Investigative Report
by
ALASKA COMMUNITY ACTION ON TOXICS
for
Delta Junction, Alaska

THE NUCLEAR REACTOR AT FORT GREELY

by

Norm Buske of NUCLEAR-WEAPONS-FREE AMERICA
and
Pamela K. Miller & Lorraine Eckstein, Ph.D. of
ALASKA COMMUNITY ACTION ON TOXICS
135 Christensen; Suite 100
Anchorage, Alaska 99501

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Abstract of Investigative Report

The U.S. Army is disguising the true mission of the nuclear reactor at Fort Greely, Alaska. Rather than a plant to provide heating and electricity to the base, the Fort Greely reactor was covertly designed and operated as a small pilot plant to produce special nuclear materials suitable for use in battlefield weapons. Although it is small, the Greely reactor is capable of causing great harm.

The Army conceals radioactive contamination at Fort Greely that affects workers, residents of nearby communities, and the environment. The cover-up is part of a larger strategy by the Department of Defense and Department of Energy to fool the public in an attempt to avoid accountability.

This report offers evidence to support these conclusions, as well as specific courses of action to remedy the damage done at Fort Greely and to make military and political leaders accountable to the public they serve.

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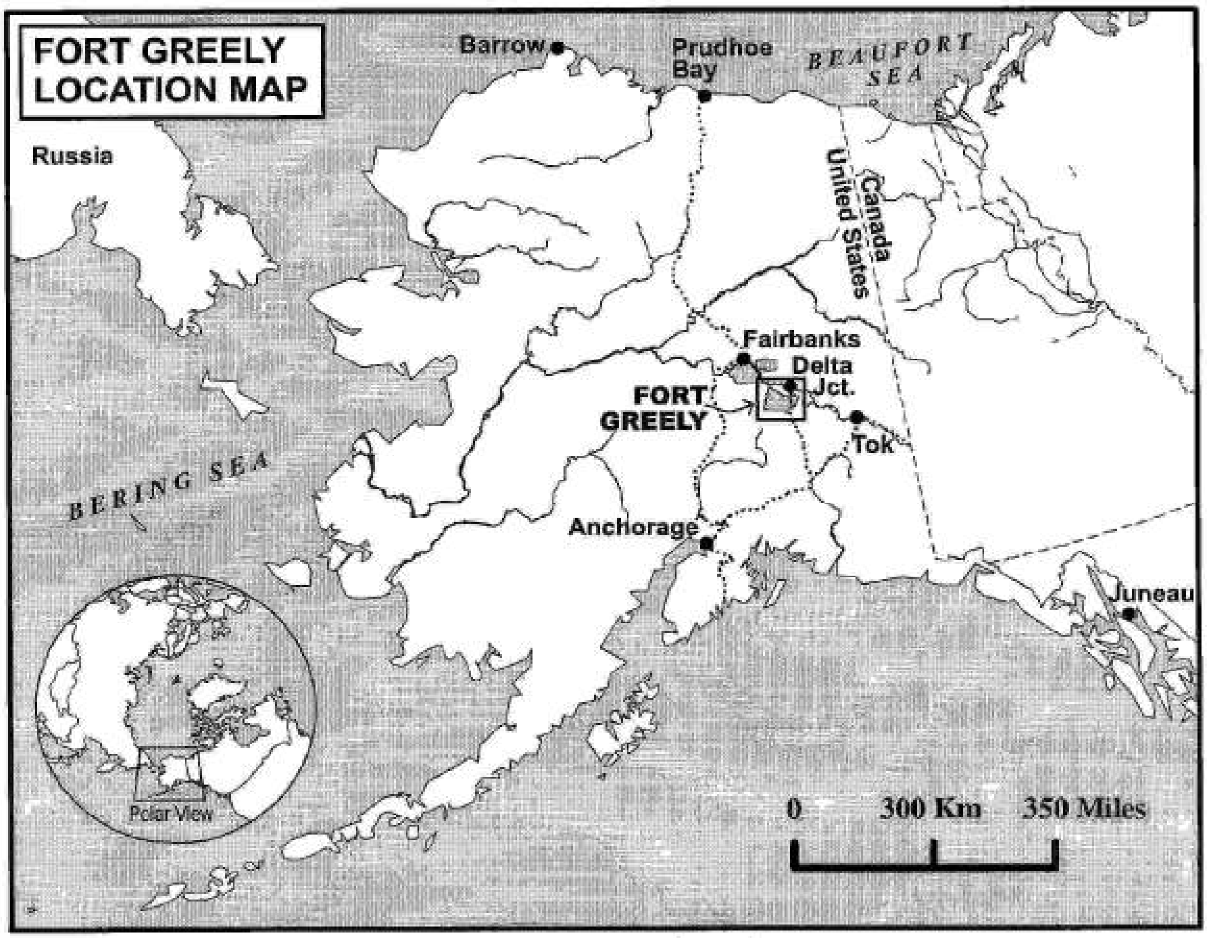
I. Background

