1. INTRODUCTION

This report provides an introduction to the U.S. Department of Energy’s (DOE) Idaho National Laboratory (INL) Site, discusses INL Site missions, and highlights the INL Site’s various environmental-related programs. Included are sections discussing INL Site compliance with local, state, and federal environmental laws and regulations; INL Site operations including environmental restoration, waste management, and footprint reduction activities; effluent and emissions from INL Site facilities; onsite and offsite environmental monitoring activities; radiological doses to public and biota; and ecological research activities at the INL Site. The report describes the INL Site’s impact to the public and the environment, particularly with regard to radioactive contaminants. It is prepared annually in compliance with DOE Orders 231.1A, 450.1, and 5400.5.

1.1 Idaho National Laboratory Site Primary Program Missions and Facilities

The INL Site mission is to operate a multi-program national research and development laboratory and to complete environmental cleanup project activities stemming from past operations. U.S. Department of Energy - Idaho Operations Office (DOE-ID) receives implementing direction and guidance primarily from two DOE Headquarters offices, the Office of Nuclear Energy (NE) and the Office of Environmental Management (EM). NE is the Lead Program Secretarial Office for all DOE-ID managed operations on the INL Site, while EM provides direction and guidance to DOE-ID for environmental cleanup operations on the INL Site and functions in the capacity of Cognizant Secretarial Office. Naval Reactors operations on the INL Site report to the Pittsburgh Naval Reactors Office and so fall outside the purview of DOE-ID.

Idaho National Laboratory

The INL mission is to ensure the nation’s energy security with safe, competitive and sustainable energy systems, and unique national and homeland security capabilities. Its vision is to be the
preeminent nuclear energy laboratory, with synergistic, world-class, multi-program capabilities and partnerships. To fulfill its assigned duties during the next decade, INL will work to transform itself into a laboratory leader in nuclear energy and homeland security research, development, and demonstration. Highlighting this transformation will be the development of a Generation IV prototype reactor, creation of national user facilities, development of high-temperature hydrogen production, advanced fuel cycle research, expansion of the Center for Advanced Energy Studies (CAES), and proven leadership in nonproliferation and critical infrastructure protection. The management and operation responsibility for the INL belongs to Battelle Energy Alliance (BEA).

Idaho Cleanup Project
The Idaho Cleanup Project (ICP) involves the safe environmental cleanup of the DOE’s INL Site, which was contaminated with waste generated during World War II-era conventional weapons testing, government-owned research and defense reactors, laboratory research, fuel reprocessing, and defense missions at other DOE sites. The 7-year, $2.9 billion cleanup project, led by CH2M-WG Idaho (CWI) and funded through the EM, focuses equally on meeting Idaho Settlement Agreement and environmental cleanup milestones while reducing risks to workers. Protection of the Snake River Plain Aquifer, the sole drinking water source for more than 300,000 residents of eastern Idaho, was the principal concern addressed in the Settlement Agreement.

CWI will treat a million gallons of sodium-bearing waste, remove targeted transuranic waste from the Subsurface Disposal Area (SDA), place spent nuclear fuel in dry storage, select a treatment for high-level waste calcine, and demolish more than 200 structures including reactors, spent nuclear fuel storage basins, and labs used for radioactive experiments.

Advanced Mixed Waste Treatment Project (AMWTP)
The AMWTP Facility is a cornerstone of DOE’s commitment to prepare and ship contact-handled transuranic waste out of Idaho. AMWTP is managed and operated by Bechtel BWXT Idaho.

Operations at AMWTP require the retrieval, characterization, treatment, and packaging of transuranic waste currently stored at the DOE’s Idaho Site. The project’s schedule is aligned with court-mandated milestones in a 1995 Settlement Agreement among the state of Idaho, the U.S. Navy, and DOE to remove the waste from Idaho. The vast majority of the waste AMWTP processes resulted from the manufacture of nuclear weapons components at Colorado’s Rocky Flats Plant. Shipped to Idaho in the 1970s and early 1980s for storage, the waste contains industrial debris such as rags, work clothing, machine parts and tools, as well as soil and sludge, and is contaminated with transuranic radioactive elements (primarily plutonium). Most of the waste is “mixed waste” that is contaminated with radioactive and nonradioactive hazardous chemicals such as oil and solvents. Since 1999, more than 21,000 cubic meters of waste historically managed as transuranic have been shipped offsite.

