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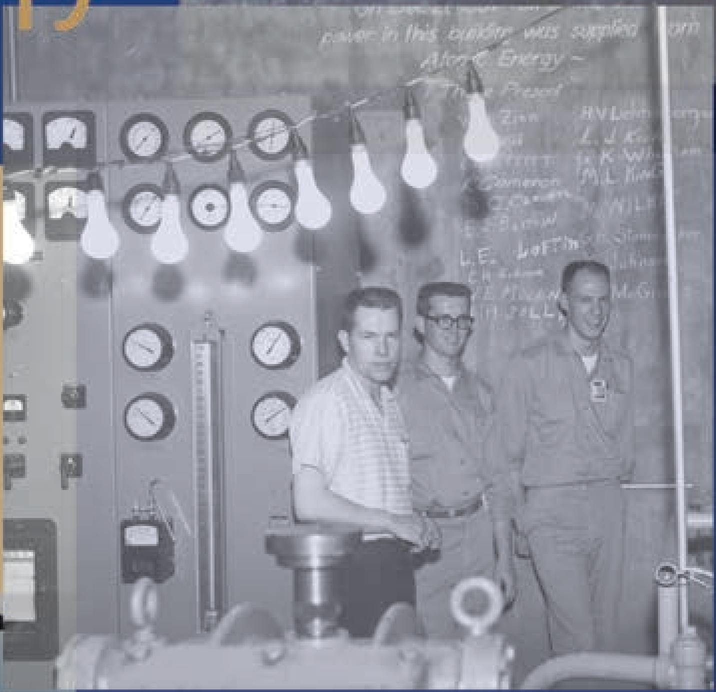
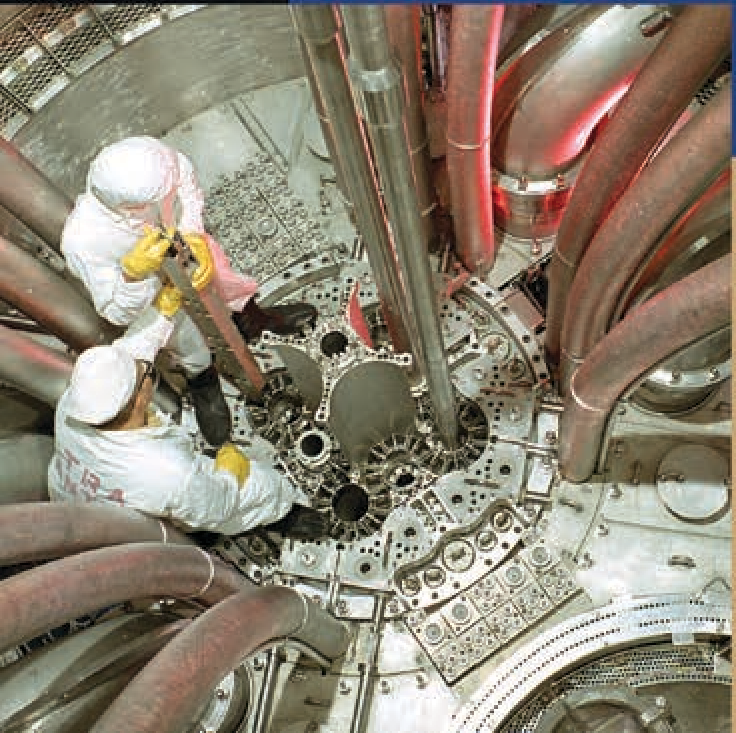
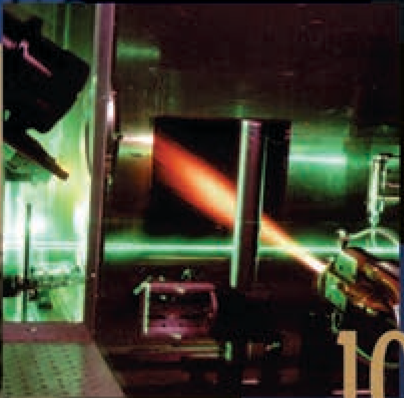


PROVING *the* PRINCIPLE

A History of the Idaho National Engineering and Environmental Laboratory 1949-1999

by Susan M. Stacy





1999

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by Susan M. Stacy

Idaho Operations Office of the Department of Energy
Idaho Falls, Idaho
DOE/ID-10799

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Dedication

To the pioneers of the NRTS who were part of the nuclear science adventure, and to the employees of the INEEL who continue the adventure of science.