A. Location

Delta Junction is a community that lies at the junction of the Richardson Highway and Alaska Highway ninety miles southeast of Fairbanks in the Interior Basin of Alaska. Big Delta and Clearwater are two smaller communities located a few miles north and east, respectively, of Delta Junction. Presently the population of the region is approximately four thousand. The Fort Greely Military Reserve covers twelve-hundred square miles with its developed post five miles south of Delta Junction.



B. Concerns of Delta Junction Residents

For ten years (1962-1972), the Army operated a nuclear reactor at Fort Greely. Some residents of Delta Junction suspect that there is a relationship between the reactor and high cancer rates in the community. The area that lies just north of Delta Junction has been dubbed "cancer row" by residents of the area. A school is located on the military reserve, and people are worried about the health of their children.

The Army conducts an aggressive public-relations program to diffuse public opposition to those past and present operations at Fort Greely that are unacceptable in peacetime America. In 1962, William Johnson was only ten years old, but he recalls his feelings about a trip he took to the Fort Greely nuclear power plant with his Cub Scout Pack.[1]

> At one of our meetings the den mothers loaded us into cars and took us to Fort Greely for a tour of the new power plant. It was an exciting event. There were fancy control rooms full of dials and gauges... Even though we could not really see the nuclear fuel because of the heavy radiation shielding in place, there was a sense of potential. The tour guides explained to us that what we were seeing was an example of how human kind had harnessed the energy of the atom for peaceful purposes. [The Cub Scout Pack] left the new power plant with a sense of destiny; we knew that we were part of something big and that we were in at the beginning [Johnson, p. 1].

The Army attempts to maintain good relations with the community of Delta Junction and makes it a point to present a cooperative attitude toward community advocates. But at the same time, the Army continues to restrict access to information that would address the environmental and human health issues that currently concern Delta Junction residents.

Over the past decade, members of the communities near Fort Greely have been looking for ways to get help with their concerns. In 1993, Johnson conducted preliminary research of cancer incidences in the area. He estimated that there had been seventy-seven Delta Junction cancer cases since the 1960s. He learned that out of forty-four documented cases of cancer, thirty-four (77%) of the people lived in the area when the reactor was in operation. Delta Junction has had five cases of leukemia since 1962, and all five lived in the area during the years from 1962 to 1972. There have been five cases of bone cancer since 1962 (Johnson, pp. 95-96). Johnson concluded that

> the preliminary information is persuasive enough to indicate that a governmental agency should comprehensively examine the demographic and disease profiles for Delta residents [Johnson, p.100].

In 1998, several families from the area asked for help from Alaska Community Action on Toxics (ACAT), while also expressing the need for caution--as most of the people who live in Delta Junction are employed directly or indirectly by the military. These requests for assistance reflect

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[1] Some of the historical information about Delta Junction and Fort Greely is drawn from *Testing Nuclear Power in Alaska: The Reactor at Fort Greely*, a masters thesis by William R. Johnson at University of Alaska Fairbanks. May 1993. He is a life-long resident of Delta Junction. A copy of Johnson's thesis can be obtained by contacting Rasmuson Library at the University.

the reasonable concerns of U.S. citizens, as does Johnson's conclusion that demographic and disease profiles should be conducted for those associated with the Fort Greely reactor. ACAT is responding to the community of Delta Junction with this investigative report.

C. Historical Overview of Events Leading to the Fort Greely Reactor

The original residents of the Fort Greely area were the Goodpaster Athabaskans. They dispersed to live in other Athabaskan communities, when the Army Air Force set up a garrison at an airstrip built by the Civil Aeronautics Administration during World War II. At that time, a ferry crossed the Tanana River, and roadhouse lodging was available for travelers on the Richardson Highway. There were thirty residents within a fifty mile radius from the roadhouse.