Primary INL Site Facilities
The INL Site is a 2305 km² (890 mi²) area located in southeastern Idaho. The INL Site consists of several facility areas situated on an expanse of otherwise undeveloped, cool desert terrain (Figure 1-1). Most buildings and structures at the INL Site occur within those developed site areas, which
Figure 1-1. Location of the INL Site, showing Facilities.
are typically less than a few square miles in size and separated from each other by miles of primarily undeveloped land. DOE controls all land within the INL Site. In addition to the INL Site, DOE owns or leases laboratories and administrative offices in the city of Idaho Falls, 40 km (25 mi) east of the INL Site border.

**Central Facilities Area (CFA)** - CFA is the main service and support center for INL’s desert facilities. Activities here support transportation, maintenance, construction, environmental and radiological monitoring, security, fire protection, warehouses and calibration activities. CFA is operated by BEA.

**Critical Infrastructure Test Range Complex (CITRC)** - CITRC encompasses a collection of specialized test beds and training complexes that create a centralized location where government agencies, utility companies, and military customers can work together to find solutions for many of the nation’s most pressing security issues. The Test Range provides open landscape, technical employees, and specialized facilities for performing work in three main areas: Physical Security, Contraband Detection, and Infrastructure Testing. CITRC is operated by BEA.

**Idaho Nuclear Technology and Engineering Center (INTEC)** - The Idaho Chemical Processing Plant was established in the 1950s to recover usable uranium from spent nuclear fuel used in DOE and Department of Defense reactors. Over the years, the facility recovered more than $1 billion worth of highly enriched uranium, which was returned to the government fuel cycle. In addition, an innovative high-level liquid waste treatment process known as calcining was developed at the plant. Calcination reduced the volume of liquid radioactive waste generated during reprocessing and placed it in a more-stable granular solid form. The facility underwent an ambitious modernization during the 1980s, when safer, cleaner, and more efficient structures were built to replace most major facilities. In 1992, the DOE announced that the changing world political situation and the lack of demand for highly enriched uranium made reprocessing no longer necessary. In 1998, the plant was renamed the Idaho Nuclear Technology and Engineering Center. Current operations at INTEC include management of sodium-bearing waste, special nuclear material disposition, spent nuclear fuel storage, nuclear material disposition, environmental remediation, and demolition of excess facilities. INTEC is operated by CWI.

**Materials and Fuels Complex (MFC)** - The MFC (formerly Argonne National Laboratory-West) is a prime testing center for advanced technologies associated with nuclear power systems. This complex is the nexus of research and development for new reactor fuels and related materials. As such, it will contribute increasingly efficient reactor fuels and the important work of nonproliferation – harnessing more energy with less risk. Facilities at MFC also support manufacturing and assembling components for use in space applications. MFC is operated by BEA.

**Naval Reactors Facility (NRF)** - The NRF is operated for Naval Reactors by Bechtel Bettis, Inc. Developmental nuclear fuel material samples, naval spent fuel, and irradiated reactor plant components/materials are examined at the Expended Core Facility (ECF). The knowledge gained from these examinations is used to improve current reactor designs and to monitor the performance of existing reactors. The naval spent fuel examined at ECF is critical to the design of longer-lived
cores, which minimizes the creation of spent nuclear fuel requiring long-term disposition. NRF is also preparing the current inventory of naval fuel for dry storage and eventual transportation to a repository.

NRF is excluded from this report. As established in Executive Order 12344 (FR 1982), the Naval Nuclear Propulsion Program is exempt from the requirements of DOE Orders 414.1c, 450.1, and 5400.5. The director, Naval Nuclear Propulsion Program, establishes reporting requirements and methods implemented within the program, including those necessary to comply with appropriate environmental laws. NRF’s program is documented in the NRF Environmental Monitoring Report (BBI 2007).