Proving the Principle

2024 Foreword

Susan M. Stacy's "Proving the Principle" offered an impeccably sourced and masterfully written history of Idaho National Laboratory's first 50 years when it was published in 1999. Twenty-five years later, it remains invaluable to those seeking to learn about the U.S. Atomic Energy Commission, its National Reactor Testing Station (NRTS) in Idaho, and the men and women who accomplished so much working there.

Anniversaries can be tricky, however. When "Proving the Principle" came out, nuclear energy research in the United States, the original NRTS mission, was at a low ebb. Only three of the reactors at the newly renamed Idaho National Engineering and Environmental Laboratory (INEEL) were still in operation. (Over its entire history, INL has been home to 52 reactors. At its peak, in the early '60s, just over 25 were operating at the same time.) These were the Advanced Test Reactor (ATR), Advanced Test Reactor Critical (ATRC), and the Neutron Radiography Reactor (NRAD). Experimental Breeder Reactor-II (EBR-II), the "jewel in the crown" of Argonne National Laboratory-West (ANL-West), had been shut down in 1994, while the neighboring Transient Reactor Test Facility (TREAT) was on standby. To most people, cleanup appeared to be about the only work left to do.

Environmental issues surrounding spent fuel, buried waste from other U.S. Department of Energy (DOE) sites, and stored reprocessing wastes had been addressed, first in the 1991 Federal Facility Agreement and Consent Order and four years later in the 1995 Idaho Settlement Agreement between DOE, the U.S. Navy, and the state of Idaho. The Idaho Settlement Agreement established firm deadlines, with fines and other remedies for noncompliance. In 1996 it survived a ballot initiative to void it, with 62.5% of Idaho voters agreeing to keep it in place.

But while the cleanup goals were laid out clearly enough, how was the lab itself going to survive? What would happen to eastern Idaho's economy if it went away? These questions weighed on the minds of state and community leaders.

Today, we can spot things that were happening at the time that eventually transformed and diversified the lab in unexpected ways while returning it to its NRTS roots. But that was no sure thing in 1999.

A Nuclear Reprieve

Although many people were eager to write off nuclear energy, by the late 1990s the rising alarm over greenhouse gas emissions and climate change had become impossible to ignore. In fact, carbon reduction was a main reason for DOE's Nuclear Energy Research Initiative program. Under its auspices, INEEL, Oregon State University, and Nexant, an engineering subsidiary of Bechtel, received funding for a project called the Multi-Application Small Light Water Reactor. That project evolved into NuScale Power, one of many companies now working with governments and organizations around the world to bring small modular reactor technology to the global energy market.

The Naval Reactors Facility (NRF) located on the INL Site also celebrates its 75th anniversary in 2024. The missions of INL and NRF have been intertwined since 1949. The Naval Nuclear Propulsion Program, a joint U.S. Navy and U.S. Department of Energy organization, is responsible for all aspects of the U.S. Navy's nuclear propulsion, including research, design, construction, testing, operation, maintenance, and ultimate disposition of naval nuclear propulsion plants. Over the last 25 years, NRF facilities and infrastructure have been and continue to be upgraded to support NRF's ongoing role in supporting the Navy's nuclear-powered fleet.

In fact, one reason INL has been able to provide continued support to the nation's commercial nuclear power plant fleet, which in 2022 supplied the United States with roughly 55% of its carbon-free electricity, has been because of the work it has done at ATR for the Naval Propulsion Program. The high-flux fuel and materials testing conducted there has provided a major boost to continued improvements and efficiencies seen in the commercial sector. While the Navy continues to be ATR's primary customer, its capabilities have been extended to academic and industrial researchers since 2007, when the reactor was designated a National Scientific User Facility.