> After World War II, the Army established the Big Delta area as the site for the first cold weather military maneuver operation, which eventually became Fort Greely Military Reserve. Its primary function has been to serve as a training and testing center for Arctic conditions [Johnson, p. 64].

Cold weather military operations were deemed important by Army tacticians after World War II, as they were concerned with potential battles with Soviet Union communists in an Arctic war over the top of the globe. The idea was to use American technology to scare off the Russians or to beat them on a nuclear battlefield, which would require small tactical nuclear weapons (micro-nukes) as well as big strategic weapons of mass destruction.

The Korean War brought on a major expansion of U.S. nuclear, biological, and conventional weapons. Pulitzer Prize-winning historian Richard Rhodes describes increases in the capacity to produce nuclear weapons in the early 1950s.[2]

> A first [Atomic Energy Commission] expansion was authorized in October 1950, a second larger program in January 1952. Oak Ridge and Hanford doubled in size... More production capacity meant more weapons, which diversified from strategic bombs into tactical and strategic warheads attached to everything from depth charges to atomic cannons to anti-aircraft missiles to ballistic missiles of every range from battlefield to intercontinental [Rhodes, p. 561].

After the Korean War, at the same time the Army was making plans to build the nuclear reactor at Fort Greely, the Inupiaq at Point Hope, Alaska were defending themselves against Project Chariot.[3] Proposed by the Atomic Energy Commission and supported by politically powerful Alaskans, Project Chariot would have used nuclear explosives to create a deep harbor in the Chukchi Sea.

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[2] Richard Rhodes, *Dark Sun: The Making of the Hydrogen Bomb*. 1995.

[3] Dan O'Neill. *The Firecracker Boys*. 1994. Written with support from the National Endowment for the Humanities. See this book for a description of attempts by the Atomic Energy Commission to develop uses of nuclear energy by first testing radiation effects on the people and natural environment of Alaska.

> It was not surprising that the Atomic Energy Commission chose Alaska as a venue for Project Chariot... Alaska was regarded as a barren wasteland, suitable only for extracting mineral resources or as a laboratory for testing *potentially hazardous technologies*. At various times, the AEC considered other Alaska projects, such as blasting an instant harbor at Point Barrow with a five-megaton shot or dredging Bering Strait with nuclear explosions [O'Neill, p. 270, emphasis added].

The Atomic Energy Commission was eventually stopped from exploding atomic bombs for Project Chariot by the efforts of Point Hope residents and fledgling conservation groups throughout the U.S. Project Chariot ground to a halt at the same time the Army was installing its nuclear reactor at Fort Greely. In 1962, amid the public outcry against Project Chariot, the Army opened its Fort Greely reactor.

> The remoteness and small population allowed great flexibility for the Army to operate its testing program. But, best of all, according to the Army there were "no major population centers within a fifty mile radius." The four hundred residents of the adjacent community of Delta Junction were apparently expendable, as were the additional one hundred who lived within the fifty mile radius [Johnson, p. 64].

Army leaders chose the Fort Greely location because it was sufficiently remote to test "potentially hazardous technologies" such as nerve gas, biological weapons, and nuclear devices. They had learned, however, from Project Chariot that the remoteness of Alaska was not enough to protect them against public opinion. The Army also covered up any questionable activities at Fort Greely.

Pulitzer Prize winner Seymour Hersh included Fort Greely in his 1968 book about chemical and biological warfare and the U.S. government.[4] Scientist John Henshaw also reports that he and over twenty other people were made sick by a biological warfare program that had gone amiss at Fort Greely in the 1960s. Seventy-five percent of those who were infected (notably trappers and hunters) died of a disease spread by Army researchers, which was later identified by an investigative reporter as tularemia. Henshaw was one of the five or six infected people who survived.[5] Both Henshaw and Hersh emphasize (separately) the secrecy and deception employed by the military concerning these Fort Greely projects.