**Radioactive Waste Management Complex (RWMC)** - Since the 1950s, the DOE has used the RWMC to manage, store, and dispose of waste contaminated with radioactive elements generated in national defense and research programs. The RWMC manages solid transuranic and low-level radioactive waste. The facility supports research projects dealing with waste retrieval and processing technology and provides temporary storage and treatment of transuranic waste destined for the Waste Isolation Pilot Plant (WIPP). Management of stored wastes at the RWMC is the responsibility of Bechtel BWXT Idaho (BBWI). During 2007, BBWI successfully maintained regular processed transuranic waste shipments to WIPP, totaling over 20,000 cubic meters since the start of the project.

**The Subsurface Disposal Area (SDA)** is a 39-ha (97-acre) radioactive waste landfill that is the major focus for remedial decisions at the RWMC. The landfill has been used for more than 50 years. Approximately 14 of the 39-ha contain waste from historical operations, including weapons production and reactor research. This waste includes radioactive elements, organic solvents, acids, nitrates, and metals. Organic solvents are now found in the aquifer beneath the SDA. Most of the waste that would be considered transuranic by today’s standards was received from the Rocky Flats Plant in Colorado prior to 1970 and buried at the SDA. Although transuranics do not threaten the aquifer, they could one day pose a threat through exposure at the surface if no action is taken.

DOE is developing a Record of Decision (ROD) in coordination with U.S. Environmental Protection Agency and the state of Idaho for comprehensive remediation activities within the SDA. The ROD will be available to the public when it is final and signed by the three agencies. Synchronous with the finalization of the ROD, DOE is operating a series of non-time-critical removal actions to perform limited excavation and retrieval of selected waste streams from a designated portion of the SDA. These projects, referred to as the Accelerated Retrieval Projects, were evaluated in Engineering Evaluation/Cost Analyses, which were released for public review. The focused objective of the non-time-critical removal actions is to perform a targeted retrieval of certain Rocky Flats Plant waste streams that are highly contaminated with transuranic radionuclides, solvent waste, and various isotopes of uranium. Pursuit of the non-time-critical removal actions in advance of actions implemented under the Operable Unit 7-13/14 ROD is maintaining an uninterrupted targeted waste retrieval schedule as was outlined in the Proposed Plan for Radioactive Waste Management Complex Operable Unit 7-13/14.
In addition, in 2007 buildings and equipment at Pit 9 of the SDA were dismantled and disposed to make way for future remediation of the SDA. The buildings, which were constructed by Lockheed Martin Advanced Environmental Systems (LMAES) during the mid-1990s, were left in place when LMAES’ contract was terminated in 1998. Cleanup of the RWMC is managed by CWI.

**Reactor Technology Complex (RTC)** - RTC was established in the early 1950s and has been the site for operation of three major test reactors: the Materials Test Reactor (1952-1970), the Engineering Test Reactor (1957-1982), and the Advanced Test Reactor (1967-present). The current primary mission at RTC is operation of the Advanced Test Reactor, the world’s premier test reactor, which is used to study the effects of radiation on materials. This reactor also produces rare and valuable medical and industrial isotopes. The complex also features the Advanced Test Reactor – Critical Facility; Hot Cell Facility; Radiation Measurements Laboratory; Radiochemistry Laboratory; and the Safety and Tritium Applied Research Facility – a national fusion safety user facility. RTC will be the focal point for designing, testing and proving the new technologies of the nuclear renaissance. RTC is operated by BEA.