Another major development came in late 2017 with the restart of TREAT. The facility's authorization and licensing were particularly remarkable for the fact that they were completely rewritten in 18 months, an accomplishment that hadn't been seen in the nuclear industry since the start of the Atomic Age. The DOE Idaho Operations Office and INL's success in authorizing TREAT is one reason INL has become the center for new reactor construction and development.

TREAT's ability to subject experimental fuel and material test samples to extreme conditions for fractions of a second plays a vital role in the nuclear industry's effort to develop fuels that last longer in normal conditions and hold up better under unexpected stress. In fact, INL has played a key role in testing new fuels and materials, including accident tolerant fuels and Tri-structural ISOtropic particle (TRISO) fuel, which consists of uranium, carbon, and oxygen pellets coated with carbon- and ceramic-based materials to prevent the release of radioactive fission products.

The Materials and Fuels Complex (MFC) is now DOE's prime testing center for advanced technologies associated with new reactor fuels and materials. It hosts the core of U.S. nuclear research and development with an array of facilities designed for remote work on highly irradiated fuels and materials. At MFC, a new fuel idea can be fabricated, tested, and thoroughly examined. For post-irradiation examination, MFC's Hot Fuel Examination Facility, Irradiated Materials Characterization Laboratory, and Analytical Laboratory offer state-of-the-art capabilities that aren't available elsewhere. In 2025, the new Sample Preparation Laboratory will elevate these capabilities further. In addition, to reduce barriers for developers bringing new reactors to market, DOE and INL are investing to repurpose the Zero Power Physics Reactor (ZPPR), the EBR-II containment building (the "dome"), and space inside the TREAT building as reactor test beds at MFC for demonstration and concept testing of new reactor designs.

Since 2003, INL researchers and engineers have participated in four missions for NASA, starting with the radioisotope heater units that powered the Spirit and Opportunity rovers during the 2003 Mars Exploration Rover mission. In 2006, NASA launched the Pluto New Horizons spacecraft equipped with a radioisotope power system (RPS) assembled at MFC. Eight years after passing Pluto in 2015, that system is still generating electricity and heat for the craft as it explores the Kuiper Belt at the edge of the solar system. An RPS assembled and tested at INL left Earth in 2011 aboard NASA's Curiosity rover, and in 2020 INL delivered another unit for Perseverance, which touched down on the Red Planet in February 2021. In addition to assembling power systems, INL is also performing irradiations in the ATR to help rebuild domestic supplies of plutonium-238 for future NASA missions. At TREAT, researchers have performed tests to determine if fuels proposed for space propulsion can endure the extreme heat and pressure that exist in a nuclear thermal rocket.

Halfway through its second half-century, INL has returned to prominence as the nation's test bed for advanced reactor research. The expansion of fuels and materials fabrication and testing capabilities has already begun to hit significant milestones. In early 2023, researchers at INL's Experimental Fuels Facility fabricated roughly two dozen pellets of high-assay low-enriched uranium (HALEU). In conventional light water reactors, HALEU offers longer cycle times, less downtime for refueling, and less waste production. Demonstrating a capability to fabricate commercial quality, HALEU provides options for industry and other government agencies to make fuel samples that cover a wider range of enrichment without impacting existing operating licenses. Later in 2023, INL researchers used NRAD to synthesize and irradiate a molten chloride salt fueled with enriched uranium. This experiment was the first of its kind since the Molten Salt Reactor Experiment at Oak Ridge National Laboratory in the 1960s. It will provide essential data for understanding how fueled molten chloride salt coolants will perform in advanced reactor cores.

By the end of 2025, INL anticipates operating the Microreactor Applications Research Validation and Evaluation Project (MARVEL). Like Experimental Breeder Reactor I, which first produced electricity in 1951, the 85-kilowatt-thermal MARVEL reactor will be cooled by a sodium-potassium alloy. It will be the first new fission reactor at INL in more than 50 years, but presumably not the last. INL is also working with the Department of Defense on Project Pele, a prototype mobile nuclear reactor using TRISO fuel. On the commercial side, INL assists such companies as TerraPower, Oklo, and X-Energy, all of which are taking decades-old principles originally proven at Atomic Energy Commission labs and adapting them to 21st century realities and demands.