Army leaders avoided risk to their plans for the nuclear reactor at Fort Greely by obfuscating the actual mission of the reactor. The public was told that it served as a "test facility" to provide the Army with field operating experience in a remote location with "harsh environmental conditions," and to supply the military base with electricity and steam heat (Johnson, p. 60-66). Investigators for this study have discovered that the actual mission of the reactor was to serve as a pilot plant for producing special nuclear materials for tactical weapons. Even to this day, the Army is disguising the truth about the reactor at Fort Greely.

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[4] Seymour Hersh, *Chemical and Biological Warfare, America's Hidden Arsenal*. Bobbs-Merrill. 1968.

[5] John Henshaw, Published Letter to Editor of *Biologist* (volume 44:2). 1997.

II. Research Methods

Researchers for this study used the Freedom of Information Act to obtain unclassified documents about the Fort Greely reactor from military and other governmental sources. Nuclear scientist Norman Buske of Nuclear-Weapons-Free America worked with other researchers from Alaska Community Action on Toxics to:

1) Analyze more than twenty documents and books about the SM-1A reactor;

2) Interview twelve workers, residents, and former residents of the Fort Greely area;

3) Conduct a ten-day field study (August 1998) of grounds surrounding the reactor, using radiological survey instruments and taking a sample of vegetation; and

4) Obtain laboratory radiological analyses of one willow sample collected from sewer outfall on site: Strontium-90, technetium-99, and high-resolution gamma spectrum.

Information obtained from these four sources serves as the basis for this report.

III. Conclusions

A. Secrecy Supersedes Safety

Documents obtained from the U.S. Department of Defense show that Army leaders were more committed to producing special nuclear materials for battlefield nuclear weapons than they were to assuring the safety of the operation. Army employees operated the reactor for ten years, during which time they made mistakes that caused radioactive exposures to military personnel, workers, and residents. The Army command chose to cover up events when contamination occurred, rather than admit their mistakes by informing those people who were exposed. This cover-up continues. The Army admits only to small and relatively insignificant nuclear waste disposal problems at Fort Greely and hides the information that would make it possible to identify those individuals (or their survivors) who have been exposed to deadly radiation.

The Army withholds information that would help those who have been contaminated because of the long-term goals of the Department of Defense and Department of Energy. The military claims that the Greely reactor was built to test relatively benign functions, such as generating electricity in Arctic conditions. But this investigation indicates that the reactor was built as part of an on-going plan to produce small nuclear weapons. Instead of serving simply as a multi-purpose power plant, the reactor at Fort Greely was part of a secret plan to produce specialized isotopes for battlefield nuclear weapons.

Army leaders will not admit to the true purpose for the reactor at Fort Greely even though it was closed thirty years ago. The cover-up at Fort Greely helps the Army to:

- Avoid setting a precedent that would make the military financially or morally accountable to the public; and

- Keep secret that the Department of Defense and Department of Energy continue to develop micro-nukes to use on the battlefield.

If the Army releases the secret documents that would identify those who were contaminated by the reactor at Fort Greely, the public outcry might preclude new production elsewhere, such as at the FFTF reactor at Hanford in Washington State.

The Department of Energy (DOE) is already facing the possibility of public outrage because of the results of multiple studies that were released in 1999. The DOE was pressured into compiling a selected group of health studies conducted on 600,000 people who worked for federal contractors at industrial and research sites, many of whom were followed for more than fifty years.[6]

> Beginning in the mid 1970's, the DOE worker studies engendered considerable controversy, in large part because of concerns over DOE's conflict-of-interest as an employer... As a result of Congressional pressure and a growing lack of public trust, the DOE [agreed in 1990] to manage and conduct DOE worker health studies...

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[6] Robert Alvarez. *The Risks of Making Nuclear Weapons: A Review of the Health and Mortality Experience of U.S. Department of Energy Workers*. 2000.

> ... Since that time, these studies were obscured from public attention... This all changed when the Secretary of Energy announced on July 14, 1999 that the Clinton Administration would seek to establish a federal compensation program for sick Energy Department contract employees [Alvarez, p. 3].

Since 1945, these workers helped produce tens-of-thousands of nuclear weapons for the United States. A review of the DOE's report demonstrates that

> workers at fourteen DOE facilities were found to have increased risks of dying from various cancers and nonmalignant diseases [Alvarez, p. 4].

