servers.

Security Alarm System Room

The Security Alarm System is used as the primary security monitoring station for the facility. All electronic security systems will be controlled and monitored from this center. These systems will include but not be limited to: Closed Circuit Television (CCTV), Intrusion Detection & Assessment (IDA), Access Control and radio dispatch.

Ancillary Areas

The following ancillary areas are located on the second floor: archive areas, conference room offices (operators, shift manager and security), stairs, and corridors.

The OSB contains the following functional areas located on the third floor:

Environmental Laboratory Area

The Environmental Laboratory Area provides rooms and space for various laboratory areas that receive, prepare, and store various samples as follows:

- Environmental Storage Room
- Environmental Sampling, Storage, Preparation and Analysis
- Fluorimetry Room

- Filter Counting Room

Exam Room

The Exam Room, which is part of the Medical Room, provides privacy for medical examinations.

Security Room

The Security Room provides a work space for the on-site shift security personnel.

Ancillary Areas

The following ancillary areas are located on the third floor: conference rooms, offices, stairs, and corridors.

2.1.2.3.5 Centrifuge Assembly Building (CAB)

The CAB is located adjacent to the Separations Building Modules (SBMs). It is used for the assembly, inspection, and mechanical testing of the centrifuges prior to installation in the Cascade Halls of the Separations Building Modules and introduction of UF_6. Centrifuge assembly operations are undertaken in clean room conditions. The building is divided into the following distinct areas:

Centrifuge Component Storage Areas

The Centrifuge Component Storage Areas serve as the initial receipt location for the centrifuge parts. They are designed to store delivered centrifuge components. These components are delivered by truck in specifically designed containers, which are then packed into International Organization for Standardization (ISO) freight containers. These containers are off-loaded via fork lift truck and placed in the storage areas through one of two roller shutter doors located at the end of the CAB.

Because the assembly operations are undertaken in clean room conditions, the centrifuge component containers will be cleaned within the Centrifuge Component Storage Areas, prior to admission to the Centrifuge Assembly Areas. The Centrifuge Component Storage Areas also act as an acclimatization area to allow components to equilibrate with the climatic conditions of the Centrifuge Assembly Areas.

Transfer of components and personnel between a Centrifuge Component Storage Area and a Centrifuge Assembly Area will be via an airlock to prevent ingress of airborne contaminants.

Centrifuge Assembly Areas

Centrifuge components are assembled into complete centrifuges in these areas. Assembly operations are carried out in one production line. The centrifuge operates in a vacuum; therefore, centrifuge assembly activities are undertaken in clean-room conditions to prevent ingress of volatile contaminants, which would have a detrimental effect on centrifuge performance. Prior to installation into the cascade, the centrifuge has to be conditioned, which is done in the Centrifuge Assembly Areas prior to storage in the Assembled Centrifuge Storage Areas.

Assembled Centrifuge Storage Areas

Assembled and conditioned centrifuges are stored in the Assembled Centrifuge Storage Areas prior to installation. During construction of the plant, a separate installation team will access these areas and transfer the assembled and conditioned centrifuges to the Cascade Halls for installation.

Centrifuges are to be routed via a covered communication corridor, which links the CAB with the Separations Building Modules.

Building Office Area

A general office area is located adjacent to the assembly areas. It contains the main personnel entrance to the building as well as entrances to the assembly storage and assembly workshop. It is a two-story area, which includes:

- Offices
- Change Rooms
- Break Room
- Maintenance Area
- Chemical Storage Area
- Battery Charging Area.

Centrifuge Test and Post Mortem Facilities

The Centrifuge Test Facility provides an area to test the functional performance of production centrifuges and ensure compliance with design parameters. It also provides an area to investigate production and operational problems. The demand for centrifuge post mortems is infrequent.

The principal functions of the Centrifuge Post Mortem Facility are to:

- Facilitate dismantling of contaminated centrifuges using equipment and processes that minimize the potential to contaminate personnel or adjacent facilities
- To prepare potentially contaminated components and materials for transfer to the TSB prior to disposal.

Centrifuges are brought into the facility on a specially designed transport cart via an airlock entry. The facility is also equipped with radiological monitoring devices, toilets and washing facilities; and hand, foot and clothing personnel monitors to detect surface contamination.

The Centrifuge Post Mortem Facility includes a centrifuge dismantling area and an inspection area. The centrifuge dismantling area includes a stand onto which the centrifuge to be dismantled is mounted providing access to the top and bottom of the centrifuge. A local jib crane is located over the stand to enable removal of the centrifuge from the transport cart and facilitate loading onto the stand.

The inspection area includes an inspection bench, portable lighting, a microscope, an endoscope and a digital video/camera.

2.1.2.3.6 Cylinder Receipt and Shipping Building (CRSB)

The CRSB is located near the Cylinder Storage Pads. All UF_6 cylinders are received and shipped from this location. It is designed to include space for the following:

- Loading and unloading of cylinders
- Preparation of cylinder overpack protective packaging, as required.

Cylinders are delivered to the facility in transport trucks. The trucks park inside the CRSB at the main vehicle loading bay. Girder bridge cranes load and unload the cylinders from the trucks and handle the cylinders within the CRSB. The cranes span the width and run the full length of the building.

After delivery, the cylinders are processed for receipt as empty tails cylinders (48Y cylinders), empty product cylinders (30B cylinders) or UF_6 feed cylinders (48Y cylinders). They are inspected and moved to their appropriate locations.

All cylinders shipped from the site are processed through the CRSB.

2.1.2.3.7 Electrical Services Building (ESB)

The Electrical Services Building is located immediately north of the Separation Building Modules. It houses four standby diesel generators (DGs), which provide the site with standby power.

The building also contains day tanks, switchgears, control panels, and building heating, ventilation, and air conditioning (HVAC) equipment. The rooms housing the DGs are constructed independent of each other with adequate provisions made for maintenance, as well as equipment removal and equipment replacement via roll-up and access doors.

The diesel fuel unloading area provides tanker truck access to the two above ground tanks, which provide diesel fuel storage. Secondary containment (berms) will be provided to contain spills or leaks from the two above ground diesel fuel tanks. The above ground diesel storage tank area will be included in the site Spill Prevention Control and Countermeasures (SPCC) plan.

2.1.2.3.8 Mechanical Services Buildings (MSBs)

The Mechanical Services Buildings are located south of the Separation Building Modules. They house air compressors, the demineralized water systems, and the centrifuge cooling water system pumps, heat exchangers and expansion tanks.

2.1.2.3.9 Cylinder Storage Pads

The EREF uses several outside areas for storage of full cylinders containing UF_6 and empty cylinders.

Cylinders containing UF_6 that is depleted in ^{235}U are temporarily stored on the Full Tails Cylinder Storage Pads. The depleted UF_6 is stored under vacuum in corrosion resistant Type 48Y cylinders. Approximately 1,222 full tails cylinders per year could be stored on the storage pads. A storage area to support lifetime plant operations would need to accommodate a maximum of 25,718 cylinders of depleted uranium. These cylinders could be stacked two high and are temporarily stored on concrete saddles that elevate the cylinders approximately 0.2 m (0.65 ft) above ground level. (See ER Section 4.13.3.2, DUF_6 Cylinder Temporary Storage.) Transporters move the cylinders from the Blending, Sampling, and Preparation Building out to the Full Tails Cylinder Storage Pads, where cranes remove the cylinders from the transporters and place them on the storage pads. Since it is expected that full tails storage cylinders will be shipped offsite soon after they are filled, the storage pads will be developed in sections over the life of the facility on an as-needed basis.

Full feed cylinders containing natural UF_6 will be temporarily stored on the Full Feed Cylinder Storage Pads prior to use in the facility. The pads are sized to store approximately 712 full feed cylinders. Full feed cylinders will not be stacked. Transporters will move the cylinders after delivery to the Cylinder Receipt and Shipping Building out to the Full Feed Cylinder Storage

Pads, where cranes remove the cylinders from the transporters and place them on the storage pads. The full feed cylinders will be subsequently transported to the Blending, Sampling, and Preparation Building prior to use in the UF_6 Handling Area.

Empty cylinders (feed, product and tails) will be temporarily stored (up to six months) on the Empty Cylinder Storage Pads. The pads are sized to store approximately 1,840 empty cylinders. Empty cylinders can be stacked two high. Transporters will move the empty cylinders from various areas of the facility out to the Empty Cylinder Storage Pads, where cranes remove the cylinders from the transporters and place them on the storage pads. Empty cylinders will subsequently be transported to the Blending, Sampling, and Preparation Building for use.

The Full Tails, Full Feed, and Empty Cylinder Storage Pads are at the north end of the facility and are adjacent pads.

Full product cylinders containing enriched UF_6 will be temporarily stored on the Full Product Cylinder Storage Pad prior to shipment offsite to a fuel fabrication facility. The pad is sized to store approximately 1,032 full product cylinders. Full product cylinders will not be stacked. Transporters will move the recently filled cylinders from the Blending, Sampling, and Preparation Building out to the Full Product Cylinder Storage Pad, where cranes remove the cylinders from the transporters and place them on the storage pad. The full product cylinders will subsequently be transported to the Cylinder Receipt and Shipping Building prior to shipment offsite.

The Full Product Cylinder Storage Pad is located near the Blending, Sampling, and Preparation Building adjacent to the Cylinder Receipt and Shipping Building.

The Cylinder Overpack Storage Pad is also located near the Blending, Sampling, and Preparation Building adjacent to the Cylinder Receipt and Shipping Building. The cylinder overpack protective packaging is stored on this pad.

2.1.2.3.10 Administration Building

The Administration Building is on the south end of the site near the Security and Secure Administration Building. It contains general office areas. All personnel access to the plant occurs at this location. Vehicular traffic passes through a security checkpoint before being allowed to park. Parking is located outside of the Controlled Access Area (CAA) security fence. Personnel enter the Administration Building and general office areas via the main lobby.

Approximately 30 work locations are provided for the plant office staff. The office environment consists of private, semiprivate, and open office space. It also contains a kitchen, break room, conference rooms, building service facilities such as the janitor's closet and public telephone, and a mechanical equipment room.

2.1.2.3.11 Security and Secure Administration Building

The Security and Secure Administration Building is on the south end of the site near the Administration Building. It contains secure office areas and the Entry Exit Control Point (EECP) for the facility. All personnel access to inside areas of the plant occurs at this location. Personnel enter the Security and Secure Administration Building after passing through the Administration Building.

Personnel requiring access to facility areas or the CAA must pass through the EECP. The EECP is designed to facilitate and control the passage of authorized facility personnel and visitors.

Entry to the plant area from the Security and Secure Administration Building is only possible through the EECP. Approximately 20 work locations are provided for the plant office staff. The office environment consists of private, semiprivate, and open office space. It also contains a kitchen, break room, conference rooms, building service facilities such as the janitor's closet and public telephone, and a mechanical equipment room.

2.1.2.3.12 Guard House

The Guard House is located at the entrance to the plant. It functions as a security checkpoint for all incoming and outgoing traffic. Employees, visitors and trucks that have access approval will be screened at the main Guard House.

2.1.2.3.13 Visitor Center

A Visitor Center is located outside the security fence area near Highway 20.

2.1.2.3.14 Electrical Services Building for the CAB (ESB-CAB)

The ESB-CAB houses four transformers and switchgear, which provide the CAB and the adjacent long term warehouse with power. The building contains switchgear, transformers, and control and lighting panels. The rooms are sized with adequate provisions made for maintenance, as well as equipment removal and equipment replacement.

2.1.2.3.15 Gasoline and Diesel Fueling Station

A Gasoline and Fueling Station is located to the northeast of the CAB. The GDFS supports vehicle fueling from an adjacent fuel pump island and on-site vehicle repair and maintenance conducted inside the building.

2.1.2.4 Process Control Systems

The EREF uses various operations and Process Controls Systems to ensure safe and efficient plant operations. The principal process systems include:

- Decontamination System
- Liquid Effluent Collection and Treatment System
- Solid Waste Collection System
- Gaseous Effluent Ventilation System
- Centrifuge Test Facility and Post Mortem Gaseous Effluent Ventilation System
- Centrifuge Test and Post Mortem Facilities Exhaust Filtration System
- Technical Support Building Contaminated Area Heating, Ventilation and Air Conditioning (HVAC) System
- Ventilated Room Heating, Ventilation and Air Conditioning (HVAC) System

2.1.2.4.1 Decontamination System

The Decontamination System is designed to remove radioactive contamination - in the form of uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4) and uranyl fluoride (UO_2F_2), i.e., uranium compounds from contaminated materials and equipment. The system consists of a series of steps, including equipment disassembly, degreasing, decontamination, drying, and inspection.

Items commonly decontaminated include pumps, valves, piping, instruments, sample bottles, and scrap metal. Decontamination is typically accomplished by immersing the contaminated component in a 5% citric acid bath with ultrasonic agitation, rinsing with water, drying using compressed air, and then inspecting before release. The process time is about one hour for most plant components. Liquid waste is sent to the Liquid Effluent Collection and Treatment System; solid waste/sludge to the Solid Waste Collection System, and enclosure exhaust air to the Gaseous Effluent Ventilation System prior to venting.

2.1.2.4.2 Liquid Effluent Collection and Treatment System

The Liquid Effluent Collection and Treatment System collects potentially contaminated liquid effluents that are generated in a variety of plant operations and processes. These liquid effluents are collected and stored in tanks prior to processing. The effluent input streams include hydrolyzed UF_6, degreaser water, citric acid, floor wash water, and miscellaneous effluent. The contaminated liquids are processed for uranium removal. Refer to ISA Summary Section 3.5 for additional information.

These liquid effluents are processed through several precipitation units, filtration units, microfiltration units and evaporation units. The final step uses an evaporation process that discharges clean steam to the atmosphere. The remaining solid waste is shipped offsite for disposal at an approved facility.

2.1.2.4.3 Solid Waste Collection System

Solid wastes are generated in two categories: wet and dry. The Solid Waste Collection System is simply a group of methods and procedures that apply, as appropriate, to the two categories of solid wastes. The wet waste portion of the system handles all plant radiological, hazardous, and industrial wastes. Input streams include oil recovery sludge, oil filters, and miscellaneous hazardous materials. Each is segregated and handled by separate procedures. The dry waste portion (i.e., liquid content is 1% or less of volume) input streams include activated carbon, aluminum oxide, sodium fluoride, filters, scrap metal, nonmetallic waste and miscellaneous hazardous materials. The wastes are likewise segregated and processed by separate procedures.

2.1.2.4.4 Gaseous Effluent Ventilation System

The Gaseous Effluent Ventilation System (GEVS) is designed to route some of the potentially contaminated gaseous streams in the Separations Building Modules (SBM), the Blending, Sampling, and Preparation Building and the Technical Support Building (TSB) that require treatment before discharge to the atmosphere. Each SBM and the TSB have an independent GEVS. The systems routes these streams through filter systems prior to exhausting via independent exhaust vents. The filter systems include a pre-filter, HEPA filter, potassium carbonate impregnated activated carbon filter and a final HEPA filter.

After filtration, the clean gases pass through a fan, which maintains the negative pressure upstream of the filter station. The clean gases are then discharged through the monitored (alpha and HF) exhaust vent on the building roofs.

Potentially contaminated gaseous streams in the SBM include cylinder operations at the stations and maintenance activities. Potentially contaminated gaseous streams in the TSB include the Chemical Trap Workshop, Mobile Unit Disassembly and Reassembly Workshop, Valve and Pump Dismantling Workshop, Maintenance Facility, Decontamination Workshop, Sub Sampling Unit Room, Mass Spectrometer Lab, Analytical Chemistry Lab, Liquid Effluent Collection and Treatment System tank vents. Potentially contaminated gaseous streams in the Blending, Sampling, and Preparation Building include blending operations, liquid sampling operations, cylinder preparation activities, and the Ventilated Room.

2.1.2.4.5 Centrifuge Test and Post Mortem Facilities Gaseous Effluent Ventilation System

The Centrifuge Test and Post Mortem Facilities Gaseous Effluent Ventilation System is used to collect and treat exhaust of potentially hazardous contaminants from the Centrifuge Test and Post Mortem Facilities. The Centrifuge Test and Post Mortem Facilities Gaseous Ventilation System is located in the Centrifuge Assembly Building and is monitored from the Control Room.

The ductwork is connected to one filter station and vents through a fan. The filter station and fan can handle 100% of the effluent. Operations that require the Centrifuge Test and Post Mortem Facilities Gaseous Effluent Ventilation System to be operational are manually shut down if the system shuts down. The filter system includes a single train of filters consisting of a pre-filter, HEPA filter, potassium carbonate impregnated activated carbon filter and a final HEPA filter. After filtration, the clean gases pass through a fan, which maintains the negative pressure upstream of the filter station. The clean gases are then discharged through the monitored (alpha and HF) exhaust vent on the Centrifuge Assembly Building.

2.1.2.4.6 Centrifuge Test and Post Mortem Facilities Exhaust Filtration System

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System ensures the Centrifuge Post Mortem Facility is maintained at a negative pressure with respect to adjacent areas. The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is located in the Centrifuge Assembly Building and is monitored from the Control Room.

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System consists of a 100% filter-fan unit. The filter-fan unit can handle 100% of the effluent. The filter-fan unit operates when the Centrifuge Test and Post Mortem Facilities are in operation and is manually shut down if the Centrifuge Test and Post Mortem Facilities are shutdown. The exhaust flow from the filter-fan unit is discharged to atmosphere through the monitored (alpha and HF) exhaust vent located on the Centrifuge Assembly Building roof.

2.1.2.4.7 Technical Support Building Contaminated Area Heating, Ventilation and Air Conditioning (HVAC) System

The Technical Support Building Contaminated Area HVAC System maintains temperature for various areas of the TSB. For the potentially contaminated areas in the TSB, which include the Chemical Trap Workshop, Mobile Unit Disassembly and Reassembly Workshop, Valve and Pump Dismantling Workshop, Decontamination Workshop, and Maintenance Facility, the TSB Contaminated Area HVAC system maintains a negative pressure in these rooms and discharges the room air to an exhaust vent on the TSB roof. The system provides for continuous alpha and HF monitoring.

2.1.2.4.8 Ventilated Room Heating, Ventilation and Air Conditioning (HVAC) System

The Ventilated Room HVAC System maintains a negative pressure in the Ventilated Room, which is located in the BSPB, and discharges the room air to an exhaust vent on the BSPB roof. The system provides for continuous alpha and HF monitoring.

2.1.2.5 Site and Nearby Utilities

Site water wells will provide water to the site. Water consumption for the EREF is calculated to be 68.2 m^3/day (18,000 gal/d) to meet potable and process consumption needs. Peak water usage for fire protection is 24 L/s (375 gal/min). Electrical service to the site will be provided by Rocky Mountain Power (RMP). The projected demand is approximately 78 MVA. A sanitary sewage treatment system will be installed onsite for the collection and treatment of sanitary and non-contaminated liquid wastes.

Identified, onsite pipelines include 20.3 to 30.5 cm (8 to12 in) diameter, underground steel and PVC water pipe lines connected to Lava Well 3 located in the northeast corner of the site buried 61 to 122 cm (2 to 4 ft) deep. Also included in this area are buried and above ground electrical utility lines servicing the well pump and center pivots used for crop irrigation. The buried electrical lines run between 91 to 122 cm (3 to 4 ft) deep. An above ground electrical line also runs from a point near Highway 20 to the potato cellar located on the south end of the site. A 3.8 to 5 cm (1 to 2 in) buried PVC water line used to service cattle troughs runs from the southeast corner to the northwest corner of the site. These water lines are buried 30.5 to 61 cm (12 to 24 in) deep. A buried electric line and a fiber optic line are located along the north side of Highway 20 within the Right of Way. There are two agricultural wells, referred to as Lava Well 3 and Spud Well, that were previously installed at the proposed site. Lava Well 3 is located in the northeast corner of the site. Spud Well is at the south end of the site near Highway 20. Two buried fuel tanks located near the Lava Well 3 were recently removed by the property owners. There are no known existing onsite underground storage tanks or sewer systems. There are no gas lines on the site.

Detailed information concerning water resources and the use of potable water supplies is discussed in ER Section 3.4, Water Resources, and the impacts from these water resources are discussed in ER Section 4.4, Water Resources Impacts. A discussion of impacts related to utilities that will be provided to the site is included in ER Section 4.1, Land Use Impacts.

2.1.2.6 Chemicals Used at EREF

The EREF uses various types and quantities of non-hazardous and hazardous chemical materials. Table 2.1-1, Chemical Hazard Classification, lists the hazardous chemicals associated with the EREF operation and their associated hazards. Tables 2.1-2 through 2.1-6 summarize the chemicals (non-hazardous and hazardous) in use and storage, categorized by building or area. These tables also include the physical state and the expected quantity of chemical materials.

2.1.2.7 Monitoring Stations

The EREF will monitor both non-radiological and radiological parameters. Descriptions of the monitoring stations and the parameters measured are described in other sections of this ER as follows:

- Meteorology (ER Chapter 3, Section 3.6)
- Water Resources (ER Chapter 3, Section 3.4)
- Radiological Effluents (ER Chapter 6, Section 6.1)
- Physiochemical (ER Chapter 6, Section 6.2)
- Ecological (ER Chapter 6, Section 6.3)

2.1.2.8 Summary of Potential Environmental Impacts

The following is a summary of the impacts from undertaking the proposed action and measures used to mitigate impacts. Table 2.1-7, Summary of Environmental Impacts for the Proposed Action, summarizes the impact by environmental resource and provides a reference to the corresponding section in ER Chapter 4, Environmental Impacts, which includes a detailed description of the impacts. Detailed discussions of proposed mitigation measures and environmental monitoring programs are provided in ER Chapter 5, Mitigation Measures, and Chapter 6, Environmental Measurements and Monitoring Programs, respectively.

Operation of the EREF would result in the production of gaseous, liquid, and solid waste streams. Each stream could contain small amounts of hazardous and radioactive compounds either alone or in a mixed form.

Gaseous effluents from both non-radiological and radiological sources will be below regulatory limits as specified in permits issued by the Idaho Department of Environmental Quality Air Quality Division (IDEQ/AQD) (IDAPA, 2008i) and release limits by NRC (CFR, 2008x). Thus, potential impacts to members of the public and workers will be minimal.

Liquid effluents would include stormwater runoff and treated sanitary wastewaster from the site Domestic Sanitary Sewage Treatment Plant. All proposed liquid effluents would be discharged on site to the evaporative retention basin.

General site stormwater runoff is collected and released untreated to the Site Stormwater Detention Basin. Two single-lined retention basins, the Cylinder Pads Stormwater Retention Basins, will collect stormwater runoff from Cylinder Storage Pads (Full Feed Cylinder Storage Pads, Full Tails Cylinder Storage Pads, Empty Cylinder Storage Pads and Full Product Cylinder Storage Pad). Treated effluent from the site domestic sanitary sewage treatment plant will also be discharged to the two single-lined Cylinder Storage Pads Stormwater Retention Basins. All stormwater discharges will be regulated, as required, by a National Pollutant Discharge Elimination System (NPDES) Stormwater permit. Approximately 65,240 m^3/yr (17,234,700 gal/yr) of stormwater from the Cylinder Storage Pads are expected to be released, based on mean precipitation discharging to the Cylinder Storage Pads Stormwater Retention Basins. There is no infiltration into the site soils. Based on mean annual precipitation, approximately 85,175 m^3/yr (22,501,000 gal/yr) of stormwater runoff from the site is expected to be released annually to the Site Stormwater Detention Basin. This value takes into account infiltration into the area soils associated with landscaped areas, natural areas and loose gravel areas of the developed portion of the site providing stormwater runoff reaching the Site Stormwater Detention Basin.

EREF liquid effluent discharge rates would be relatively low; for example, total annual discharge from the site domestic sanitary sewage treatment plant is expected to be approximately 18,700 m^3/yr (4,927,500 gal/yr). This discharge source is not expected to contain any uranic material. These treated discharges would be collected and contained in the single-lined Cylinder Storage Pads Stormwater Retention Basins. Emergency hand washing and shower water is collected, monitored and treated by the Liquid Effluent Collection Treatment System as necessary.

Groundwater from two on-site wells would supply water for the proposed EREF. The wells could supply up to 1,713 m^3/day (452,500 gpd) under the current property water appropriation. Average and peak potable water requirements for operation of the EREF are expected to be approximately 68.2 m^3/day (18,000 gpd) and 47 L/sec (739 gpm), respectively. These usage rates are well within the capacities of the wells and are under the appropriation.

The preferred location for non-hazardous construction-related waste is the Bonneville County's construction and demolition landfill (currently the Hatch Pit). When the Hatch Pit approaches its maximum capacity as determined by Bonneville County, a new landfill for construction and demolition wastes will either be opened by Bonneville County or another location found, as alternative locations for disposal of non-hazardous construction-related waste exist in Bingham and Jefferson Counties. These counties are within a reasonable haul distance of the EREF. AES contacted these counties and both acknowledged that they accept construction and demolition waste from outside their respective borders.

Solid waste that would be generated at the proposed EREF, which falls into non-hazardous, radioactive, hazardous, or mixed waste categories, would be collected and transferred to authorized treatment or disposal facilities off site as follows. All solid radioactive waste generated would be Class A low-level waste as defined in 10 CFR 61 (CFR, 2008ee). Approximately 146,500 kg/yr (323,000 lbs/yr) of low-level waste would be generated. During operation, the proposed EREF would generate about 5,062 kg/yr (11,160 lbs/yr) of hazardous waste and about 100 kg/yr (220 lbs/yr) of mixed wastes. As a result, the EREF would be a small quantity generator (SQG) of hazardous waste, which would be disposed by licensed contractors. AES does not plan to treat hazardous waste or store quantities longer than 180 days. Non-hazardous and industrial waste, expected to be approximately 70,307 kg/yr (155,000 lbs/yr) annually, would be collected and disposed of by a licensed solid waste disposal contractor. For example, the non-hazardous wastes could be disposed of in the Bonneville County Peterson Hill Landfill. This landfill accepted 81,647 MT (90,000 tons) of waste in 2007. The estimated annual non-hazardous waste would represent less than 0.01% of the total annual waste accepted at the landfill. This landfill will maintain this yearly 81,647 MT (90,000 tons) waste capacity for the next 80 years.

No communities or habitats defined as rare or unique, or that support threatened and endangered species, have been identified as occurring on the EREF site. Thus, proposed activities are not expected to impact communities or habitats defined as rare or unique, or that support threatened and endangered species, within the 1,700-ha (4,200-ac) proposed site.

Noise generated by the operation of the proposed EREF would be primarily limited to the area immediately surrounding the proposed EREF footprint and U.S. Highway 20. Noise from traffic on U.S. Highway 20 associated with deliveries and worker vehicles during the operation of the proposed EREF would be heard at residences along U.S. Highway 20. There is considerable existing traffic already present on U.S. Highway 20. Therefore, maximum noise levels would not increase, although there would be a longer duration of noise associated with peak commute traffic.

A pedestrian cultural resource survey of the area where the proposed EREF is to be located was conducted from April through July, 2008. The survey resulted in the recording of 11 sites and 17 isolated occurrences (finds); there are three prehistoric, four historic, and four multi-component sites. Further investigation was conducted to determine the national Register of Historic Places (NRHP) eligibility for the prehistoric components of three sites (MW002, MW012, and MW015). Subsequent testing of these sites resulted in a recommendation of not eligible. The historic component of one site (MW004) is recommended as eligible. Seven sites (MW003, MW006, MW007, MW009, MW011, MW013, and MW014) are recommended not eligible for inclusion in the NRHP. The potentially eligible site is within the proposed plant footprint. A treatment/mitigation plan for MW004 will be developed by AES in consultation with the Idaho SHPO to recover significant information. Therefore, the impact on archaeological and cultural resources would be small.

The size and industrial nature of this proposed plant would be new to the immediate area. However, similarly sized industrial facilities are located west of the proposed site. The proposed facility would be about 2.4 km (1.5 mi) or greater from public viewing areas such as U.S. Highway 20, the Wilderness Study Area and the Wasden Complex, making details of the proposed facility difficult to observe. Therefore, the impact on views would be small.

The results of the economic analysis show that the greatest fiscal impact will derive from the 11-year construction period (including four years of assemblage and testing) associated with the proposed facility. The largest impact on local business revenues stems from local construction expenditures, while the most significant impact in household earnings and jobs is associated with construction payroll and employment projected during the 11-year construction period.

Annual facility operations will involve up to 550 employees receiving pay of $36.6 million and $12.7 million in benefits. AES expects that most of these jobs will be filled by residents of the nearby 11-counties, providing numerous opportunities in construction of new housing, in provision of services, and in education. EREF operations could have minor impacts on local public services including education, health services, housing, and recreational facilities, but are anticipated to be minimal.

Radiological release rates to the atmosphere during normal operations are estimated to be less than 19.5 MBq/yr (528   Ci/yr). As stated above, EREF liquid discharges are not expected to contain any uranic material. Estimated annual effective dose equivalents and critical organ (lung) dose equivalents from discharged gaseous effluent to a maximally exposed teen individual located at the plant site boundary are 8.8E-04 mSv (8.8E-02 mrem) and 6.4E-03 mSv (6.4E-01 mrem), respectively. The annual effective dose equivalent and critical organ (teen-lung) dose equivalents from discharged gaseous effluent to the nearest resident located beyond 8 km (5 mi) in any sector are expected to be less than 3.5E-05 mSv (3.5E-03 mrem) and 2.6E-04 mSv (2.6E-02 mrem), respectively.

These dose equivalents due to normal operations are small fractions of the normal background radiation range of 2.0 to 3.0 mSv (200 to 300 mrem) dose equivalent that an average individual receives in the United States (NCRP, 1987a), and within regulatory limits (CFR, 2008x). Given the conservative assumptions used in estimating these values, these concentrations and resulting dose equivalents are insignificant, and their potential impacts on the environment and health are inconsequential.

Operation of the EREF would also result in the annual nominal production of approximately 15,270 MT (16,832 tons) per year of depleted UF_6. The depleted UF_6 would be temporarily stored on site in depleted uranium tails cylinders and would have minor impact while in storage. The maximum annual dose equivalent due to external radiation from the cylinder storage pads (skyshine and direct) is estimated to be less than 1.5E-02 mSv (1.5 mrem) to the maximally exposed person at the nearest point on the site boundary (2,000 hrs/yr) and less than 1.0E-12 mSv (less than 1E-10 mrem) to the maximally exposed resident (8,760 hrs/yr) located approximately 8 km (5 mi) from the cylinder storage pads.

Based on 2000 U.S. Census Bureau data, construction and/or operation of the EREF would not pose a disproportionate impact to the minority or low-income populations within Bonneville, Bingham, and Jefferson counties.

2.1.3 Reasonable Alternatives

This section includes a discussion of alternative enrichment technologies available for an operational enrichment facility, significant alternative designs selected for the Eagle Rock Enrichment Facility (EREF) to improve environmental protection, and the site selection process AES used to select the proposed EREF site and to identify alternatives to that site.

2.1.3.1 Alternative Technologies

AES proposes to use the gas centrifuge enrichment process at the EREF. The gas centrifuge technology used by AES (i.e., Enrichment Technology Company (ETC) technology that is operated by Urenco at three facilities in Europe) has been operated and improved several times over the past 35 years. AES considers the alternative technologies of gaseous diffusion or laser enrichment, to be unreasonable due to their high operating, economic, and environmental costs and/or lack of demonstrated commercial viability.

Gaseous diffusion technology involves the pumping of gaseous uranium hexafluoride (UF_6) through diffusion barriers, resulting in the gas exiting the barrier being slightly enriched ^{235}U isotope. The diffusion barriers and their associated compressed gases are staged, similar to the staging of centrifuges, to produce higher enrichments. The technology, which was developed in the United States during the 1940s, would entail increased capital cost requirements and excessive electrical energy consumption, without obvious environmental advantages. The amount of energy to produce one separative work unit (SWU) is about 50 times greater than the energy required for centrifuge technology (NRC, 1994). Gaseous diffusion technology is currently being used by the U.S. Enrichment Corporation (USEC) at its Paducah facility.

There are two types of laser enrichment technologies, the AVLIS and SILEX technologies. The development of the AVLIS technology has involved USEC. AVLIS is the Atomic Vapor Laser Isotopic Separation process based on selective photo-ionization (through a laser light) and subsequent separation of ^{235}U atoms from vaporized uranium metal. This technology was proposed as a commercial venture by USEC and its partners in the late 1990s, but soon suspended due to operating and economic factors.

SILEX (Separation of Isotopes by Laser Excitation) is an advanced laser-based process developed by the Australian company, SILEX Systems, Ltd. Particularly, the SILEX technology is a molecular process, which uses lasers that expose ^{235}U and ^{238}U isotopes to an intense monochromatic laser light, producing ionization in one isotope (in this case, ^{235}U), but not in the others. This results in isotope separation and leaves one isotope enriched and the others relatively unaffected. (SILEX, 2008)

General Electric (GE)-Hitachi Nuclear Energy (GEH) has initiated work that is based on SILEX laser enrichment technology (GLE) On January 30, 2009, GEH delivered its environmental report to the NRC with the rest of the license application to be submitted by June 2009 (SILEX, 2009). If GEH ultimately makes the decision to deploy GLE commercially, following results of testing that is scheduled to occur during 2009, GEH then expects to have a commercial Lead Cascade operational by 2012 or 2013. Accordingly, the commercialization of the SILEX enrichment process is still in the early stages of development. Hence, the SILEX laser enrichment technology continues to lack demonstrated commercial viability.

2.1.3.2 Alternative Designs

The EREF design is, in effect, an enhancement to the design of the Claiborne Enrichment Center formerly proposed by Louisiana Energy Services (LES). LES submitted a license application to NRC in 1991 for the proposed Claiborne Enrichment Center. Although the NRC staff approved the Claiborne Enrichment Center design, the underlying ETC (formerly Urenco) centrifuge plant design has undergone certain enhancements in recent years due to operating experience in Europe. Summarized below are the six systems with significant features that have been incorporated into the EREF to improve plant efficiency and further reduce environmental impacts. They include the Cascade System, UF_6 Feed System, Product Take-Off System, Product Liquid Sampling System, Product Blending System, and Tails Take-Off System. Similar improvements are also included in the NRC-licensed, and currently under construction, LES National Enrichment Facility (NEF) in New Mexico.

The primary difference between the Claiborne Enrichment Center and the EREF cascade systems is that all assay units are now identical, whereas in the Claiborne Enrichment Center, one assay unit was designed to produce low assays - in the region of 2.5%. An additional change is the increase from seven Cascades per Cascade Hall to twelve Cascades per Cascade Hall. Maximum Cascade Hall capacity has been increased to 825,000 SWU/yr.

There are two major differences in the "UF_6 Feed System" for the EREF as compared to the Claiborne Enrichment Center. First, the liquid UF_6 phase above atmospheric pressure has been eliminated. Sublimation from the solid phase directly to the gaseous phase below atmospheric pressure is the process proposed in the EREF. A sealed autoclave is replaced with a Solid Feed Station enclosure for heating the feed cylinder. A second major difference is the use of chilled air to cool the feed purification cylinder rather than chilled water.

The EREF "Product Take-Off System" uses a process similar to the Claiborne Enrichment Center, but there are differences. In the current system there is only one product pumping stage, while the Claiborne Enrichment Center used two pumping stages to transport the product for desublimation. In this system, pressures are controlled such that desublimation cannot occur in the piping, eliminating the need for heat tracing and valve hot boxes. In the Claiborne Enrichment Center the product cylinder stations relied on common chillers to cool the stations, but the current system uses a dedicated chiller for each station. The cold traps used to desublime any UF_6 in the vent gases are smaller than in the Claiborne Enrichment Center design and each is on load cells to continuously monitor accumulation.

EREF’s "Product Liquid Sampling System" uses a process very similar to Claiborne Enrichment Center. EREF has a permanent vent system, the Blending and Sampling Vent Subsystem, rather than a mobile unit as used in Claiborne Enrichment Center.

The EREF "Product Blending System" uses a process similar to the Claiborne Enrichment Center, but one major difference is that the EREF uses Solid Feed Stations to heat the donor cylinders. In the EREF system, the feed material is heated and sublimed directly to a gas under low pressure. Autoclaves were used to heat the donor cylinders in the Claiborne Enrichment Center. In that system, the feed material was heated to a liquid and then drawn off as a gas. The EREF utilizes two Product Blending Subsystems with a total of three donor stations and three receiver stations. Another difference is the use of a dedicated vacuum pump/trap set in the current design versus a mobile set in the Claiborne Enrichment Center.

EREF's "Tails Take-Off System" uses a process similar to the Claiborne Enrichment Center, but there are differences. In the new system there is only one depleted UF_6 pumping stage, while the Claiborne Enrichment Center used two pumping stages to transport the depleted UF_6 for desublimation. Depleted UF_6 is desublimed in cylinders cooled with chilled air in the current system, while the Claiborne Enrichment Center used chilled water to cool the cylinders. The Claiborne Enrichment Center contained a total of ten tail cylinders in five double cooling stations for each Separation Plant Module (two Cascade Halls), but the EREF system uses eleven cylinders in single cooling stations for each Cascade Hall. Finally, the current system has a dedicated vacuum pump/trap set for venting and does not use the Feed Purification System like the Claiborne Enrichment Center.

In addition to enhancements in the EREF design as compared to the Claiborne Enrichment Center, the EREF design of the Separations Building Modules (SBM) Gaseous Effluent Ventilation System (GEVS) is an improvement over that licensed by LES for the NEF. The EREF GEVS consists of two separate systems. The “Items Relied on for Safety (IROFS)” portion of GEVS called the GEVS with Passive IROFS that Contain Safe-by-Design Component Attributes is sized and arranged such that a nuclear criticality cannot occur. The other portion of the GEVS, local extraction, is not connected to any sources of enriched material.