Separation of Missions

Organizationally, the most significant event at the DOE's Idaho site in the last 25 years was the separation of research from cleanup work. On April 30, 2003, Energy Secretary Spencer Abraham announced that DOE intended to divide activities at INEEL into two contracts. The first would be for the Idaho Cleanup Project (ICP) and the second for the management of a new Idaho National Laboratory, which would combine INEEL's research activities with ANL-West's. Under the plan, INL was to be the lead laboratory for DOE's nuclear energy R&D activities and the only national laboratory owned by DOE's Office of Nuclear Energy.

The decision to divide research from cleanup work came after – and possibly in reaction to – what might have been the lab's greatest moment of peril. In its blueprint for fiscal year 2003, the Office of Management and Budget had included this statement: "Even though (INEEL) receives substantial earmarked funding through the EM Office of Science and Technology, it is unable to complete projects on time and within budget. The Administration proposes accelerating the completion date from the current date of 2050 and closing the lab."

Although the merger of INEEL and ANL-West into INL included the sort of issues that typically arise when two organizations with widely different cultures are wedded, for budgetary and planning purposes the new INL/ICP arrangement made things much easier for all parties, including members of Congress in charge of appropriations. Today, Battelle Energy Alliance continues to run INL while the Idaho Environmental Coalition (IEC), an integrated team of small business subcontractors headed by Jacobs Engineering Group, holds a 10-year, $6.4 billion cleanup contract funded through DOE's Office of Environmental Management (DOE-EM).

Laying to rest old questions surrounding the disposition of spent fuel and buried waste, a DOE-EM report released in late 2022 characterized the work at the Radioactive Waste Management Complex as a tremendous success in processing nearly 62,000 cubic meters of on-site legacy waste. Earlier that year, and 18 months ahead of schedule, cleanup crews exhumed the last "targeted" radioactive and hazardous wastes from 5.69 acres of the 97-acre Subsurface Disposal Area. Demolition of seven steel-framed, fabric-sided buildings used in the project resumed in late 2022, with the contractor setting a December 2024 deadline to remove all structures. Once the structures are gone, the final remediation plan calls for an earthen cover of roughly 130 acres involving an estimated 250,000 dump truck loads of soil and rocks. Shipments of the exhumed transuranic wastes to the Waste Isolation Pilot Plant in New Mexico are scheduled to continue for several years.

Since the original publication of "Proving the Principle," the question of what to do with 900,000 gallons of liquid sodium-bearing radioactive waste at the Idaho Nuclear Technology and Engineering Center (INTEC) has been addressed. A holdover from INTEC's decades of reprocessing spent nuclear fuel, the waste is being treated at the Integrated Waste Treatment Unit (IWTU), a 53,000-square-foot facility that uses a steam reforming process. Although steam reforming is used widely in the chemical and petrochemical industries, its application to sodium-bearing liquid waste is unique. In April 2023, after years of modifications to the plant and tests involving simulants and blends of simulant and actual tank farm waste, IWTU crews began treating sodium-bearing waste. In its first five months, the plant converted 68,000 gallons to a more stable granular solid, to be stored in stainless steel canisters inside concrete vaults as it awaits final disposal. Factoring in outages necessary for regular plant maintenance, the process is expected to take three to seven years.

The years between 2001 and 2010 saw the removal of several legacy reactors and a 1-million-pound hot cell at the ATR Complex. Demolition projects throughout the site included the Materials Test Reactor (first operated in 1952), the Engineering Test Reactor (1957), EBR-II (1963), the Zero Power Physics Reactor (1969), the Power Burst Facility Reactor (1972), and the Test Area North Hot Shop. Contractors drained, grouted, and closed all the original 1950s-era spent nuclear fuel pools on-site, with the largest one, built in the mid-1980s, now empty of spent nuclear fuel and awaiting final closure.