The Army's nuclear facility at Fort Greely was not included in the fourteen sites that were reported by the DOE study, precisely because the DOE and the Army have never admitted that the Greely reactor was producing weapons grade nuclear materials. This study, however, reveals that Fort Greely had such a function. The connection between the fourteen facilities for the DOE study and the Greely reactor for this study is obvious. Like the 600,000 workers from the DOE study, workers at the Fort Greely nuclear facility also have "increased risks of dying from various cancers and nonmalignant diseases."

B. Sources of Possible Contamination

The secret mission of the Fort Greely reactor was to produce super fissile material that could be used in small weapons on the battlefield. Therefore, when nuclear accidents or exposures to humans occurred in the Fort Greely area, the Army simply concealed the facts. The cover-up serves to deflect any investigation that might prevent the production of super special nuclear materials in the future.

In spite of the cover-up, researchers for this study have obtained enough information to conclude that the nuclear reactor at Fort Greely is a significant source of radioactive exposures to humans living or working on or near the military base in the past, present, and future. This investigation has identified six sources of probable exposures:

Liquid radioactive wastes released into the ground water and used for drinking water from dug wells in Clearwater;

Radioactive steam used in the laundry and to heat the military base;

Control rod accident and subsequent cleanup process;

Fallout near reactor from accident that caused permanent closing;

Improper methods of disposal of solid radioactive wastes;

Radiation remaining in containment structure of decommissioned reactor.

IV. Recommendations

A. Hold Military and Civilian Leaders Accountable

The Cold War is over and the reactor at Fort Greely has been shut down since 1972. Current activity has to do with the scheduled closure of the military base under the Base Realignment and Closure Act. Alaska State and local governments are working toward the economic development of Fort Greely. The town of Delta Junction is considering plans to put a private prison at the base. There is also a possibility that Congress will approve Fort Greely as a missile defense site with 250 workers slated to work at the installation. In any case, the Army is in the position of assuring policy makers and the public that Fort Greely is safe and free of radioactive hazards. This report concludes otherwise, and the Department of Defense must be held accountable.

One of the researchers for this study is a civilian member of three Department of Defense Restoration and Advisory Boards for three military bases in Alaska. She has observed that local military commanders are tightly constrained by National Security restrictions that prevent them from either knowing about or acting on civilian concerns about nuclear contamination. Army commanders for Fort Greely are thus limited by National Security restrictions. They may not have been told, until now, that the reactor was used to produce weapons-grade nuclear material. They may not have known about the nuclear accidents that occurred, endangering human and environmental health. They have been behaving as if the major problem is one of public relations. They make a great show of "partnering with stakeholders," while they find ways for the military to avoid taking responsibility for those workers and residents who have been exposed to deadly radiation.

It now behooves military and civilian leaders to take responsibility for past and present actions concerning the reactor at Fort Greely. Members of the concerned public, as well as Alaska State and local governments now have sufficient information to put pressure on the Army Corps of Engineers and the Department of Defense to be accountable for the consequences of the nuclear facility at Fort Greely. Actions to address the problems are described below.

B. Address Specified Courses of Action

1. **Provide Factual Information about Reactor's Mission and Operations.** Courageous leaders will be relentless in separating the true facts from those glossy "facts" previously presented to the public.

   - Political and military leaders should give official endorsements to investigate the consequences of the nuclear reactor at Fort Greely that will lead to designating the base as a *Superfund Site*. This designation by the U.S. Environmental Protection Agency is designed to acknowledge sites with high levels of toxicological hazards, as well as radioactive contamination, and establish the urgent necessity for clean up.

   - Policy makers both in and out of the military should locate and *declassify* those secret papers that document the covert mission of the Greely reactor and the accidents that may have caused harm to human health and the environment.

- o Independent social scientists should *interview* people who know about the reactor's true mission or can provide an overview of plant operations to fill any gaps in information left by lost documents.

2. **Determine Extent of Ground Water Contamination.** This warrants an aggressive radiological and chemical study to determine the historic extent of contaminated groundwater affecting dug wells in Clearwater. Such a study should seek to determine the location and size of effects rather than attempt to prove there are no such impacts. Once the likely underground river from the reactor to residential wells is located, one or two indicators of its presence can be identified, and then the extent of contamination can be mapped.

3. **Perform Pathway Analysis of Sewer System.** The sewer system at Fort Greely warrants radiological pathway analysis. Calculations should be made of representative exposures to personnel who worked with sewage treatment and solid waste disposal.