Other differences between EREF and NEF include:

- EREF does not utilize cooling towers and therefore, uses much less water since evaporative losses and cooling tower blowdown are eliminated.
- EREF will use evaporators in the liquid effluent treatment system and therefore, eliminate the need to discharge treated process water to an onsite basin.
- EREF has redesigned the NEF Technical Services Building into two separate buildings: Technical Support Building (TSB) and Operation Support Building (OSB). The TSB will contain the radiological support functions and the OSB will contain only non-radiological support functions. This design allows for more compact control of the facility’s radiological areas.
- EREF does not utilize a circulating water system for the building HVAC air-conditioning units. The use of glycol, biocides and other chemicals to treat this water is eliminated.
- EREF HVAC units include economizer sections which allow for full outside air intake during moderate weather conditions, thus minimizing the use of air-conditioning compressors and associated electrical power.

Beyond other minor changes, there were no other major design alternatives considered by AES that could further lower the impact of the EREF on the environment.

2.1.3.3 Alternate Sites

AES plans to construct and operate a uranium enrichment facility in the United States (U.S.). Site selection is one of the first steps of this process. The selection process needs to identify a site that will meet AES’s technical specifications, business and sustainable development standards, safety requirements, and minimize environmental impacts. The process must also meet environmental review requirements under the National Environmental Policy Act of 1969 as implemented by the U.S. Nuclear Regulatory Commission (NRC) codified in 10 CFR Part 51 (CFR, 2008a) for NRC license applications. In particular, the environmental report (ER) prepared by AES should consider the full range of reasonable alternatives, including alternative sites. The ER should evaluate potential impacts of alternatives at a similar level of detail and compare the results of the evaluation. Therefore, the site selection process must use consistent evaluation criteria, data, and analytical processes; and all steps need to be documented. This report describes the site selection process and results.

2.1.3.3.1 Methodology

AES used a four-step process to select a preferred site that meets technical, environmental, safety, and business requirements. The steps included: (1) identifying potential regions and sites, (2) screening candidate sites (Phase I), (3) evaluation of sites passing Phase I criteria (Phase II), and (4) identifying a preferred site. AES also used three primary siting objectives throughout the four-step process; these objectives were: (1) meet technical requirements, (2) be environmentally acceptable, and (3) provide operational efficiencies.

Step 1 Identification of Potential Regions and Sites

The region of interest for this project was the continental United States. AES conducted an initial review of the contiguous U.S. to identify smaller regions that met fundamental operating requirements of low seismic hazard and low likelihood of extreme weather conditions. Unstable seismic settings and extreme weather conditions can affect safety, design costs, and operational continuity.

The four criteria used to identify suitable regions were: (1) peak ground acceleration, (2) tornado frequency, (3) hurricane frequency, and (4) severe winter weather. Peak ground acceleration (PGA) was selected because of centrifuge sensitivity to vibrations. A PGA greater than 0.09 g was identified as exceeding upper design-cost limits. Constructing the facility in areas with a PGA no greater than 0.09 g was considered to be necessary to meet design standards, safety requirements, and operational requirements. United States Geologic Survey (USGS) general seismic hazard maps were evaluated through the nationalatlas.gov interactive map system. Areas with a PGA greater than 0.09 g (10 percent probability of exceedance in 50 years) were avoided. Tornado event frequency was selected because of its influence on design to meet safety requirements. Constructing the facility in areas having a tornado design wind speed no greater than 160 mph (probability of 10^{-5} yr^{-1}) was considered to be cost prohibitive to meet design standards and safety requirements. Areas were identified using general maps in NRC NUREG/CR-4461 (NRC, 2007b). Areas having a tornado design wind speed of 257 km/hr (160 mi/hr) (probability of 10^{-5} yr^{-1}) were avoided. Hurricane frequency was selected because of its influence on design to meet safety requirements and potential impact on maintaining operations during an event. Constructing a facility in areas potentially affected by hurricanes with wind speeds no greater than 154 km/hr (96 mi/hr) was considered necessary to meet design standards, safety requirements, and operational requirements. Maps of the U.S. potentially affected by Category 1 though 5 hurricanes (Saffir-Simpson index) based on data from 1950 through 2003 were evaluated to identify regions with a high likelihood of impact (wind or flood damage). Areas with a high likelihood of being impacted by a hurricane with wind speeds in excess of 154 km/hr (96 mi/hr) (Saffir-Simpson scale categories 2-5) were avoided. Severe winter weather was selected because of potential impacts on maintaining operations. Road closures could impact worker safety during commutes and the ability to maintain operations if workers or materials were not able to reach the facility. National Oceanic and Atmospheric Administration (NOAA) and Federal Highway Administration (FHWA) data and maps were reviewed to evaluate frequency of snow fall and road closures. Areas with a high potential to have road closures due to winter weather were avoided.

This initial review was conducted to be inclusive of regions and to only exclude regions that clearly were in areas to be avoided because of seismic or weather concerns. Regions that were at the margins of avoidance areas were retained for further consideration. Through discussions with AES, local elected officials and economic development organizations identified and offered sites for consideration within the acceptable regions. The available site locations were overlain on general hazard maps representing seismic and weather conditions to confirm that they were in suitable regions.

Step 2 Screen Candidate Sites (Phase I)

Candidate sites passing the initial review were screened in Phase I. A set of Phase I' criteria were established to screen the sites. The Phase I' criteria were based on guidance developed by AES. The screening criteria used were: (1) Seismic History, (2) Geology, (3) Facility/Site (site size relative to facility footprint), (4) Redundant Electrical Power Supply, (5) Flooding Potential, (6) Prior Land Contamination, (7) Availability of Existing Site Data, (8) Threatened and Endangered Species Near or On-Site, (9) Sensitive Properties (e.g., National Parks), (10) Climate and Meteorology, and (11) Wetlands within the Facility Footprint on the Site.

Data were gathered for each site pertaining to each screening criterion. Data included information that was publicly available from agency and organizational websites, technical literature, and agency reports. AES met with site representatives to gain a better understanding of the sites. Site sponsors provided site-specific information on screening criteria to assist AES in screening. No other contacts were made and no field data were collected. Data sources were similar across regions and sites to ensure that data quantity and quality allowed for equitable comparisons.

Each site was evaluated against each criterion based on professional judgement. Each site assigned a “Yes” as passing the criterion while a “No” was given when a site failed the criterion. A site that failed any criterion was not carried forward into Phase II (site evaluation).

Step 3 Site Evaluation (Phase II)

Sites that passed the Phase I screening process were evaluated in greater detail in the Phase II site evaluation. A decision analysis approach known as multi-attribute utility analysis (MAUA) was used to conduct a consistent, repeatable, and documented evaluation. The method is a widely used and proven method for evaluating alternatives that address multiple objectives. The method provides a quantitative basis to evaluate the extent that alternative sites meet the project objectives. The basic steps of MAUA are:

- Establish objectives
- Identify and define criteria to measure how well an alternative achieves the objectives and place the criteria in a hierarchy under each objective. Grouping criteria into categories can improve the organization of the hierarchy for more complex processes requiring many criteria
- Assign weights to each objective, category, and criterion to calculate the relative importance (contribution to site score) of each criterion, category, and objective to selecting the site
- Develop performance measures (rating scales) for each of the criteria
- Data collection and site scoring for each criterion using the performance measures

- Combine relative importance factor and scores to obtain overall measure of desirability for each site and conduct sensitivity analysis
- A team of technical specialists, project managers, and environmental specialists worked together to develop, review and assess the product of each step. Technical staff and others participated in reiterative reviews to ensure that the MAUA approach was technically credible and defensible.

2.1.3.3.1.1 Establish Objectives

AES established three site selection objectives to reflect the diverse requirements that the project needed to meet. The three objectives were related to technical, environmental, and operational requirements of the project. The technical requirements objective reflects the need of the site and area to be seismically and structurally stable, have sufficient area for safety, have adequate electricity and water supply, an adequate workforce, and have a straight-forward mechanism for land transfer. The environmental objective reflects a need to have an environmentally acceptable site that avoids large environmental impacts. This objective also reflects adjacent land use compatibility and the quality of services and community infrastructure. The operational efficiencies objective includes low-level radioactive waste disposal options, transportation capabilities, business environment, and support from the public.

2.1.3.3.1.2 Criteria Identification and Hierarchy Organization

Thirty-eight criteria were identified to describe the objectives and to measure how well a site achieves the objectives. Criteria categories were first identified that captured critical aspects of the site-selection objectives. As shown in Figure 2.1-5, 17 criteria were identified to measure sites against the technical requirements objective; 14 criteria were identified to measure sites against the environmental acceptability objective; and 7 criteria were identified to measure sites against the operational efficiencies objective.

2.1.3.3.1.3 Objective, Category, and Criteria Weighting

The third step in the MAUA approach was to weigh each of the objectives, categories, and criteria. Weighting provides a quantitative estimate of the relative importance of each objective, category, and criterion to selecting the site. Weighting was accomplished for objectives, then categories, and finally criteria by a small team. The larger technical team reviewed the preliminary weighting and rank ordered the 38 criteria based on the contribution to the site score for each criterion. Weighting was modified and refined to ensure that the rank order of criteria met AES's selection requirements. As an example, seismic and geologic stability of a site were considered more important compared to construction and operational workforce availability. Individual criterion weights ranged from 6.0 to less than 1.0. Because weighting (and therefore contribution to site score) is relative among all criteria, the total of the contribution to site score of all 38 criteria equals to one as does the total of the contribution to site score for all categories, and the three objectives. Table 2.1-8, Objectives, Categories, and Criteria with Weights and Contribution to Site Score, lists the weights and contribution to site score of each objective, category, and criteria to the scoring.

The ten most heavily weighted criteria included all three objectives. Six of the top ten criteria measure a site's ability to meet the technical requirements objective. Three of the top ten criteria measure a site's ability to meet the environmental objective. One criterion of the ten highest ranked criteria measures a site's ability to meet the operational efficiencies objective.

2.1.3.3.1.4 Develop Performance Measures for Each Criterion

Performance measures were developed for each criterion to define the important attributes of site quality. A scale of 1 to 10 was used to quantify the technical specialists' assessment of each criterion. The scale quantified the quality of the site in meeting that portion of an objective represented by the criterion. In addition, the scale provided a consistent score comparison among criteria and among scorers.

2.1.3.3.1.5 Obtain Overall Measure of Desirability for Each Site and Conduct Sensitivity Analysis

The criteria scores for each site were combined with their weights to determine the relative contribution of each criterion to the overall value of the site. These relative criterion scores were summed to obtain the measure of how well each site met the three site objectives. Sensitivity analysis was used to examine the relative importance of each criterion and objective to project ranking. The sensitivity analyses also demonstrates how sites compare based on their scores for each criterion and objective.

2.1.3.3.1.6 Preferred Site Identification

The final step in the process was to identify a preferred site. The results of the MAUA provided a ranking among the sites evaluated in Phase II. The ranking among sites was considered, in combination with AES's business needs to select a preferred site.

Step 4 Identifying a Preferred Site

2.1.3.3.2 Identification of Potential Regions and Sites

The four criteria used to identify regions of the U.S. that may be suitable for an enrichment facility were: (1) peak ground acceleration, (2) tornado frequency, (3) hurricane frequency, and (4) severe winter weather. Three regions of the contiguous U.S. were identified as having suitable characteristics for an enrichment facility and included portions of the mid-Atlantic states, portions of the southwest, and portions of the inter-mountain west. Figure 2.1-6, Regions of the U.S. Meeting the Four Initial Criteria for an Enrichment Facility, shows the avoidance areas and the regions that meet the initial acceptance criteria. Areas to be avoided because of high PGA included the west coast, major portions of the intermountain west, portions of the lower Midwest, portions of South Carolina and Tennessee, and portions of the Northeast. Areas to be avoided because of high tornado/wind risk included most of the central U.S., much of the Ohio Valley, portions of Pennsylvania, central and northern portions of the Gulf Coast states, and Georgia. Areas to be avoided because of high incidence of hurricanes included portions of states along the Atlantic and Gulf coasts. Areas to be avoided because of a potential for heavy snow, ice conditions, and high winds included most states bordering Canada and portions of northern Great Plains states.

AES in consultation with site sponsors identified 54 potential sites in nine states. Of those sites, 44 were passed forward to be evaluated in the Phase I screening process. Ten sites were eliminated from consideration due to being in areas of high potential of hurricane flooding and wind or high potential of tornados. These sites were eliminated using the criteria shown in Figure 2.1-6, Regions of the U.S. Meeting the Four Initial Criteria for an Enrichment Facility and are listed in Table 2.1-9, Potential Sites Eliminated During the Initial Review and the Basis for Elimination.

2.1.3.3.2.1 Phase I Screening Results

The 44 sites, located in seven states, identified in the initial review step were screened using the Phase I criteria to identify potential high-quality sites suitable for the Phase II evaluation. Table 2.1-10, Candidate Sites for Phase I Screening, summarizes the screening results for all 44 sites. Of the 44 sites, 33 sites failed at least one criterion and one site was modified to include additional acreage (at the request of the site sponsor). The remaining ten sites, located in seven states, include the: Bonneville site, ID; McNeil site, ID; Grist site, TX; WCS-2 site, TX; ELEA site, NM; WIPP-2 site, NM; Horn Rapids site, WA; Fleming Smith site, SC; Portsmouth site, OH; and Wildwood site, VA. Below is a summary highlighting some of the key attributes of the sites passing the Phase I screening.

The Bonneville, ID site, about 32 km (20 mi) west of Idaho Falls, was one of two sites selected from a cluster of six sites screened for the Idaho area. The site is under single private ownership, is close to power, and is not close to sensitive resources (e.g., Class I air receptors, national parks or monuments, recreational areas). It is currently used for grazing and cropping and does not appear to have habitat for endangered or threatened species. The past land uses of grazing and cropping suggests no potential contamination. It is about 24 km (15 mi) from the DOE Idaho National Laboratory (INL) and, therefore, environmental information is available that reflects the conditions of the site. INL also is a major source of a trained workforce.

The McNeil, ID site, about 19 km (12 mi) west of Idaho Falls, was selected from the cluster of six sites screened for the Idaho area. It is about 6 km (4 mi) from the Bonneville site. The site is under single private ownership, is close to power, and is not close to sensitive resources (e.g., Class I air receptors, national parks or monuments, recreational areas). It is currently used as crop land and therefore has no habitat for protected species. The past land use of cropping suggests no potential contamination. It is about 31 km (19 mi) from the INL and, therefore, environmental information is available that reflects the conditions of the site. INL also is a major source of a trained workforce.

The WCS-2, TX site is about 48 km (30 mi) west of Andrews and the western edge of the site is about 3 km (2 mi) east of the New Mexico border. This property is close to areas with detailed environmental data and monitoring systems (e.g., Waste Control Specialists facility boundary is about 0.8 km (0.5 mi) and the National Enrichment Facility boundary is about 5 km (3 mi)), which are the closest potential contamination sources. It is within 2 km (1 mi) of the state highway. There are no recreational areas within 16 km (10 mi) of the site.

The Grist, TX site is about 40 km (25 mi) west of Andrews and the western edge of the site is about 7.2 km (4.5 mi) east of the New Mexico border. It is currently uncultivated cropland. This property is close to areas with detailed environmental data and monitoring systems (e.g., Waste Control Specialists facility boundary is within 8 km (5 mi) and the National Enrichment Facility boundary is about 10 km (6 mi)), which are the closest potential contamination sources. It is within 5 km (3 mi) of the state highway. There are no recreational areas within 24 km (15 mi) of the site.

The ELEA, NM site is about 48 km (30 mi) northeast of Carlsbad and 48 km (30 mi) southwest of Hobbs. The property is owned by a consortium, which includes Eddy and Lea Counties. The consortium is interested in transferring their property to AES. The site is about 19 km (12 mi) from the Department of Energy (DOE) Waste Isolation Pilot Project (WIPP) boundary. There are potash and oil and gas leases on the property. The site has access to electrical power and other infrastructure. In addition, site-specific environmental data is available from a detailed site-specific siting study, Bureau of Land Management (BLM) EISs, and DOE's WIPP monitoring system. The majority of the workforce could be drawn from both Carlsbad and Hobbs. There is evidence of contamination (primarily metals and radionuclides) from prior use.

The contamination is isolated to the northeast corner of the site and likely would not be disturbed if the facility is located at this site.

The WIPP-2, NM site is about 48 km (30 mi) west of Carlsbad and 64 km (40 mi) south of Hobbs. It is on BLM 259 ha (640 acres) and the State of New Mexico 227 ha (560 acres) lands. All parties are interested in transferring their property to AES and BLM has demonstrated processes to lease and transfer surface and mineral titles. There are no mineral leases on the BLM owned property, but likely mineral leases are present under the State of New Mexico property. Potash is known to exist under the property. There is no evidence of contamination from prior use. The site is about 3 km (2 mi) from the DOE WIPP boundary and, therefore, has access to electrical power and other infrastructure. In addition, site-specific environmental data is available from drilling and well logs, BLM EISs, and DOE's WIPP monitoring system. The majority of the workforce could be drawn from both Carlsbad and Hobbs

The Horn Rapids, WA site is on the southern border of the DOE Hanford Reservation immediately north of the city of Richland. It is owned by DOE and is in an area planned for industrial use. It has two electric substations and waterlines nearby. It has no wetlands or floodplains within the footprint, and no sensitive properties in the vicinity. There is contamination on portions of the site. A trichloroethene plume is in the groundwater under a portion of the eastern side of the site. The contaminant is at levels that allow for unrestricted use. There also is asbestos on a portion of the southern edge of the site. The contaminant levels allow for restricted use. Configuration of the AES facility would likely avoid these contaminated areas. The AREVA fuel fabrication facility is immediately south of the site. There are remediation activities occurring immediately east and several kilometers (miles) north of the site. The Richland Airport is about 3 km (2 mi) south of the site.

The Fleming Smith, SC site is in the west central portion of the state and is about 24 km (15 mi) from the town of Laurens (county seat); it is on private land (held by Duke Energy). Electric power lines and water lines are on or adjacent to the property. It has no wetlands or floodplains within the footprint, no sensitive properties in the vicinity and few permitted air emission or waste facilities nearby. Aerial photographs show only limited disturbance on the site and therefore, likely no contamination is present. An interstate road is within 2 km (1 mi) of the site and an industrial/commercial site is adjacent to the site.

The Portsmouth, OH site is in the south central portion of the state and is about 5 km (3 mi) from the town of Piketon. It is owned by multiple private land owners. It has no wetlands within the facility footprint and no sensitive properties in the vicinity. The formerly operating Portsmouth Gaseous Diffusion Plant (PGDP) is within 2 km (1 mi) of the site. Electric power and water would be available from the PGDP site. The USEC American Enrichment Plant is being constructed within 2 km (1 mi) of the site. Similarly, DOE will operate a depleted uranium hexafluoride deconversion plant in the vicinity. In addition, the surrounding DOE property is being remediated from former activities. There are no other permitted air emission or waste facilities nearby. There is contamination associated with the PGDP, but not on the proposed site.

The Wildwood, VA site is located in southwest Virginia, near the North Carolina border in Carroll County, and about 16 km (10 mi) northeast of Galax. A 138-kV powerline is about 5 km (3 mi) from the site. The Blue Ridge Parkway, located over 16 km (10 mi) from the site, is the closest known sensitive resource. Site-specific data may be available from Department of Transportation studies associated with siting Interstate 77 and mineral resource reports. There is a small regional airport runway located approximately 0.8 km (0.5 mi) west of site.

2.1.3.3.2.2 Phase II Site Evaluation Results

The ten sites recommended from the Phase I screening were assessed using the 38 criteria identified for the Phase II site evaluation. The ten sites are located in seven states as shown on Figure 2.1-7, General Locations of the Ten Sites Assessed in the Phase II Site Evaluation. Pairs of sites within close proximity to each other are located in Idaho, New Mexico, and Texas and single sites are located in Washington, Ohio, South Carolina, and Virginia. Each site received an unweighted score for each criterion, which are listed in Table 2.1–11, Unweighted Scores for Each Criterion for the Ten Sites Assessed in the Phase II Site Evaluation.

2.1.3.3.2.3 Summary of Total Scores and Scores by Objective

Using the unweighted scores and the individual criterion weights, the MAUA analysis produced a weighted score for each site. The Idaho sites scored highest (0.81 and 0.80) followed in order by the Texas (0.75 and 0.75), Washington (0.71), New Mexico (0.68 and 0.65), South Carolina (0.64), Ohio (0.62), and Virginia (0.57) sites. The resultant scoring along with the contribution by objective is shown in Figure 2.1-8, Total Weighted Scores for the Ten Sites Assessed in the Phase II Site Evaluation. Both Idaho sites had high scores for all three objectives. The Texas sites had high scores for technical requirements but lower scores compared to the Idaho sites for environmental acceptability and operational efficiencies. The New Mexico sites were generally lower across all three objectives compared to the Idaho and Texas sites. The Washington site was comparable to the Idaho and Texas sites related to technical requirements; however, it received the lowest score among all sites for operational efficiencies. The South Carolina site generally scored lower than the New Mexico sites with the exception that it had a higher score for the technical requirements objective compared to the WIPP-2, New Mexico site. The Ohio site scored lowest for environmental acceptability and relatively high for operational efficiencies. The Virginia site consistently scored low for all three objectives.

Scores for the technical requirements objective, shown in Figure 2.1–9, Weighted Scores for the Technical Requirements Objective for the Ten Sites Assessed in the Phase II Site Evaluation,, were driven primarily by site characteristics criteria scores (e.g., topography and geology, size, ownership, and surface and mineral rights) followed by electrical systems criteria. Differences among scores, for this objective, primarily were a result of variations in topography and geology, size, land ownership, mineral rights, water supply, and PGA (safety design criterion) scores.

Scores for the environmental acceptability objective, shown in Figure 2.1–10, Weighted Scores for the Environmental Acceptability Objective for the Ten Sites Assessed in the Phase II Site Evaluation, were driven primarily by land use and demography, environmental protection, and human services criteria scores. Differences among scores, for this objective, primarily were a result of variations in permitting, hazardous facilities proximity, sensitive area proximity (e.g., nearest resident), and housing scores.

Scores for the operational efficiencies requirements objective, shown in Figure 2.1-11, Weighted Scores for the Operational Efficiencies Objective for the Ten Sites Assessed in the Phase II Site Evaluation, were driven primarily by support and business environment criteria scores. Differences among site scores, for this objective, primarily were a result of variations in public support, business environment, construction traffic, and low level waste disposal option scores.

2.1.3.3.2.4 Summary of Site Scores and Comparison of Sites

The Bonneville and McNeil, Idaho sites had the highest overall scores. Their similar scores reflect the close proximity of the two sites (about 6 km (4 mi)). Both sites offer remote locations near a major highway with few residences or other activities in the area. They are bounded by BLM and private properties that are used for grazing and/or farming. The topography and geology are favorable; land transfer would be simple and nearly immediate; and there are no surface or mineral rights issues. Water from the Snake River Aquifer would be delivered by on-site wells. There is strong consistent support at the local and state levels, and the permitting process will be straight-forward with no special permitting issues. In addition, the sites scored high for workforce availability and housing. The key differences between these two Idaho sites are that the Bonneville site is substantially larger (over 1,619 ha (4,000 acres)) than the McNeil site (405 ha (1000 acres)) and the distance to the nearest resident was much closer to the McNeil site (2.0 km (1.25 mi) for McNeil versus 7.6 km (4.75 mi) for Bonneville).

The WCS-2 and Grist, Texas sites had the next highest overall scores after the Idaho sites. Their similar scores reflect the close proximity of the two sites (about 6 km (4 mi)). Both sites offer remote locations near a major highway with few residences in the area. Both sites are surrounded by private property owned by different landowners. The sites have favorable seismic characteristics, topography, and geology; land transfer would be simple and nearly immediate. Water from the Ogallala Aquifer would be delivered via new lines from the water well field north of the sites in Gaines County. There is strong consistent support at the local and state levels, and there are no special permitting issues. The differences between the two Texas sites include that the WCS-2 site is within 3 km (2 mi) of the WCS low-level and hazardous waste facility. Therefore, the WCS-2 site scores lower than the Grist site for the criterion of proximity to a hazardous facility; however, the WCS-2 site scores higher for the criterion of existing survey data. In addition, the WCS-2 site is the second largest site 1,036 ha (2,560 acres), while the Grist site is one of the smallest sites at nearly 364 ha (900 acres).

The Grist and WCS-2 sites scored lower than the Idaho sites because there are rights-of-way (pipelines) on the WCS-2 site and mineral rights on both sites (oil and gas development) that would need to be purchased. There is at least one pressurized pipeline within 2 km (1 mi) of each site. Construction traffic likely will affect the traffic flow on the two-lane highway that provides access to both sites. In addition, the sites scored lower for workforce availability and housing.

The Horn Rapids, Washington site had an intermediate score compared to all the sites. It is on the south edge of the DOE Hanford Reservation. There are no surface rights or mineral rights. The site is about 3 km (2 mi) from the town of Richland and the nearest residents. An industrial road leads directly to the site and the nearest highway access is about 5 km (3 mi) from the site. The electric, water, sewage, and other infrastructure are excellent, as is workforce availability. There is an AREVA fuel fabrication facility adjacent to the site. There are no nearby sensitive resources or areas.

While the site has excellent technical project attributes, the site scores lower than other sites because of a combination of characteristics. Although a process is in place under the 1999 Comprehensive Land-Use Plan EIS, land transfer may be complicated because of DOE transfer process requirements. There is a small regional airport about 3 km (2 mi) from the site. The runway is oriented to have flight patterns coming over the site. The site lacks strong support at the State and National level.

The ELEA and WIPP-2, New Mexico sites had overall scores which were lower than the Washington site. Their similar scores reflect the close proximity of the two sites (about 11 km (7 mi)). Both sites offer remote locations near a major highway with few residences in the area. Both sites are surrounded by BLM and private property owned by different landowners. The sites have favorable seismic characteristics and there is strong local support.

There are several differences between the two New Mexico sites that reduced the score of the WIPP-2 site compared to the ELEA site. The ELEA site is privately owned, while the WIPP-2 site is owned by the BLM and the State of New Mexico. Transfer of the BLM property will be more complicated and will require more time, compared to transfer of private property. While the WIPP-2 site has good regional data generated by the DOE WIPP about two miles south, the site-specific data is less complete compared to the ELEA site. The ELEA site has the most complete site-specific data of all ten sites. Future use of properties adjacent to the WIPP-2 site has greater risk for mineral development compared to the ELEA site; although other companies own the mineral leases under and adjacent to both sites. Additional cultural resource permitting may be required on the WIPP-2 site for a known archaeological site that is located on the edge of the property but falls outside the area likely to be disturbed. Water from the Ogallala Aquifer would be supplied to the WIPP-2 site from an Eddy County water system. This water system would need to be expanded to ensure sufficient water availability during peak water use. Conversely, water from the Ogallala Aquifer would be supplied to the ELEA site from a Lea County water system, which has sufficient current capacity even during peak demand periods.

The ELEA and WIPP-2 sites scored lower than the other sites because of the rights-of-way (i.e., pipelines, transmission line, water line, and communication tower) on the ELEA site. In addition, there are mineral leases (i.e., potash, oil, and gas) on both sites. In addition, the sites scored lower for workforce availability and housing.

The Fleming Smith, South Carolina site had an overall score somewhat less than the New Mexico sites. The site is near the town of Laurens and near a major interstate highway. The site is next to existing and proposed industrial developments, but there are also residents within 0.4 km (0.25 mi) of the site. The site has readily available electric supply and other utilities, a large regional workforce, and there is strong local and state support. Water from reservoirs would be supplied to the site via an existing Laurens water system, which has sufficient capacity during peak use.

The site scores lower than the other sites assessed (other than the Portsmouth, Ohio and Wildwood, Virginia sites) due to a combination of characteristics. The topography of the site will require extensive earth moving. The extensive fill may also impact the seismic stability characteristics of the site. There are several right-of ways, with a sewer right-of-way bisecting the site, and a pressurized pipeline running along the southern edge of the site. In addition, there is a wetland within the footprint of the site which will require a wetland permit. An increase in the size of the facility footprint following Phase I screening brought the wetland into the footprint boundary.

The Portsmouth, Ohio site had an overall score which was the second lowest score of all the sites. The site is about 5 km (3 mi) from the town of Piketon. The site is immediately adjacent to a major interstate highway. The electric, water, sewage, and other infrastructure are excellent, as is operational workforce availability. There are DOE and USEC enrichment facilities immediately adjacent to the site. Residents are within 2 km (1 mi) of the site. The site is owned by multiple private owners. There are no other surface or mineral rights.

The site scores were lower than most other sites assessed due to a combination of characteristics. Land transfer may be complicated because of multiple ownership. The topography of the site will require earth moving. The fill may also negatively impact the seismic characteristics of the site. In addition, there is a floodplain within the site boundary associated with the Little Beaver Creek on the southwest portion of the site. The site is irregularly shaped which results in one of the smallest effective areas compared to all other sites. There is a closed landfill (with monitoring wells) adjacent to the site, which has trichloroethylene (TCE) contamination. A road and rail line divide the site.

The Wildwood, Virginia site had an overall score which was the lowest score of all the sites. The site is about 16 km (10 mi) from the town of Hillsville. The site is immediately adjacent to a major interstate highway and a commercial development currently under construction. In addition, residents are within 3 km (2 mi) of the site. It is privately owned with no surface or mineral rights. Therefore, land transfer can be simple and rapid. Water from reservoirs would be supplied to the site via a new line from the county system. However, system capacity would need to be expanded to handle peak use demands.

The site scores lower than the other sites assessed due to a combination of characteristics. The topography of the site will require extensive earth moving. The extensive fill may also negatively impact the seismic characteristics of the site. In addition, there may be wetlands associated with the drainage that bisects the site. The site is irregularly shaped which results in the smallest effective area compared to all other sites. The site has the least site-specific data available. In addition, there is a small regional airport (light commercial use) less than 3 km (2 mi) from the site. The runway is oriented to have flight patterns coming over the site.

2.1.3.3.3 Sensitivity Analysis

A sensitivity analysis was conducted for each of the three objectives (technical requirements, environmental acceptability, and operational efficiencies) to ensure that site evaluation was not sensitive to small changes in the relative weights of objectives or criteria. Figures 2.1-12, 2.1-13, and 2.1-14 show the site rank and score sensitivity to different weights of the three objectives. Each sensitivity graph shows how the rank and score may change with an increase in the weight of one objective. The horizontal axis measures the weight of an objective and the vertical axis measures the overall site score. The vertical line on each of these graphs represents the current weight for each objective. In general, the analysis demonstrates that the site ranks are robust to objective weight changes.

Figure 2.1–12, Sensitivity of Site Ranking and Scores to Variable Weighting of the Technical Requirements Objective, shows that the site rank (order among sites) is relatively insensitive to a change in the weight of the technical requirements objective and the supporting criteria. The weight would have to be increased from 49 percent to 56 percent for a reordering of the Fleming Smith and WIPP-2 sites or decreased to 41 percent for a reordering between the Grist and WCS-2 sites, which is reflective of the close scoring between the sites.

Figure 2.1–13, Sensitivity of Site Ranking and Scores to Variable Weighting of the Environmental Acceptability Objective, shows that the site rank (order among sites) is relatively insensitive to a change in the weight of the environmental acceptability objective and the supporting criteria. The weight would have to increase from 34 percent to 55 percent for a reordering of the Wildwood and Portsmouth sites or decreased to five percent for a reordering of the WIPP-2 and Portsmouth sites.

Figure 2.1–14, Sensitivity of Site Ranking and Scores to Variable Weighting of the Operational Efficiencies Objective, shows that the site rank (order among sites) is relatively insensitive to changes in the weight of the operational efficiencies objective and supporting criteria with the exceptions of the Horn Rapids and Portsmouth sites. The weight would have to increase from 17 to 28 percent for a reordering between the ELEA and Horn Rapids sites or decrease to 13 percent for a reordering between the WIPP-2 and Fleming Smith sites. The Horn Rapids site had a relatively low score for this objective and high scores for the other two objectives. Therefore increasing the importance weight of this objective would decrease the weight of the other two objectives, dropping the rank for the Horn Rapids site to last when the objective is weighted 73 percent or higher. Conversely, the Portsmouth site received high scores for this objective and therefore, the site score increases greatly as the weighting for this objective increases.

2.1.3.3.4 Conclusions

The site selection process considered over 50 potential sites across the United States. Ten sites passed the Phase I screening and were reviewed in greater detail during the Phase II site evaluation. The evaluation demonstrated that all ten sites would be technically and environmentally suitable locations for the AES enrichment plant.

Based on its review, AES has identified the Bonneville, Idaho site as the proposed site for an enrichment plant. The site has the greatest amount of acreage, which can be readily transferred from a single private landowner. Water is available through on-site wells and existing water rights can be transferred. Estimated costs for electric power, labor, and materials are among the lowest considered. In addition, Bonneville County and the State of Idaho have shown strong support for the proposed enrichment plant.

None of the candidate sites were obviously superior to the proposed site.

An expansion of the EREF from 3.3 million SWU/year to 6.6 million SWU/year would not alter any of the site selection criteria values that are used in the original site selection study for the proposed site in Idaho. Some adjustments would occur for alternate sites, specifically related to operational workforce for the Texas sites and peak water use for the South Carolina site. An increase in operational workforce would lower this scoring for the two Texas sites, and an increase in peak water use would lower this scoring for the South Carolina site. However, these adjustments do not alter the overall ranking of sites or conclusions of the site selection study.

TABLES

Table 2.1-1 Chemical Ha ard Classification [1]
(Page 1 of 2)

Chemical	Formula	Phase(s) [2]	Radioactive	Toxic	Corrosive	Water Reactive	Flammable	Combustible	Oxidi er	Other	Comments
uranium hexafluoride [3]	UF_6	S/L/G									
uranic compounds	UO_2F_2, UF_4, U_3O_8,	S/L									UF_6 reaction byproducts, deposits & in solution
hydrogen fluoride	HF	G									UF_6 reaction byproduct
sodium fluoride	NaF	S									granules
aluminum oxide (activated)	Al_2O_3	S									irritant, powder / granules
carbon (activated)	C	S									powder / granules
paper, polymers		S									ventilation filter media, anti-contamination clothing, ion exchange resin, etc.
potassium hydroxide	KOH	S									
phosphate		S									surfactant, irritant, P-3 Plastoclin 4100 B
scrap metals		S									contaminated scrap/parts
citric acid	$C_6H_8O_4$	S/L									crystals & solution (5-10%)
sodium hydroxide	NaOH	S/L									powder & solution (0.1N)
hydrocarbon oils / greases	varies	S/L									
hydrocarbon sludges	varies	S/L									
perfluoropolyether fluids	varies	L									irritant, long chain perfluorocarbons
methylene chloride	CH_2Cl_2	L									Health hazard
polydimethylsiloxane (silicone oil)	varies	L									
hydrocarbon / polar solvents and liquids	varies	L									gasoline,ethanol, acetone, toluene, petroleum ether, paint, cutting oils
nitric acid	HNO_3	L									(50-70%) weight concentration
hydrofluoric acid	HF (H_2O)	L									38% weight concentration
hydrogen peroxide	H_2O_2	L									
sulfuric acid	H_2SO_4	L									
phosphoric acid	H_3PO_4	L									(10-25%) weight concentration

Table 2.1-1 Chemical Ha ard Classification [1]
(Page 2 of 2)

Chemical	Formula	Phase(s) (2)	Radioactive	Toxic	Corrosive	Water Reactive	Flammable	Combustible	Oxidi er	Other	Comments
diesel fuel	varies	L									generator / vehicle fuel
deionized water	H_2O	L									
hydrofluorocarbons	varies	L/G									refrigerant, irritant
nitrogen	N_2	L/G									asphyxiant, test gas / purge gas
propane	C_3H_8	L/G									test gas
hydrogen	H_2	G									test gas
acetylene	C_2H_2	G									welding gas
oxygen	O_2	G									test gas / welding gas
argon	Ar	G									asphyxiant, test gas / welding gas
helium	He	G									asphyxiant, test gas

Notes:

1. Hazardous material classifications per the International Fire Code (IFC). Radioactive classification has also been included although not identified as a specific IFC classification.
2. Lists the phases applicable based on facility use of chemical; S – solid, L – liquid, G – gas/vapor.
3. Solid UF_6 cylinders also have ullage space containing vapor UF_6 and traces of HF, air, non-condensables and U non-volatiles (1% total wt)

Table 2.1-2 Chemical Inventory Separations Building Module (SBM) and Blending, Sampling and Preparation Building (BSPB)[1], contains Security-Related Information Withheld Under 10 CFR 2.390

Table 2.1-3 Chemical Inventory - Centrifuge Assembly Building (CAB), contains Security-Related Information Withheld Under 10 CFR 2.390

Table 2.1-4 Chemical Inventory   Technical Support Building (TSB) and Operation Support Building (OSB), contains Security-Related Information Withheld Under 10 CFR 2.390

Table 2.1-5 Chemical Inventory Mechanical Services Building (MSB) and Electrical Services Building (ESB), contains Security-Related Information Withheld Under 10 CFR 2.390

Table 2.1-6 Chemical Inventory Exterior Areas, contains Security-Related Information Withheld Under 10 CFR 2.390

Table 2.1-7 Summary of Environmental Impacts for the Proposed Action (Page 1 of 2)

Environmental Impact	Proposed Action[a]	ER Reference Section
Land Use	Small impact; about 86% of the site would remain undeveloped and current activities on nearby properties would not change.	4.1
Transportation	Construction Period – Moderate to Large Impact; The impact of traffic volume increases associated with construction of the EREF would be mitigated by constructing highway entrances early in the construction process and designing the highway entrances to minimize the disruption of traffic flow, particularly during the times of peak commute. Operation Period-Small Impact; 5,025 radiological and 3,700 non-radiological additional heavy truck shipments/yr; traffic patterns impact predicted to be inconsequential. Decommissioning period – small impact; 363 additional vehicle trips/day; traffic patterns impact predicted to be inconsequential.	4.2
Geology and Soils	Small impact; potential short-term erosion during construction, but enhanced afterward due to soil stabilization.	4.3
Water Resources	No impact from operation on surface waters. Small impact from operation to groundwater. Stormwater discharges to basins controlled by NPDES permit.	4.4
Ecological Resources	Small impact. No rare, threatened, or endangered (RTE) species present.	4.5
Air Quality	Small impact; vehicle and fugitive emissions less than NAAQS regulatory limits during construction or operation.	4.6
Noise	Small impact; operational noise levels would be within HUD guidelines of 60 dBA_{Ldn} (residential use) and EPA limit of 55 dBA_{Ldn}	4.7
Historic and Cultural	Small impact; NRHP sites can be avoided or mitigated, if required.	4.8
Visual/Scenic	Small impact; facility would be out of character but distant from public observation areas.	4.9
Socioeconomic	Small impact to economy and local public services.	4.10
Environmental Justice	Small impact.	4.11

Table 2.1-7 Summary of Environmental Impacts for the Proposed Action (Page 2 of 2)

Environmental Impact	Proposed Action[a]	ER Reference Section
Public and Occupational Exposure	Small impact; dose equivalents below NRC and EPA regulatory limits.	4.12
Waste Management (Rad/NonRad)	Small impact; within off-site licensed facility capacities; reduced waste streams due to new and high efficient technology.	4.13
- Gaseous	Well below regulatory limits/permits.	3.12
- Solid	Approximately 146,500 kg/yr (323,000 lbs/yr) of low-level wastes[b]	3.12
- Mixed	100 kg/yr (220 lbs/yr)	3.12
- Hazardous	5,062 kg/yr (11,160 lbs/yr)	3.12
- Non-hazardous	70,307 kg/yr (155,000 lbs/yr)	3.12

Notes:

[a] Projected impacts are based on preliminary design and assumed to be bounding. Impacts are expected to occur for the life of the plant.