DOE, the Naval Nuclear Propulsion Program, the U.S. Environmental Protection Agency (EPA), and the state of Idaho used the 1991 Federal Facility Agreement and Consent Order framework to draft and sign an agreement for IEC to remove buildings, support structures, and the naval prototype reactors S1W and A1W at NRF. These prototypes are considered historically significant scientific and technological facilities associated with expanding science and technology, nuclear propulsion, and Cold War history. Along with the vessels, all contaminated equipment will be disposed of on-site at the Idaho Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Disposal Facility, which DOE, EPA, and the state have agreed to expand. For the on-site disposal of this and other site-generated cleanup wastes, the new landfill cell will increase the overall capacity of the facility to 1.38 million cubic yards, extending its mission by 25 years.

A MULTIMISSION LABORATORY

While nuclear energy research will always dominate INL's mission, there is plenty of other work going on, some of it dating back decades. INL has become a leading center for electric vehicle and battery research since 1983, when U.S. Sen. James McClure from Idaho, an early EV enthusiast, made Idaho the home of DOE's Energy Storage Testing Laboratory, for testing batteries in support of the Electric and Hybrid Vehicle Program. The following year, DOE opened its Electric Vehicle Center here for EV dynamometer and road testing.

At the time, lithium-ion batteries had not come into widespread use, and EVs were routinely dismissed for being slow and underpowered. But from tiny seeds big trees can take root, and by 1987, the Idaho team became managers of the DOE Site Operator Program, aiding industry, government, and universities with on-road and track testing of electric vehicles. By 2015, INL was collecting and analyzing data from 6 million charging events and bench testing wireless charging systems to support the Society of Automotive Engineers International wireless charging guidelines.

During the '80s and '90s, Work for Others, now called Strategic Partnership Projects, helped the lab maintain core competencies and grow new ones. Idaho National Engineering Laboratory (INEL) became the home of Project X, making armor out of depleted uranium for the U.S. Army's M1 Abrams Main Battle tank at Test Area North in the hangar that had been built in the 1950s for the Nuclear Aircraft Propulsion Program. The program continues today as the Army's Specific Manufacturing Capability, representing a significant INL mission.

Eastern Idaho is a heavily agricultural region, and in the 1980s a group of INEL energy researchers turned their attention to how alternative fuels and chemicals might be made from the stalks, cobs, and leaves left in farmers' fields after harvest. The research focus was on micro-organisms that could live in extreme environments and how their enzymes could be applied to biomass and other materials through industrial bioprocessing. When DOE and the U.S. Department of Agriculture agreed in the 1990s to apply national lab-developed technologies such as GPS and wireless communications to farming, the lab expanded its focus to robotics and autonomous vehicle control and guidance systems, laying a foundation for today's precision agriculture.

By the early 2000s, DOE's newly formed Bioenergy Technologies Office became the main sponsor of the lab's bioenergy research, and in 2008 it funded the construction of a Process Demonstration Unit to solve preprocessing and handling challenges facing the biorefining industry. That investment, coupled with funding from DOE's Office of Energy Efficiency and Renewable Energy for a battery testing facility, enabled construction of the Energy Systems Laboratory in 2013, a major part of INL's Research and Education Campus on the north side of Idaho Falls. In 2023, the Biomass Feedstock National User Facility unveiled a major upgrade, expanding the lab's capability to handle all types of waste recycling, including municipal solid waste.

Homeland Security

Even before the attacks of Sept. 11, 2001, homeland security experts in the U.S. worried that terrorists might detonate an explosive device enhanced with radiological source materials. INL offered distinct advantages for training professionals to respond to any potential "dirty bomb" attack. These included longtime experience in radiation detection and hazard mitigation, plus a large inventory of radiological and nuclear materials. In 2002, INL finalized an agreement with the U.S. National Technical Nuclear Forensics program to develop training that grew to include radiation detection and search techniques. Participation expanded to include response teams from Army, Navy, FBI, and National Guard units across the country. Today, INL conducts more than 75 training and exercise demonstrations annually.

In the 1990s, INL expanded research into testing new lightweight armor materials. Today, the INL Defense Systems division operates the National Security Test Range, where military and security experts from across the country test the effectiveness of barriers and armor packages. In addition to DOE, organizations such as the National Nuclear Security Administration, Department of Defense, and Department of Homeland Security regularly send teams to INL for training.