**Science and Technology Campus** - The Research and Education Campus, operated by BEA, is the collective name for INL’s administrative, technical support, and computer facilities in Idaho Falls, as well as the in-town laboratories where researchers work on a wide variety of advanced scientific research and development projects. The name of this cadre of facilities indicates both basic science research and the engineering that translates new knowledge into products and processes that improve our quality of life. This reflects the emphasis INL is placing on strengthening its science base and increasing the commercial success of its products and processes. New laboratory facilities and a new building for the CAES are under development within this campus environment. The CAES facility is designed to promote education and world-class research and development. Other facilities proposed over the next 10 years include a national security building, a visitor’s center, visitor housing, and a parking structure—all in close proximity to current campus buildings. Facilities already in place and those planned for the future are integral for transforming INL into a renowned research laboratory.

**Test Area North (TAN)** – TAN was established in the 1950s to support the government’s Aircraft Nuclear Propulsion program. The goal was to build and fly a nuclear-powered airplane. When President Kennedy cancelled the nuclear propulsion program in 1961, TAN began to host a variety of other activities. The Loss of Fluid Test (LOFT) reactor became part of the new mission. LOFT, constructed between 1965 and 1975, was a scaled-down version of a commercial pressurized water reactor. Its design allowed engineers, scientists and operators to create or recreate loss-of-fluid accidents (reactor fuel meltdowns) under very controlled conditions. The LOFT dome provided containment for a relatively small, mobile test reactor that was moved in and out of the facility on a railroad car. The Nuclear Regulatory Commission received the results from these accident tests and incorporated the data into commercial reactor operating codes. The facility conducted 38 experiments, including several small loss-of-coolant experiments designed to simulate the type of accident that occurred at Three Mile Island in Pennsylvania, before the LOFT facility was closed.

TAN also housed the Three Mile Island (TMI) Unit 2 Core Offsite Examination Program that ended in 1990. Shipment of TMI-2 core samples to the INL Site began in 1985 to study and obtain technical
data necessary to understand the sequential events tied to the TMI-2 reactor accident. INL scientists also used the core samples to develop a database that predicts how nuclear fuel will behave when a reactor core degrades. Currently, the TAN facilities support one project. The Specific Manufacturing Capability Project, operated for the U.S. Department of Defense by BEA, manufactures protective armor for the U.S. Army M1-A1 and M1-A2 Abrams tanks. TAN personnel have completed cleanup of environmental contamination from previous operations. The TAN decommissioning process is complete. The project involved the demolition of the LOFT reactor building, the TAN Hot Shop, hot cells, spent nuclear fuel storage pool, high bay facility, and decontamination shop. The cleanup mission at TAN is performed by CWI.

1.2 Physical Setting of the INL Site

The INL Site is located in a large, relatively undisturbed expanse of sagebrush steppe habitat. Approximately 94 percent of the land on the INL Site is open and undeveloped. The INL Site has an average elevation of 1500 m (4900 ft) above sea level and is bordered on the north and west by mountain ranges and on the south by volcanic buttes and open plain. Lands immediately adjacent to the INL Site are open rangeland, foothills, or agricultural fields. Agricultural activity is concentrated in areas northeast of the INL Site. Approximately 60 percent of the INL Site is open to livestock grazing.

The climate of the high desert environment of the INL Site is characterized by sparse precipitation (less than 22.8 cm/year [9 in./year]), warm summers (average daily temperature of 15.7°C [60.3°F]), and cold winters (average daily temperature of -5.2°C [22.6°F]) (DOE-ID 1989). The altitude, intermountain setting, and latitude of the INL Site combine to produce a semiarid climate. Prevailing weather patterns are from the southwest, moving up the Snake River Plain (SRP). Air masses, which gather moisture over the Pacific Ocean, traverse several hundred miles of mountainous terrain before reaching southeastern Idaho. Frequently, the result is dry air and little cloud cover. Solar heating can be intense with extreme day-to-night temperature fluctuations.

Basalt flows, which produce a rolling topography, cover most of the plain. Vegetation is visually dominated by big sagebrush (*Artemisia tridentata*). Beneath these shrubs are grasses and flowering plants, most adapted to the harsh climate. A recent inventory counted 409 plant species on the INL Site (Anderson et al. 1996). Vertebrate animals found on the INL Site include small burrowing mammals, snakes, birds, and several game species. Published species counts include six fishes, one amphibian, nine reptiles, 164 birds, and 39 mammals (Reynolds et al. 1986).