[b] Excludes depleted UF_6.

Table 2.1-8 Objectives, Categories, and Critieria with Weights and Contribution to Site Score (Page 1 of 2)

OB ECTIVE			CATEGORY			CRITERIA		
Objective	Weight	Contribution	Category	Weight	Contribution[a]	Criteria & Contribution	Weight	Contribution
Technical Requirements	100	0.49	Site	100	0.17	Topography & Geology	100	0.05
						Size	70	0.04
						Surface & Mineral Rights	70	0.04
						Zoning & Ownership	70	0.04
						New Radiation Hazard	5	0.01
			Safety Design	70	0.12	Peak Ground Acceleration	100	0.06
						Fire Hazard	15	0.01
						Wind Hazard	40	0.02
						Existing Survey Data	60	0.03
			Electrical System	60	0.10	Quality	100	0.03
						Rates	90	0.03
						Cost	75	0.02
						Feeders	70	0.02
			Workforce	30	0.05	Construction Workforce	100	0.03
						Operational Workforce	65	0.02
						Technical Resources	35	0.01
			Water Treatment & Supply	20	0.04	Water Treatment & Supply	100	0.04

Table 2.1-8 Objectives, Categories, and Criteria with Weights and Contribution to Site Score (Page 2 of 2)

OB ECTIVE			CATEGORY			CRITERIA		
Objective	Weight	Contribution	Category	Weight	Contribution[a]	Criteria & Contribution	Weight	Contribution
Environmental Acceptability	70	0.34	Environmental Protection	95	0.10	Permitting	100	0.04
						On-site Water Features	65	0.02
						Groundwater	100	0.04
			Off-site Contamination Hazard	40	0.04	Current Off-site Plumes	100	0.02
						Future Migration	30	0.01
						Documented Monitoring	50	0.01
			Land Use & Demography	100	0.11	Environmental Justice	100	0.04
						Hazardous Facilities	95	0.03
						Sensitive Areas	75	0.03
						Adjacent Site Plans	40	0.02
			Human Services	80	0.09	Emergency Services	100	0.03
						Housing & Necessities	90	0.03
						Schools	65	0.02
						Recreational & Cultural Options	50	0.01
Operational Efficiencies	34	0.17	LLW Disposal	15	0.02	LLW Disposal	100	0.02
			Transportation	35	0.04	Highway Access	100	0.02
						Construction Traffic	80	0.02
			Support & Business Environment	100	0.11	Business Environment	30	0.02
						Public Support	100	0.05
						Agencies	50	0.03
						Labor Support	30	0.02

[a] Values do not add to 1.00 in the contribution columns for category and criteria due to rounding.

Table 2.1-9 Potential Sites Eliminated During the Initial Review and the Basis for Elimination

(Page 1 of 1)

No.	State	Site	Basis for Elimination
1	AL	Dothan County	High risk hurricane zone
2	IA	Cedar Rapids	High risk tornado zone
3	TX	Amarillo	High risk tornado zone
4	VA	Cooke Rail Site	High risk hurricane zone
5	VA	Crosspointe Centre	High risk hurricane zone
6	VA	Cypress Cove	High risk hurricane zone
7	VA	Grayland	High risk hurricane zone
8	VA	Pickett Park	High risk hurricane zone
9	VA	Simpson Property	High risk hurricane zone
10	VA	Windsor Mega Site	High risk hurricane zone

Table 2.1-10 Candidate Sites for Phase I Screening
(Page 1 of 2)

No.	County, State	Site	Result Basis for Exclusion
1	**Bonneville, ID**	**Bonneville**	**Passed Evaluated in Phase II**
2	**Bonneville, ID**	**McNeil**	**Passed Evaluated in Phase II**
3	Power, ID	Power County-1	Failed: Sensitive properties
4	Power, ID	Power County-2	Failed: Contamination
5	Bingham, ID	Blackfoot	Failed: Sensitive properties
6	Butte, ID	Atomic City	Failed: Ownership/Transfer
7	**Lea, NM**	**ELEA**	**Passed Evaluated in Phase II**
8	Lea, NM	Lea County-1	Failed: Data availability
9	Lea, NM	Lea County-2	Failed: Wetlands
10	Lea, NM	Lea County-3	Failed: Karst
11	Eddy, NM	Seven Rivers	Failed: Size, bisected by a public road
12	Eddy, NM	Berry Parcel	Failed: Liquefaction
13	Eddy, NM	Harroun	Failed: Liquefaction, karst, electric power, sensitive properties
14	Eddy, NM	Becker	Failed: Liquefaction, karst, contamination
15	Eddy, NM	WIPP-1	Failed: Ownership/Transfer
16	**Eddy, NM**	**WIPP-2**	**Passed Evaluated in Phase II**
17	**Pike, OH**	**Portsmouth**	**Passed Evaluated in Phase II**
18	Pike, OH	Zahn’s Corner-1	Failed: Size, contamination, wetlands
19	Pike, OH	Zahn’s Corner-2	Failed: Wetlands, contamination
20	Aiken, SC	Savannah River Site (DOE)	Failed: Ownership/transfer, endangered species, wetlands
21	Cherokee, SC	Jobe Sand	Failed: Size

Table 2.1-10 Candidate Sites for Phase I Screening
(Page 2 of 2)

No.	County, State	Site	Result Basis for Exclusion
22	Laurens, SC	Copeland Stone	Failed: Sensitive properties, wetlands
23	**Laurens, SC**	**Fleming Smith**	**Passed Evaluated in Phase II**
25	Greenwood, SC	Solutia	Failed: Size
26	Chester, SC	L&C Mega Site	Failed: Data availability, wetlands
27	Edgefield, SC	Gracewood	Failed: Wetlands
28	**Andrews, T**	**Grist**	**Passed Evaluated in Phase II**
29	Andrews, TX	Tom	Failed: Site characterization data
30	Andrews, TX	Parker	Failed: Site characterization data
31	Andrews, TX	Fisher	Failed: Site characterization data
32	Andrews, TX	WCS-1	Modified to become part of WCS-2
33	**Andrews, T**	**WCS-2**	**Passed Evaluated in Phase II**
34	Martin, TX	Midland North	Failed: Site characterization data
35	Midland, TX	Midland South	Failed: Data availability
36	Amherst, VA	Amherst County-1	Failed: Floodplains, wetlands
37	Amherst, VA	Amherst County-2	Failed: Endangered species, sensitive properties
38	Appomattox, VA	Concord	Failed: Floodplains, wetlands
39	**Carroll, VA**	**Wildwood**	**Passed Evaluated in Phase II**
40	Benton, WA	West Richland	Failed: Seismic, faults
41	**Benton, WA**	**Horn Rapids (DOE)**	**Passed Evaluated in Phase II**
42	Benton, WA	Energy NW-1 (DOE)	Failed: Faults, contamination, ownership/transfer
43	Benton, WA	Energy NW-2 (DOE)	Failed: Contamination, ownership/transfer
44	Benton, WA	Highway 240 (DOE)	Failed: Seismic, ownership/transfer, sensitive properties

Table 2.1-11 Unweighted Scores for Each Criterion for the Ten Sites Assessed in the Phase II Site Evaluation

(Page 1 of 2)

	Criteria	Bonne-ville	McNeil	Grist	WCS-2	Horn Rapids	ELEA	WIPP-2	Fleming Smith	Ports-mouth	Wild-wood
1	Top.& Geology	9	9	8.5	8	9	5	6	5.5	4	3.5
2	Size	9	7	6	10	6	5	6	5	3	2
3	Surface & Mineral	10	9	6	5	8	6	6	6	4	8
4	Zoning & Owner.	10	10	10	10	6	10	6	10	6	10
5	New Rad. Hazard	7	7	7	7	7	8	7	3	5	2
6	Peak Ground Accel.	1	1	8	8	1	7	7	5	7	5
7	Fire Hazard	6	10	5.5	5.5	8	8	5	4	5.5	7
8	Wind Hazard	9	9	4	4	10	4	4	4	3	7
9	Existing Surveys	5	5	5	9	10	10	7	8	10	4
10	Electric Supply	10	10	10	10	10	9	9	9	10	10
11	Cost-Sharing	5	5	7	7	5	3	3	7	3	3
12	Electric Rates	10	10	8	8	8	8	8	8	7	8
13	Transmission Feed	6	6	8	8	10	10	9	10	10	8
14	Constr. Workforce	8	8	6	6	10	5	5	9	8	4
15	Operat. Workforce	10	10	8	8	10	7	7	9	8	7
16	Techn. Resources	10	10	7	7	10	8	8	5	10	5
17	Water Trt. & Supp.	8	9	8	8	10	9	3	7	9	3
18	Permitting	8	9	9	9	6	5	4	3	3	4
19	Water Features	9	9	9	9	9	9	9	5	5	5
20	Groundwater	6	6	8	8	5	8	8	5	5	6
21	Off-site Plumes	9	9	9	8	4	5	6	6	2	9
22	Future Migration	9	9	9	7	5	7	6	6	1	9
23	Doc. Monitoring	8	8	9	9	9	9	9	10	10	10

Table 2.1-11 Unweighted Scores for Each Criterion for the Ten Sites Assessed in the Phase II Site Evaluation

(Page 2 of 2)

	Criteria	Bonne-ville	McNeil	Grist	WCS-2	Horn Rapids	ELEA	WIPP-2	Fleming Smith	Ports-mouth	Wild-wood
24	Environ. Justice	10	10	10	10	10	10	10	10	10	10
25	Sensitive Areas	7	5	10	8	5	5	5	3	1	3
26	Hazardous Facilities	10	10	4	1	2	1	9	3	1	3
27	Adjacent Site Plans	9	9	8	7	9	7	3	5	3	3
28	Emergency Services	10	10	8	8	10	8	8	8	10	6
29	Housing & Necessities	9	9	5	5	9	4	4	9	8	5
30	Schools	9	9	8	8	9	8	8	7	7	6
31	Rec. & Cultural	9	9	5	5	9	4	4	7	7	6
32	Business Environment	8	8	5	5	6	5	5	7	6	6
33	Agencies	9	9	7	7	4	5	5	7	9	7
34	Public Support	9	9	9	9	4	9	9	5	7	5
35	Labor Support	6	6	3	3	5	5	5	1	5	1
36	Highway Access	9	10	7	8	7	10	8	8	10	10
37	Construction Traffic	6	6	6	6	6	6	6	6	6	6
38	LLW Disposal	7	7	6	6	9	7	7	10	5	5

FIGURES

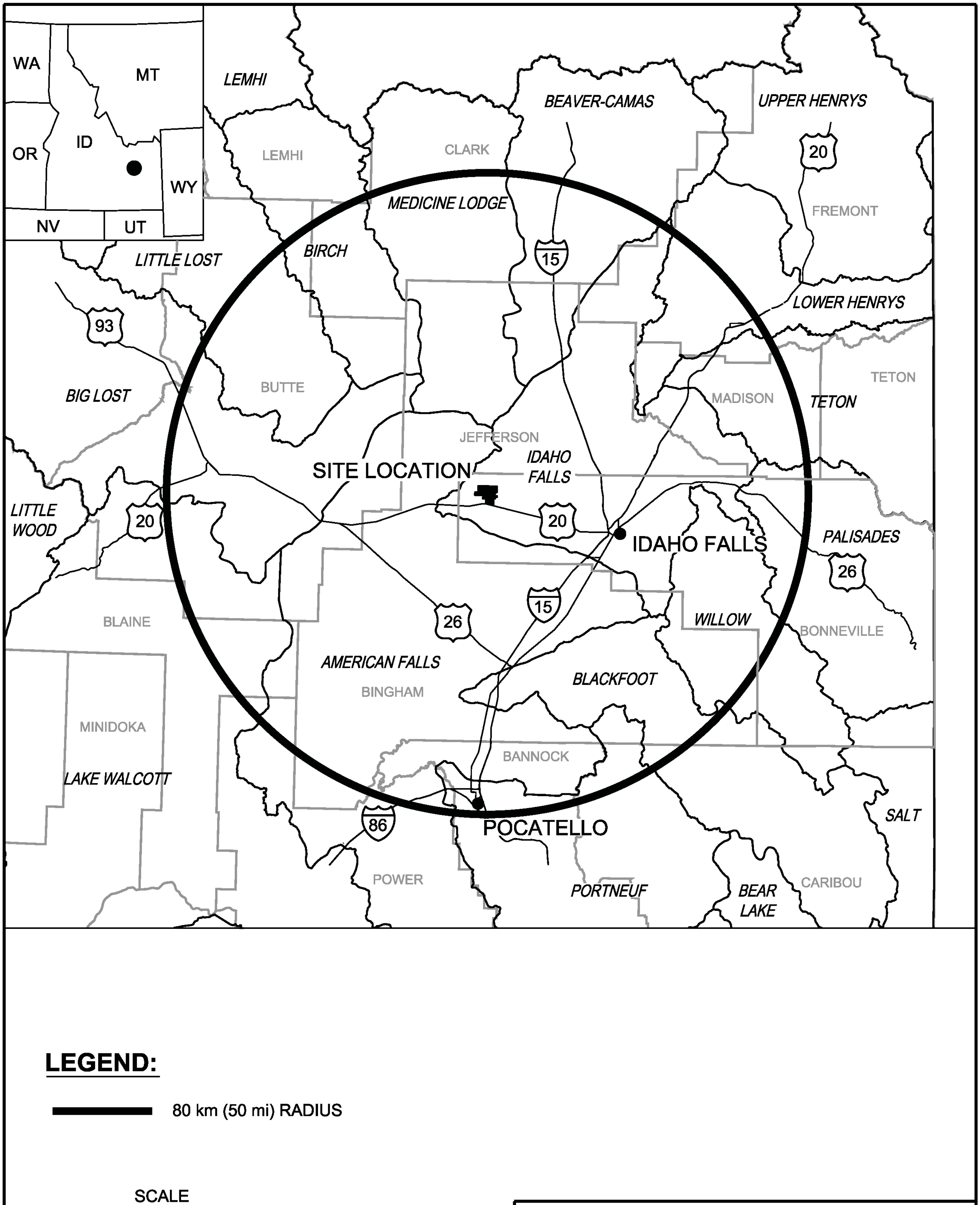
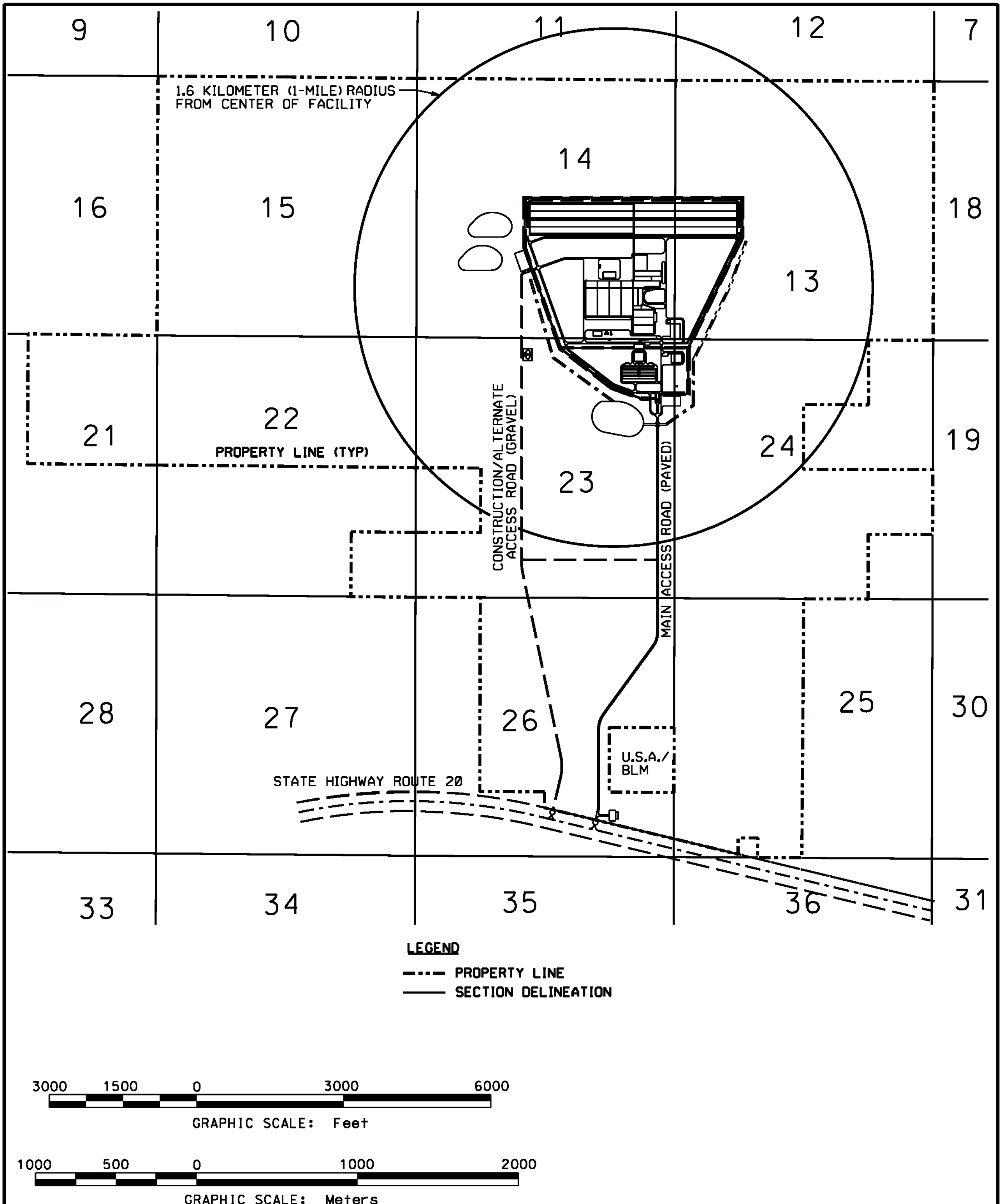


Figure 2.1-1 **Rev. 2**

80-KILOMETER (50-MILE) RADIUS
WITH CITIES AND ROADS

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT



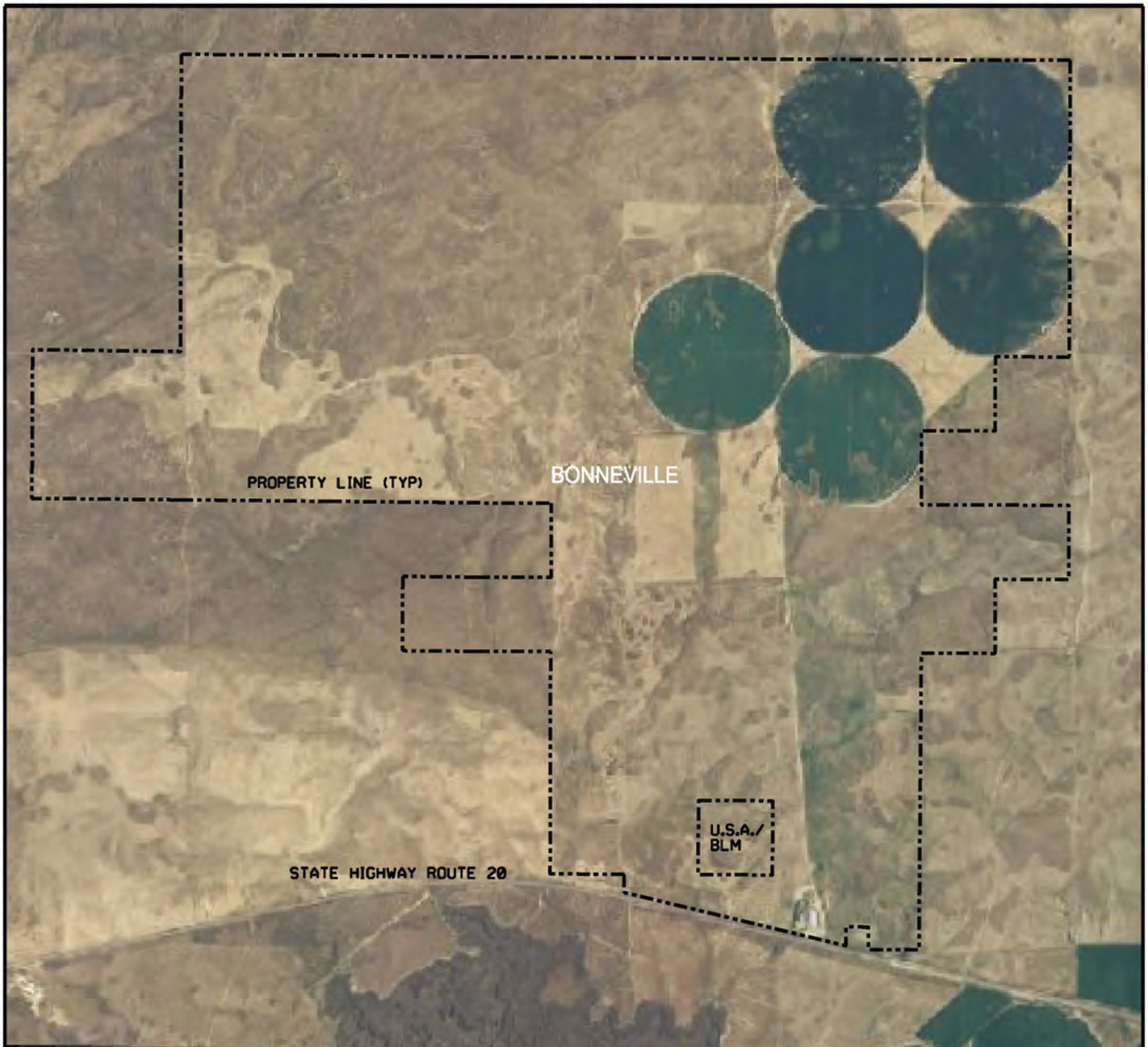
NOTES:

1. SEE FIGURE 2.1-4 FOR ENLARGED FACILITY LAYOUT.

Figure 2.1-2 **Rev. 2**

Site Area and Facility Layout Map
1.6 Kilometer (1 Mile) Radius

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT



LEGEND:

PROPERTY LINE

GRAPHIC SCALE

3000 1500 0 3000 6000FT

SCALE: 1''= 3000'

GRAPHIC SCALE (METRIC)

1000 500 0 1000 2000meters

Figure 2.1-3 **Rev. 2**

Existing Conditions
Site Aerial Photograph

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

Figure 2.1-4, EREF Buildings, contains Security-Related Information Withheld from Disclosure under 10 CFR 2.390

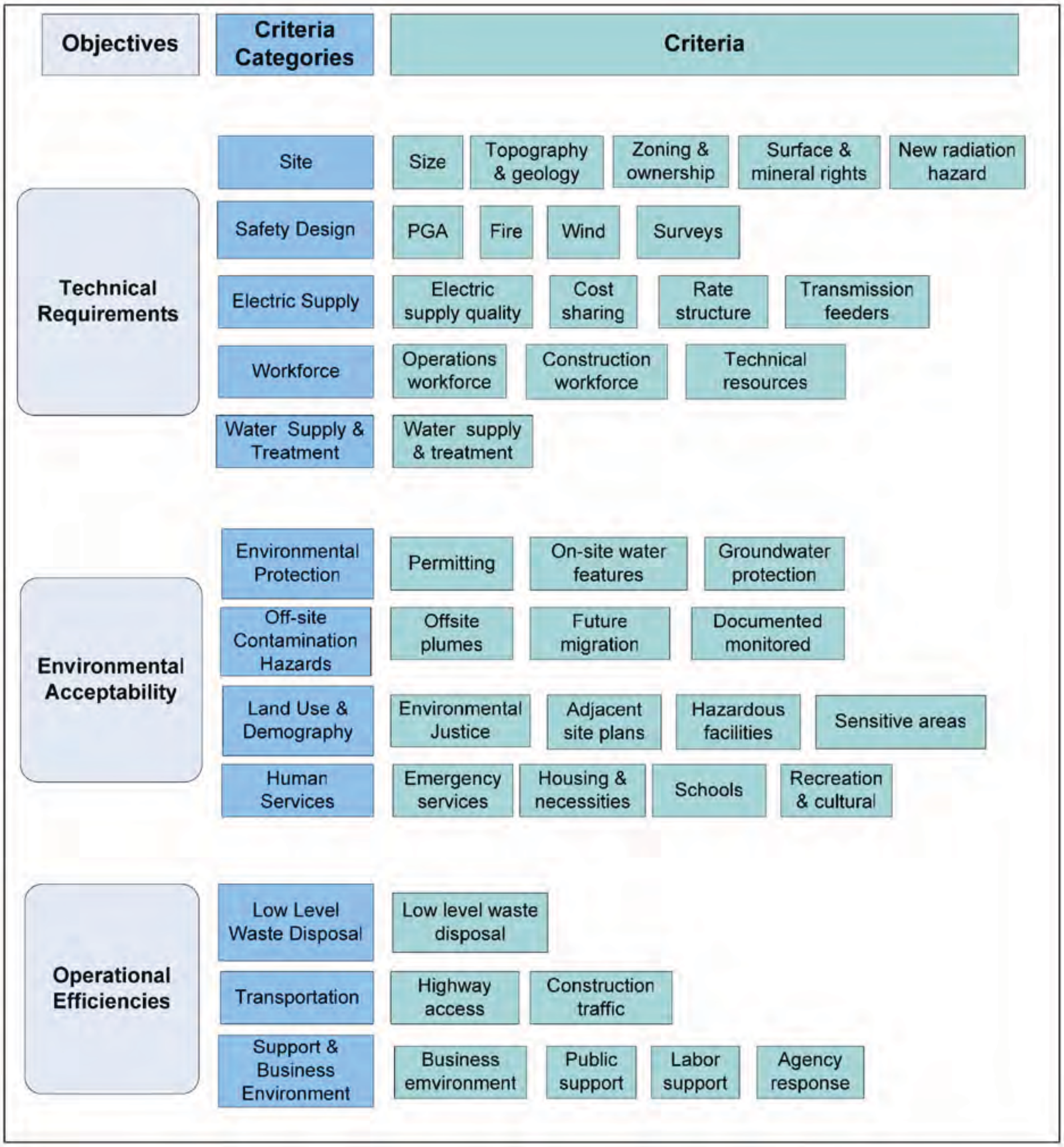


Figure 2.1-5 **Rev. 2**

Hierarchal Organization of Site Selection Objectives, Criteria Categories, and Criteria

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

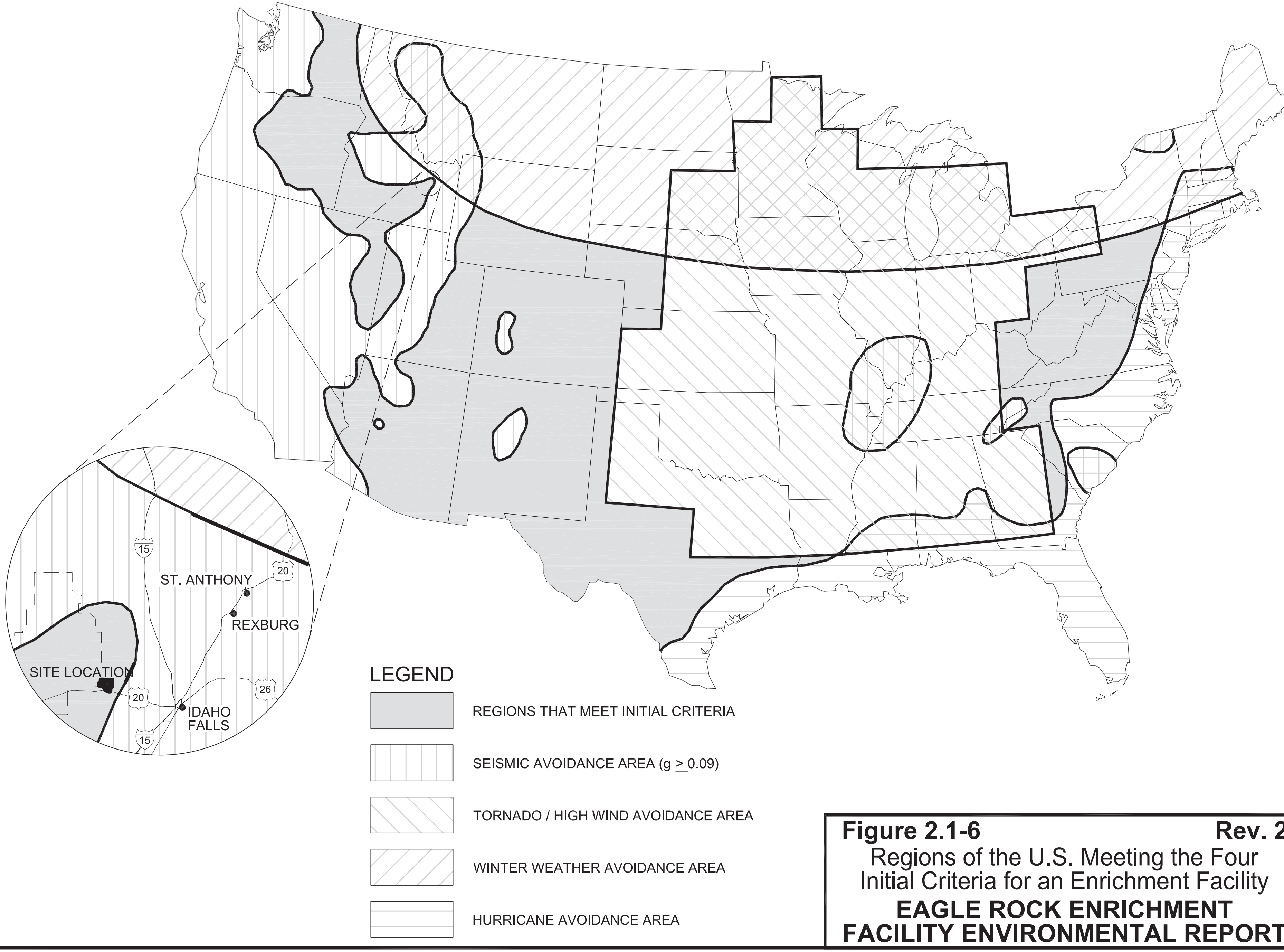


Figure 2.1-6 **Rev. 2**

Regions of the U.S. Meeting the Four Initial Criteria for an Enrichment Facility

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

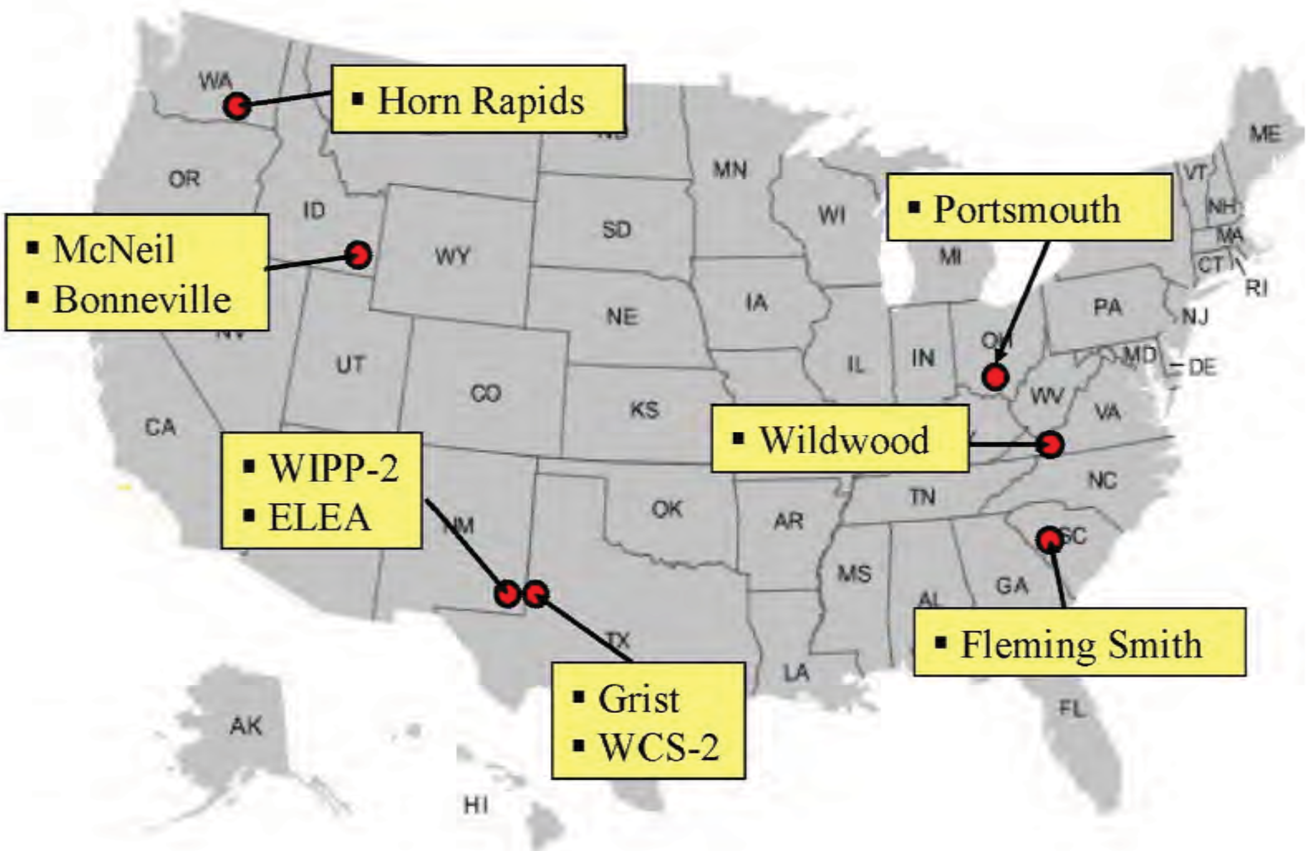


Figure 2.1-7 **Rev. 2**

General Locations of the Ten Sites Assessed in the Phase II Site Evaluation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

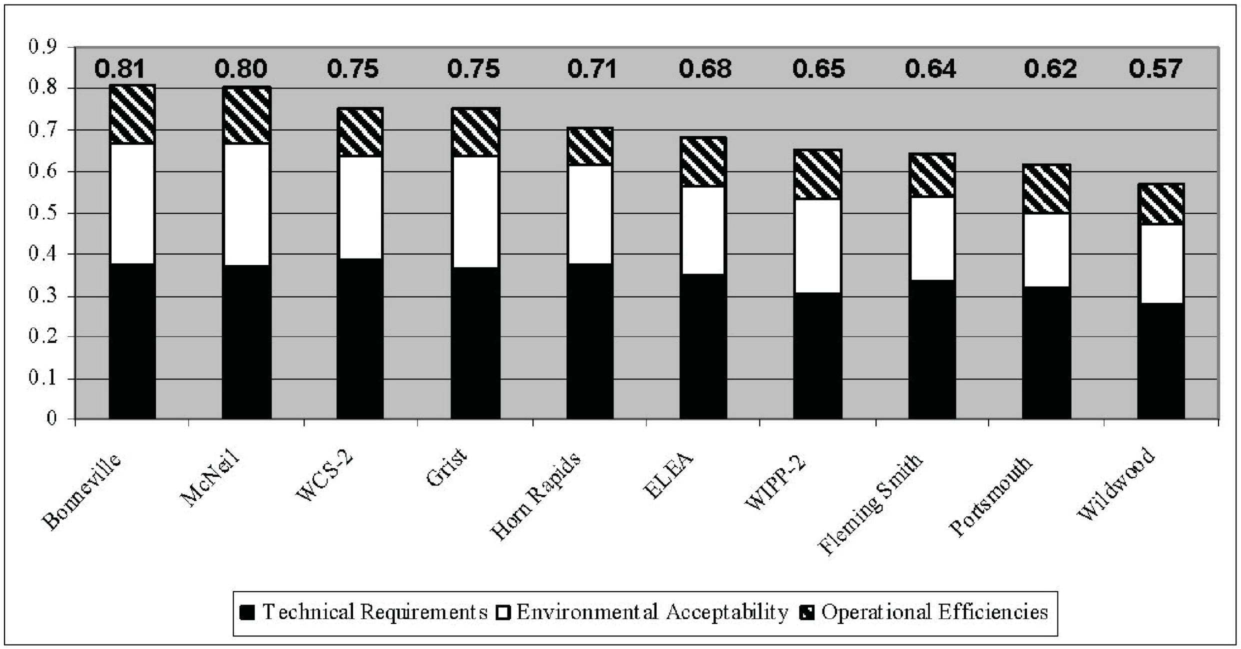


Figure 2.1-8 **Rev. 2**

Total Weighted Scores for the Ten Sites Assessed in the Phase II Site Evaluation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