As the nation learns how vulnerable its pipelines, factories, dams, municipal water systems, and power plants are to cyberattack, INL researchers have led efforts to address digital threats to industrial control systems. The 890-square mile INL Site encompasses a fully operational electric power grid to test cybersecurity challenges to critical infrastructure. With seven substations, a control center, 61 miles of 138-kilovolt transmission lines, and multiple distribution circuits, sections of the grid can be isolated and reconfigured for integrated testing and demonstration of state-of-the-art power systems, components, and SmartGrid technologies. Recent enhancements incorporate fiber connectivity, instrumentation, and SmartGrid interface test points. The test bed's loop-fed substations are linked with modern supervisory control and data acquisition (SCADA) systems and a dedicated fiber-optic communication network.

In digital modeling and simulation, INL has one of the largest Real-Time Digital Simulator systems in the national laboratory complex. INL researchers use this physics-based simulator to enhance the security of the nation's electric power grid and related control systems, including SCADA systems. Engineers can use it to visualize the effects of power grid failures and have staged exercises with regional power utilities to discover how supercapacitors and battery storage can be paired with hydropower infrastructure in emergency situations.

INL's high-performance computing capabilities, unimaginable to all but a very few in 1999, have made the lab a central training center for the Department of Homeland Security and its Industrial Control Systems Cybersecurity (301) course. The hands-on course provides a deep understanding of the network environment, allowing participants to identify potential vulnerabilities and evaluate how they might be exploited. Since 2007, more than 4,000 cybersecurity professionals from around the world have taken the course, helping establish widespread public-private partnerships to protect critical infrastructure.

INTEGRATED ENERGY SYSTEMS

Creating a more prosperous world that runs on carbon-free energy will not be a matter of choosing one preferred technology over another. Although nuclear power offers the greatest capacity with the smallest footprint, energy planners envision pairing it with variable sources like wind and solar as well as generation from fossil fuels, geothermal, and biomass, along with energy storage, to provide unique integrated energy solutions.

Integrated energy systems include two distribution networks: electric and thermal. Although electric networks (grids) are well understood, there is much to learn about thermal networks that can shift heat from power generation to other industrial processes. Control systems are complex, often complicated by heat losses or variations in temperature and pressure. Ideally, the goal is to have clean, emission-free heat and steam from nuclear energy for industrial processes as well as to produce hydrogen. This hydrogen can be used to generate electricity, as a transportation fuel in fuel cell vehicles, or in industrial processes such as steel manufacturing, petroleum refining, and chemical production. Clean nuclear heat and electricity for clean hydrogen production enable a unique path to decarbonization across all energy use sectors.

To wean chemical production off fossil fuel combustion, INL is helping U.S. companies invest in technologies that use energy produced by nuclear reactors and renewable energy sources. One of those technologies, high-temperature electrolysis, uses electricity and heat generated from a nuclear reactor to split steam into hydrogen and oxygen. INL's electrolysis research supports the development and testing of steam electrolysis technologies and systems from multiple companies, proving their performance and safety.

2024 Foreword

The Mission, Now and Then

From its earliest days under the Atomic Energy Commission, INL has put ideas into action. The path has not always been straight, nor has the road always appeared clear. Halfway through its second half-century, however, Idaho's lab has emerged as a unique, multipurpose laboratory that has regained a connection with its original purpose while expanding its scope in unexpected and exciting directions.

This expansion is reflected most noticeably on Idaho Falls' north side, along MK Simpson Boulevard (named for Rep. Mike Simpson, a steadfast INL supporter in Congress). Year by year, INL's Research and Education Complex campus has grown to include such cutting-edge facilities as the Energy Systems Laboratory, Energy Innovation Laboratory, and four national security research buildings. Distinctive agreements with the state of Idaho helped build the Center for Advanced Energy Studies, the Cyberbercore Integration Center, and the Collaborative Computing Center, where INL researchers can collaborate and mentor students from Idaho's three public universities.