The Big Lost River on the INL Site flows toward the northeast, ending in a playa area, called the Big Lost River Sinks, on the northwest portion of the Site. Here it evaporates or infiltrates into the subsurface with no surface water moving offsite. The fractured volcanic rocks under the INL Site, however, form a portion of the Eastern Snake River Plain Aquifer (ESRPA), which stretches 267 km (165 mi) from St. Anthony to Bliss, Idaho, and stores one of the most bountiful supplies of groundwater in the nation. An estimated 80 to 120 million ha-ft (200 to 300 million acre-ft) of water is stored in the aquifer’s upper portions. The aquifer is primarily recharged from waters of the Henry’s Fork and the South Fork of the Snake River, as well as the Big Lost River, the Little Lost River, Birch Creek, and irrigation. Beneath the INL Site, the aquifer moves laterally to the southwest at a rate of
1.5 to 6 m/day (5 to 20 ft/day) (Lindholm 1996). The ESRPA emerges in springs along the Snake River between Milner and Bliss, Idaho. The primary use of both surface water and groundwater on the SRP is crop irrigation.

1.3 History of the INL

The geologic events that have shaped the modern SRP took place during the last 2 million years (Ma) (Lindholm 1996, ESRF 1996). The plain, which arcs across southern Idaho to Yellowstone National Park, marks the passage of the earth’s crust over a plume of melted mantle material.

The volcanic history of the Yellowstone-Snake River Plain (YSRP) volcanic field is based on the time-progressive volcanic origin of this region that is characterized by several large calderas in the eastern SRP with dimensions similar to those of Yellowstone’s three giant Pleistocene calderas. These volcanic centers are located within the topographic depression that encompasses the Snake River drainage. Over the last 16 Ma, there was a series of giant, caldera-forming eruptions, with the most recent at Yellowstone National Park 630,000 years ago. The youngest silicic volcanic centers correspond to the Yellowstone volcanic field that are less than 2.0 Ma and are followed by a sequence of silicic centers at about 6 Ma, southwest of Yellowstone. A third group, near ~10 Ma, is centered near Pocatello, Idaho. The oldest mapped silicic rocks of the SRP are ~16 Ma, and are distributed across a 150 km-wide (93 mi-wide) zone in southwestern Idaho and northern Nevada, the suspected origin of the YSRP (from Smith and Siegal, 2000).

Humans first appeared on the upper SRP approximately 11,000 years ago. Tools recovered from this period indicate these earliest human inhabitants were almost certainly hunters of large game. The ancestors of the present-day Shoshone and Bannock people came north from the Great Basin around 4500 years ago (ESRF 1996).

The earliest exploratory visits by European descendants came between 1810 and 1840. Trappers and fur traders were some of the first to make their way across the plain seeking new supplies of beavers for pelts. Between 1840 (by which time the fur trade was essentially over) and 1857, an estimated 240,000 immigrants passed through southern Idaho on the Oregon Trail. By 1868, treaties had been signed forcing the native populations onto the reservation at Fort Hall. During the 1870s, miners entered the surrounding mountain ranges, followed by ranchers grazing cattle and sheep in the valleys.

A railroad was opened between Blackfoot and Arco, Idaho, in 1901. By this time, a series of acts (the Homestead Act of 1862, the Desert Claim Act of 1877, the Carey Act of 1894, and the Reclamation Act of 1902) provided sufficient incentive for homesteaders to attempt building diversionary canals to claim the desert. Most of these canal efforts failed because of the extreme porosity of the gravelly soils and underlying basalts.