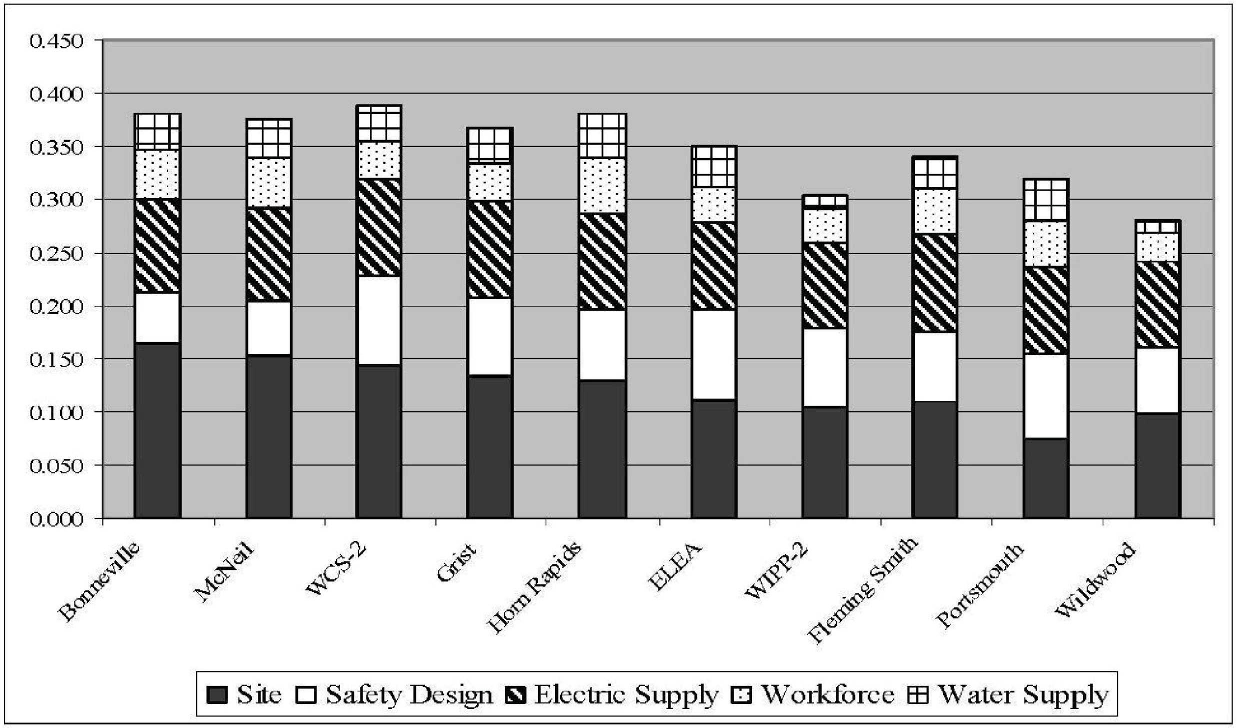


Figure 2.1-9 **Rev. 2**

Weighted Scores for the Technical Requirements Objective for the Ten Sites Assessed in the Phase II Site Evaluation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

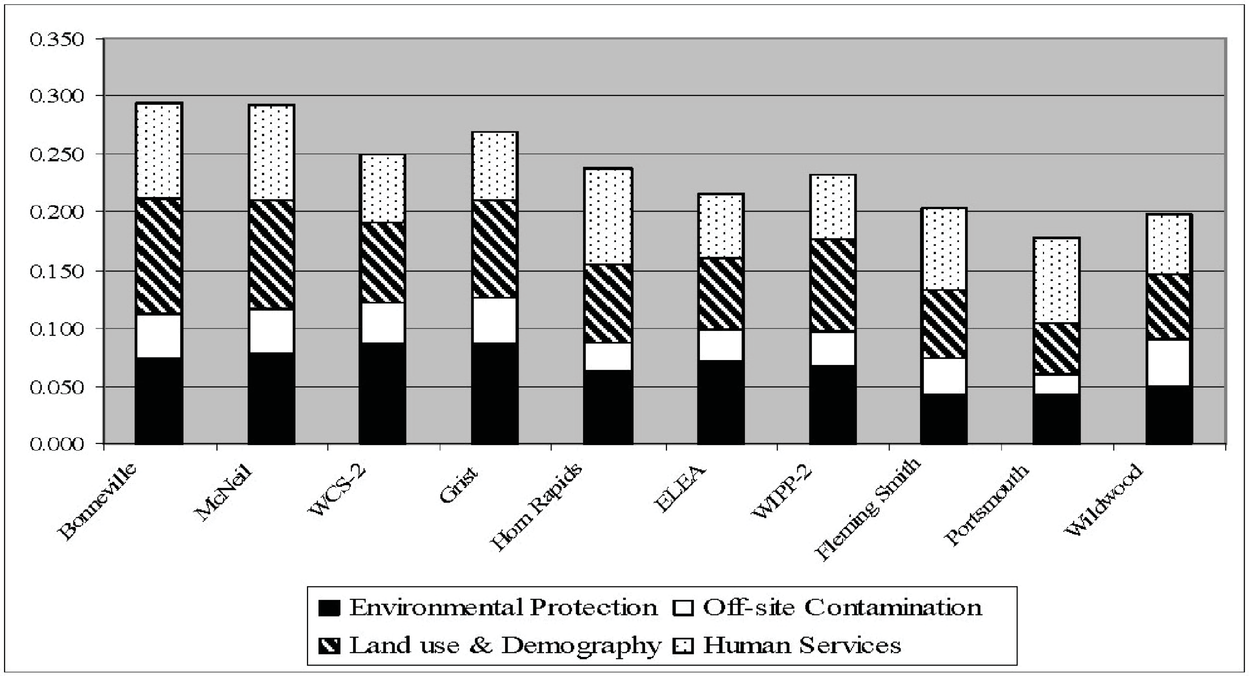


Figure 2.1-10 **Rev. 2**

Weighted Scores for the Environmental Acceptability Objective for the Ten Sites Assessed in the Phase II Site Evaluation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

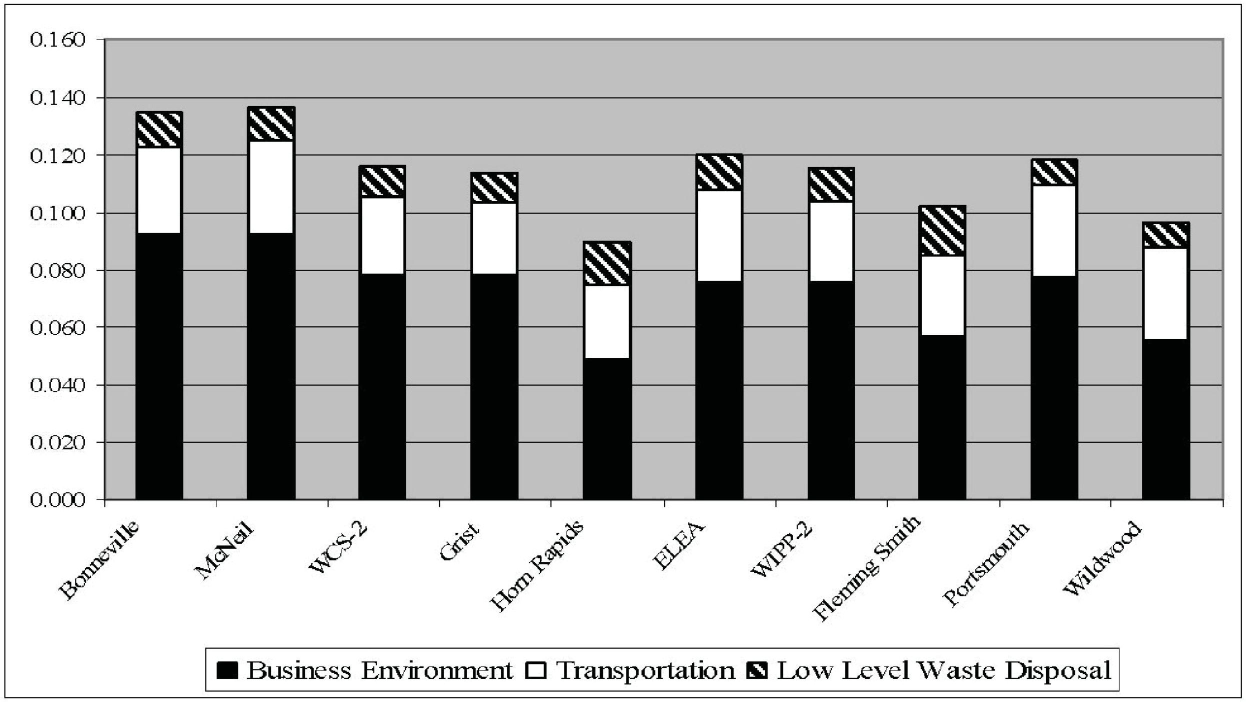


Figure 2.1-11 **Rev. 2**

Weighted Scores for the Operational Efficiencies Objective for the Ten Sites Assessed in the Phase II Site Evaluation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

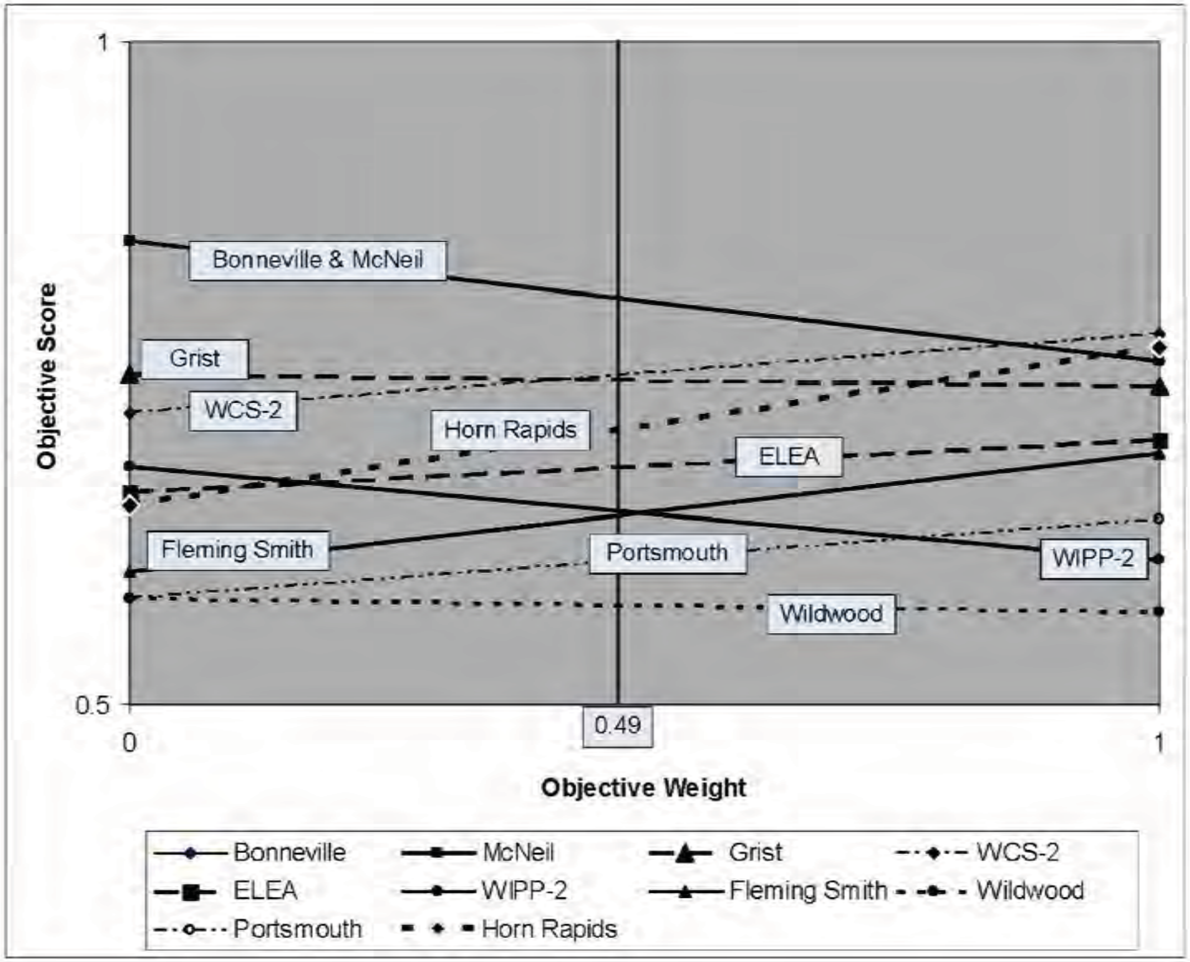


Figure 2.1-12 **Rev. 2**

Sensitivity of Site Ranking and Scores to Variable Weighting of the Technical Requirements Objective

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

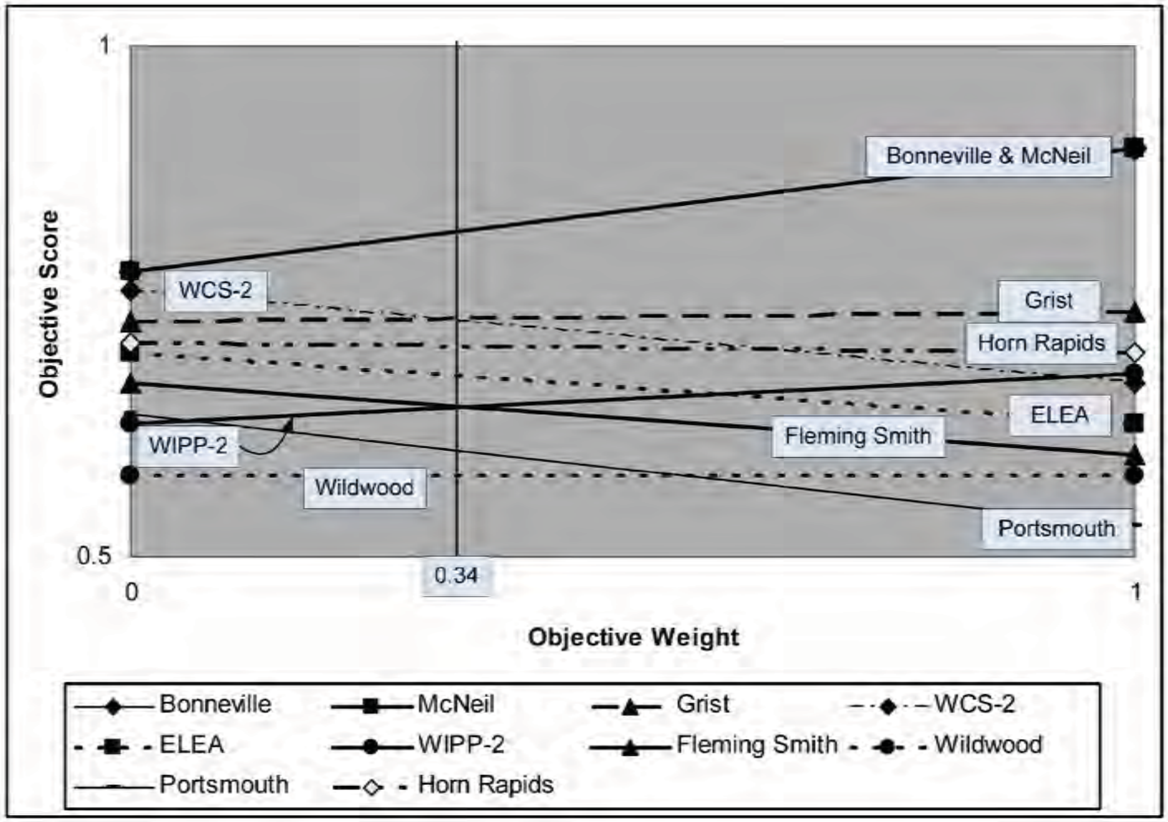


Figure 2.1-13 **Rev. 2**

Sensitivity of Site Ranking and Scores to Variable Weighting of the Environmental Acceptability Objective

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

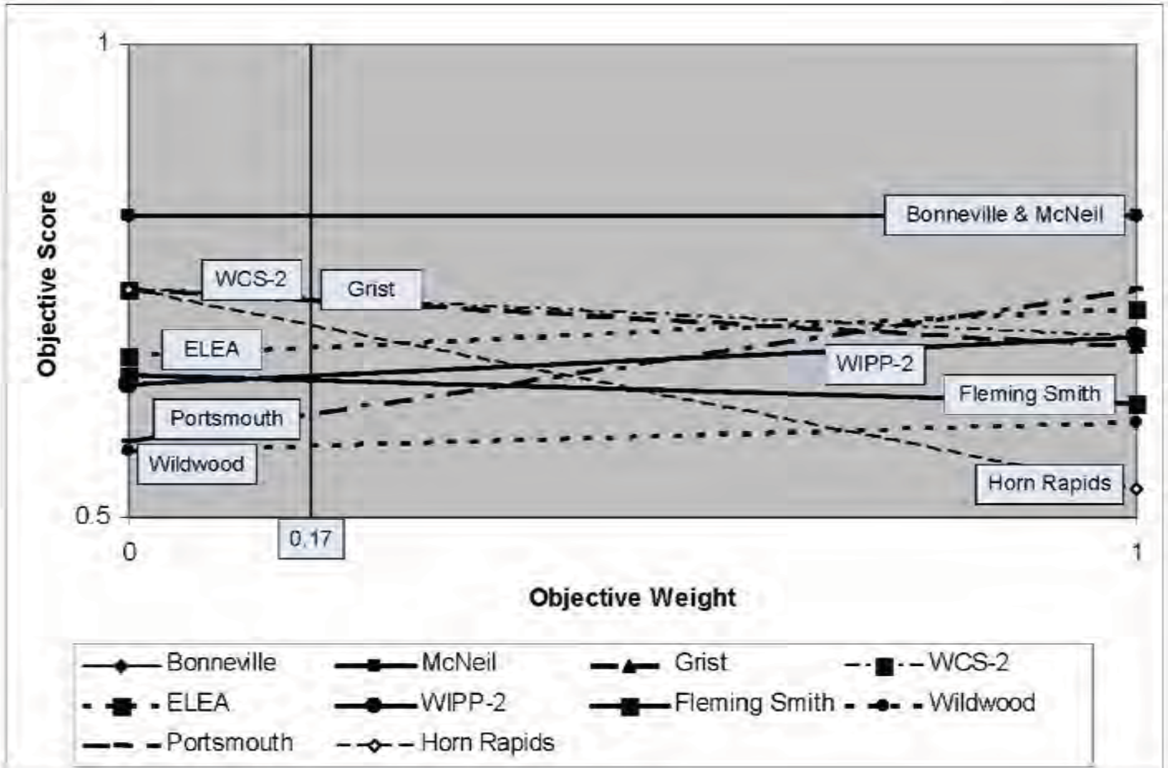


Figure 2.1-14 **Rev. 2**

Sensitivity of Site Ranking and Scores to Variable Weighting of the Operational Efficiencies Objective

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

2.2 ALTERNATIVES CONSIDERED BUT ELIMINATED

As set forth in ER Section 1.1, Purpose and Need for the Proposed Action, AREVA considered primary alternatives to the proposed action, i.e., alternatives to the construction and operation of the Eagle Rock Enrichment Facility (EREF). These alternatives include alternative sources of low-enriched uranium (LEU) currently available and potentially available to U.S. nuclear utilities in the future, such as the future deployment of a gas centrifuge plant by USEC; expansion by Urenco of its centrifuge capability in Europe; commissioning by Urenco's subsidiary, Louisiana Energy Services (LES), of its new plant in New Mexico, the National Enrichment Facility (NEF); continued sales of HEU-derived LEU under the U.S.-Russia HEU Agreement through 2013; and the potential increased availability of LEU derived from U.S.-owned HEU. The alternatives considered do not meet the underlying need for the proposed EREF, which is to provide additional reliable and economical uranium enrichment capacity in the United States, in accordance with U.S. energy and security policy objectives. The alternatives considered similarly fail to meet the important related commercial objectives of enhancing security of supply and eliminating dependence on the current single domestic enricher (USEC) or dependence on only two domestic enrichers when the NEF is commissioned. Additionally, various combinations of technical, economic, and political uncertainties associated with the alternatives identified in ER Section 1.1.2 warrant their elimination from further consideration in this ER. However, for completeness, the environmental impacts of several of the alternatives are compared to those of the proposed action in ER Section 2.4, Comparison of the Predicted Environmental Impacts.

AES also considered various secondary alternatives to the proposed action. These include alternative enrichment technologies, design alternatives, and alternative sites.

With respect to alternative technologies, AES considered the gaseous diffusion technology as an alternative method for enriching uranium, in so far as it is the only presently commercially operating process in the United States that allows for enrichment of uranium on the scale sought by AES for the proposed EREF. AES has concluded that the gas centrifuge process is superior because the production of the same amount of separative work units (SWU) by the gaseous diffusion process requires approximately 50 times more electricity. Indeed, as evidenced by its American Centrifuge Project, USEC intends to replace its use of the gaseous diffusion technology with the use of a gas centrifuge technology.

With respect to alternative designs, AES considered six system design changes from the Claiborne Enrichment Center for the EREF that would reduce the impact to the environment (see ER Section 2.1.3.2, Alternative Designs). The systems changed to improve plant efficiency and reduce environmental impact include the Cascade System, Feed System, Product Take-Off System, Product Liquid Sampling System, Product Blending System, and Tails Take-Off System. The EREF also includes several improvements over that licensed by LES for the NEF. These improvements include the redesigned Gaseous Effluent Ventilation System (GEVS), elimination of cooling towers, elimination of an onsite laundry, elimination of an onsite basin for disposal of treated liquid effluent, elimination of a circulating water system for building HVAC, addition of improved economizer HVAC units and consolidation of radiological support functions within a single building. Beyond other minor changes, there are no other significant design alternatives that could lower the impact of the EREF on the environment.

With respect to alternative sites, ten sites passed the Phase I screening (see ER Section 2.1.3.3). The Bonneville and McNeil, Idaho sites had the highest overall scores (0.81 and 0.80, respectively). The WCS-2 and Grist, Texas sites had the next highest overall scores (0.75 each) followed by the Horn Rapids, Washington site (0.71), the ELEA, New Mexico site (0.68), the WIPP-2, New Mexico site (0.65), the Fleming Smith, South Carolina site (0.64), the Portsmouth, Ohio site (0.62) and the Wildwood, Virginia site (0.57). Based on its review, AREVA selected the Bonneville, Idaho site as the proposed site for the EREF.

2.3 CUMULATIVE EFFECTS

Cumulative effects are those cumulative impacts that result from the incremental impact of an action added to other past, present, and reasonably foreseeable future actions. In conducting this analysis, AES considered past, current, and potential future facilities and activities that could have some potential for cumulative impacts when combined with the proposed construction and operation of the EREF.

AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. Thus, the local cumulative effects are those associated with the construction and operation of the EREF and the existing offsite development on surrounding properties. The anticipated direct and indirect impacts of the proposed construction and operation of EREF are expected to be small, except for the moderate to large impact due to the high percentage increase in traffic during the construction time frame for the EREF. The incremental cumulative impacts caused by EREF are also small, except for the moderate to large impact due to the high percentage increase in traffic during the construction time period.

The local cumulative effect on land use will be the impact caused by the construction and operation of the EREF and the existing offsite development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. Section 4.1, Land Use Impacts, discusses the land use impact associated with the construction and operation of the EREF. The cumulative impact associated with land use will be small, because the EREF impact is small and the nearby land is primarily utilized for grazing and cropping.

While INL and the city of Idaho Falls are contributing factors to cumulative impacts to transportation (U.S. Highway 20 use), AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. Section 4.2.8, Cumulative Impacts, discusses the transportation impacts from the existing traffic and the EREF. The cumulative impacts of traffic volume increases associated with construction of the EREF will be moderate to large, while the cumulative impacts of traffic volume increases associated with operation of the EREF will be small. The mitigation measures for the traffic increase during the construction phase of the EREF are defined in Section 4.2.5, Mitigation Measures.

A non-local cumulative impact is the cumulative dose to the general public or worker from transportation of UF_6 as feed, product or depleted material, and solid waste. Section 4.2.7, Radioactive Material Transportation, describes the radiological impacts associated with transportation of radiological materials associated with the EREF. The cumulative dose impacts to the general public or worker will be small.

The local cumulative impact to the geology and soils is limited to those resulting from construction and operation of the EREF and the existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. As described in Section 4.3.2, Cumulative Impacts to Geologic Resources, the cumulative impact to the geology and soils is small.

The local cumulative impact to water resources is limited to those resulting from construction and operation of the EREF and the existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. As described in Section 4.4.8, Identification of Predicted Cumulative Effects on Water Resources, the cumulative impact to the water resources will be small.

The local cumulative impact to ecological resources is limited to those resulting from construction and operation of the EREF and the existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. As described in Section 4.5.11, Cumulative Impacts, the cumulative impact to the ecological resources will be small.

In addition to the EREF, there are ten sources of emissions that could affect air quality in the four county local region as described in Section 3.6.3.9, Regional Emissions. Section 4.6.7, Cumulative Air Quality Impacts, determined that the cumulative impact to regional air quality will be small.

The cumulative non-local effect to noise from the EREF, existing traffic along U.S. Highway 20, farm and ranch operations, infrequent small aircraft, and environmental noise will be small per Section 4.7.6, Cumulative Impacts.

The local cumulative impact to historic and cultural resources is limited to those resulting from construction and operation of the EREF and the existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. As described in Section 4.8.7, Cumulative Impacts, the cumulative impact to historic and cultural resources will be small.

The local cumulative impact to visual/scenic resources is limited to those resulting from construction and operation of the EREF and existing offsite development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. As described in Section 4.9.7, Cumulative Impacts to Visual/Scenic Quality, the cumulative impact to visual/scenic resources will be small.

Section 4.10.5 describes that several proposed developments within 80 km (50 mi) of the proposed site may contribute to regional cumulative socioeconomic effect. The cumulative socioeconomic effect of the proposed developments and the construction and operation of the EREF will be small.

A summary assessment of the potential for cumulative impacts is shown in Table 2.3-1, Potential Cumulative Effects for the EREF.

TABLES

Table 2.3-1 Potential Cumulative Effects for the EREF
(Page 1 of 1)

ER Section Reference	Effect On	EREF Effect	Cumulative Effects
4.1	Land Use	Small	Small
4.2	Transportation	Moderate to large for construction and small for operation	Moderate to large for construction and small for operation
4.3	Geology and Soils	Small	Small
4.4	Water Resources	Small	Small
4.5	Ecological	Small	Small
4.6	Air Quality	Small	Small
4.7	Noise	Small. Increased noise levels during construction, but few nearby receptors.	Small cumulative environmental noise effects when combined with existing U.S. Highway 20 noise levels from other local and non-local facilities and activities.
4.8	Historic and Cultural	Small	Small
4.9	Visual/Scenic Resources	Small	Small
4.10	Socioeconomics	Small	Small
4.11	Environmental Justice	Small	None
4.12	Public and Occupational Health	Small	Small
4.13	Waste Management	Small	Small

2.4 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

ER Section 1.1.2 analyzes various scenarios that assume that the Eagle Rock Enrichment Facility (EREF) is not built, referred to here as the no-action alternative scenarios. Only two of the scenarios are relevant to a comparison of domestic environmental impacts (C and D) because the others either include the proposed action (A, H), support the proposed action (B), would require an analysis of environmental impacts in Europe or Russia (E and F) which is outside of the scope required to be considered in the National Environmental Policy Act, or is a scenario that must be recognized as being highly speculative (G). The anticipated impacts to the environment for each of the no-action alternative scenarios (C and D) compared to the proposed action are described below.

Table 2.4-1, Comparison of Potential Impacts for the Proposed Action and the No-Action Alternative Scenarios, summarizes the potential impacts of each scenario and compares them against the proposed action in terms of domestic capacity and supply for both Reference and High Nuclear Power Growth. In the Reference Growth forecast, AREVA assumes that world nuclear plants currently in operation will dominate nuclear capacity through 2025. The High Growth forecast assumes a higher contribution from license renewals and new plants. Both growth scenarios are described in detail in ER Section 1.1.2.1. Table 2.4-1 also provides an overall summary of the environmental impacts for the ER Chapter 4 categories as tabulated in Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and No-Action Alternative Scenarios.

Table 2.4-2 compares the two no-action scenarios against the proposed action for each of the ER Chapter 4 environmental categories in relative terms, i.e., it estimates whether the impacts are the same, greater than or less than those anticipated for the proposed action. ER Chapter 4 itself contains the detailed description of potential impacts of the proposed action on individual resources of the affected environment.

Proposed Action (Scenario A)

The Proposed Action or Scenario A represents the scenario that is being actively pursued by AES, LES and USEC: AES deploys the EREF with a nominal capacity of 6 million SWU while LES and USEC complete their domestic enrichment projects consistent with schedules announced by each company as described in Section 1.1.2.3.1. This includes USEC's replacement of the Paducah Gaseous Diffusion Plant with the 5.9 million SWU-capacity American Centrifuge Plant and LES' completion of the 3 million SWU-capacity National Enrichment Facility.

Scenario C - Base Supply Without EREF Plus GEH Deployment of GLE

Scenario C assumes that General Electric Hitachi (GEH), parent company of Global Laser Enrichment (GLE), successfully deploys the Silex enrichment technology with commercial deployment of a 6 million SWU commercial plant by 2015 and ramping up to 6 million SWU by 2020. With Reference Nuclear Power Growth, there is small surplus enrichment capacity until the 2021-2025 period and the 2026-2030 period when there is a deficit of 0.7% and 4.4% respectively. With the High Nuclear Power Growth forecast, a deficit of 1.2% occurs in the 2011-2015 period and grows to 3.9% in the 2016-2020 period, 10.6% in the 2021-2025 period, and 16.2% in the 2026-2030 period.

While providing for indigenous U.S. supply, there are several critical concerns associated with this alternative scenario. On January 30, 2009, GEH delivered its environmental report to the

NRC with the rest of the license application to be submitted by June 2009 (SILEX, 2009). GEH will decide if GLE will be deployed commercially, following results of testing that is scheduled to occur during 2009. Therefore, Scenario C, far from being a certain alternative source of enrichment services, is at the present time highly speculative from both a technological and commercial perspective. Ultimately, GEH may decide not to proceed with construction and deployment of GLE. Even if it does make the decision to proceed, there remain uncertainties associated with the schedule and licensing of a new technology, and ultimately financing, building and operating it.

While GLE may eventually offer value as a supplier of enrichment services to the industry in the long term, it is not prudent to substitute (i) a potential source of supply for which the enrichment technology has not yet been commercially tested and a commercial plant deployment decision has not yet been made for (ii) the proposed AREVA plant in the U.S. that would be using commercially proven centrifuge enrichment technology that would be built and operated by a company that has been providing enrichment services world wide for many decades. The selection of Scenario C would not alleviate concerns among U.S. purchasers of enrichment services regarding long-term security of supply. Therefore, Scenario C is not viewed by AREVA as a responsible alternative to that of proceeding with the AREVA plant in the U.S.

Scenario D - Base Supply Without EREF Plus USEC Expansion of ACP

Scenario D assumes that USEC successfully completes and then, during the 2013-2016 period, successfully expands the ACP by an additional 3.2 million SWU per year enrichment capacity to attain its licensed maximum capacity of 7 million SWU per year. With the Reference Nuclear Power Growth forecast, a 5.0% deficit of requirements over available supply appears in the 2021-2025 period, and an 8.4% deficit of requirements over available supply appears in the 2026-2030 period. With the High Nuclear Power Growth forecast, a 2.3% deficit occurs in the 2011-2015 period and grows to 7.3% in the 2016-2020 period, 14.0% in the 2021-2025 period, and 19.2% in the 2026-2030 period.

However, it should be noted that at the present time, the USEC ACP is not operational and USEC has also not obtained all the financing needed to construct the initial 3.8 million SWU of capacity. In addition, USEC has not publicly stated that a decision has been made to expand enrichment capacity of the ACP immediately upon completion of capacity that is presently under construction, as would be required under this scenario. Ultimately, USEC may decide not to proceed with such an expansion.

While USEC offers value as a long term supplier of enrichment services to the industry, it is not prudent to substitute (i) potential sources of supply for which commercial plant expansion decisions have not yet been made, and in the case of USEC the enrichment technology not yet commercially proven, or (ii) the proposed AREVA plant in the U.S. using commercially proven centrifuge enrichment technology that would be built and operated by a company that has been providing enrichment services world wide for many decades. The selection of Scenario D would not alleviate concerns among U.S. purchasers of enrichment services regarding long-term security of supply. In addition, it would not result in an additional source of indigenous competitive supply, but just USEC with greater enrichment capacity and LES. Therefore, Scenario D is not viewed by AES as a responsible alternative to that of proceeding with the AES plant in the U.S.

Summary

Not building the EREF could have the following consequences:

- A uranium supply deficit for which other sources of supply must compensate.
- Expansion of other facilities resulting in a higher concentration of production in one location.
- Diminished long-term security of supply for U.S. commercial nuclear power generating stations.
- Decreased competition potentially resulting in higher fuel costs for U.S. commercial nuclear generating stations.
- Diminish the objective of long-term security of supply.

Accordingly, AES considers that the EREF would be a complementary and competitive supplier for the uranium enrichment services required for the nuclear generating stations that are currently in operation and for the impending growth of nuclear generation consistent with growing world electric generation demand and an increased reliance on nuclear power as a means of reducing carbon emissions. EREF would foster increased competition and would provide a means to offset foreign enrichment supplies. It would also avoid reliance on new unproven enrichment technologies and a concentration of enrichment services in a single location.

While the no-action alternative scenarios would avoid any impacts to Bonneville County, Idaho, due to construction and operation of the EREF, it would lead to impacts at other locations. If the proposed EREF is not built, there will be a continued and increasing need for uranium enrichment services. The no-action alternative scenarios, as discussed above, would allow for at least two domestic options in regard to continued uranium enrichment supply; Scenarios C and D.

As summarized in Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios, the impacts to the environment of all no-action alternative scenarios are anticipated to be about the same (Scenario C) or greater than (Scenario D) the proposed action in both the short and long term. There are potentially lesser impacts in some environmental categories, which are offset by greater environmental impacts in other categories due to, for instance, concentration of enrichment in one location. In addition, the important objective of security of supply is delayed. Hence, it is reasonable to reject the no-action alternative scenarios because the affect to the environment from the proposed action is small, as demonstrated in ER Chapter 4, Environmental Impacts, and the benefits desirable, as demonstrated in ER Chapter 7, Cost-Benefit Analysis.

TABLES

Table 2.4-1 Comparison of Potential Impacts for the Proposed Action and the No-Action Alternative Scenarios (Page 1 of 1)

Potential Impact	Proposed Action[1]	Alternative Scenarios		
		Scenario C Base Supply Without EREF Plus GEH Deployment of GLE		Scenario D Base Supply Without EREF Plus USEC Expansion of ACP
Domestic Capacity	EREF provides a nominal 6 million SWU/yr supply; ACP provides 3.8 million SWU/yr; and NEF provides 5.9 million SWU/yr. Paducah GDP is removed from service as ACP comes on line.	GLE operational in 2015 and provides base enrichment capacity of 3.5 million SWU/yr and ramping up to 6 million SWU/yr by 2020. Under Reference Growth, deficit begins in 2021; under High Growth, deficit begins in 2011.		ACP increases capacity to 7 million SWU/yr in 2013-2016 period. Under Reference Growth, deficit begins in 2021; under High Growth, deficit begins in 2011.
Domestic Supply	Establishes three indigenous long-term sources of energy efficient, low cost, reliable enrichment services; fosters competition and results in more secure source; ensures competitive procurement process for customers; provides replacement supply for inefficient and noncompetitive gaseous diffusion enrichment plants and protects against prospect of supply shortfalls if foreign sources become unavailable.	Growing supply to requirement deficit after early surplus under Reference Growth; GLE is unproven technology and is undergoing testing and no commitment to build has been made.		Growing supply to requirement deficit after early surplus; USEC ACP not operational and USEC has not stated that a decision has been made to expand.
Summary of Environmental Impacts (see Table 2.4-2 for list of categories)	Total Scoring[2]: 0	Total Scoring[2]: 0		Total Scoring[2]: -2.0

[1]Proposed action assumes that AES, LES and USEC deploy centrifuge plants and GDP is shutdown when the USEC centrifuge plant comes on line. The proposed action receives a neutral score of zero (i.e. baseline impact on the environment).
[2]All Alternative Scenarios are compared against the Proposed Action. A positive score means less impact on the environment than the Proposed Action; a negative score means greater impact.