Twenty-five years ago, original pioneers like Deslonde de Boisblanc, designer of the Advanced Test Reactor's serpentine core, were still with us. While researching this book, Susan M. Stacy interviewed them and heard their stories. Stacy wrote, "If these in any way encourage people to record their own memories and their own explanation of why things were done the way they were, I say, 'Get busy.'"

Today, there is a new generation taking Idaho National Laboratory toward its centennial in 2049. The vision remains the same: to change the world's energy future and secure our nation's critical infrastructure. The researchers, scientists, and engineers of 2024 may look a lot different from the men in coveralls who lit four lightbulbs at EBR-I in 1951, but the common threads of brilliance and dedication can be found in people of all backgrounds from every part of the world. INL welcomes them to the adventure. Their challenges and solutions, happening right now, will become the stories and legends of tomorrow. No one can say for sure how things will turn out, but if history offers any clues, it's a safe bet that big things lie ahead.

Lance L. Lacroix
U.S. Department of Energy
Manager, Idaho Operations Office

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*Updated for 75th Anniversary Edition

Introduction

"What did they actually do there?" This question has come my way frequently while researching and writing this history. Idahoans seem to have a sense of continuity with their mining and timber roots, their agricultural heritage, and the great themes of the West—Lewis and Clark, the Oregon Trail, Reclamation. But when it comes to their nuclear heritage, connections seem vague. The Idaho National Engineering and Environmental Laboratory (INEEL) was set up deliberately in a remote area. Fifty years later, it still is remote, in more ways than one.

I became curious about the INEEL after hearing a lecture about Hanford, the government's other nuclear facility in the Pacific Northwest. The speaker described Hanford's secret war-time mission to manufacture plutonium for weapons and criticized its later environmental record. The talk made me wonder about the role of INEEL in the nuclear world, for I knew little of its history. Therefore, when I was asked in June 1998 to prepare a history of the INEEL on the occasion of its 50th anniversary in 1999, I was ready with questions to ask of the past.

The story of the INEEL, originally named the National Reactor Testing Station (NRTS), is really a thousand stories. Sadly, not all could be in this book. Among those not here are certain defense research topics—the Centaurus laser-pumping experiments, for example—and medical topics like the campaign to recycle the Power Burst Facility for Boron Neutron Capture Therapy, a potential treatment for a deadly type of brain tumor. The accomplishments of the Radiological and Environmental Sciences Laboratory and a kaleidoscopic array of recent non-nuclear research are likewise missing. Recent decades in general receive less attention than the early days. But then, recent decades are full of programs and issues that continue to evolve, so perhaps it is better to let them mellow before a historian tries to characterize them.

This book is neither a technical report nor a scientific assessment. It is intended for the general reader with no background in physics, chemistry, or any other science. It aims to trace the changing relationship between a federal nuclear laboratory and its home state. Nuclear science is a character in the story, however, but not dressed in all its technical finery. A glossary and acronym list are available at the back of the book for those who wish an occasional reminder.

It is the question "What did they do?" that produces the thousand stories. The INEEL was the scene of thousands of scientific experiments. I learned to correct my notion of an "experiment." The word brought up vague memories of high school chemistry class—pouring a liquid of one color into a glass filled with a liquid of another color. The result was a third color, and that was it. In nuclear matters, however, an experiment may require acres of land, huge buildings, hundreds of people, and millions of dollars. It may take years to conceive, design, and build. After all that, the action phase of an experiment might take about the same time it took to pour liquid A into liquid B.

Large-scale laboratory work requires the well-orchestrated efforts of teams. Nevertheless, a historian, particularly when commissioned for a golden anniversary, looks for insight by talking to individuals. Who can interview a team that existed and dissolved forty-five years ago? Yet accomplishments are so often the product of teams, working groups, task forces, and committees, that it is hard to identify the individual who might have flashed the first breakthrough light on a problem. Team work is a fact of life in Big Science, perhaps most science. People demonstrate creativity and imagination in ways not often recognized. This book does not mention all the times that someone said of another, "He was the most brilliant physicist I've ever known," "We had superb back-up from our radiochemists," "The weather service sent their best meteorologists to the NRTS," "Our welders were the best in the business." I heard that sort of thing frequently.