During World War II, large guns from U.S. Navy warships were retooled at the U.S. Naval Ordnance Station in Pocatello, Idaho. These guns needed to be tested, and the nearby uninhabited plain was put to use as a gunnery range, then known as the Naval Proving Ground. The U.S. Army Air Corps
also trained bomber crews out of the Pocatello Airbase and used the area as a bombing range. After the war ended, the nation turned to peaceful uses of atomic power. The DOE’s predecessor, the U.S. Atomic Energy Commission (AEC), needed an isolated location with an ample groundwater supply on which to build and test nuclear power reactors. The relatively isolated SRP was chosen as the best location. Thus, the Naval Proving Ground became the National Reactor Testing Station (NRTS) in 1949.

By the end of 1951, EBR-I became the first reactor to produce useful electricity. In 1955, the BORAX-III reactor provided electricity to Arco, Idaho – the first time a nuclear reactor powered an entire community in the U.S. The laboratory developed prototype nuclear propulsion plants for Navy submarines and aircraft carriers. Over time, the Site evolved into an assembly of 52 reactors, associated research centers, and waste handling areas. The NRTS was renamed the Idaho National Engineering Laboratory in 1974 and Idaho National Engineering and Environmental Laboratory (INEEL) in 1997 to reflect the Site’s leadership role in environmental management. The AEC was renamed the U.S. Energy Research and Development Administration in 1975 and reorganized to the present-day DOE in 1977.

With renewed interest in nuclear power the DOE announced in 2003 that Argonne National Laboratory-West (ANL-W) and the INEEL would be the lead laboratories for development of the next generation of power reactors. On February 1, 2005, the INEEL and ANL-W became the INL. The INL is committed to providing international nuclear leadership for the 21st Century, developing and demonstrating compelling national security technologies, and delivering excellence in science and technology as one of the DOE’s multi-program national laboratories.

1.4 Regional Impact

In 2006, Boise State University’s (BSU) College of Business and Economics evaluated the effects on the Idaho economy of all cleanup, research and administrative operations at the INL Site (Black et al. 2006). The Impacts 2006 report details the results of this latest comprehensive research and demonstrates to stakeholders the significant and positive effects INL Site operations have on the region immediately surrounding its facilities, as well as on the entire state.

The report provides an analysis of three dimensions of the lab’s contributions to the state and region. The first is INL’s impact on employment, personal income and total output for the state. Second, the report assesses the impacts of the lab and its employees on state and local tax revenues. Third, the study examines the effects of INL Site employees’ charitable contributions, educational outreach, and volunteer activities on the surrounding communities and the state. The report measures direct, secondary, and tertiary impacts of INL’s operations.

Major findings of Impacts 2006 include:

- The INL Site, when considered as a whole, is the third-largest employer in Idaho, with 8452 employees, ranking behind only Micron and state government. When secondary and tertiary impacts on employment are analyzed, INL operations annually account for 19,860 jobs in Idaho.
Wages and salaries to INL Site employees account for more than 2.5 percent of personal income in Idaho with direct and secondary effects on personal income amounting to $1.108 billion annually.

Fiscal impacts of Idaho state tax revenues by the INL Site and its employees approach $85 million or nearly three percent of all tax revenues received by the state.

These direct tax payments to the state of Idaho by INL employers and their workers exceed the cost of state-provided services by a broad margin.

Annual property tax payments by INL employees approach $23 million.

The INL Site provides $3.4 million to Idaho colleges and universities for continuing education of its employees.

The research for Impacts 2006 was performed by three highly respected BSU economists - Dr. Geoffrey Black, chair of the Economics Department; Dr. Don Holley, former corporate economic forecaster and analyst and now a visiting professor; and John Church, former corporate economist and now special lecturer in the Economics Department and a member of the Western Blue Chip Forecast Panel (Black et al. 2006).

In their summary comments, the researchers conclude, “Whether improving quality of life through the development and commercialization of cutting-edge technologies, reducing risks through accelerated environmental cleanup, providing much-needed tax revenues, or stabilizing and strengthening Idaho’s economy by its mere presence, INL’s overall impacts on Idaho are unquestionably significant.”

REFERENCES


Environmental Science and Research Foundation (ESRF), 1996, “The Site, the Plain, the Aquifer, and the Magic Valley (Part One of Four),” Foundation Focus, Volume 3, Issue 3, October.