Table 2.4-2 Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios (Page 1 of 4)

Environmental Category	Proposed Action	Alternative Scenarios		
		Scenario C Base Supply Without EREF Plus GEH Deployment of GLE		**Scenario D Base Supply Without EREF Plus USEC Expansion of ACP**
Land Use	Minimal for EREF (See ER Section 4.1)	Same impact since three enrichment plants are built Scoring: 0		Same or less impact since only two of three GCPs built but expansion at ACP impacts some additional land Scoring: +0.5
Transportation	Minimal for EREF (See ER Section 4.2)	Same impact since three enrichment plants are built Scoring: 0		Greater impact since concentrating shipments at fewer locations Scoring: -1
Geology and Soils	Minimal for EREF (See ER Section 4.3)	Same impact since three enrichment plants are built Scoring: 0		Same impact if increased capacity on undisturbed land; less impact if on already disturbed land Scoring: 0 or +1 (use +0.5)
Water Resources	Minimal for EREF (see ER Section 4.4)	Same impact if similar water requirements Scoring: 0		Greater impact since concentrating water usage at one location Scoring: -1

Table 2.4-2 Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios (Page 2 of 4)

Environmental Category	Proposed Action	Alternative Scenarios		
		Scenario C Base Supply Without EREF Plus GEH Deployment of GLE		**Scenario D Base Supply Without EREF Plus USEC Expansion of ACP**
Ecological resources	Minimal for EREF (See ER Section 4.5)	Same impact since three enrichment plants are built Scoring: 0		Same or greater impact since expansion concentrates at one location Scoring: -0.5
Air Quality	Minimal for EREF, less than regulatory limits (See ER Section 4.6)	Same impact since three enrichment plants are built Scoring: 0		Same or greater impact since expansion concentrates at one location Scoring: -0.5
Noise	Minimal for EREF, within HUD and EPA limits (See ER Section 4.7)	Same impact since three enrichment plants are built Scoring: 0		Same or greater impact since expansion concentrates at one location Scoring: -0.5
Historic and Cultural	Minimal for EREF, impacts can be avoided or mitigated (See ER Section 4.8)	Same impact since three enrichment plants are built Scoring: 0		Same or less impact Scoring: +0.5

Table 2.4-2 Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios (Page 3 of 4)

Environmental Category	Proposed Action	Alternative Scenarios		
		Scenario C Base Supply Without EREF Plus GEH Deployment of GLE		**Scenario D Base Supply Without EREF Plus USEC Expansion of ACP**
Visual/Scenic	Minimal for EREF (See ER Section 4.9)	Same impact since three enrichment plants are built Scoring: 0		Same or less impact Scoring: +0.5
Socioeconomic	Positive impact to local economy due to EREF (See ER Section 4.10	Same impact since three enrichment plants are built Scoring: 0		Same or less positive impact Scoring: -0.5
Environmental Justice	No disproportionate impact for EREF (See ER Section 4.11)	Same impact Scoring: 0		Same impact Scoring: 0
Public and Occupational Exposure	Minimal for EREF; doses below NRC and EPA regulatory limits (See ER Section 4.12)	Same impact since three enrichment plants are built Scoring: 0		Same impact since overall SWU capacity would be about the same Scoring: 0
Waste Management	Minimal for EREF (See ER Section 4.13)	Same impact since three enrichment plants are built Scoring: 0		Same impact since overall SWU capacity would be about the same Scoring: 0

Table 2.4-2 Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios (Page 4 of 4)

Scoring	ey is as follows
+1	Less impact than Proposed Action
+0.5	Same or less impact than Proposed Action
0	Same impact as Proposed Action
-0.5	Same or greater impact than Proposed Action
-1	Greater impact than Proposed Action
-1.5	Significantly greater impact than Proposed Action

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3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

This chapter provides information and data for the affected environment at the proposed Eagle Rock Enrichment Facility (EREF) and surrounding vicinity. Topics include land use (3.1), transportation (3.2), and geology and soils (3.3), as well as various resources such as water (3.4), ecological (3.5), historic and cultural (3.8), and visual/scenic (3.9). Other topics included in this chapter are meteorology, climatology, and air quality (3.6), environmental noise (3.7), socioeconomic information (3.10), public and occupational health (3.11), and waste management (3.12).

3.1 LAND USE

This section describes land uses on the proposed Eagle Rock Enrichment Facility (EREF) site and within 8 km (5 mi) of the proposed site. It also provides a discussion of land uses in the general region within 80 km (50 mi) of the proposed site. Figure 3.1-1, Land Ownership Within 80-km (50 mi), shows the site in relation to regional lands. Major transportation corridors are identified in Section 3.2, Transportation.

3.1.1 Description of the Proposed Property

The proposed site is situated within Bonneville County, Idaho, on the north side of U.S. Highway 20, about 113 km (70 mi) west of the Idaho/Wyoming state line. Portions of Bonneville, Jefferson, and Bingham counties are within 8 km (5 mi) of the proposed site. The approximately 1,700 ha (4,200 ac) property is currently under private ownership by a single landowner. There is a 16-ha (40-ac) parcel within the proposed site, which is administered by the Bureau of Land Management (BLM). The privately held land will be purchased by AREVA Enrichment Services, LLC (AES).

There are no right-of-ways on the property with the exception of the right-of-way for U.S. Highway 20, which forms part of the southern boundary of the proposed site. Otherwise, the site is in native rangeland, non-irrigated seeded pasture, and irrigated cropland. A dirt road provides site access from U.S. Highway 20, while other dirt roads provide access throughout the proposed site.

There are no mineral or oil and gas leases on or near the proposed site. However, the Federal government did reserve for itself certain mineral rights which were not subject to claim or patent by anyone under the General Mining Act of 1872 (USC, 2008f). The reservations were for mineral rights on two, 16-ha (40-ac) parcels located within the proposed site (Figure 3-1.2, Location of U.S. Fissionable Material Land Reservations, Pursuant to the Atomic Energy Act of 1946, as Amended). The mineral rights so retained by the U.S. Government were subject to entry and exploitation by the U.S. only. Although the U.S. Government reserved the right to enter, explore for and recover fissionable materials, the geologic setting at the site is not consistent with the occurrence of such deposits because the proposed site is underlain by basaltic lava flows that range up to a few thousand feet in total thickness. Basaltic lavas are not known to host any significant uranium deposits anywhere in the world (Nash, 1981). At the current time, no exploration activity for uranium or active uranium mining is reported to be occurring anywhere in Idaho (Gillerman, 2008a). AREVA Enrichment Services (AES) contacted the Department of Interior office in Washington, D.C. and the Idaho State office of the Bureau of Land Management (BLM) to determine the current status of these reservations. AES was advised that while the reservation may continue to appear in title searches to be a part of the land patent, in fact, these reservations were released, remised and quitclaimed to the person to whom the land was patented pursuant to Section 64.b of the Atomic Energy Act of 1954, as amended. A review of the Atomic Energy Act confirms that the two mineral reservations associated with the property are no longer valid and have no force or effect in law. Refer to Section 3.3, Geology and Soils, for further discussion on mineral resources in the site vicinity.

3.1.2 Local and Regional Setting

Grazing and cropping are the main land uses within 8 km (5 mi) of the proposed site (Table 3.1-1a, Land Use Within 8 km (5 mi) of the Proposed Eagle Rock Enrichment Facility Classification and Area). State land immediately west of the proposed site and BLM land immediately east of the site are grazed. The nearest croplands are within 0.8 km (0.5 mi) of the southeast corner of the proposed site. The nearest feedlot and dairy operations are about 16 km (10 mi) east of the proposed site. The Department of Energy's Idaho National Laboratory (INL) eastern boundary is 0.8 km (0.5 mi) west of the proposed site. The INL property near the site is undeveloped rangeland (Anderson, 1996a). The closest facility on the INL property is the Materials and Fuels Complex (MFC), located approximately 16 km (10 mi) west of the proposed site boundary. The lands north, east, and south of the site are a mixture of private-, State-, and Federal-owned parcels as shown in Figure 3-1.3, Land Ownership Map Within 8 km (5 mi). (Inside Idaho, 2008) (USCB, 2008a)

The city of Idaho Falls is located about 32 km (20 mi) east southeast from the site. Land uses surrounding Idaho Falls include residential, recreational, agricultural, and commercial (Inside Idaho, 2008, USCB, 2008a). Several lines and branches of the Union Pacific Railroad pass through Idaho Falls. The Union Pacific Railroad Aberdeen Branch runs parallel to U.S. Highway 26, about 40 km (25 mi) south of the proposed site, with the Scoville Branch leading onto the Idaho National Laboratory and ending at Scoville Siding. In addition, the Eastern Idaho Rail Road operates short line tracks connecting towns north and east of Idaho Falls to the Union Pacific Line (USCB, 2008a).

The towns of Rigby and Rexburg are located approximately 23 km (14 mi) and 42 km (26 mi) north of Idaho Falls, respectively. Atomic City is about 32 km (20 mi) west of the site. South of the proposed site are the towns of Blackfoot at 40 km (25 mi) and Pocatello at 76 km (47 mi). The Fort Hall Indian Reservation comprises about 220,150 ha (544,000 ac) and also lies to the south. The nearest boundary of the reservation is about 44 km (27 mi) from the proposed site (Inside Idaho, 2008). The town of Fort Hall is located at a distance of approximately 60 km (37 mi).

The nearest residence is 7.7 km (4.8 mi) east of the proposed site boundary. Temporarily occupied structures in the 8-km (5-mi) radius include two potato storage facilities, one 3.2 km (2 mi) west of the proposed site boundary, and one about 7.7 km (4.8 mi) to the east of the site boundary (next to the nearest residence). In addition, a powerline transformer is adjacent to the proposed site boundary to the east. Public use areas include a hiking trail south of the proposed site in Hell's Half Acre Wilderness Study Area (WSA) and a small lava tube cave located approximately 8 km (5 mi) east and south (BLM, 2008a). There are landfills in Jefferson, Bonneville, and Bingham counties and two waste transfer stations in Bonneville County. However, none of the facilities are within the 8-km (5-mi) area surrounding the proposed site. U.S. Highway 20 is immediately south of the proposed site and Interstate 15 runs through Idaho Falls about 32 km (20 mi) east of the proposed site. Additional discussion of transportation is presented in Section 3.2, Transportation. A discussion of schools and hospitals is included in Section 3.10, Socioeconomic.

3.1.3 Geology and Soils

The proposed site is located in the eastern portion of the Snake River Plain geologic province (NRCS, 2008a). The Snake River Plain is a crescent-shaped area of topographic depression that is bounded on three sides by mountain ranges and extends across much of the southern portion of Idaho, covering about 40,400 km^2 (15,600 mi^2). The geology of the Snake River Plain has experienced extensive volcanism that has deposited a thick sequence of rhyolitic and basaltic rocks, ranging up to 1,676 m (5,500 ft) thick. On-site soils are primarily of the Pancheri series and consist of deep silt loams (NRCS, 2008b), that commonly support crops, grazing, and wildlife. Refer to Section 3.3.2, Geology at the Proposed Site, for further discussion.

3.1.4 Land Use Within 8 km (5 mi)

Referring to Table 3.1-1a, Land Use Within 8 km (5 mi) of the Proposed Eagle Rock Enrichment Facility Classification and Area, Table 3.1-1b, Land Use Within 8 km (5 mi) of the Proposed Eagle Rock Enrichment Facility Site Classification Descriptions, and Figure 3.1-4, Land Use Map Within 8 km (5 mi), rangeland comprises 53% of the area within an 8-km (5-mi) radius of the proposed site, including 10,161 ha (25,108 ac) within Bonneville County, 4,442 ha (10,977 ac) in Bingham County, and 6,527 ha (16,130 ac) in Jefferson County, Idaho (Bonneville County, 2008) (Jefferson County 2008) (Inside Idaho, 2008) (USCB, 2008a) The rangeland, typical of that found in southeastern Idaho, is composed of shrub and herbaceous vegetation and supports livestock grazing and wildlife.

Non-irrigated seeded pasture comprises 10% of the area within the 8-km (5-mi) radius, all 3,914 ha (9,673 ac) of which is located within Bonneville County. Non-irrigated seeded pastures are areas where native rangelands have been cleared to create improved pasture for livestock grazing.

Agricultural land comprises 18% of the area within an 8-km (5-mi) radius of the proposed site, including 5,063 ha (12,510 ac) within Bonneville County, and 1,931 ha (4,771 ac) in Jefferson County. There are no agricultural lands in Bingham County. The agricultural lands are used primarily for production of food and fiber.

Barren land, comprised of bare exposed rock and volcanic flows constitutes the other land use classification in the proposed site vicinity, is 19% of land area.

3.1.5 Special Land Use Classifications

Special land use classifications (e.g., Native American reservations, national parks, prime farmland) within the vicinity of the site include the following:

- Two Wildlife Management Areas (WMAs), Mud Lake WMA, approximately 35 km (22 mi) to the north, and the Market Lake WMA, approximately 32 km (20 mi) to the northeast (IFG, 2008);
- Camas National Wildlife Refuge (NWR), approximately 44 km (27 mi) to the north (USFWS, 2008b);
- Hell’s Half Acre WSA, located on the south side of Highway 20 (BLM, 2008a), adjacent to the proposed site, and;
- Fort Hall Indian Reservation, about 60 km (37 mi) to the south.

The soil in the northeast portion of the proposed site where the irrigated farmland occurs is classified by the U.S. Natural Resources Conservation Service (NRCS) as prime farmland, if irrigated (NRCS, 2008b). The NRCS is responsible for the preservation of prime or unique farmlands as outlined in the Farmland Protection Policy Act (FPPA) (USC, 2008l). Although the proposed enrichment facility will occupy soils identified as prime farmland, private actions on private lands and Federal permitting and licensing involving prime farmland are not subject to protection under FPPA. Therefore, no NRCS formal land evaluation and site assessment are required for the proposed enrichment facility.

3.1.6 Ecological Use

Wildlife observed on and near the proposed site during field visits in May 2008, June 2008, October 2008, January 2009 and April 2009 were species common to the area. Mammals observed included Pronghorn (*Antilocapra americana*), jack rabbit (*Lepus spp.*), and coyote (*Canis latrans*).

Common bird species observed included horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Brewer's sparrow (*Spizella breweri*), sage thrasher (*Oreoscoptes montanus*), northern harrier (*Circus cyaneus*), mourning dove (*Zenaida macroura*), killdeer (*Charadrius vociferus*), brown-headed cowbird (*Molothrus ater*), crow (*Corvus brachyrhynchos*), and long-billed curlew (*Numenius americanus*). A single greater sage grouse (*Centrocercus urophasianus*) was observed in May 2008 about 1.6 km (1 mi) north of the proposed site, and multiple roost sites were observed in three areas of the proposed site during June 2008 surveys.

See Section 3.5, Ecological Resources, for a detailed discussion of other animals that may be found near the site.

3.1.7 Water Resources

Known sources of water in the vicinity of the proposed site include Mud Lake, Market Lake WMA, the Snake River, Camas NWR, and American Falls Reservoir (American Falls Chamber of Commerce, 2008) (IFG, 2008) (USFWS, 2008b). Both Mud Lake and Market Lake are designated as Wildlife Management Areas dedicated to primary uses such as big game, waterfowl, fishing and general public use (IFG, 2008).

The Snake River is located 32 km (20 mi) east of the proposed site and runs north to south through the town of Idaho Falls and is used for recreational activities as well as providing wildlife habitat along its extensive corridor in the surrounding area (Idaho Falls Chamber of Commerce, 2008). Camas NWR located 44 km (27 mi) to the north of the proposed site is comprised of over 4,050 ha (10,000 ac) of marshes, meadows, and uplands used for wildlife observation, waterfowl, and upland game bird hunting (USFWS, 2008b).

American Falls Reservoir, located 68 km (42 mi) southwest of the proposed site is the largest reservoir on the Snake River and is used for a variety of outdoor sporting and recreational activities (RecreationGov, 2008). Although commercial fishing for some species is permitted at Mud Lake and along designated reaches of the Snake River, there are no commercial fishing operations on or near the proposed site.

3.1.8 Agricultural Use

Various crops are grown in Bonneville, Bingham and Jefferson Counties. About 389 ha (962 ac) of irrigated land on the proposed site are used to grow potatoes and grains. The crop land stubble is grazed in the winter and the remainder of the property is grazed in the spring. Within the vicinity of the proposed site, agricultural activity is comprised mainly of corn, wheat, oats, barley, potato, and hay farms; small dairy and feedlot operations, and; cattle and sheep grazing. See Table 3.1-2, USDA Agriculture Census, Crop, and Livestock Information (USDA, 2008a). No leafy vegetable crops are grown within 8 km (5 mi) of the proposed site. Potato production in the area loses approximately 6 to 8% of the crop to disease damage, with the remaining portion going to direct consumption, processing, or as future seed source. For grazing animals in the vicinity of the proposed site, the fraction of daily intake from pasture varies by the animal as noted in Table 3-1.3, Estimated Fraction of Daily Intake from Pasture.

The principal livestock for Bonneville, Bingham and Jefferson counties is cattle. Milk cows comprise a small portion of the number of cattle in the three counties, with the nearest feedlot and milking operation located about 16 km (10 mi) east of the proposed site. A small farm that raises dairy cows is located about 19 km (12 mi) east of the proposed site. The largest dairy operation near the proposed site is Reed's Dairy, located 32 km (20 mi) east, near the city of Idaho Falls, Idaho.

Cattle and sheep grazing occur both east and west of the proposed site. The State-owned L-shaped land adjacent to the property to the west (Figure 3.1-3, Land Ownership Map Within 8 km (5 mi)), is currently leased to the Siddoway Sheep Company until 2012. The parcel is used in conjunction with other BLM lands as part of the Twin Butte Allotment and is used by BLM for sheep grazing and trailing use from early spring to late fall. Cattle grazing from early spring to late June, and again in November on the BLM lands immediately adjacent to the property boundary to the east, is part of the Kettle Butte Allotment.

There are no unusual animals, facilities, agricultural practices, game harvests, or food processing operations within the vicinity of the proposed site. As listed in Table 3.1-2, USDA Agriculture Census, Crop, and Livestock Information, between 1997 and 2002, the number and total acreage in farms has increased in Bonneville County. Bingham County has shown a decrease in the number of farms, but an increase in total acreage in farms, while Jefferson County has shown a slight decrease in both acreage and number of farms (USDA, 2008a).

3.1.9 Proposed Development

Multiple agencies were contacted to determine if there were any known current, future, or proposed plans for development in the 11 counties located within 80 km (50 mi) of the proposed site.

In Bonneville County, which includes the proposed site, there are several development projects within or near Idaho Falls. These projects include mixed residential, office, retail developments, and hotel developments. There are no industrial developments planned within Bonneville County; however, Idaho National Laboratory, a small portion of which is located in Bonneville County, has started preliminary planning for a Component Test Facility supporting the High Temperature Gas Reactor.

The largest development plan within the region is the Power County Energy Center, located in Power County. The project will include 182 ha (450 ac) of land near American Falls, with construction proposed to start in 2009 and lasting at least five years. The project is for a facility to gasify coal and petroleum coke to produce nitrogenous fertilizers and sulfuric acid (IDEQ, 2008e). Major components of the project are to 1) gasify 1,814 to 2,087 MT (2,000 to 2,300 tons) per day of coal and coal/petroleum coke blends, 2) install two GE gasifiers (one for production, one in hot standby as backup), and 3) produce ammonia, urea, urea ammonium nitrate (UAN), sulfuric acid, and slag/frit products for sale for road mix or other uses. The proposed site is about 9.7 km (6.0 mi) southwest of American Falls, just south of the Lamb Weston Potato Processing Plant. Power for the proposed facility operations will be supplied by the local utility.

Smaller projects within the region include a 90-home subdivision in Clark County, a mixed-use 364-ha (900-ac) development in Madison County, a 370-unit development and two large hotels in Blaine County, construction of several cell towers, and a potential 150-unit windmill farm in Bingham County.

Of the projects listed above, there are no known potential conflicts of land use plans, policies, or controls.

TABLES

Table 3.1-1a Land Use Within 8 km (5 mi) of the Proposed Eagle Rock Enrichment Facility Classification and Area

(Page 1 of 1)

Classification	Area							
	(Hectares)				(Acres)			
	Bonneville	Bingham	efferson	Total	Bonneville	Bingham	efferson	Total
Agricultural Land	5,063	0	1,931	6,994	12,510	0	4,771	17,281
Rangeland	10,161	4,442	6,527	21,130	25,108	10,977	16,130	52,215
Non-irrigated Seeded Pasture[a]	3,914	1	0	3,914	9,637	0	1	9,673
Barren	7,685	0	0	7,685	18,990	0	0	18,990
Total[b]	26,823	4,442	8,458	39,723	66,281	10,997	20,901	98,159

Notes:

a. Pasture is identified as part of agriculture in USGS land use categories. However, these areas are used for seasonal grazing similar to rangelands but are not native rangelands. Therefore, this category has been identified separately from agriculture and rangeland.

b. The number of hectares (acres) in a circle with an 8 km (5 mi) radius is 20,342 (50,265). The total acres listed reflects an integration of 8 km (5 mi) radius circles originating from the site boundary.

Table 3.1-1b Land Use Within 8 km (5 mi) of the Proposed Eagle Rock Enrichment Facility Site Classification Descriptions

(Page 1 of 1)

Classification	Description
Agricultural Land	Cropland, Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas; Confined Feeding Operations; and Other Agricultural Land.
Rangeland	Herbaceous Rangeland, Shrub and Brushland; Mixed Rangeland, and Non-irrigated Seeded Pasture
Barren	Bare Exposed Rock; Volcanic Flows

Table 3.1-2 USDA Agriculture Census, Crop, and Livestock Information (Page 1 of 2)

Information	County					
	Bonneville		Bingham		efferson	
Census Data	**1997**	**2002**	**1997**	**2002**	**1997**	**2002**
Number of Farms	909	963	1,339	1,273	888	784
Total Land in Farms Hectares (acres)	187,611 (463,598)	193,352 (477,784)	328,961 (812,881)	332,313 (821,163)	136,335 (336,891)	123,553 (305,305)
Ave. Farm Size Hectares (acres)	206 (510)	201 (496)	246 (607)	261 (645)	153 (379)	157 (389)
Crop Annual Average Yields (Most Current)	**Area Harvested Hectares (Acres) in 2002**	**Yield per Hectare (Acre) in 2002**	**Area Harvested Hectares (Acres) in 2002**	**Yield per Hectare (Acre) in 2002**	**Area Harvested Hectares (Acres) in 2002**	**Yield per Hectare (Acre) in 2002**
All Corn	966 (2,387)	59.31 MT/ha (26.45 tons/ac)	1,208 (2,986)	55.34 MT/ha (24.68 tons/ac)	1,233 (3,047)	44.86 MT/ha (20.01 tons/ac)
All Wheat	33,709 (83,296)	3.59 m^3/ha (41.25 bu/ac)	5,308 (13,117)	8.13 m^3/ha (93.33 bu/ac)	9,833 (24,298)	7.55 m^3/ha (86.67 bu/ac)
Oats	233 (576)	4.04 m^3/ha (46.46 bu/ac)	247 (611)	6.52 m^3/ha (74.85 bu/ac)	230 (567)	5.41 m^3/ha (62.09 bu/ac)
Barley	25,348 (62,636)	5.36 m^3/ha (61.65 bu/ac)	9,118 (22,531)	7.66 m^3/ha (87.97 bu/ac)	15,117 (37,356)	8.49 m^3/ha (97.45 bu/ac)
Potatoes	11,912 (29,436)	9,640 kg/ha (8,601 lbs/ac)	27,829 (68,767)	37,241 kg/ha (33,226 lbs/ac)	11,245 (27,788)	39,838 kg/ha (35,543 lbs/ac)
All Hay	14,775 (36,510)	774.49 MT/ha (316.62 tons/ac)	29,530 (72,969)	9.08 MT/ha (4.05 tons/ac)	39,642 (97,958)	10.29 MT/ha (4.59 tons/ac)
Sugarbeets	0	0	10,350 (25,574)	56.15 MT/ha (25.04 tons/ac)	0	0

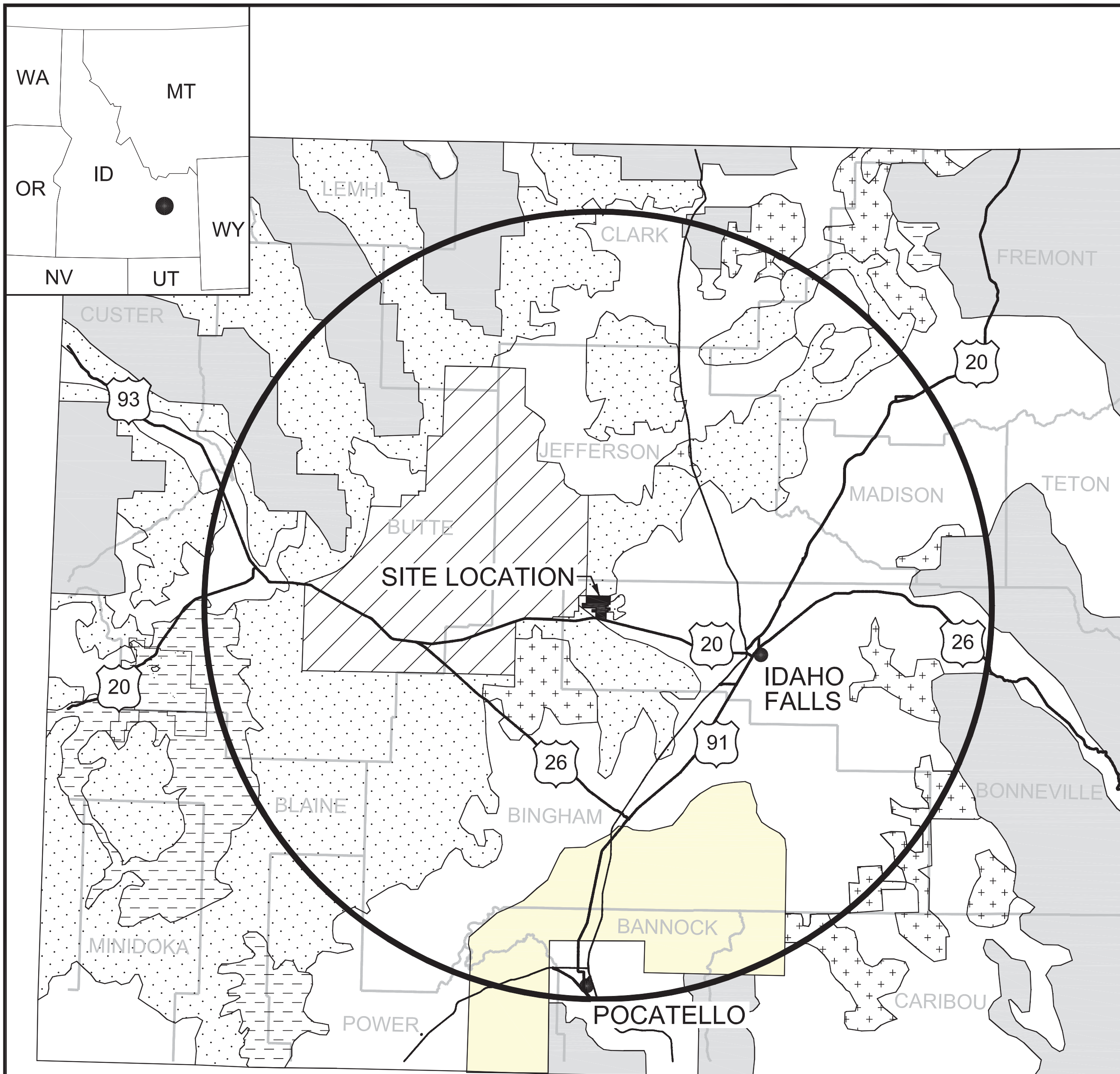
Table 3.1-2 USDA Agriculture Census, Crop, and Livestock Information (Page 2 of 2)

Information	County		
	Bonneville	Bingham	efferson
Livestock (Most Current)	Number in 2002	Number in 2002	Number in 2002
All Cattle	50,847	84,096	65,844
Beef Cows	16,518	27,298	17,774
Milk Cows	1,023	10,783	4,266
Other Cattle (Includes cattle on feed)	33,306	46,015	43,804
Sheep and Lambs	3,272	10,329	14,531

Table 3.1-3 Estimated Fraction of Daily Intake from Pasture
Page 1 of 1

Gra ing Animal	Estimated Fraction of Daily Intake from Pasture (dry matter)
Idle Horse	2.0
Yearling Animal	2.0
Pregnant Cow	2.5
Cow	2.0
Lactating Dairy Cow	3.0

FIGURES



LEGEND:

USFS
STATE
INDIAN RESERVATION
INL
PRIVATE
BLM
NPS
80 km (50 mi) RADIUS

NOTE:

1. SMALL PRIVATE AND STATE LANDS EXISTING WITHIN LARGE FEDERAL LAND BLOCKS ARE NOT SHOWN DUE TO SCALE.

SCALE
0 30 60 km

SCALE
0 20 40 miles

N

Figure 3.1-1 **Rev. 2**

Land Ownership within 80-km (50-mi)

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

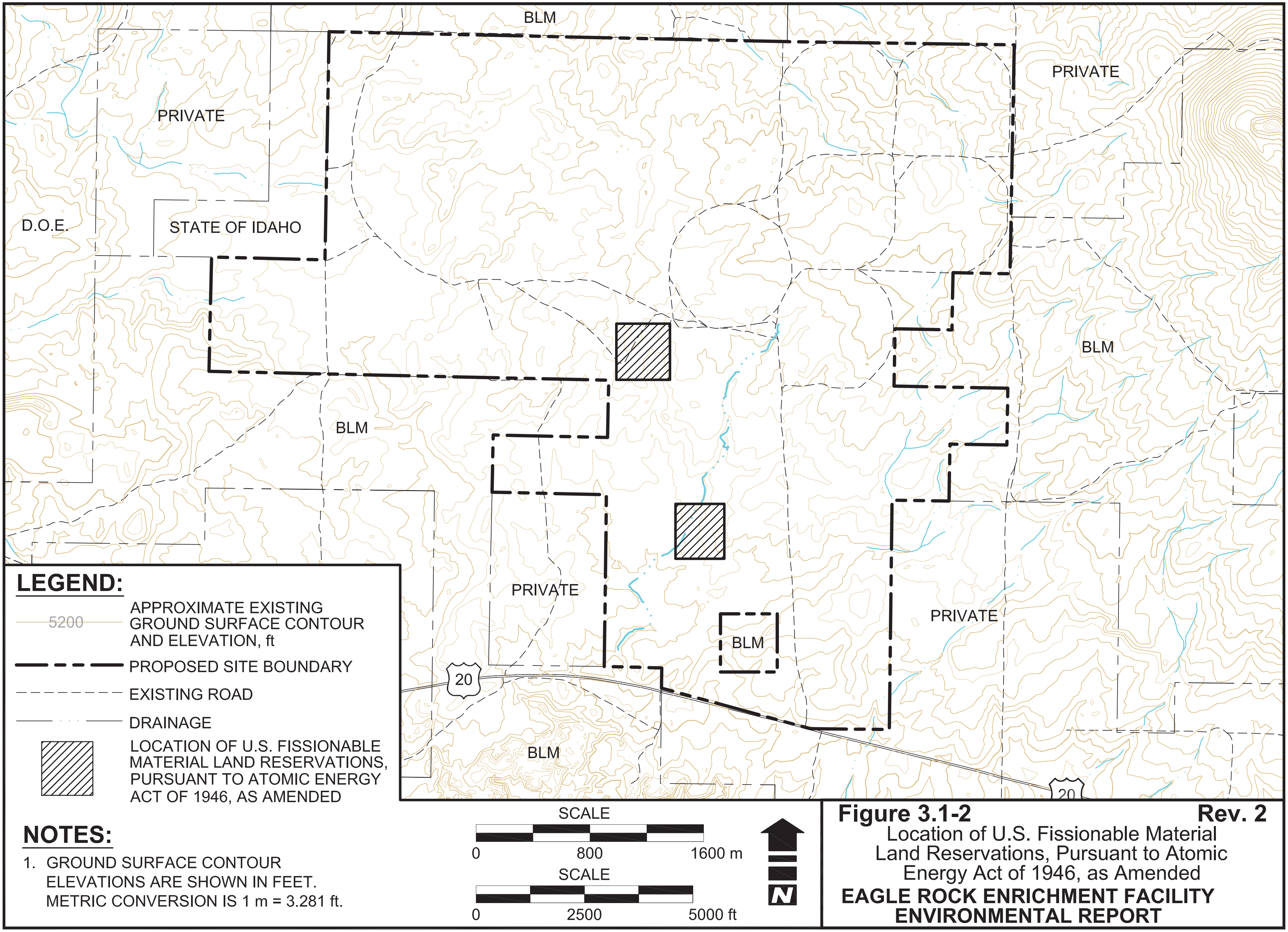
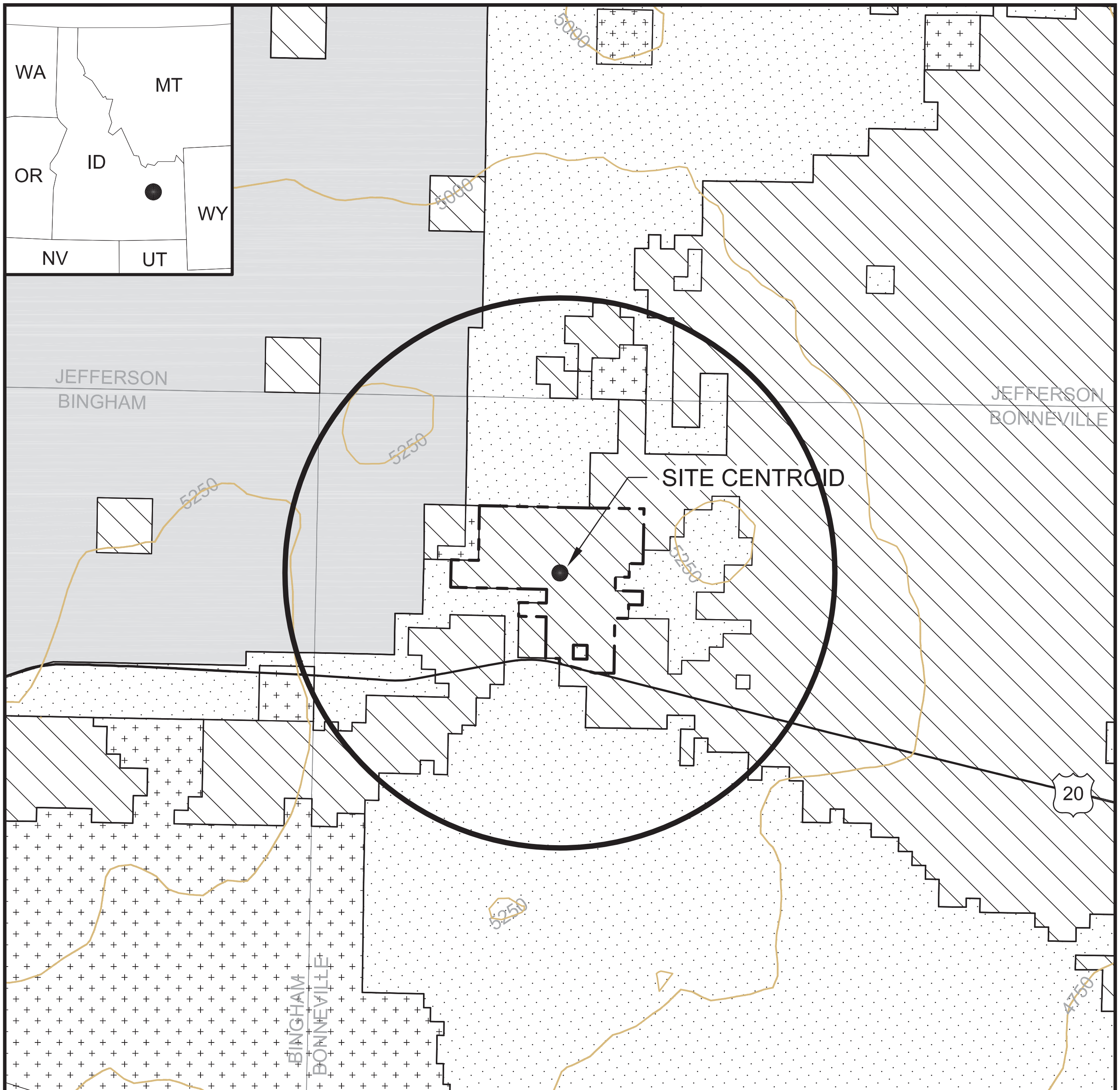


Figure 3.1-2 Rev. 2

Location of U.S. Fissionable Material Land Reservations, Pursuant to Atomic Energy Act of 1946, as Amended

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT



LEGEND:

D.O.E. (INL)

STATE

PRIVATE

BLM

5250 APPROXIMATE EXISTING GROUND SURFACE CONTOUR AND ELEVATION, ft

PROPOSED SITE BOUNDARY

8 km (5 mi) RADIUS

NOTES:

1. GROUND SURFACE CONTOUR ELEVATIONS ARE SHOWN IN FEET. METRIC CONVERSION IS 1 m = 3.281 ft.

SCALE
0 4 8 km

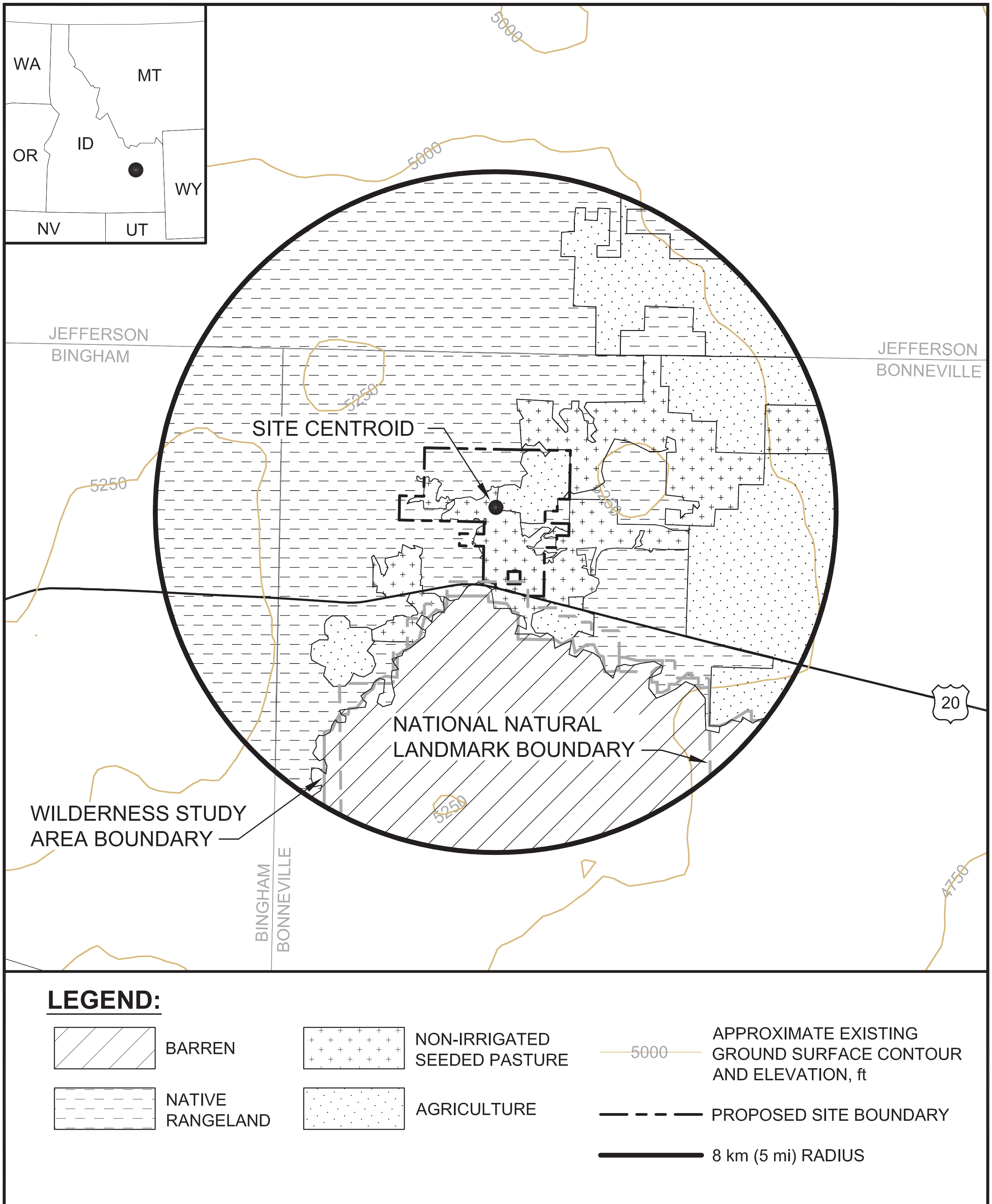
SCALE
0 2 4 miles

N

Figure 3.1-3 **Rev. 2**

Land Ownership Map Within 8 km (5 mi)

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT



NOTES:

1. GROUND SURFACE CONTOUR ELEVATIONS ARE SHOWN IN FEET. METRIC CONVERSION IS 1 m = 3.281 ft.

Figure 3.1-4 **Rev. 2**

Land Use Map Within 8 km (5 mi)

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

3.2 TRANSPORTATION

This section describes transportation facilities at or near the proposed Eagle Rock Enrichment Facility (EREF) site. The section provides input to various other sections such as Section 3.11, Public and Occupational Health and Section 3.12, Waste Management, and includes information on access to and from the site, proposed transportation routes, and applicable restrictions.