Therefore, I regret the many stories not recorded here, the many exceptional individuals not acknowledged, the many discoveries and engineered systems not mentioned, the many ingenious experiments not described. I hope that the all-too-few names and episodes that do appear in the book will be understood partly as stand-ins for the many others that could just as well have been included—and stand-ins, as well, for the teams that made it possible for individuals to have stories to tell.

All historians of the Atomic Energy Commission or the Department of Energy (DOE) and its laboratories have had to cope with the multiple-arena aspect of their subjects: activity moves on several fronts at the same time. At the INEEL this is notably the case. Major programs were under different contractors and progressed simultaneously, sometimes having little more in common than the desert scenery and the landlord. Rather than chart INEEL history using internal bench marks such as the change in DOE secretaries or the five-year increments of operating contracts, I tried to keep in mind the general reader and the non-scientist, for most of whom this book will be an introduction to the INEEL.

As this manuscript neared completion, a criticality accident occurred in Tokaimura, Japan, in a plant fabricating highly enriched nuclear fuel. Having learned some basic nuclear language, I saw how carelessly many journalists reported this news. They used the word "contaminated," for example, when they meant "irradiated." The Idaho Chemical Processing Plant (renamed Idaho Nuclear

Introduction

Technology and Engineering Center, INTEC, in 1998) at the INEEL has been the scene of three accidental criticalities. These episodes, although as grave as any unintentional criticality, were not germane to the general flow of the history and were piled on the stack of untold stories. Lest anyone believe that these were deliberately omitted, information about them is supplied in the appendix.

Associates have asked if my research exposed any "secrets" at the INEEL. DOE supplied me with no security clearance. Considering the broad scope of the history—and the time given in which to complete it—this was not a concern. I consulted many documents that were at one time classified and subsequently declassified. Nevertheless, the manuscript managed (inadvertently) to arouse classification concerns in connection with certain activities at the Chem Plant in the 1950s. For the rest, the selection of material, its interpretation, and any errors it may contain are entirely my own responsibility.

It was a special privilege to become acquainted with dozens of retired and current employees at the INEEL. Selected excerpts from some of these conversations appear in the book. If these in any way encourage INEEL people to record their own memories and their own explanation of why things were done the way they were, I say, "Get busy." The tons of scientific reports on the shelves omit all too well the flavors of human experience, be they disappointment, tedium, or exhilaration.

Now at the end of the project, I reflect once more on the lecture about Hanford and consider what I learned about the INEEL. In trying to understand environmental and other events within the context of their time and place, it seems to me that the managers and scientists of the INEEL were neither careless nor casual about the disposition of hazardous materials, radioactive waste, or radioactive releases. Some people account for this by remarking, "This was not a weapons production site." This explanation, expressed as a negative, gives insufficient credit to more positive themes in INEEL history. A research mentality, the daily use of the scientific method, the safety traditions established by the founders, and the integration of Site employees into surrounding communities—all of these must count for something.

Environmental concerns are surely important, but it is possible that when future generations consider the impact of the INEEL on the environment, they will find that impact to be far outweighed and outlived by the laboratory's remarkable legacy of scientific discovery and engineering achievement.

Susan M. Stacy

Acknowledgments

The one-year horizon for preparing this book required some serious help from a lot of people. Greg Hula, the DOE/ID project manager, asked DOE/ID's contractor Jason Associates to supply a lot of it. Nelson Soucek managed the project for Jason, sensitive always to the tension between the deadlines that crowd and the space required to do work. I appreciate the many quiet ways he kept these contending forces in a productive balance. Greg Hula was on the other side of that coin, and I thank him for the many ways his kind patience, guidance, and astuteness helped to improve the manuscript.

Jason placed Lori McNamara on the project as research assistant and photo researcher. Lori and Kris Burnham compiled the information on historic NRTS reactors found in Appendix B. Assisted by Terese Nield, she located most of the photos appearing in the book. This task took her into many private homes, and we thank all of those generous people, including Bertie Lee Marvel, Pat Gibson, the Thomas Sutton family, the Ada Marcia Porter family, Orville and Margaret Larsen, and William Holden, Jr., who permitted the use of their photos.

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