3.2.1 Transportation Access

The proposed site is located in eastern Idaho about 32 km (20 mi) west northwest of Idaho Falls, Idaho and immediately east (0.8 km (0.5 mi))of the Department of Energy Idaho National (INL) Laboratory in Bonneville County, Idaho. The site lies immediately north of U.S. Highway 20, which is a two-lane highway with 12.5-m (41.0-ft) driving lanes, and shoulders centered on a right-of-way easements of 122–m (400-ft). U.S. Highway 20 provides direct access to the site. To the east, U.S. Highway 20 intersects with Interstate 15 on the west side of Idaho Falls, Idaho. To the west, U.S. Highway 20 intersects with U.S. Highway 26 northwest of Atomic City and ultimately intersects with Interstate 84 outside the town of Mountain Home, Idaho, southeast of Boise. Refer to Figure 2.1-1, 80-Kilometer (50-Mile) Radius with Cities and Roads. Current traffic volume for the nearby road systems is shown in Table 3.2-1, Current Traffic Volume for the Major Roads in the Vicinity of the Proposed EREF site. Additional information regarding corridor dimensions, corridor uses, and traffic patterns and volumes is provided in Section 4.2, Transportation Impacts.

Several lines and branches of the Union Pacific Railroad run through Idaho Falls. These branches are about 32 km (20 mi) from the proposed site at their nearest point. The Montana Main Branch averages up to sixteen train operations (through trains plus switching) each day (FRA, 2008), while the Yellowstone Branch averages four train operations each day. A Union Pacific Railroad line (Aberdeen Branch) runs parallel to U.S. Highway 26 about 40 km (25 mi) south of the proposed site. This branch averages about two train operations each day. The Scoville Branch leads onto the Idaho National Laboratory ending at the Scoville Siding. The Scoville Branch and Siding are about 40 to 45 km (25 to 28 mi) west of the proposed EREF site, with the siding closer. The Scoville Branch and Siding averaged 26 trains per year from 1993 through 1997 (DOE, 2002b). Likely, this number of rail shipments will continue during construction and operation of the proposed EREF. In addition, up to 20 rail shipments per year of naval spent fuel are permitted from 1997 through 2035 (DOE, 2002b). Therefore, about 46 rail shipments will be received on the Scoville Siding per year during construction, operation, and decommissioning of the proposed EREF. In addition, the Eastern Idaho Rail Road operates short line tracks connecting towns north and east of Idaho Falls to the Union Pacific Line and averages up to six train operations each day. The nearest distance of this railroad line to the proposed site is about 32 km (20 mi).

The nearest airports are in Idaho Falls, approximately 32 km (20 mi) east of the site and in Atomic City, approximately 32 km (20 mi) southwest of the site. The Idaho Falls Regional Airport is used by commercial and privately-owned planes with approximately 8,500 to 9,800 aircraft operations each year (IFRA, 2008). The Midway Airport in Atomic City is used by private planes and averages about 400 aircraft operations each year (AIRNAV, 2008).

3.2.2 Transportation Routes

3.2.2.1 Plant Construction Phase

The transportation route for conveying construction material to the site is via Interstate 15 to U.S. Highway 20, which leads directly to the site. The mode of transportation will consist of over-the-road trucks, ranging from heavy-duty 18-wheeled delivery trucks, concrete mixing trucks and dump trucks, to box and flatbed type light-duty delivery trucks.

3.2.2.2 Plant Operation Phase

All radioactive material shipments will be transported in packages that meet the requirements of 10 CFR 71 (CFR, 2008e) and 49 CFR 171-173 (CFR, 2008j; CFR, 2008w; CFR 2008k). Uranium feed, product, associated low-level radioactive waste, depleted uranium, and empty cylinders will be transported to and/or from the facility. The following distinguishes each of these conveyances and associated routes.

Uranium Feed

The uranium feed for the facility is natural uranium in the form of uranium hexafluoride (UF_6). The UF_6 is transported to the facility in 48Y cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standard Institute (ANSI) N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Feed cylinders are transported to the site by 18-wheeled trucks, one per truck. Since the facility has an operational capacity of 1,424 feed cylinders per year, up to 1,424 shipments of feed cylinders per year will arrive at the site.

Uranium Product

The enriched uranium from the facility is transported in 30B cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSI N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Product cylinders are transported from the site to fuel fabrication facilities by modified flat bed truck. Product cylinders contain up to 2,300 kg (5,071 lbs) of enriched product. Typically, two product cylinders are shipped per truck although up to five product cylinders could be transported on the same truck resulting in a maximum of 11,500 kg (25,355 lbs) per truck shipment. There will be approximately 1,032 product cylinders shipped per year, which will typically result in a shipment frequency of approximately two shipments per work day (516 shipments per year).

Low-Level Radioactive Wastes

Waste materials are transported in packages by truck via highway in accordance with 10 CFR 71 (CFR 2008e) and 49 CFR 171-173 (CFR, 2008j; CFR, 2008w; CFR 2008k). Detailed descriptions of radioactive waste materials which will be shipped from the facility for disposal are presented in Section 3.12, Waste Management. Table 3.12-1, Estimated Annual Radiological and Mixed Wastes, presents a summary of these waste materials. Based on the expected generation rate of low-level radioactive waste (see Table 4.2-5, Annual Radioactive material Quantities and Shipments), an estimated 954, 55-gallon drums of solid waste are expected annually. Using a nominal 60 drums per radiological waste truck shipment, approximately sixteen low level waste shipments per year are anticipated.

Depleted Uranium Tails

Depleted Uranium tails will be shipped to conversion facilities via truck in 48Y cylinders similar to feed cylinders. These cylinders are designed, fabricated and shipped in accordance with

ANSI N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Depleted Uranium tails will be transported from the site by 18-wheeled trucks, one per truck (48Y). Since the facility has an operational capacity of approximately 1,222 cylinders containing Depleted Uranium tails per year, approximately 1,222 shipments of Depleted Uranium tails per year will leave the site. At present, Depleted Uranium tails will be temporarily stored on site until shipment to conversion facilities.

Empty Cylinders

The number of empty cylinders to be transported annually is as follows: empty feed cylinders (1,424), empty product cylinders (1,032), and empty depleted uranium tails cylinders (1,222). These cylinders are included because they contain decaying residual material (heel) and produce a higher dose equivalent than full 48Y cylinders due to the absence of self-shielding. The empty feed cylinders (with heel) are assumed to be shipped two per truck, totaling 712 shipments per year. The empty product cylinders (with heel) are assumed to be shipped two per truck, totaling 516 shipments per year. The empty depleted uranium tails cylinders (with heel) are assumed to be shipped two per truck, totaling 611 shipments per year.

3.2.3 Transportation Modes, Routes and Distances

Construction material will be transported by truck from areas north and south of the site via Interstate 15 and then west via U.S. Highway 20.

The feed and product materials of the facility will be transported by truck via highway travel only. Most of the feed material is expected to be obtained from UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL, although a small amount could come from other non-domestic sources. Empty feed cylinders (with heel) are assumed to be returned from the EREF to the UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL, as well as to ports for overseas shipping near Portsmouth, VA, and Baltimore, MD. The product could be transported to fuel fabrication facilities near Richland, WA, Columbia, SC, and Wilmington, NC, and to ports for overseas shipment near Portsmouth, VA, and Baltimore, MD. Empty product cylinders (with heel) are assumed to be returned to the EREF from the fuel fabrication facilities near Richland, WA, Columbia, SC, and Wilmington, NC. The designation of the supplier of UF_6 and the product receiver is the responsibility of the utility customer. Waste generated from the enrichment process may be shipped to a number of disposal sites or processors depending on the physical and chemical form of the waste. Potential disposal sites or processors are located near Richland, WA; Clive, UT; Oak Ridge, TN; Paducah, KY; and Portsmouth, OH. Refer to Section 3.12.2.1, Radioactive and Mixed Wastes, for disposition options of other wastes.

The primary transportation route between the site and the conversion, fuel fabrication and disposal facilities is via U.S. Highway 20 to Interstate 15 on the west edge of Idaho Falls, about 32 km (20 mi) east of the site. Table 3.2-2, Possible Radioactive Material Transportation Routes and Estimated Distances from the Proposed EREF, lists the approximate highway distances from the site to the respective conversion facilities site, fuel fabrication facilities, and radioactive waste disposal sites.

U.S. Highway 20 serves as the primary commuting route for workers and delivery route from Idaho Falls to the INL. Traffic volume on this highway varies greatly during the day. Commuter traffic is heavy in the early morning and evenings. Traffic volume is low at other times. The condition and design basis for this highway is adequate to meet current traffic flow requirements. There are no improvements funded at this time; however, proposals have been discussed to develop additional passing lanes or expand U.S. Highway 20 to a four-lane highway from Idaho Falls to the INL.

3.2.4 Land Use Transportation Restrictions

The proposed site is on land that will be purchased by AREVA Enrichment Services (AES) from a private owner. There are no restrictions on the types of materials that may be transported along this transportation corridor. AES is working with the Idaho Transportation Department to design and receive permit approval for access to U.S. Highway 20.

TABLES

Table 3.2-1 Current Traffic Volume for the Major Roads in the Vicinity of the Proposed EREF Site

(Page 1 of 1)

Road Name	Average Traffic Volume Vehicles Per Day	Average Traffic Volume Vehicles Per Year [c]
U.S. Highway 20	2,282 [a]	832,930
Interstate-15 south side of Idaho Falls	20,041[a]	7,314,965
U.S. Highway 26	1,100 [b]	401,500
U.S. Highway 20 at the U.S. Highway 26 intersection	1,900 [b]	693,500
U.S. Highway 20 at the I-15 intersection	21,000 [b]	7,665,000

Notes:

(a) Source: (ITD, 2008c).

(b) Source: (ITD, 2007).

(c) Assumes 365 travel days in a year.

Table 3.2-2 Possible Radioactive Material Transportation Routes and Estimated Distances from the Proposed EREF Site

(Page 1 of 1)

Facility	Description	Estimated Distance, km (mi)
UF_6 Conversion Facility Port Hope, Ontario	Feed/Empty Feed/Empty Depleted Uranium Tails	3,547 (2,204)
UF_6 Conversion Facility Metropolis, IL	Feed/Empty Feed/Empty Depleted Uranium Tails	2,580 (1,603)
UF_6 Conversion Facility Overseas Port: Portsmouth, VA	Feed/Empty Feed Empty Depleted Uranium Tails	3,789.1(2,354.5)
UF_6 Conversion Facility Overseas Port: Baltimore, MD	Feed/Empty Feed/Empty Depleted Uranium Tails	3,557.0 (2,210.3)
Fuel Fabrication Facility Richland, WA	Product/Empty Product	948 (589)
Fuel Fabrication Facility Columbia, SC	Product/Empty Product	3,744 (2,326)
Fuel Fabrication Facility Wilmington, NC	Product/Empty Product	4,109 (2,554)
U.S. Ecology Richland, WA	LLW Disposal	871 (541)
Fuel Fabrication Facility Overseas Port: Portsmouth, VA	Product	4021.9 (2,499.1)
Fuel Fabrication Facility Overseas Port: Baltimore, MD	Product	3,760.5 (2,336.8)
Energy*Solutions* Clive, UT	LLW & MLLW Disposal	475 (295)
Energy Solutions [(a)] Oak Ridge, TN	Waste Processor	3,068 (1,907)
Depleted UF_6 Conversion Facility [(b)] Paducah, KY	Depleted UF_6 Disposal/Empty Depleted Uranium Tails	2,610 (1,622)
Depleted UF_6 Conversion Facility [(b)] Portsmouth, OH	Depleted UF_6 Disposal/Empty Depleted Uranium Tails	3,002 (1,865)

Notes:

(a) Other off-site waste processors may also be used.

(b) To be operational in approximately two to three years.

3.3 GEOLOGY AND SOILS

This section provides a description of the regional and local geologic setting and soil characteristics of the proposed site for the proposed Eagle Rock Enrichment Facility (EREF). Summaries of the volcanism, mineral resource potential, and seismology of the area are also provided. In addition, the results of field investigations to determine site-specific conditions are presented. The geologic overview presented below is a brief synopsis based on published scientific literature that is cited in subsequent sections of this report.

Geologic Overview

The proposed EREF site lies within the Snake River Plain volcanic field of southeast Idaho approximately 32 km (20 mi) west northwest of Idaho Falls, Idaho. Location of the site within the Snake River Plain (SRP) and locations of regional physiographic features are shown on Figure 3.3-1, Regional Shaded-Relief Topographic Map of Snake River Plain and Surrounding Physiographic Regions. The Snake River Plain is an arc shaped (convex south) belt of topographically subdued volcanic and sedimentary rocks. The SRP crosses southern Idaho, transecting the high-relief mountain ranges of the surrounding Basin and Range province. Volcanic and sedimentary rocks of the SRP occur in a 50-km (31-mi) to 100-km (62-mi) wide belt, spanning 600 km (373 mi) (Kuntz, 1979) from the Oregon-Idaho border, and northeastward to the Yellowstone Plateau. The total area of the SRP (Figure 3.3-1, Regional Shaded-Relief Topographic Map of Snake River Plain and Surrounding Physiographic Regions) is about 40,400 km^2 (15,600 mi^2). The SRP slopes upward from an elevation of about 750 m (2,500 ft) at the Oregon border to more than 1,500 m (5,000 ft) at Ashton, Idaho located northeast of the proposed site. The SRP is a relatively recent geologic feature that is superimposed on older and semi-contemporaneous geologic features of the Cordilleran Mountain Belt of western North America. Early volcanism of the SRP involved violent, voluminous eruptions of silicic rhyolite tuffs and lava flows, many of them associated with volcanic centers known as calderas. The nature of the volcanic activity changed over time to less violent, relatively lower volume eruptions of predominantly basaltic lavas. The older calderas and associated rhyolitic materials were buried beneath younger basaltic volcanic and sedimentary deposits.

Geologists have divided the Snake River Plain into eastern (ESRP) and western (WSRP) segments, based on physiographic features described above and tectonic characteristics. The EREF site is located close to the center of the ESRP, near the southeastern corner of the Idaho National Laboratory (INL). The ESRP has been structurally and volcanically active since approximately 17 million years ago (Ma) when this portion of the North American Plate began passing over a feature known as the Yellowstone hotspot. Radiometric age dating (Armstrong, 1975) indicates that the early silicic volcanism of the SRP becomes systematically younger from southwest to northeast (Figure 3.3-2, Age–Distance Plot Of Late Cenozoic, Bimodal Volcanism in Snake River Plane–Yellowstone Province). The northeastward progression of age dates supports the interpretation that the older silicic volcanic rocks of WSRP in southwest Idaho (Idavada volcanics and older rhyolites) and the younger silicic rocks of the ESRP in southeast Idaho (Heise volcanics) represent the track of a mantle plume (Pierce and Morgan, 1992) hotspot. The ESRP topographic depression resulted from subsidence behind the Yellowstone hotspot as it tracked towards its present location in northwest Wyoming (Hughes, 1999).

The igneous, metamorphic, and sedimentary rocks exposed in the mountainous areas adjacent to the ESRP range in age from Precambrian to Holocene. A geologic time scale is shown on Figure 3.3-3, Geologic Time Scale. Given their ages and position within the Central Cordillera of North America, these rocks have a highly varied yet common geological heritage that is tied to the development of western North America. Precambrian, Paleozoic, Mesozoic, and Early Cenozoic sedimentary formations were deposited along the western North American continent during several episodes of mountain building and erosion. Deformation of the Cordillera culminated during the Early Cenozoic with the formation of the easternmost thrust faults that can be observed in the Caribou and Snake River Mountain Ranges, east of Idaho Falls. Volcanic and intrusive igneous rocks were extruded/emplaced during and after the destruction of the continental margin basins and are exposed in the Challis Volcanic Field and Idaho Batholith, Owyhee Plateau (north and west of the ESRP), and in the Basin and Range fault block mountains that generally surround the ESRP. The Basin and Range, fault block mountains formed in response to crustal extension during the Late Cenozoic.

The following sections provide general descriptions of the regional and local geology in the vicinity of the EREF site.

3.3.1 Regional Geology

Idaho-Wyoming Thrust Belt

The ESRP is bounded to the east by a physiographic region known as the Idaho-Wyoming Thrust Belt. The rocks and associated thrust faults of this region were the culmination of sedimentary deposition and deformation along the western margin of North America. Approximately 11,000 m (36,090 ft) of Paleozoic and Mesozoic sedimentary rocks were deposited near the shelf- basin boundary that ran the length of the North American craton (Momley, 1971; Blackstone, 1977).

Destruction of the continental margin began in late Jurassic moved eastward, and culminated in the east during Early Eocene time (Armstrong, 1965). Structural features associated with the Idaho-Wyoming Thrust Belt include low-angle thrust faults and folds. Armstrong and Oriel (Armstrong, 1965) determined the stratigraphic throw of the thrusts to be near 6,100 m (20,013 ft) and lateral displacements near 16 and 25 km (10 to 16 mi). Younger tectonic features of the Basin and Range and SRP have been superimposed on the Thrust Belt.

Idaho Batholith

The Idaho Batholith is a large region of multiple granitic plutons covering over 38,850 km^2 (15,000 mi^2) in central portions of Idaho. The batholith formed during two stages of activity in the Cretaceous Period, 105 to 75 million years ago (Ma) and 85 to 65 Ma. The batholith formed beneath the surface as the Cretaceous oceanic Farallon Plate was subducted beneath the North American Plate (Hyndman, 1983). The southern portion of the Idaho Batholith is known as the Atlanta Lobe and it occurs north of the western end of the ESRP. As the plutons of the Idaho Batholith were emplaced, the older overlying rocks decoupled along low angle faults and moved laterally away from the uplifted area (Hyndman, 1983)

Challis Volcanic Field

The Challis volcanic field is an area of volcanism dating from approximately 34 to 56 Ma northwest of the ESRP. Three stages of eruptive activity occurred during this time (Sanford, 2005). The first stage was the eruption of andesite and dacite lava flows. Up to 1,524 m (5,000 ft) of andesitic and dacite volcanic deposits cover the area. The second eruption stage consisted of explosive ash- flow tuff eruptions of rhyolite and dacite from calderas. The last stage was the formation of dacite dome complexes. Basin and Range extensional caused faulting in the area (Sanford, 2005).

Owyhee Plateau

The Owyhee Plateau is an area of volcanic rocks located southwest of the ESRP. Volcanic activity in this area began approximately 17.5 Ma near the intersection of the Oregon-Idaho-

Nevada borders, as the North American Plate passed over the Yellowstone (hotspot) mantle plume (Shoemaker, 2002). Initial activity was synchronous with flood basalts that were erupted onto the Columbia and Oregon Plateaus. Younger silicic volcanism in this area is related to large cataclysmic eruptive centers (Shoemaker, 2002).

Basin and Range

Extensional tectonism in the Basin and Range province began around 30 Ma in present day Nevada (Kuntz, 1979). In Idaho, physiographic features that are typical of the Basin and Range province can be found north and south of the ESRP. Folded and thrust faulted Paleozoic and Mesozoic rocks that have been affected by extensional tectonics are found throughout the Idaho portion of the Basin and Range province (Kuntz, 1979). Reactivation of Late Mesozoic and Early Cenozoic thrust fault surfaces, and normal faulting occurred during Tertiary and Quaternary time, uplifting the block faulted mountain ranges (Link, 1999). Movement along range front normal faults has been observed throughout the province as crustal extension continues. The Lost River Range, Lemhi Range, and Beaverhead Range are three mountain ranges that developed along Basin and Range structures located north-northwest of the EREF site area. The tectonic setting of these areas and their apparent relationship with the ESRP volcanic rift zones will be discussed later in this section.

Western Snake River Plain

The Western Snake River Plain (WSRP) is a large structural graben that formed between 10 and 12 Ma (Shervais, 2005) and is filled with sediments and basalts. Extensive rhyolite deposits were extruded coincident within and adjacent to the WSRP graben (Shervais, 2005). Rhyolitic volcanic activity in the WSRP occurred between 11.8 to 9.2 Ma as the North American Plate passed over the Yellowstone hotspot mantle plume. Basaltic lava flow eruptions occurred between 9.0 and 7.0 Ma, and are interspersed within the graben with Miocene sediments (Vetter, 2005). A later phase of basaltic activity, shield volcanoes and cinder cones, began approximately 2.2 Ma and continued until approximately 0.7 Ma. The later basaltic volcanic deposits are also intermitted with fluvial and lacustrine sediments (Vetter, 2005). West of Twin Falls, the Snake River has cut a valley through the tertiary basin fill sediments and interbedded volcanic rocks. The stream drainage is well developed, except in areas covered by recent thin basalt flows.

Yellowstone Plateau

The Yellowstone Plateau is an area of contemporary seismicity, hydrothermal activity, and recent volcanismic activity in northeastern Idaho, southwestern Montana, and northwestern Wyoming. Volcanic activity in this plateau occurred during three eruptive cycles (Christiansen, 1987a). Initial activity for each cycle began as small scale bimodal basaltic and rhyolitic eruptions. Rhyolitic eruptions are believed to have continued for several hundred thousand years during each eruptive cycle as the magma chamber continued to grow beneath the plateau. Each cycle ended in a large cataclysmic explosive eruption that dispersed ejecta hundreds of kilometers (miles) away from the Plateau. The three large caldera-forming eruptions that occurred at the end of each eruptive cycle were approximately 700,000 years apart, 2.0, 1.3, and 0.6 Ma (Christiansen, 1987a). The middle eruptive phase was associated with feature known as the Island Park Caldera near West Yellowstone, Montana and forms the northeastern boundary of the ESRP (Christiansen, 1987a). The mantle plume hotspot responsible for the formation of the SRP is now considered to underlie the Yellowstone Plateau, accounting for the geothermal features and the more than 6,000 km^3 (1,440 mi^3) of late Pliocene and Quaternary silicic volcanic rocks in the Yellowstone Plateau Volcanic Field (Christiansen, 2000). Hydrothermal activity at Yellowstone in the form of geysers, fumaroles, hot springs, and mud pots are present today.

Sedimentary Deposition

During the late Pleistocene, the geomorphology of the ESRP was affected by continued eruptions of basaltic lava flows and also by glaciation particularly in the mountains on the northern side of the ESRP (Hughes, 1999). Important processes associated with glaciation were outburst flooding that deposited gravels and granitic boulders on top of the basaltic lavas in the ESRP and drainages eroded into the basaltic lavas. Extensive eolian (wind) erosion of glacial silts and sands resulted in deposition of loess of variable thicknesses throughout the ESRP. Lacustrine deposits from the formation of lakes and ponds are found in some areas of the ESRP. In recent times, range fires, subsequent wind erosion and re-deposition of soils and sands have been the dominant processes affecting the surface of the ESRP (Hughes, 1999).

Eastern Snake River Plain

The Eastern Snake River Plain (ESRP) is an east-northeast trending topographic depression that extends approximately 100 km (62 mi) by 300 km (186 mi) through southeastern Idaho (Kuntz, 1979). Most of the ESRP has a gently rolling topography at elevations from about 1,830 m (6,000 ft) above sea level in the northeastern portion to about 1,070 m (3,500 ft) at the southeastern edge along the Snake River (Figure 3.3-4, General ESRP Geology and Stratigraphy). Several prominent buttes are scattered along the central part of the ESRP, including Big Southern Butte, Middle Butte, East Butte, and Menan Buttes (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology). Big Southern Butte is the largest, rising 760 m (2,493 ft) above the plain. The topographic features of the ESRP of volcanic origin may be associated with geologic structures that are oriented both perpendicular and parallel to its axis. The general trends of structures in the adjacent Basin and Range province are also perpendicular to the ESRP axis and fault block mountain ranges occur to the north, east, and south as shown on Figure 3.3-1, Regional Shaded-Relief Topographic Map of Snake River Plain and Surrounding Physiographic Regions. To the northeast and west, the ESRP is bounded by the Yellowstone and Owyhee Volcanic Plateaus, respectively.

The well preserved volcanic features and associated deposits of the ESRP have been the subject of numerous studies and technical papers. Additionally, many of the ESRP studies have been associated with the Idaho National Laboratory (INL) property located immediately west of the EREF site. Many of the published sources that are cited in this section are part of the geologic literature associated with the INL. The geologic history of the ESRP is dominated by late Tertiary to Quaternary events that deposited a thick sequence of volcanic rocks of rhyolitic and basaltic composition. The general order of major geologic events from early to most recent is as follows (Hughes, 1999):

1. Miocene to Pliocene age rhyolitic volcanism associated with Yellowstone mantle plume hotspot,
2. Miocene to Recent age crustal extension associated with the Basin and Range province,
3. Quaternary eruptions of basalts and associated buildup of elongated, intermingled lava fields, small shield volcanoes, and cinder cones,
4. Quaternary glaciation and associated eolian, fluvial, and lacustrine sedimentation.

At the land surface, Quaternary basaltic lava flows, monogenetic shield volcanoes, rhyolite domes, and accumulations of unconsolidated sediments of variable thickness dominate the regional physiography (Hughes, 1999). Scoria cones, pyroclastic deposits near the volcanic vents, dikes, and less chemically evolved basaltic rocks are found to a lesser extent within the ESRP (Hughes, 1999) than in the WSRP. Most of the surface (Kuntz, 1994) and subsurface basalt lava flows (Champion, 2002) of the INL area have normal magnetic polarity associated with the Brunhes Normal Polarity Chron, and are therefore younger than 780 thousand years ago (ka).

Thermal contraction and subsidence in the ESRP occurred after the cessation of rhyolitic activity from the Yellowstone mantle plume (Christiansen, 1987b). The effects of the Yellowstone mantle plume persist to the present day and the heat flux (110 mW/m^2) beneath the ESRP is the highest found in the region. Recent volcanic activity has been the greatest beneath the northeastern ESRP where most of the heat is concentrated (Smith, 2004). Tectonic processes, including uplift of the Yellowstone plateau above the mantle hotspot and normal faulting in the adjacent Basin and Range province, maintain the high elevations and mountainous character of the region surrounding the ESRP.

Yellowstone Hotspot

The Yellowstone hotspot is considered to be responsible for formation of the ESRP. As the North American Plate passed over the Yellowstone hotspot beginning approximately 17 Ma, melting above the hotspot produced (Pierce and Morgan, 1992; Smith, 2004) thick rhyolitic ash flows, tuffs, and lavas. The hot spot has left a trail of volcanism that records the southwestward relative motion of the North American plate over a fixed mantle plume, at a rate of about 3 cm per year.

Miocene and Pliocene rhyolitic calderas are believed to be buried under younger Pleistocene volcanic deposits. Subsidence within the ESRP began approximately 4 Ma, as the hotspot track continued to the northeast beneath and relative to the North American plate, to its present day location in northwest Wyoming. Cooling of the crust, crustal extension, increased loads from denser magmatic rocks, and isostatic adjustment were other factors contributing to subsidence. Approximately 1.5 to 2 km (0.9 to 1.2 mi) of subsidence has occurred within the ESRP continues today as the crust continues to reach isostatic equilibrium (Smith, 2004).

Axial Volcanic Zone

Researchers have identified a northeast trending volcanic highland within the ESRP known as the axial volcanic zone (AVZ). The AVZ is a topographic high that runs parallel to the long axis of the ESRP (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology). This zone of higher elevation is the locus of numerous volcanic features including lava flows, spatter cones, shield volcanoes, and rhyolitic domes. Volcanic activity within the AVZ has occurred in the last two million years. Additionally, a series of volcanic rifts and fissures are located perpendicular to the AVZ (Figure 3.3-6, Volcanic Rift Zones, Volcanic Vents, and Dike-Induced Fissures and Faults). The AVZ also acts as a drainage divide separating the Snake River and Big Lost River watersheds (Wetmore, 1999). The EREF site is located within the AVZ (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology).

Rhyolite Domes

Pleistocene rhyolite domes are found scattered along the Axial Volcanic Zone of the ESRP. Big Southern Butte, Middle Butte, and East Butte are prominent examples. They range in age from approximately 300 ka (Big Southern Butte) to 1.4 Ma (a thyolite dome near East Butte) (Kuntz, 1979). The Big Southern Butte is believed to have formed in close relation to the chemically evolved lavas at the Cedar Butte eruptive center (Hughes, 1999) dated around 400 ka (Kuntz, 1994). Volcanism at these volcanic buttes is believed to reflect the extensional structural deformation that affects near surface and deeper crustal rocks at the intersection of the Arco and Rock Coral volcanic rift zones. Both these domes were formed as non-explosive extrusive plugs of compositionally evolved magmas (Kuntz, 1979). East Butte and Middle Butte will be discussed later.

Hydromagmatic Eruptions

The Menan Buttes volcanic deposits, located about 45 km (28 mi) northeast of the proposed EREF site (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology), is one of several hydromagmatic (also known as phreatomagmatic) eruptive centers found in the ESRP. As basaltic magma encountered shallow ground water associated with the Snake River, moderately explosive eruptions occurred. These eruptions produced unconsolidated ash mixed with pebbles and sand sized fragments from the near surface alluvial deposits. The Menan Buttes are the largest hydromagmatic eruptive centers found in the ESRP (Hughes, 1999).

Basaltic Plains Volcanism

The distinctive low relief produced by coalesced shield and lava flows of the ESRP prompted Greeley (Greeley, 1982) to name the features of the area “basaltic plains volcanism,” to distinguish them from the more voluminous flood-basalt volcanism of regions such as the Columbia Plateaus. Flood-basalt volcanism involves a small number of voluminous eruptions having high effusion rates (high magnitude, low frequency volcanism). In contrast, basaltic plains volcanism of the ESRP involves a large number of small eruptive centers with comparatively low effusion rates (high frequency, low magnitude volcanism). Hundreds of lava flow units are produced during each eruption, extending up to tens of kilometers (miles) from the vent, possibly during a period of months to years; certainly no longer than a few decades (Kuntz, 1992a; Champion, 2002).

It is estimated that approximately 3.3 km^3 (0.8 mi^3) per 1,000 years of basaltic volcanic deposits erupted throughout the region during the past 15,000 years (Kuntz, 1992a). Basaltic volcanism in the region occurred as lava and scoria was erupted from dikes beneath volcanic rift zones. The regional northwest trend of these zones and their associated vents suggest they were oriented perpendicular to the least-compressive regional stress. Tube fed pahoehoe lava flows were erupted from fissures at shield volcanoes and extended up to 48 km (30 mi) away from their vents (Kuntz, 1992a). Lava flows follow subtle creases in the terrain and are capable of moving great distances by endogenous flow. As a result, nearly planar surfaces are produced by ponding of successive effusions and the widespread overlapping of lava fields. Isolated Strombolian (mild pyroclastic) events also occurred in the ESRP, and this style of volcanism is marked by cinder and spatter cones situated on eruptive fissures and at the summits of small shield volcanoes. The thickness of each lava flow ranges from 5 to 25 m (16 to 82 ft).

Smaller flow thicknesses can be observed in outcrops or core samples that are near the flow margins. Volcanic features typically associated with the basaltic plains volcanism include:

- Low Profile Basaltic Shields (e.g., Kettle Butte) comprised of interlaced basaltic lava flows that are generally aligned along rifts or fissures (Hughes, 1999): Basaltic plains volcanism produces low shield volcanoes of modest volume (5 +/- 3 km^3 (1.2 +/- 0.7 mi^3)), composed of fluid, vesicular lavas. Low shields are generally characterized by gentle slopes and small size of usually less than 16 km (10 mi) in diameter. The individual lava flows making up Low Shields show various volcanic features, such as collapse depressions, flow and pressure ridges, lava toes with extensive vertical and horizontal jointing, but generally lack lava tubes.
- Fissures, vents and flows associated with rift zones: Fissures and vents, such as spatter cones, pyroclastic cones, and cinder cones, are indicative of point source eruptions along rift zones. Eruptions commonly begin from a fissure system, and long-lived eruptions eventually

consolidate to one or several vents along the fissure system. Evidence of lava lakes is also associated with many vents (Hughes, 1999). Fissure flows are complexes of numerous basaltic lava flows of generally less than 1.5 m (5.0 ft) thickness. The Craters of the Moon and Hells Half Acre are examples of large areas of young, intermingled fissure vents and flows.

- Lava tubes and channels that originate from both fissures in rift zones and less commonly in low shields: Lava tubes were a common mode of lava flow movement across the ESRP landscape. During emplacement of ESRP basalt lava flows, molten rock is continuously supplied to the advancing flow front through lava tubes. The solidified crust on the top, bottom, and ends of the lava flows is kept inflated by the pressure of the molten material in the interior of the flow. As the flow front advances, the crust at the end of the flow is laid down and overridden by the new lava, and the upper crust is stretched, broken, and fissured by movements of magma beneath. Lava tubes can occur in large networks. An example is the Shoshone lava tube system located approximately 160 km (100 mi) southwest of the proposed site which covers about 207 km^2 (80 mi^2). The open topped nature of lava channels makes them difficult to discern once they are covered by younger flows. Lava tubes tend to collapse and fill with sediment and rubble during burial.

Over the last 13,000 years, volcanism has occurred at the following seven monogenetic basaltic lava fields within the region. Locations of these lava fields near the site are shown on Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology.

- Shoshone
- Wapi
- Kings Bowl
- North Robbers
- South Robbers
- Cerro Grande
- Hells Half Acre

Craters of the Moon volcanic field is compositionally and temporally different from the other lava fields listed above. It is a polygenetic volcanic field that evolved during several cycles of volcanism, consisting of numerous eruptive centers of balsaltic through andesitic composition. Eruption ages at Craters of the Moon vents range from 1.5 to 15 ka (Kuntz, 1988).

Unlike the earlier silicic volcanism, no systematic, eastward migration of basaltic volcanism is apparent on the ESRP; and Holocene lavas (younger than 15,000 years) occur across the ESRP. No eruptions have occurred on the ESRP during recorded history, but the basaltic lava flows of the Hell's Half Acre lava field erupted near the southern boundary of the proposed site as recently as 5,400 years ago (Kuntz, 1986).

Volcanic Rift Zones

Volcanic rift zones are found throughout the ESRP (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology). Kuntz et al. (Kuntz, 1992a) suggest that as many as nine volcanic rift zones cross the ESRP. The majority of the rift zones reflect a northwest-southeast trending lineation similar to what is observed in the Basin and Range province to the north and south of the ESRP. The following volcanic rift zones (from northeast to southwest) are found in the ESRP (Kuntz, 1992a):

- Spencer-High Point volcanic rift zone
- Menan volcanic rift zone
- Circular Butte-Kettle Butte volcanic rift zone
- Lava Ridge-Hells Half Acre volcanic rift zone
- Howe-East Butte volcanic rift zone
- Arco-Big Southern Butte volcanic rift zone
- The Great Rift volcanic rift zone
- Borkum volcanic rift zone
- Richfield-Burley Butte volcanic rift zone

The Rock Corral Butte volcanic rift zone is a southwest-northeast trending rift zone that is perpendicular to all other rift zones found in the ESRP. This rift zone is believed to be related to a Pre-tertiary zone of crustal weakness (Kuntz, 1979).

The northwest trending volcanic rift zones in the ESRP are believed to have formed within the same, extensional, regional-stress field of the adjacent Basin and Range mountains. However, in contrast to the range front faults, there is evidence that the volcanic rift zones are underlain by basaltic dikes. The emplacement of magma as vertical dikes within the rift zones is believed to be the mechanism of crustal extension and low-magnitude seismicity within the ESRP volcanic province (Parsons, 1991). In contrast, crustal extension in the surrounding Basin and Range occurs by normal faulting with accompanying earthquakes of varying magnitudes.

3.3.1.1 Eastern Snake River Plain Stratigraphy

ESRP stratigraphy is composed of igneous and sedimentary rocks over 3,048 m (10,000 ft) thick (Doherty, 1979). The products of rhyolitic, andesitic, and basaltic volcanism are interspersed with sedimentary fluvial, lacustrine, and eolian (wind) deposits. The thickness and lateral extent of the volcanic deposits varies greatly in response to the composition, volume, and location of the erupted material. Most of the ESRP is covered with basaltic materials. Deep boreholes on the adjacent INL have intersected nearly 1 km (0.6 mi) of late Tertiary and Quaternary basalt lava flows and interbedded sedimentary deposits overlying older silicic tuffs (Hackett, 1992). Because they host the vadose zone and the underlying ESRP aquifier, the Quaternary basalts of the INL area have been studied in greater detail than the underlying units.

Subsurface investigations to date at the EREF site included drilling six groundwater monitoring wells with a maximum depth of 223.0 m (730.5 ft). Continuous core samples were collected from one of the monitoring well borings and basalt was the primary rock type encountered from the ground surface to the total depth of the well. Further details regarding the site-specific geology are provided in Section 3.3.2, Geology at the Proposed Site.

Stratigraphic Units

The Snake River Group is the main geologic unit beneath the EREF site in the ESRP (Figures 3.3-2, Age–Distance Plot of Late Cenozoic, Bimodal Volcanism in Snake River Plane-Yellowstone Province, and 3.3-4, General ESRP Geology and Stratigraphy). The Heise volcanics are mostly silicic lava flows and ash tuffs and are estimated to be greater than 1,000 m (3,280 ft) thick in some areas.

Most basaltic eruptions were effusive rather than explosive, and typical landforms of Quaternary mafic volcanism on the ESRP are small shield volcanoes with summit pit crates, fissure fed lava flows associated with zones of tensional fracturing and relatively uncommon tephra cones of magmatic or phreatomagmatic origin (Greeley, 1982). The surface distribution, ages and lithologies of surface basalts and sediments in the INL area have been mapped by Kuntz et al. (Kuntz, 1994), and the surficial deposits of the ESRP have been mapped by Scott (Scott, 1982).

Groundwater investigations at the INL site have led to creation of a working stratigraphic system to describe the complex assemblage of eruptive and sedimentary materials (Anderson, 1996b; Anderson, 1996c). An example of the INL stratigraphic system is presented in Table 3.3-1, INL Stratigraphic Units. The EREF site is located near the southeastern corner of the INL.

Silicic Rocks

Rhyolite deposits presumed to be associated with the rhyolite domes in the region are found in some of the wells in the area. Older rhyolitic and andesitic tuffs are also found at few outcrops within the ESRP (Anderson, 1996c). These older rhyolite deposits are believed to be associated with the buried calderas from past Yellowstone hotspot eruptions, 6 to 10 Ma. The deep Geothermal test well INEL-1 was drilled in 1979 to a depth of 3,160 m (10,367 ft). Samples from the well included rhyolitic ash-flow tuffs with interbeds of tuffaceous sands and air fall ash between depths of 658 and 2,460 m (2,159 and 8,071 ft). Altered rhyodacite porphyry was encountered below a depth of 2,460 m (8,071) ft. The rhyodacite porphyry may have been responsible for altering the overlying welded tuffs and basalt flows (Doherty, 1979).

Basalts

Basalts are the most abundant rock types found at the surface of the ESRP. Thousands of separate lava flows associated with shield volcanoes and cinder cones are found across the ESRP and into the subsurface. Anderson et al (Anderson, 1996c) have separated the basalt flows into stratigraphic units and have attempted to associate these stratigraphic units with surface and subsurface units. The basalts found throughout the region are dense to vesicular with zones of fracturing being the most intense near the top and bottom of flows. The mineralogical compositions are dominated by labradorite plagioclase, augite, and olivine with minor amounts of ilmenite, magnetite, hematite, and apatite (Nimmo, 2004). Flows may be up to 34 m (110 ft) thick and are dispersed with cinders and sediment (Smith, 2004). While small in individual volume, the basalt lava flows were extremely numerous and have produced a total thickness in combination with sediment interbeds ranging from 305 m (1,000 ft) to 914 m (3,000 ft). The total thickness of the Quaternary basalt flows is greatest in the central axis of the ESRP and decreases to the west into the WSRP (Figure 3.3-4, General ESRP Geology and Stratigraphy) (Nimmo, 2004).

Sedimentary Deposits

Sedimentary deposits are interspersed throughout the basalt flows and were deposited during times of volcanic quiescence and continued subsidence of the ESRP. Unconsolidated surface deposits in the ESRP range in thickness from ≤ 3 m (10 ft) in the central portions of the ESRP, where basalt lava flows are thickest, to 305 m (1,000 ft) near the boundaries. The thickness of the surficial unconsolidated deposits is controlled by the proximity to source erosional areas in the upland areas and thinning of the Quaternary basalt lava flows toward the edges of the SRP. Eolian, well sorted fine-grained (clays, silts, and sands), and fluvial and lake deposits, poorly to well sorted deposits with clays, silts, sands, and gravels, are most common in the ESRP (Anderson, 1996b). The sediment interbeds are characterized as having the texture of silt-loam with a particle-size distribution of approximately 10% clay, 55% to 80% silt, and 10 to 25% sand (Nimmo, 2004). Minerals in the sediments include quartz, plagioclase, potassium feldspar, pyroxenes, olivine, calcite, dolomite, and clays (mostly illite with lesser amounts of smectite, chlorite, and kaolinite) (Nimmo, 2004).

Fourteen composite stratigraphic units have been identified during hydrogeologic investigation the INL. These units were assigned using similar rock types and ages and are made up of 5 to 90 separate units (Table 3.3-1, INL Stratigraphic Units). Each volcanic deposit in a composite unit was erupted from a different vent source (Anderson, 1996c). The reductions of volcanic deposits in the oldest units are attributed to large and infrequent volcanic eruptions. The location of these units throughout the region depends on the local subsidence and uplift during their respective eruption times (Anderson, 1996c). The characteristics of each rock type are discussed below. The oldest unit, undifferentiated (U), is composed of multiple basalts and sedimentary interbeds (Anderson, 1996c).

Anderson and Liszewski (Anderson, 1997) indicated that the stratigraphic correlations were for the rock units that comprise the unsaturated zone and the Snake River Plain aquifer beneath the INL site. Additionally, the interrelationships of basalt lava flows can be complex and additional data (since 1996) may affect the correlations. Sample and borehole geophysical data below the base of the Snake River Plain aquifer is very limited because few boreholes or wells extend beyond a thick and widespread layer of clay, silt, and altered basalt.

3.3.1.2 Potential Mineral and Energy Resources

Idaho is home to two major mining districts, including the Coeur d’Alene District in northern Idaho and the Western Phosphate Reserve in southeastern Idaho. Underground mines in the Coeur d’Alene District produce silver, lead, and zinc. Associated metals produced from these mines include molybdenum, copper, and gold (Gillerman, 2008b; IGS, 2004). Open-pit mines in southeastern Idaho, near Soda Springs, produce phosphate for conversion to fertilizers and elemental phosphorus. Idaho also produces a number of industrial minerals, including garnets, sand and gravel, cement, crushed stone, limestone, pumice, dimension stone, zeolites, gemstones, feldspar, and perlite.

The major mining districts of Idaho are distant from the proposed site location. The thick sequences of basaltic lava flows in the area of the proposed site are not known to host economically valuable metallic mineral or hydrocarbon resources. The Mineral Industry Yearbook for 2004 (IGS, 2004) shows no occurrences of metal mining activities in the vicinity of the proposed site (Figure 3.3-7, Mineral Producing Areas of Idaho). The basaltic lava flows are mined for pumice in some areas, but no current mining operations exist at the proposed site location. The closest quarrying operations for pumice, sand and gravel, and crushed stone are those at INL where these materials are used for road construction and maintenance, waste burial activities, and new facility construction (DOE, 2005).

Idaho has limited fossil fuel resources, although there is potential for undiscovered oil and gas in some areas of the state, such as the overthrust belt in southeastern Idaho and the Tertiary sediments in far western Idaho (Gillerman, 2008b). The ESRP is not in an area where oil and gas are expected to be found due to the very thick sequence of young volcanic strata beneath the ESRP, which are not known to generate or store economic amounts of hydrocarbons as either petroleum or natural gas.

The ESRP does have potential for geothermal energy sources because crustal heat flow beneath the ESRP remains high due to the recent movement of the plate across the mantle hot spot (Smith, 2002; Smith, 2004; Wood, 1988). The effect of the high heat flow is a small increase in groundwater temperatures from east to west across the ESRP. For example, recharge water temperatures range from 5 to 7 C (41 to 45 F) compared to 11 to 12 C (52 to

54 F) for the water table in the area of INL and locally up to 18 C (64 F) at the water table in some anomalously hotter zones (Smith, 2002; Smith, 2004). Groundwater temperatures have been related to the rate of water movement with higher temperatures occurring in low permeability zones where water moves slowly and has greater time to heat and lower temperatures occurring in higher permeability zones were water moves more rapidly and mixes with greater amounts of cooler recharge water.

However, geothermal resources in Idaho have been generally defined as groundwater temperatures greater than 29 C (84 F) for direct use or greater than 100 C (212 F) for power generation (Fleischmann, 2006). Measured groundwater temperatures in the ESRP are less than 29 C (84 F), and at the current time, there are no facilities that directly utilize geothermal energy at the proposed site or in its vicinity. A study of geothermal resources conducted in 1979 (DOE, 2005) indicated that no economic geothermal resources exist in the area of INL.

3.3.2 Geology at the Proposed Site

The specific geologic characteristics of the proposed site are described in this section. Additional hydrologic and hydrogeologic information is presented in Section 3.4, Water Resources.

3.3.2.1 Natural Drainage Patterns

The Snake River and its tributaries are located near the southern and eastern margins of the ESRP. Near Twin Falls, the Snake River has carved a vertical-walled canyon in the Quaternary basalts and interbedded sedimentary deposits. Elsewhere on the ESRP stream drainage is poorly developed and chaotic because of continual resurfacing by highly permeable basalt lava flows.

The area of the proposed site is comprised mostly of relatively flat and gently sloping surfaces with small ridges and areas of rock outcrop. Most of the site is semi-arid steppe covered by eolian soils of variable thickness that incompletely cover broad areas of volcanic lava flows. Elevations at the site range from 1,556 m (5,106 ft) to 1,600 m (5,250 ft). Many of the areas with thickest soils and gentle slopes with a minimum of rock outcrop are currently used for crops as shown by the irrigation circles outlined by dirt roads in Figure 3.3-8, Topography, Roads, and Drainage.

The U.S. Geological Survey Kettle Lake topographic map shows a few small intermittent stream drainages in the northeastern corner, southeastern and southwestern areas of the proposed site (Figure 3.3-8, Topography, Roads, and Drainage). However, the drainages in the northeastern corner are no longer evident in the field because they are within irrigated crop circles where the natural topography has been smoothed to accommodate crop production. The southeastern and southwestern drainage features likely originated from natural erosional processes during spring snowmelt or heavy rains but now primarily conduct minor amounts of water from irrigated agriculture areas. The southeastern drainages terminate as seepage loss into the ground or by evapotranspiration. In the southwestern area, a single natural drainage was identified during field reconnaissance and this ephemeral drainage can convey water offsite during episodic melt water and precipitation events or agricultural flooding. The drainage is located in the southwestern corner of the proposed site and runs from the south-central area of the proposed site southward toward Highway 20. The source of the water within the site boundary is likely the westernmost center pivot agricultural irrigation system. The drainage also potentially conveys surface water during large rainfall events. Just to the north of Highway 20, a series of small ponds were used historically to collect and store water from this drainage for agricultural uses, but these ponds are no longer in use and are dry. Highway 20 has a culvert to convey water from this drainage to the south away from the roadway. Based on field observations, this drainage has an incised channel into the soil exposing bedrock in some areas.

Only one distinct natural stream drainage was found within the proposed site boundaries by field reconnaissance. It is located in the southwestern corner of the proposed site and runs from the south-central area of the proposed site southward toward U.S. Highway 20 (Figure 3.3-8, Topography, Roads, and Drainage). Just to the north of U.S. Highway 20, a series of small ponds were used in the past to collect and store water from this drainage for agricultural uses; but these ponds are no longer in use. U.S. Highway 20 has a culvert to convey water from this drainage to the south away from the roadway.

3.3.2.2 Surface Geology

Most lava flows at the surface in the vicinity of the proposed site are Pleistocene in age and are blanketed with unconsolidated sedimentary deposits. Areas of rock outcrop within the boundaries of the proposed site are shown in Figure 3.3-9, Areas of Exposed Basaltic Lava Flows. Rock outcrops cover about 14% of the total area of the proposed site and exist in the form of low irregular ridges, small areas of thin soils mixed with blocky rubble, and erosional surfaces in the intermittent stream drainage on the southwest side of the proposed site. The outcrops are typically surrounded by soils of variable depths, producing an irregular pattern of rock exposure in map view (Figure 3.3-9, Areas of Exposed Basaltic Lava Flows). The outcrops are sparsely to moderately vegetated where plants have become established in cracks and joints in the rock.

The northwestern corner, southeastern corner, and southwestern portions of the proposed site contain the highest relative areas of outcrop (Figure 3.3-9, Areas of Exposed Basaltic Lava Flows). These portions of the proposed site are vegetated with sagebrush and grasses of variable density surrounding the outcrops. The northeastern and central portions of the proposed site have relatively smaller areas of outcrop and appear to have thicker soils. Crop circles used for ongoing and past crop production cover the majority of the central and northeastern portions of the proposed site.

The outcrops at the proposed site are comprised of 100% basaltic lava flows of the Quaternary Snake River Group. The basalts are typically strongly vesicular and show a range of oxidation of iron minerals and formation of secondary minerals in vesicles and exposed surfaces (Figure 3.3-10, Photos of Typical Basalt Outcrops 1). In some areas, the surfaces of the vesicular basalts are partially covered with white calcium carbonate. The lava flows show a range of morphologies indicative of eruption, flow, and cooling. These morphologies include jointing in approximate columnar patterns (Figure 3.3-10, Photos of Typical Basalt Outcrops 1), extensive vertical, less extensive horizontal jointing, and open cavities and rubble at the ends of flows (Figure 3.3-11, Photos of Typical Basalt Outcrops 2). The lava flows as a whole show no particular directional orientation. Geologic mapping (Kuntz, 1994) and the close proximity of these lava flows to the volcanic vent at Kettle Butte, which is located near the northeastern corner of the proposed site (Figure 3.3-9, Areas of Exposed Basaltic Lava Flows), indicate that the flows are associated with eruptions originating from that location.

3.3.2.3 Notable Geological Features Within and Adjacent to the EREF

There are few notable geologic features within the proposed site boundaries. The most significant features are the following:

- All flows have the same general appearance of being highly vesicular, extensively jointed, and filled with cavities (Figure 3.3-11, Photos of Typical Basalt Outcrops 2);
- Several basalt flow outcrops exhibit a narrow linear morphology, suggestive of pressure ridges. Figure 3.3-12, Photos of Significant Geological Features, shows a photo of a pressure ridge.

The site lies within a shallow topographic depression about 230 km^2 (89 mi^2) in area. This depression is bounded by surrounding topographically higher elevations ranging from 1,554 to 1588 m (5,100 to 5,210 ft). The summits of seven small basalt shield volcanoes rise above the surrounding terrain. Together, the gently sloping lava fields from these shield volcanoes (erupted mainly 200 to 400 ka) form a shallow topographic depression enclosing the proposed site. The local geology of the adjacent area surrounding the EREF site consists primarily of basaltic volcanic rocks that erupted during the last 500,000 years. Rhyolitic domes and alluvial fan deposits occur to a lesser extent within the adjacent region (Hughes, 1999). The site is located between two volcanic rift zones, the Lava Ridge-Hells Half Acre and the Circular Butte-Kettle Butte rift zones. Volcanism and tectonic activity from these two zones produced shield volcanoes, spatter cones, small calderas, and fissure eruptions (Hughes, 1999).

The western edge of the proposed site near the INL boundary is underlain by basalt lava flows from various shield volcanoes located 5 to10 km (3 to 6 mi) to the west and northwest of the site. Relative stratigraphy along the lava-flow contacts shows that these lava flows are older than the Kettle Butte lavas, but a similar age is indicated by the normal magnetization of the flows and by the correlation of one of the flows with a dated subsurface lava flow from a nearby borehole: the correlated subsurface lava flow has a K-Ar age of 325 +/- 45 ka, the same apparent age as Kettle Butte.

Weakly developed, intermittent drainage channels occur on the lava surfaces and along the contacts of lava flows, particularly near the eastern boundary of the proposed site. Overland flow and the development of strong drainage networks is not facilitated by the thin, discontinuous cover of permeable, unconsolidated surficial sediment and the underlying, highly fractured-permeable lava flows.

Outside of the proposed site boundaries, the most significant geologic features include the following (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology):

- Axial Volcanic Zone:

  The Axial Volcanic Zone is a northeast-trending, constructional volcanic highland that occupies the central topographic axis of the ESRP. It is underlain by many basalt lava flows erupted from many fissure eruptions and small shield volcanoes during the past 4 Ma. The proposed EREF site is situated within the Axial Volcanic Zone.

- East, unnamed and Middle Buttes:

  East, unnamed, and Middle Buttes are located about 20 to 30 km (12 to 18 mi) from the western boundary and stand well above the elevation of the ESRP. The age of these deposits range from 1.9 to 0.5 Ma (Kuntz, 1979). East Butte is composed of parallel layers of rhyolitic lava (Kuntz, 1979). The unnamed butte studied through well borings and outcrops is a rhyolitic dome (Kuntz, 1979). Middle Butte has been less studied than East Butte thus less is known about its internal structure. The upper surface of Middle Butte is composed of approximately 75 m (246 ft) of basaltic lava flows, but an endogenous rhyolite dome is believed to underlie the butte at depth and account for the uplift of the basalt lava flows (Kuntz, 1979).

- Lava Ridge – Hells Half Acre Rift Zone

  The Lava Ridge – Hells Half Acre rift zone (Kuntz, 1992a) extends 50 km (31 mi) southeast across the ESRP from the southern end of the Lemhi Range. The southeast end of the rift zone is defined by the dike-induced fissures and vent complex of the Hells Half Acre lava field. The central part of the rift zone is defined by several small- to medium-sized shield volcanoes with vents elongated north-south. The northwest end of the zone is ill defined by poorly exposed lava flows of reversed magnetic polarity, mantled by fluvial, lacustrine and eolian sediment. The earliest volcanism (730 ka) occurred at the northwestern end, volcanism of the central part is of intermediate age (200 to 500 ka), and the youngest volcanism occurred about 5 ka at the Hells Half Acre lava field at the southeastern end of the zone.

- Hells Half Acre Lava Field

  The EREF site is located approximately 0.5 km (1.1 mi) north of the northernmost outcrops of Hells Half Acre lava field (Figure 3.3-13, Geologic and Physiographic Features Near the Proposed Site). The volcanic features associated with this lava field consist of a basaltic shield volcano and its vents (Kuntz, 2002). The main basalt shield volcano and its eruptive-fissure system, is about 5 km (3 mi) south of the proposed site. Basaltic lavas at Hells Half Acre lava field were erupted along a fissure system and consist of basaltic pahoehoe lavas. The vents of the shield volcano occur within an elongated area 800 m (2,625 ft) long by 100 to 200 m (328 to 656 ft) wide (Kuntz, 2002). Lavas traveled more than 20.0 km (12.4 mi) southeast from their vents, forming a lava field composed of many individual fields up to 100 m (328 ft) wide and over 10 m (33 ft) thick. Hells Half Acre lava flows cover approximately 400 km^2 (154 mi^2) and form one of the largest lava fields on the ESRP. Besides lava flows, spatter and cinder deposits are also found within the lava field and reflect the explosive nature the volcano at different times in its eruptive history. A northwest-trending tension crack is considered to be the feeder system for the fissure eruptions that controlled the lava field (Hughes, 1999).

- Circular Butte – Kettle Butte Rift Zone

  The Circular Butte – Kettle Butte volcanic rift zone (Kuntz, 1992a) is to the east of the EREF site. This rift zone is not well defined or described in the literature as other zones that have experienced more recent activity. Kettle Butte is a large basalt shield which is close to the proposed EREF site and is likely the source of most of the lava flows that are exposed in outcrops at the proposed site.

- Kettle Butte

  Kettle Butte is located about 1.6 km (1.0 mi) off the northeastern corner of the site (Figures 3.3-12, Photos of Significant Geological Features, and 3.3-13, Geologic and Physiographic Features Near the Proposed Site) and is one of the largest ESRP basalt shields. Its prominent summit is occupied by several small collapse craters and pyroclastic cones. Eruptions of Kettle Butte produced an extensive lava field covering at least 320 km^2 (124 mi^2) and about 6 km^3 (1.4 mi^3) in volume (Kuntz, 1979) (Figure 3.3-13, Geologic and Physiographic Features Near the Proposed Site). Although the lava flowed mainly to the northeast, Kettle Butte is the source for most of the lava-flow outcrops within the boundaries of the proposed site. The normal magnetic polarity of Kettle Butte lava indicates an age of volcanism 730 ka and the lava has a K-Ar age of 316 +/- 75 ka (sample 84ILe-1; Kuntz, 1994). The lava flows and near-vent pyroclastic deposits of Kettle Butte and most other basalt shield volcanoes near the proposed site are included as part of unit Qbc on the geologic map of the INL area, a widespread lithostratigraphic unit composed of middle

Pleistocene basalt lava flows and minor pyroclastic deposits estimated to have erupted about 200 to 400 ka (Kuntz, 1994).

3.3.2.4 Local Stratigraphy

3.3.2.4.1 Soils at the Proposed Site

Thicknesses of unconsolidated surficial sediment and soil cover in the ESRP are variable, ranging from zero in areas of recent volcanism to tens of meters (tens of feet) in areas of wind-blown loess derived from exposed lava flows, lacustrine deposits, and alluvial fill (Hughes, 1999; Scott, 1982; Whitehead, 1994a). Thin soils and basalt outcrops are typical of ridge lines and wind-swept areas, of the axial volcanic zone, the broad constructional volcanic highland on which the proposed site is located.

During the fall of 2007 and the spring of 2008, thirty boreholes were drilled to determine depth to bedrock and collect samples for geotechnical and geochemical testing. Geotechnical testing was conducted at 14 locations, and geochemical testing was conducted at 10 surface locations (Figures 3.3-14A, Borehole and Soil Sample Locations, and 3.3-14B, Cross Section A-A' and B-B' on the Proposed EREF Footprint) and latitude and longitude for soil sampling locations are provided in Table 3.3-2, Site Soil Sample Locations. As shown in Figure 3.3-14B, Cross Section A-A' and B-B' on the Proposed EREF Footprint, the depth of bedrock at the proposed EREF ranges between bedrock outcrop and a soil depth of up to 6.2 m (20.5 ft).

Soil Deposits

Unconsolidated surficial deposits at the proposed site are primarily transported sedimentary materials of eolian origin rather than soils developed in situ as a result of regolith weathering. Scott (Scott, 1982) mapped the surficial deposits in the area of the proposed site as Pleistocene loess deposits, which form a thin discontinuous cover overlying Pleistocene basalt lava flows. The loess is composed of silt and sandy silt containing sparse angular to subrounded basalt gravel derived from nearby lava outcrops, is massive or faintly bedded, and overall is moderately to well sorted.

The U. S. Department of Agriculture soil survey for Bonneville County, Idaho (NRCS, 2008c) categorizes most of the soils at the proposed site as Pancheri silt loams with slopes ranging from 0 to 8 percent (50 to 75% of the area) (Figure 3.3-15, Soil Map of the Proposed Site; Table 3.3-3, Summary of Soils by Map Unit). The Pancheri series consists of deep and very deep, well-drained soils that formed in loess covered lava plains (NRCS, 2008c). The taxonomic class for the Pancheri series is coarse-silty, mixed, superactive, frigid Xeric Haplocalcids. This description is consistent with detailed studies of soils at the nearby INL where they are described as falling mostly in the silt-loam textural class with 0 to 27% clay, 55 to 80% silt, and 10 to 35% sand (Nimmo, 2004). The drainage and permeability of the Pancheri series are described as well-drained, medium or slow runoff, moderate permeability (NRCS, 2008c). The remainder of the proposed site is characterized as Polatis-rock outcrop complex, Pancheri-rock outcrop complex, and lava flows.

3.3.2.4.2 Lithology of GW-1 Rock Cores

Core hole GW-1 was drilled near the geographic center of the proposed site and a continuous rock core was collected from land surface to a total depth of 223.0 m (730.5 ft) below land surface (Figure 3.3-16, Existing Agricultural and Newly Installed Monitoring Wells). A rock boring log was compiled during the drilling process to describe the general features of the core materials. Geophysical logs were also obtained, including a subsurface photographic record of the inner borehole walls, a caliper log of borehole diameter, and a natural-gamma log. Core recovery was excellent, with very little lost material, with relatively few intervals of drilling-induced fracturing, and with the borehole depths indicated on the geophysical logs being minus-0.3 m (1.0 ft) to plus-0.6 m (2.0 ft), relative to the depth markers contained in the core boxes. The lithologic information reported here is based on visual examination of the core materials and selected geophysical logs. The purpose of this report section is to generally describe the subsurface lithologies, to identify individual basalt lava flows and sedimentary interbeds, to describe the overall stratigraphy of the borehole, and to suggest possible correlations of the GW-1 rock cores with other subsurface cores and outcrops near the drill site.

Summary of Lithologic Features Observed in GW-1

Figure 3.3-17, GW-1 Lithologic Log – Summary, summarizes the subsurface lithologies of rock cores from GW-1. Two types of materials were intersected: basalt lava flows and sedimentary interbeds.

Sediment

Sediment composes only 2.4 percent of the core materials from GW-1. Three interbeds of silty loess, each less than 3 m (10 ft) thick, occur in the upper 125 m (410 ft) of the core. The small percentage of eolian and colluvial sediment in the GW-1 core is consistent with its location within the axial volcanic zone, a northeast-trending constructional volcanic highland that forms the topographic axis of the ESRP. Subsurface data from the southern INL area show that the axial volcanic zone has received relatively little sediment during the past several million years, mostly of eolian origin. This is in contrast to the subsided sedimentary basins of the INL to the north and northwest of the axial volcanic zone, which have received thick accumulations of alluvial, lacustrine and eolian sediment, averaging 15% of borehole materials (Anderson, 1997; Champion, 2002). All of the sedimentary deposits in the GW-1 core are moderately to well sorted, calcareous loess of eolian origin, lithologically similar to surficial sediment near the drill site and consisting mainly of silt with minor clay and sand. The loess commonly contains angular blocks of vesicular basalt, a colluvial component derived from the tops of underlying lava flows (e.g., 18 to 20 m (60 to 66 ft) interval). Beneath the loess interbeds, fine calcareous sediment commonly occupies the apertures of open fractures (e.g., 20 to 21.6 m (66 to 71.0 ft) interval). Solution and re-deposition of calcium carbonate from the loess has produced white caliche, commonly deposited on basalt fracture surfaces and vesicles of surface outcrops, and in fractured lava flows beneath the subsurface sedimentary interbeds.

Basalt

Basalt lava flows comprise 97.6% of the GW-1 core. No pyroclastic deposits were identified. About 59 individual lava flows were identified, ranging from 0.6 to 15 m (2 to 50 ft) in thickness. Intervals of numerous thin, vesicular pahoehoe lava flows occur at depths of 95, 131, 152, 157 and 209 m (310, 430, 500, 515 and 685 ft). Thin pahoehoe flows occur near volcanic vents and at the margins of advancing lava flows. They form through a type of budding process at the leading edge of an advancing flow, and a stack of pahoehoe crusts can form at a given location during the effusion of a single parental lava flow. If the stacks of multiple, thin pahoehoe flows at the depths indicated above are each assumed to be the products of a single parental lava flow, then a total of about 40 basalt lava flows is observed in GW-1.

The tops of pahoehoe flows are marked by the presence of black, fine-grained to glassy, chilled lava crusts a few centimeters (inches) thick, with stretched vesicles, pervasive oxidation of matrix and olivine phenocrysts, and commonly occurring in the GW-1 core as a jumble of vesicular, angular clasts having these lithologic features. Beneath the pahoehoe rubble and within a few meters (feet) of the lava-flow tops is a highly vesicular zone with closely spaced (about 0.3-m (1.0-ft) spacing in outcrops), vertically oriented cooling fractures. In thicker lava flows, the highly vesicular, pervasively fractured lava grades downward into finely vesicular to nonvesicular (massive) lava of the flow interior. Flow interiors formed during slower cooling, yielding greater crystallinity of the intergranular rock matrix, a lighter gray color. Within the massive flow interiors, widely spaced, subhorizontal fractures and thin subhorizontal vesicular zones were formed as a result of simple shear during endogenous flow. Within a few meters (feet) of the bases of the lava flows, vesicularity increases and within 0.3 m (1.8 ft) of the basal contacts the lava matrix becomes black and fine-grained, evidence of chilling against the underlying substrate. The lithologic features of ESRP basaltic lava flows and their modes of formation are further described in greater detail by Kattenhorn and Schaefer (Kattenhorn, 2007) and Welhan et al. (Welhan, 2002).

Most lava flows show little or no petrographic contrast across individual flow boundaries, such as changes in phenocryst sizes, or differences in the absolute or relative abundances of plagioclase and olivine phenocrysts. This suggests that groups of adjacent lava flows were the products of single magma batches, producing cogenetic lava-flow groups, composed of several individual lava flows, and formed in a single volcanic event of geologically brief duration. The best criterion for distinction of lava-flow groups is the presence of a sediment interbed, indicating a hiatus between the emplacement of two lava flows or lava-flow groups. Lava-flow groups can also be distinguished in rock cores, based on visible petrographic changes across flow contacts. Such petrographic contrasts suggest separate magma batches, each with a different history of generation, storage and ascent. In the GW-1 rock core, such petrographic differences include the sizes and relative abundances of plagioclase and olivine phenocrysts, and the presence or absence of glomerophenocrysts in basalt lava flows. Based on their separation by sedimentary interbeds and gross petrographic changes across lava-flow contacts, about ten lava-flow groups are identified in the GW-1 core.

Response of the Natural-Gamma Signal to Basalt and Sediment

Downhole natural-gamma geophysical logs show greater intensities within the more potassium-rich sedimentary interbeds, relative to the potassium-poor basalt lava flows. In GW-1, the natural-gamma signal begins to increase within 0.3 m (1.0 ft) of sedimentary interbeds, relative to lower-intensity natural-gamma signals within the basalt lava flows. For intervals where basalt clasts are a significant proportion of the sediment, the gamma signal increases by about a factor of two, relative to the surrounding basalt lava flows (e.g., the 18-20 m (60-66 ft) interval; 17.9-19.5 m (59.0-64.0 ft) on natural-gamma log). In the core where silty loess composes nearly 100 percent of a sedimentary interbed (e.g., the 59.9-60.8 m (196.5-199.5 ft) interval; 59.4-60.4 m (195.0-198.0 ft) on gamma log), the gamma signal increases three to five-fold, relative to the surrounding basalt. Beneath sedimentary interbeds, fine sediment commonly has percolated downward into the fractures and vesicles of underlying lava flows, but such intervals generally do not display elevated natural-gamma signals.

Potassium in basalts of the INL area varies from about 0.2 to 1.3 wt % K_2O (Anderson, 1997) is lower than the abundance of potassium in sedimentary interbeds, and the intensity of the natural-gamma signal across lava-flow contacts therefore varies much less than across basalt-sediment contacts. Nonetheless, natural-gamma logs are potentially useful for identifying lava-flow contacts and for distinguishing subsurface lava-flow groups, particularly when used together with petrographic, geochemical, paleomagnetic and other information (Anderson, 1995). Lava-flow contacts that are marked by strong petrographic differences are indicated on the GW-1 lithologic summary (Figure 3.3-17, GW-1 Lithologic Log - Summary). Several of these lava-flow contacts are also marked by changes in the intensity of the natural-gamma signal across the contacts, suggesting a significant compositional difference between basalts. The lava flows above the contact at a depth of 74 m (243 ft) have a relatively constant natural-gamma signal of 10-15 units; below this contact, the gamma signal is more elevated and more variable, 20-45 units. Beneath the sedimentary interbed at about 125 m (411 ft) depth, the underlying lavas have a natural-gamma signal of 35-40 units, in contrast to the 20-30 unit signal of lavas above the sedimentary interbed. For the lava-flow contact at 128 m (421 ft) depth, the natural-gamma signal of the overlying lava-flow group decreases abruptly from 35-40 units, to 15-20 units in the underlying group.

Correlation of GW-1 Rock Cores with Outcrops and other Boreholes

No detailed sampling or analysis of lava outcrops erupted from vents near the proposed site has been accomplished, but reconnaissance observations at six roadside localities along a 12.8-km (8-mi) length of U.S. Highway 20 to the south of the proposed site suggest the following tentative correlations between surface and subsurface lava flows. The three basalt lava flows in the uppermost 18 m (60 ft) of GW-1, above the first sedimentary interbed, were erupted from Kettle Butte, a large shield volcano several kilometers (miles) east of the proposed site. Surface lava flows at the location of GW-1 are mapped as having erupted from Kettle Butte (Kuntz, 1994), and subsurface basalt flows from the 1.2-18.0 m (4.0-60.0 ft) interval of GW-1 are petrographically similar to surface outcrops of Kettle Butte lava flows on much of the proposed site. For the 20-109 m (66-357 ft) interval of GW-1, the lava flows are nonporphyritic to weakly porphyritic in plagioclase and olivine, and the location(s) of their source vent(s) are unknown. From 109.0-155.5 m (357.0-510.0 ft) the lavas are strongly porphyritic and contain glomerophenocrysts of plagioclase and olivine up to 1.0 cm (0.4 in); such textures are similar to those observed in outcrops of lavas erupted from a vent to the west of the GW-1 drill site (Qbc map unit of Kuntz, 1994; vent 32 of Anderson, 1997), and are also similar to the porphyritic textures of lava outcrops from Butterfly Butte and nearby vents to the southeast of the GW-1 drill site (Qbd map unit of Kuntz, 1994; vents 28 through 31 of Anderson, 1997).

Anderson and Liszewski (Anderson, 1997) describe the stratigraphy of the unsaturated zone in the INL area, based on more than 300 wells. Most wells are located near INL facilities more than 15.0 km (9.3 mi) to the west and northwest of GW-1. As a result, subsurface correlations are highly uncertain for the southeastern part of the INL and in the area near the GW-1 drill site, but some speculative conclusions can be reached about the GW-1 rock core, its stratigraphic relationships to other subsurface units from the INL region to the west of the proposed site, and possible correlations with nearby volcanic vents that may have been sources for the lava flows in the GW-1 rock core. Table 3.3-4, Characteristics of Volcanism in the INL Area, summarizes information about possible source vents and subsurface stratigraphic units near the proposed site, based on data from Anderson and Liszewski (Anderson, 1997) and Kuntz et al. (Kuntz, 1994).

About 4.8 km (3.0 mi) southwest of GW-1, the well Highway 2 (USGS 214) was drilled to a depth greater than the 223.0 km (730.5 ft) total depth of GW-1; this well has produced stratigraphic data and it anchors the eastern end of a northwest-southeast geologic section across the INL area (Anderson, 1997). Although stratigraphic correlations are uncertain between USGS 214 and other INL wells to the west and northwest, Anderson and Liszewski (Anderson, 1997) suggest the following stratigraphy for USGS 214: the corehole intersects Composite Stratigraphic Units (CSU) 1, 2 and 3, and the upper part of CSU4. These CSUs are composed of basalt lava flows and sediment, with approximate thicknesses as follows: CSU1, 61 m (200 ft); CSU2, 55 m (180 ft); CSU3, 91 m (300 ft); and CSU4, 46 m (150 ft). Very general stratigraphic descriptions of the CSUs are given by Anderson and Liszewski (Anderson, 1997). These general descriptions conform with the GW-1 core observations, with the exception of the very low sediment content of GW-1.

Based on general observations, an uncertain correlation with a nearby well (Highway 2 (USGS 214)), and other data from Anderson and Liszewski (Anderson, 1997), it is likely that most or all of the GW-1 rock core was emplaced between about 200 to 450 ka, has normal magnetic polarity, and consists of CSUs 1 through 3 (and perhaps the upper part of CSU4) as defined by Anderson and Liszewski (Anderson, 1997) for the unsaturated zone and the upper Snake River Plain aquifer in the INL area. All of these CSUs are part of the Snake River Group, a regional stratigraphic unit composed of basalt and sediment that underlies most of the eastern Snake River Plain.

3.3.3 Site-Specific Volcanic Ha ard Analysis

The details of the site-specific volcanic hazard analysis are included in Appendix D. A summary of the approach and results of the analysis is presented in the following paragraphs.

For this analysis, the probabilistic approach of Hackett et al. (Hackett, 2002) is adopted, using surficial and subsurface geologic data from the INL area, together with observations of active volcanism from the analog regions of Iceland and Hawaii. Critical references providing much of the supporting data for this analysis include Champion, 2002; Hackett, 1992; Hackett, 2002; Hughes, 1999; Hughes, 2002; Kuntz, 1992a; Kuntz, 1992b; Kuntz, 1994; Kuntz, 2002; and the Volcanism Working Group, 1990. The interpretation of late-Quaternary volcanism in the INL area is the basis for analyzing the characteristics, frequency and magnitude of any future volcanic events, following the paradigm that “the recent geologic past is the key to understanding the future.”

Site volcanic hazards are divided into two categories (silicic and basaltic), which have characteristically different chemistry and associated eruption styles. Five silicic volcanic centers formed 1.4 to 0.3 Ma along the axial volcanic zone. This yields a recurrence interval for silicic volcanism within the axial volcanic zone of 220,000 years (5 events per 1.1 Ma = 4.5×10^{-6} per year). This is more than an order of magnitude less frequent than the estimated recurrence of basaltic volcanism within the axial volcanic zone. Additionally, the spatial distribution of Quaternary silicic volcanism in the INL area, and the areas inferred to have been impacted by individual eruptions, are far smaller than for basaltic volcanism. Therefore, the hazards associated with near-field silicic volcanism are considered to be far less important than those of basaltic volcanism and no further analysis was performed.

Inundation by basalt lava flows is the most significant volcanic hazard at the proposed site. During the past 4.3 Ma, the ESRP has been repeatedly inundated by basaltic lava flows, which today are exposed over about 58 percent of the INL area and are found in subsurface wells and boreholes across most of the ESRP.

Combining the similar results of the two analyses detailed in Appendix D, the estimated mean annual probability (preferred value) of lava inundation at the proposed site is 5×10^{-6}. The estimated upper and lower bounds of the annual probability distribution span two orders of magnitude, from 10^{-5} to x 10^{-7} respectively.

Comparison with Other Results

Hackett et al. (Hackett, 2002) calculated the annual probability of lava inundation at the Central Facilities Area (CFA), a cluster of facilities on the southwestern INL about 12.0 km (7.5 mi) from vents in the volcanic zones to the west and south, and within a topographic basin about 100 m (328 ft) lower than the surrounding volcanic highlands. The estimated annual probability of lava inundation for the CFA is 5×10^{-6}, without attempted mitigation. This result is identical to the results calculated here for the proposed site. Unlike the proposed site, the CFA is not situated within a volcanic source zone. The agreement of results is understandable because the CFA is nearby and downslope from two volcanic source zones with high recurrence intervals, including the axial volcanic zone.

The New Production Reactor (NPR) site was a proposed facility in the south-central INL, about 10.0 km (6.2 mi) from the nearest vents of the axial volcanic zone to the south. The Volcanism Working Group (Volcanism Working Group, 1990) considered basalt lava-flow inundation to be the most significant volcanic hazard at the NPR site. The annual probability of future lava inundation at the NPR site was qualitatively estimated by the Volcanism Working Group (Volcanism Working Group, 1990) to be "less than 10^{-5}.

These results for the proposed EREF site agree with the results of two other probabilistic volcanic-hazard analyses for sites on the southern INL, suggesting that 5×10^{-6} per year is a robust probability estimate for future lava-flow inundation across the southern INL and adjacent areas within about 10 km of the axial volcanic zone.

3.3.4 Site Soil Chemical Characteristics

Geotechnical tests included moisture content, natural dry density, specific gravity, grain size analysis, Atterberg limits, modified Proctor, R value, pH and resistivity, sulfate content and consolidation tests. The laboratory testing was conducted in accordance with ASTM standards. The specific ASTM standards used were ASTM C136 (ASTM, 1992), ASTM D1140 (ASTM, 2000a), ASTM D1557 (ASTM, 2002a), ASTM D422-63 (ASTM, 2002b), ASTM D2216 (ASTM, 1998), ASTM D2435 (ASTM, 2002c), ASTM D2487 (ASTM, 2000b), ASTM D2844 (ASTM, 2001), and ASTM D4318 (ASTM, 2000c). Geotechnical test results are presented in Section 3.3.5, Geotechnical Investigation, and the radiological results of soil samples are discussed in Section 3.11, Public and Occupational Health.

Non-radiological chemical analyses include the eight Resource Conservation and Recovery Act (RCRA) metals, moisture content, organochlorine pesticides, organophosphorous compounds, chlorinated herbicides, fluoride, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The non-radiological analyses were conducted by certified laboratories. The laboratories used EPA approved methods and all detection limits met or exceeded EPA methods.

The results of the metals, fluoride and moisture content in soils analyses are provided in Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils. The results for VOCs and SVOCs are provided in Table 3.3-6, Concentrations of VOCs and SVOCs in Soils. The results for pesticides and herbicides are provided in Table 3.3-7, Concentrations of Pesticides and Herbicides in Soils. Analysis results were compiled to evaluate background concentrations and compared to soil background concentrations at the nearby INL. The data are presented to establish the natural range of background concentrations against which soil samples collected in the future at the time of decommissioning can be compared against to evaluate site contamination.

The metals arsenic, barium, cadmium, chromium and lead were detected in all soil samples. Arsenic concentrations ranged from 5.5 to 7.7 mg/kg (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). The range of arsenic concentrations is similar to soils at the INL (5.8 - 7.4 mg/kg), to the average arsenic concentration in soils in the U.S. of 7.2 mg/kg (Shacklette, 1971) and range for southern Idaho (3.8 to 8.3 mg/kg) (Gustavsson, 2001). The barium concentrations ranged from 160 to 200 mg/kg for barium. These concentrations are less than the range for background used at the INL of 300 to 440 mg/kg. Cadmium concentrations ranged from less than detection limit of 0.50 to 0.71 mg/kg. These concentrations are less than the range for background used at the INL of 2.2 to 3.7 mg/kg. Chromium concentrations ranged from 20 to 25 mg/kg. These concentrations are less than the range for background used at the INL of 33 to 50 mg/kg. Lead concentrations ranged from 14 to 18 mg/kg. These concentrations are similar to the range for background used at the INL of 17 to 23 mg/kg.

Two soil samples had detectable silver at 0.70 mg/kg, but this concentration is close to the detection limit and all other samples had concentrations less than detection levels (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). The silver background at the INL is non-detect with detection levels similar to those for this study.

Selenium concentrations ranged from 0.13 mg/kg to 0.42 mg/kg (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). The range of selenium concentrations is within the range of selenium concentrations in soils in Bonneville County, Idaho (0.10 to 1.312 mg/kg) (USGS, 2008a).

The concentrations of mercury are less than the analytical detection limits (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). Background levels for mercury at the INL are 0.05 to 0.075 mg/kg or similar to the detection limits for the soil samples collected for this study.

Fluoride concentrations ranged from less than the detection limit of 5 mg/kg to 12 mg/kg (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). A background comparison for fluoride from the INL was not available.

Moisture content varied from 9.1 to 16.5 percent (Table 3.3-5, Concentrations of Metals, Fluoride, and Moisture Content in Soils). Moisture content in surface soils can be expected to vary seasonally and with the frequency of precipitation events.

The only VOCs detected in surface soil samples were 1,3,5-trimethylbenzene, 1,3-dichlorobenzene, and tetrachloroethene (Table 3.3-6, Concentrations of VOCs and SVOCs in Soils). All detections were close to the detection limits for these VOCs and all occurred at the same location, SS1. The occurrence of 1,3-dichlorobenzene may be related to herbicide use. The presence of tetrachloroethene may be due to its presence in numerous consumer products or its use as a solvent at the site; however, the exact source of this compound is uncertain. The presence of 1,3,5-trimethylbenzene could be related to vehicle exhaust, but it is also used as a solvent.

SVOCs detected in surface samples include benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene (Table 3.3-6, Concentrations of VOCs and SVOCs in Soils). All the concentrations of SVOCs that were detected were close to the detection limits. Benzo(a)pyrene was detected in the soil samples from locations SS2, SS4, SS9, and SS10. Indeno (1,2,3-cd) pyrene was detected in the soil samples from locations SS2, SS4, SS9, and SS10. Dibenzo(a,h)anthracene was detected at locations SS2, SS4, SS9, and SS10. These compounds are Polyaromatic Hydrocarbons (PAHs). These compounds can occur as a result of road runoff (found in fuels or exhaust and road tar) or incomplete combustion of wood as a result of (natural) fire residue. Given the low concentrations for all these compounds, either source is possible. Because these PAH compounds are probably due to vehicle exhaust/road runoff or natural wildfires, these PAH occurrences are considered to represent background concentrations.

No detection of pesticide or herbicide compounds occurred in the surface samples, except for chlorpropham (Table 3.3-7, Concentrations of Pesticides and Herbicides in Soils). Chloropropham was detected in three of the 10 surface soil samples at concentrations ranging from 0.0055 to 0.0110 mg/kg. This compound is used to inhibit sprouting of potatoes to be stored and its detection is consistent with the agricultural history of this site.

The soil samples were also analyzed for radiological chemical components. These analyses were performed by gamma isotopic and uranium specific analyses. Soil samples were analyzed for naturally-occurring primordial radionuclides, the thorium decay series, and the uranium decay series. The 10 soil samples were also analyzed for cesium, potassium, and actinium. Refer to Section 3.11, Public and Occupational Health, for a discussion of the radiological analyses results for these soil samples.

3.3.5 Geological Investigation

Site geotechnical investigations were conducted in November 2007 and in May 2008. The results of these investigations are provided in Appendix E. The investigation in November 2007 consisted of 20 test borings. The subsequent investigation in May 2008 consisted of 10 test borings. The boreholes were drilled using a hollow-stem auger, split-spoon sampling and a Dames and Moore sampler. Split spoon sampling was performed in accordance with ASTM D1586-99 (ASTM, 1999). The data from the subsurface investigation was generally consistent with the published regional information obtained during the review of available geologic and soil information. The site investigations included the installation and monitoring of groundwater wells, geophysical investigations in boreholes, and surface geology mapping. The borings and sample locations are shown in Figure 3.3-14A, Borehole and Soil Sample Locations and were located to provide coverage of the site.

The soil is generally 0 to 4.3 m (0 to 14.0-ft) thick and overlies fractured basalt lava flows. At one of the test-hole locations the soil was approximately 6.2 m (20.5 ft) thick. Soils are of eolian origin and are classified primarily as low-plasticity clays. Colors of the soil include light tan, tan, light brown, and dark brown. Rock outcrops cover 14% of the total area of the proposed site. Geologic mapping of the bedrock exposures indicates that the basalt is strongly vesicular and contains discontinuities such as strongly developed columnar jointing and cavities. Several collapsed lava tubes filled with rubble were reported in the northern portion of the site area.

The Standard Penetration Test (SPT) N-values ranged from 1 to 53. N-values ranged from 1 to 43 for a depth of 1.5 m (5.0 feet) below ground surface and between 11 and 53 for depths 3 m (10 feet) or more below ground surface. The N-values suggest a consistency that ranges from very soft to hard. Rock Quality Designations (RQD) for one deep cored boring indicate that the bedrock ranges from fair to excellent quality (64% to 100%) within the top 30 m (100 ft) of the boring. Several localized zones of broken rock and soil were observed at considerably greater depths. A fractured interval between 69 m (225 ft) and 70 m (230 ft) yielded an RQD of 0 and a 2.5 m (8.0 ft) layer of soil was encountered between 123 m (403 ft) and 125 m (410 ft). Thin layers of soil were encountered between 18.6 m (61.0 ft) and 19.5 m (64.0 ft) and 59.1m (194.0 ft) and 60.8 m (199.5 ft). The depths of these zones greatly exceed the anticipated depth of influence of foundations and will not negatively impact the capacity of the rock to provide adequate bearing.

Laboratory tests on soil samples included moisture content, natural dry density, specific gravity, grain size analysis, Atterberg limits, modified Proctor, Hveems's resistance value (R value), pH, resistivity, sulfate content, and consolidation tests. The laboratory testing was conducted in accordance with ASTM standards. The specific ASTM standards used were ASTM C136 (ASTM, 1992), ASTM D1140 (ASTM, 2000a), ASTM D1557 (ASTM, 2002a), ASTM D422-63 (ASTM, 2002b), ASTM D2216 (ASTM, 1998), ASTM D2435 (ASTM, 2002c), ASTM D2487 (ASTM, 2000b), ASTM D2844 (ASTM, 2001), and ASTM D4318 (ASTM, 2000c). The natural dry density of finer soil samples tested, were 1.30, 1.41, 1.45, 1.67, and 1.79 g/cm^3 (81.2, 88.0, 90.4, 104.4, and 112.0 lbs/ft^3). The natural moisture content of the materials tested ranged from 9.6 to 19.0%. The liquid limit and plasticity index ranged from 27 to 42% and 10 to 24%, respectively. Percent passing the No. 200 sieve ranged from 84 to 98%. The samples of the site soils are classified as CL, low plasticity clays, according to the Unified Soil Classification System. Modified Proctor tests performed in accordance with ASTM D1557 (ASTM, 2002a) resulted in maximum dry densities of 1.8 g/cm^3 (111.0 lbs/ft^3) at an optimum moisture content of 14.5% and 1.8 g/cm^3 (112.5 lbs/ft^3) at an optimum moisture content of 14.0%.

Two resistance R-value tests were performed on samples taken from depths of 0.3 m (1.0 ft) and 1.5 m (5.0 ft). The R-values for these samples were 17 and 16 respectively. These values are at the upper limit of the typical range (5-15) of R-values for clays.

The pH for the soils was 8.36 and the water soluble sulfate values from two tests were 100 and 1,700 ppm. Tests on two samples yielded resistivities of 1,229 Ohm-cm and 245 Ohm-cm. The resistivity values are low and suggest an environment with corrosion potential.

The compression index, C_c, from consolidation tests ranged from 0.114 to 0.260 indicating soil of low compressibility.

Groundwater was not encountered during the subsurface investigations that were limited to the surface soils. Groundwater was encountered in the monitoring wells at depths of more than 150 m (500 ft).

Basalt of the nature found at the site typically provides adequate support for footings, mats, and deep foundations for the anticipated loads. The Naval Facilities Engineering Command Design Manual (NAVFAC) (NAVFAC, 1986a) presents presumptive allowable bearing pressures for spread footings that range from 960 kpa to 7,660 kpa (10 to 80 tons per sq ft) for rock with consistency varying from soft to hard. Peck, Hanson and Thornburn (Peck, 1974) present allowable contact pressures on jointed rock as a function of RQD. An allowable contact pressure of 10 tons/ft^2 is recommended for an RQD of zero. Peck, Hanson and Thornburn (Peck, 1974) note that the allowable contact pressure beneath foundations is governed exclusively by the settlement associated with the defects in the rock, and not by strength. The expected loading for the proposed structures will therefore be far less than that required by bearing capacity (strength) considerations.

Other support alternatives to be considered in detail at the final design and discussed in Appendix E will be removal of unsuitable surface soils and backfilling with structural or engineered fill to the founding elevation of the foundation. The site soil is generally classified as low plasticity clay and is unlikely to be suitable for use as structural fill. The structural fill requirements will be detailed at the final design stage but suitable materials will include crushed rock, well graded gravel and sand mixtures.

Additional soil borings and rock coring will be performed at the site. Laboratory testing of soil and rock samples and additional in-situ tests will be performed as necessary to determine static and dynamic soil and rock properties. This information will be used to evaluate foundation bearing capacity, estimated settlement and provide geotechnical input for soil/rock structure interaction analysis.

It is expected that the final design subsurface information will confirm there is no need to perform a liquefaction analysis. Liquefaction potential is greatest where the groundwater level is shallow and saturated loose fine sands occur within a depth of about 15 m (50 ft). Groundwater was encountered in the monitoring wells at depths of more than 150 m (500 ft). The surface soils at the site are dry and partially saturated. Therefore, potential for liquefaction of the surface soils with groundwater at these depths appears highly unlikely. If required, the assessment of soil liquefaction potential will be performed using the applicable guidance of Regulatory Guide 1.198, Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites, dated November 2003 (NRC, 2003c).

Allowable bearing pressures will be determined for the proposed foundations and anticipated loading. Allowable bearing pressure for the stability of structures will be based on the strength of the underlying soil and rock. For structures founded on rock the allowable bearing capacity is expected to be much higher than the loads that will be applied. The methods used to determine allowable bearing pressure will follow applicable methods in one or more of the following publications: NAVFAC DM7.02, Foundations and Earth Structures (NAVFAC, 1986a); Foundation Engineering Handbook (Winterkorn and Fang, 1975); Foundation Analysis and Design (Bowles, 1996); Foundation Engineering (Peck, 1974); and Rock Foundations (ASCE, 1996).

Settlement evaluation will consider the manufacturers and or other specified allowable total and differential settlement of equipment and buildings. The methods used will follow applicable methods in one or more of the following publications: NAVFAC DM7.01, Soil Mechanics (NAVFAC, 1986b); Foundation Engineering Handbook (Winterkorn and Fang, 1975); Foundation Analysis and Design (Bowles, 1996); and Foundation Engineering (Peck, 1974).

3.3.6 Regional and Local Tectonics

3.3.6.1 Basin and Range Tectonics

Extensional tectonics within the Basin and Range province, north and south of the ESRP, play an important role in dike emplacement and local ESRP tectonics. Although it is believed that the shallow and mid-crustal magma chambers related to the Yellowstone hotspot have solidified and cooled, relatively high temperatures within the upper mantle beneath the ESRP continued to produce basaltic magmas that form dikes or have erupted onto the surface. Continued stretching of the ESRP in the northeast southwest direction is evident by the northwest trending tension crack and fissure systems (Smith, 2004). Outside of the ESRP, the extension is accommodated by north to northwest-trending normal faulting (Parsons, 1998).

Three distinct structural features are common within the northern portion of the Basin and Range province:

- Reactivated thrust faults – extension resulted in renewed movement along low angle, pre-Basin and Range structures;
- Older Folds – deformation of originally flat lying rocks and;
- Normal faults – extensional stresses result in typically listric faults creating ranges within the Basin and Range province.

Thrust faults are associated with tectonic activity from the Mesozoic Cordilleran orogenic belt (Link, 1999) and pre-Basin and Range extensional. However active normal fault grabens are believed to be linked to these older thrust fault and their preferential zones of weakness. The Putnam thrust is an example of extensional normal faulting associated with a reactivated thrust fault located southeast of the ESRP (Kellogg, 1999). Extensional tectonics of the basin and range in the ESRP was initiated 17 to 5 Ma (Rodgers, 1990; Janecke, 1992; Janecke, 1993; Janecke, 1994; Fritz, 1993; Anders, 1993; Sears, 1998). To the north of the ESRP, the Lost River, Lemhi, and Beaverhead ranges show that the Basin and Range extension was accommodated by north to northwest trending normal faults.

Seismic activity in the Basin and Range province is associated with rupture events, producing earthquakes, as faulting occurs. The 7.3 magnitude Borah Peak earthquake was a rupture event of the Lost River normal fault in 1983 (Link, 1999). The Borah Peak earthquake produced an approximate 1.8 m (6.0 ft) dip slip. The Borah Peak earthquake was centered approximately

137 km (85 mi) from the EREF site. In contrast, emplacement and inflation of dikes has allowed the crust of the nearby ESRP to expand nearly aseismically by allowing release of accumulated elastic strain with only small magnitude earthquakes (Parsons, 1998).

3.3.6.2 Subsidence

Subsidence and volcanism have continued into recent times (Holocene). The ESRP has subsided approximately 1.0 km (0.6 mi) since the passage of the Yellowstone mantle plume beneath the area. The subsidence began approximately 4 Ma and continues today in response to isostatic adjustments to the mid-crustal intrusions of gabbro and crustal contraction as the area cools (Smith, 2004). The subsidence has not been uniform and regions with a faster subsidence have accumulated sediments at faster rates. Smith (Smith, 2004) infers that a feature known as the Big Lost Trough, located along the north and northeastern boundary of the INL is an area of relatively higher subsidence, where up to 50% of the stratigraphic column is comprised of sedimentary interbeds within the basalt flow sequence.

3.3.6.3 Tension Cracks, Fissures, and Faults

A tension crack is an extensional feature within the ESRP that forms as lava migrates beneath the surface in dikes. Tension cracks are commonly found together, up to five, with multiple crack sets found within a small area (Kuntz, 2002). These cracks are propagated as lava ascends to the surface at different rates and volumes. Tension cracks in the ESRP represent pressure cracks formed on the edges of fissures due to dike emplacement. Fissures represent the dikes that were able to breach the surface (Kuntz, 2002). Local tension cracks, faults, fissures, and grabens are found at Kings Bowl and Craters of the Moon lava fields, the Spencer-High Point and Arco-Big Southern Butte volcanic rift zones, and adjacent to the site in the Lava-Ridge – Hell's Half Acre volcanic rift zone (Kuntz, 2002) (Figure 3.3-5, Regional Shaded-Relief Topographic Map of Eastern Snake River Plain (ESRP) and Local Geology).

Kings Bowl and Craters of the Moon

Kings Bowl lava field erupted approximately 2,200 years ago (Kuntz, 2002). Eighteen eruptive fissure segments make up a 0.600 km (0.375 mi) fissure system that produced the volcanic materials and structures found in this location. Tension cracks at Kings Bowl extend to 11.3 km (7.0 mi) northwest-southeast. The Open Crack rift set at Craters of the Moon lava field are two tension cracks sets (Kuntz, 2002). At Minidoka, the northern tension crack set consists of two pairs of cracks that extend 8 km (5 mi) and 6.5 km (4.0 mi). The cracks are separated by 1.9 km (1.2 mi) and are 4,500 years old, the same age as the Craters of the Moon lava field. The New Butte crack system is a composite of two crack set segments. The northern and southern tension crack segments extend 5 and 10 km (3.1 and 6.2 mi), respectively (Kuntz, 2002).

Spencer-High Point and Arco-Big Southern Butte

The Spencer – High Point rift zone is a west-northwest to east-southeast trending volcanic rift zone that extends 70.0 km (43.5 mi). Vertical off-sets are observable associated with two grabens within the rift zone. The northern graben has steep walls up to 10 m (33 ft) high and is 700 m (2,297 ft) wide by 1.4 km (0.9 mi) long. This graben is believed to be related to dike emplacement beneath the area (Kuntz, 2002) as evidenced by the eruptive fissures along the graben and volcanic vents. Similar to the northern graben the western graben has steep walls, up to 12 m (39 ft) high, is 2.5 km (1.6 mi) long and up to 250 m (820 ft) wide. Unlike the northern graben, the southern graben is believed to be related to faulting in bedrock beneath the lava flows. This is based on a 14 difference in the trend direction for southern graben (Kuntz, 2002).

The Arco-Big Southern Butte volcanic rift zone trends from the northwest to the southeast for 45 km (28 mi). Extensional faults are abundant throughout Box Canyon, located at the north end of the Arco-Big Southern Butte rift zone. These faults have offsets ranging from 1.0 to 8.0 m (3.3 to 26.2 ft) and extend up to 4.0 km (2.5 mi) in length. The extensional faults mark a large graben 10.0 km (6.2 mi) long and up to 3.5 km (2.2 mi) wide. Volcanic activity is absent within the northern portions of the graben but abundant on its flanks and in the southern region. This trend is due to faulting in the northwestern portion and dike emplacement within the central and southeastern portions (Kuntz, 2002).

Lava-Ridge – Hell's Half Acre

Tension cracks are evident within the Lava-Ridge - Hells Half Acre rift zone and lava field. Local tension cracks extend greater than 2.0 m (6.6 ft) in width. One individual tension crack found at Hells Half Acre lava field is approximately 1.0 km (0.6 mi) long (Kuntz, 2002). The total length of the measured tension cracks at Hell's Half Acre lava field is 4.3 km (2.7 mi). The total length of the fissure system at Hell's Half Acre is 5.5 km (3.4 mi).

3.3.6.4 Dike Emplacement

Dike emplacement and inflation are important controls on extensional features in the ESRP (Parsons, 1998). Dikes within the ESRP are believed to vertically ascend to the surface from depth. The vertical ascent of the dikes reduced the amount of faulting in the region. Instead an abundant amount of tension cracks and fissures are found (Kuntz, 2002). Parsons and Thompson (Parsons, 1991) found that in extensional basaltic systems normal faulting can be suppressed when magmatic pressures are greater than the least principle stress. These magmatic pressures push dikes against their walls effectively opposing tectonic stresses. Thus, earthquakes and faulting are limited in areas with vertical dike emplacement, like the ESRP (Parsons, 1991). As dikes migrate to the surface only small to moderate earthquakes (maximum magnitudes of less than 5.5) are associated with their movement (Parsons, 1998; Hackett, 1994; Hackett, 1996). Parsons et al. (Parsons, 1998) estimated the rate of dike emplacement at 10 m (33 ft) (width) per 1,000 years at the estimated strain rate in the ESRP.

3.3.7 Seismic Ha ard Assessment

A site-specific probabilistic seismic hazard assessment (PSHA) was performed for the planned EREF to be sited in Bonneville County, Idaho (Appendix F). Seismic ground motion amplitudes in bedrock were determined for annual frequencies of exceedance ranging from of 10^{-2} to 10^{-5}. Uniform hazard response spectra (UHRS) were determined for top of bedrock for annual frequencies of exceedance of 10^{-3}, 10^{-4}, and 10^{-5}.

The site is situated in a less seismically active region of the ESRP. Introduction and solidification of molten volcanic materials in ESRP fracture zones as they developed in the past are believed to be a possible mechanism responsible for the present low level of seismic activity (Parsons, 1991). Most of the areas to the north, east, and south of the ESRP experience earthquake activity along faults related to regional Basin and Range crustal extension; the ESRP, however, is an area of low present-day seismicity. The PSHA models the site region to be composed of a less seismically active ESRP surrounded by more seismically active Basin and Range provinces and faulted terrain.

Uniform hazard response spectra were determined for the top of basalt bedrock. The uppermost 30.5 m (100.0 ft) of bedrock material is estimated to have a shear wave velocity of approximately 1,400 m/sec (4,700 ft/sec) based on regional geophysical measurements in ESRP bedrock. The EREF site most likely has a bedrock shear wave velocity that is equal to but more likely greater than the National Earthquake Hazards Reduction Program (NEHRP) site condition B-C characterized by a shear wave velocity of 760 m/sec (2,493 ft/sec) in the uppermost 30 m (98 ft) of geologic material. It is noted that USGS 2008 seismic hazard maps are developed for the NEHRP B-C Boundary site condition (Petersen, 2008). Ground motion prediction equations by Spudich et al. (Spudich, 1999) and by Boore and Atkinson (Boore, 2008) were used in this site-specific PSHA to estimate seismic ground motion response spectra in bedrock ranging from the B-C boundary condition to hard bedrock conditions. The selected attenuation models predict seismic ground motion amplitude scaling for earthquakes caused by normal slip on regional faults that is a tectonic characteristic of the intermountain west Basin and Range geologic province within which the site is situated.

The PSHA was performed using a logic-tree format in which a total of 4 seismic source models were convolved with three ground motion prediction models. This method produced 12 combinations of seismic source and ground motion models. The weighed PSHA results for these 12 examined cases are listed below:

Annual Probability of Exceedance	Peak Hori ontal Ground Acceleration	Spectral Acceleration (5 damping ratio)	Peak Pseudo-Relative Velocity (5 damping)
10^{-3}	61.37 cm/sec^2 0.063 g	161.15 cm/sec^2 (5 Hz) 0.164 g	6.96 cm/sec (2.5 Hz)
10^{-4}	147.09 cm/sec^2 0.150 g	373.09 cm/sec^2 (5 Hz) 0.381 g	15.97 cm/sec (2.5 Hz)
10^{-5}	293.61 cm/sec^2 0.299 g	743.50 cm/sec^2 (5 Hz) 0.758 g	33.53 cm/sec (1.0 Hz)

The site-specific PSHA results are below those determined for the 2008 update of the USGS national hazard maps. USGS PGA estimates are 30% higher at 10^{-3} per year and 40% higher at 10^{-5} per year than values shown above determined in the site-specific PSHA. The difference in seismic hazard estimates resulted from the following causes.

- The site-specific PSHA used ground motion models for normal slip fault mechanisms; the USGS used various fault mechanisms, or unspecified fault mechanisms, which predict higher amplitude seismic ground motions.
- The weighted result for the site-specific PSHA includes hazard results for hard rock attenuation models, which leads to lower amplitude seismic ground motions. The USGS 2008 results are for the NEHRP B-C Boundary site condition that is a firm rock condition that results in higher amplitude seismic ground motions relative to hard rock site conditions.
- The site-specific PSHA used a local earthquake frequency model determined for the ESRP; the USGS used a larger background seismicity model for the Basin and Range province and a local cell earthquake activity rate that could exceed the historical earthquake rate (Petersen, 2008).

Refer to Appendix G for documentation that supports these conclusions.

TABLES

Table 3.3-1 INL Stratigraphic Units
(Page 1 of 1)

Eastern Snake River Plain Stratigraphic Units	Composite Unit Number (Anderson, 1996b Anderson, 1997)	Thickness of Deposits (m / ft) (variable by well location)	Number of Basalt Deposits	Number of Sedimentary Deposits	Number of Andesite Deposits	Number of Rhyolite Deposits	Age of Deposits (ka)
Snake River Group	1	0-86.5 / 0-284	78	12	0	0	5-250
	2	0-97.8 / 0-321	18	13	0	1	250-350
	3	0-93.0 / 0-305	17	17	1	0	350-440
	4	0-146.9 / 0-482	9	11	4	0	440-515
	5	0-100.3 / 0-329	3	6	0	0	515-580
	6	0-105.8 / 0-347	5	8	0	1	580-650
	7	0-124.7 / 0-409	7	10	0	0	650-800
Upper part of Idaho Group	8	0-490.4 / 0-1609	11	9	0	0	800-1800
	9		10	4	0	0	
	10		6	4	0	1	
	11		2	3	0	0	
	12		5	2	1	1	
	13		3	3	0	0	
	14		4	1	0	0	
	U	Varies	Multi	Multi	Multi	Multi	1800-4000

Sources: Anderson, 1996b; Anderson, 1997

Table 3.3-2 Site Soil Sample Locations
(Page 1 of 1)

Soil Sample No.	Location Description	Latitude	Longitude
SS1	Northeast corner of site	43 35' 39.7"	112 24' 59"
SS2	Full Tails Cylinder Storage Pad	43 35' 31.7"	112 25' 54"
SS3	Northwest portion of site	43 35' 25.3"	112 26' 48.3"
SS4	West of Cascade Halls	43 35' 17.1"	112 25' 54"
SS5	Cascade Hall	43 35' 10.6"	112 25' 35"
SS6	Between access road, stormwater detention basin and perimeter drainage swale	43 34' 50.7"	112 25' 54"
SS7	South portion of footprint	43 34' 50.5"	112 25' 23"
SS8	West of facility	43 34' 47.6"	112 26' 44.2"
SS9	Down gradient of facility along drainage	43 34' 29.6"	112 25' 35"
SS10	South east portion of site	43 33' 40.7"	112 25' 10.9"

Table 3.3-3 Summary of Soils by Map Unit
(Page 1 of 2)

Map Unit Name	Soil Description	Unified Soil Classification Designation(s)
Pancheri silt loam, 0 to 2 percent slopes	The Pancheri component makes up 85 % of the map unit. Slopes are 0 to 2 %. The parent material consists of loess. Depth to a root restrictive layer is greater than 152 cm (60 in). The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 152 cm (60 in) is moderate. Shrink-swell potential is low. This soil is not flooded and is not ponded. There is no zone of water saturation within a depth of 183 cm (72 in). Organic matter content in the surface horizon is about 2 %.	CL – ML
Pancheri silt loam, 2 to 4 percent slopes	The Pancheri component makes up 85 % of the map unit. Slopes are 2 to 4 %. The parent material consists of loess. Depth to a root restrictive layer is greater than 152 cm (60 in). The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 152 cm (60 in) is moderate. Shrink-swell potential is low. This soil is not flooded and is not ponded. There is no zone of water saturation within a depth of 183 cm (72 in). Organic matter content in the surface horizon is about 2 %.	CL – ML
Pancheri silt loam, 4 to 8 percent slopes	The Pancheri component makes up 85 % of the map unit. Slopes are 4 to 8 %. The parent material consists of loess. Depth to a root restrictive layer is greater than 152 cm (60 in). The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 152 cm (60 in) is moderate. Shrink-swell potential is low. This soil is not flooded and is not ponded. There is no zone of water saturation within a depth of 183 cm (72 in). Organic matter content in the surface horizon is about 2 %.	CL – ML
Pancheri-Rock outcrop complex, 2 to 25 percent slopes	The Pancheri component makes up 70 % of the map unit. Slopes are 2 to 25 %. The parent material consists of loess. Depth to a root restrictive layer is greater than 152 cm (60 in). The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 152 cm (60 in) is moderate. Shrink-swell potential is low. This soil is not flooded and is not ponded. There is no zone of water saturation within a depth of 183 cm (72 in). Organic matter content in the surface horizon is about 2 %.	CL – ML

Table 3.3-3 Summary of Soils by Map Unit
(Page 2 of 2)

Map Unit Name	Soil Description	Unified Soil Classification Designation(s)
Polatis-Rock outcrop complex, 2 to 25 percent slopes	The Polatis component makes up 65 % of the map unit. Slopes are 2 to 25 %. The parent material consists of loess over bedrock derived from basalt. Depth to a root restrictive layer, bedrock, lithic, is 51 to 102 cm (20 to 40 in). The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 152 cm (60 in) is moderate. Shrink-swell potential is low. This soil is not flooded and is not ponded. There is no zone of water saturation within a depth of 183 cm (72 in). Organic matter content in the surface horizon is about 2 %.	CL – ML

Table 3.3-4 Characteristics of Volcanism in the INL Area
(Page 1 of 1)

	CALDERA FORMATION	RIFT- ONE VOLCANISM	A IAL- ONE VOLCANISM	AREAS BETWEEN VOLCANIC ONES
MAGMA TYPES	rhyolite (viscous and gas-rich)	basalt (fluid and gas-poor)	basalt and subordinate rhyolite	basalt (and minor rhyolite)
VOLCANIC STYLE AND PRODUCTS	highly explosive; voluminous pumice and fine ash blankets entire regions	mild & effusive; erupt mainly lava flows from fissures, low shield volcanoes and small tephra cones	as per rift zones, but also local rhyolite domes & intrusions (Big Southern, Middle, East Buttes) with local explosive phenomena	as per volcanic rift zones (VRZs) and axial volcanic zone
STRATIGRAPHY	calderas filled with up to several km (several mi) of welded, silicic ash-flow tuffs, lava flows and volcaniclastic sediment [Heise Volcanics]	piles of 1 to 30m (3.3 to 99 feet) thick basalt lava flows &minor interbedded sediment; total lava thickness up to 1 km (0.6 mile) in INL area [Snake River Group]	basaltic lava flows and dispersed small tephra cones; isolated rhyolite domes and intrusions [Snake River Group]	fine clastic sediment of fluvial, lacustrine and eolian origin; fewer lava flows than near VRZs [Snake River Group]
TECTONICS AND PHYSICAL CONFIGURATION	collapse: broad, oval depressions, 10s to 100 km (10s to 62 miles) wide and 1 to 2 km (0.6 to 1.2 mi) deep, ringed by inward- dipping fractures	extensional: NW- trending belts of open fissures, monoclines small normal faults and basaltic vents	extensional, but magma-induced fissures or, faults are rare; a diffuse, NE-trending, volcanic highland along the ESRP axis	subsidence: broad, low topographic basins between extensional and constructional volcanic highlands; seldom disturbed by magma intrusion
GEOLOGIC AGE	6.5 to 4.3 million yrs in site area, now covered by younger basaltic lava. [2.1 to 0.6 million yrs on Yellowstone Plateau]	Surficial INL basalts: 1.2 to 0.05 million yrs; most are 0.7 to 0.1 million yrs. Inception of major basaltic volcanism was ca. 4 million yrs ago.	Basalt: 1 million yrs (Middle Butte), to 5,400 yrs (Hells Half Acre). Rhyolite: 1 million yrs (near East Butte) to 300,000 yrs (Big Southern Butte)	As per rift zones
QUATERNARY ERUPTION FREQUENCY	zero in Site area; Quaternary calderas closest to INL occur on Yellowstone Plateau	low; one eruption per 35,000 to 125,000 yrs	low: one basaltic eruption per 35,000 yrs one rhyolitic intrusion or dome every 200,000 yrs or longer	very low; by definition less frequent than within rift zones; one eruption per 125,000 yrs or longer

Source: Hackett, 2002.
Note: Refer to Figure 3.3-6 for Map Description of Volcanic Zones and Related Features

Table 3.3-5 Concentrations of Metals, Fluoride, and Moisture Content in Soils (Page 1 of 2)

Analyte	Soil Sample Concentrations (mg/kg)					Detection Limits (mg/kg)
	SS1	SS2	SS3	SS4	SS5	
Arsenic	5.5	7.7	5.5	7.1	6.6	1.3 - 1.8
Barium	160	180	180	200	170	0.50
Cadmium	0.56	0.61	ND	0.69	0.59	0.50
Chromium (III)	21	20	20	25	23	0.50
Lead	15	16	14	18	16	0.60 - 0.81
Selenium	0.26	0.19	0.15	0.17	0.42	0.05
Silver	ND (0.8)	ND (0.5)	ND (0.6)	0.7	ND (0.7)	0.5 - 0.8
Total Mercury	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.05
Soluble Fluoride	12	ND (5)	ND (5)	ND (5)	10	5
Percent Moisture (%)	15.9	12.2	9.1	12.2	15.7	0.1

ND (0.8) = Not Detected (parenthetical numbers denote the sample specific detection limit for which the result was less)

Table 3.3-5 Concentrations of Metals, Fluoride, and Moisture Content in Soils (Page 2 of 2)

Analyte	Soil Sample Concentrations (mg/kg)					Detection Limits (mg/kg)
	SS6	SS7	SS8	SS9	SS10	
Arsenic	7.3	6.7	7.1	6.9	6.5	1.3 - 1.8
Barium	170	200	170	170	190	0.50
Cadmium	0.58	0.74	0.57	0.6	0.55	0.50
Chromium (III)	21	23	21	22	25	0.50
Lead	16	17	16	16	18	0.60 - 0.81
Selenium	0.2	0.15	0.16	0.16	0.13	0.05
Silver	ND (0.6)	ND (0.6)	0.7	ND (0.6)	ND (0.5)	0.5 - 0.8
Total Mercury	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.05
Soluble Fluoride	ND (5)	10	ND (5)	ND (5)	ND (5)	5
Percent Moisture (%)	11.1	15.7	11.8	16.5	10.5	0.1

ND (0.8) = Not Detected (parenthetical numbers denote the sample specific detection limit for which the result was less)