4. **Use Safe Methods to Clean up Contaminated Heating System.**

5. **Identify Consequences of Radioactive-Fallout Event.** The 1972, radioactive-fallout event warrants reconstruction and publication. Doses to each individual should be calculated. The affected persons (or their survivors) should be advised and made eligible for medical treatment and compensation[7].

6. **Identify and Remediate Solid Radioactive Wastes on Site.** Identification of solid radioactive waste on site is required before the needs for remediation can be assessed. The Army needs to locate its sewage sludge (reportedly deposited in the 1970s landfill) to determine the level of danger to public health the sludge presents, and to determine if the amount of recovered sludge matches calculations based on all records. While tracking the sewage sludge pathway, investigators should be able to identify and report other solid waste disposal pathways.

7. **Develop Protocol for Long-Term Monitoring of Radioactivity in Containment Structure.** The Army should reasonably characterize the radioactivity remaining at Fort Greely rather than presenting easy public assurances that are untrue.

8. **Sponsor Health Assessment Conducted by Independent Researchers.** Any workers or others affected by radioactive exposure, or their survivors, should be advised and made eligible for medical treatment and compensation (See footnote on this page).

9. **Locate Workers Who Were Exposed During Recovery from Control Rod Accident of June 1967.** (See footnote on this page).

10. **Address Impacts of Other Contaminants Identified by Above Courses of Action.**

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[7] Alaska labor unions have recently established a process with support from Alaska Community Action on Toxics to identify and assist the nuclear-test-site workers who were contaminated at Amchitka Island, Alaska. A similar model should be employed by the Department of Defense and Department of Energy to locate the nuclear workers from Fort Greely to make them eligible for medical treatment and compensation.

V. Supporting Information

A. Description of the SM-1A Nuclear Reactor

1. Historical Background

The world's first nuclear explosion (code-name "Trinity") conducted in New Mexico in July of 1945 was a proof test--a test to prove that a nuclear bomb was feasible. Immediately after the proof test the U.S. used nuclear bombs against Japan, which brought World War II to an end in August 1945. A few years after the war, as early as 1949, military leaders were requesting smaller nuclear weapons as well as more large bombs.

> The US Army, it seemed, was joining what [was called] "this Buck Rogers universe"; for the first time the Joint Chiefs had proposed a requirement for tactical as well as strategic atomic weapons [Rhodes, p. 362].

As a result of this proposal by military leaders, the U.S. became deeply involved in proof tests to establish the feasibility of small nuclear weapons. According to Norris and Cochran,[8] a series of proof tests were conducted for projects operated by the Atomic Energy Commission with a single purpose: "to conduct exploratory and development tests directed toward warheads of smaller size and weight" (p. 27). Government records, described by Norris and Cochran (pages 26-28), reveal the following proof tests:

- Yuma test explosion on a tower on Eniwetok Atoll (South Pacific), May 27, 1956. The device was 5-inches in diameter and 24.5 inches long with a yield of 190 tons (TNT equivalent).
- Pascal-B explosion in a shaft at Nevada Test Site on August 27, 1957 (300-ton yield).
- Wheeler explosion from a balloon at Nevada Test Site on September 6, 1957 with a yield of 197-tons. The device weighed only 158 pounds.
- LaPlace explosion from a balloon at Nevada Test Site on September 8, 1957 was a "proof test of gun-type weapon" with a device weight of 503 pounds (1000-ton yield).
- Project 58A at Nevada Test Site on February 22, 1958. Two explosions in tunnels (Venus on February 22, 1958; and Uranus on March 14th). Both reported yields of less than one ton.

The three 1957 explosions (Pascal-B, Wheeler, and LaPlace) were part of Operation Plumbob, which was approved by President Eisenhower on December 28, 1956. The U.S. government was developing smaller and lighter nuclear weapons to be used on the battlefield.

To draw public attention away from the battlefield goals of the military, the government extolled peaceful uses for nuclear power. O'Neill quotes from President Eisenhower's famous "Atoms for Peace" speech before the United Nations in 1953. Eisenhower:

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[8] R. S. Norris and T. B. Cochran. *United States Nuclear Tests, July 1945 to 31 December 1992.* 1994.

> declared that "this greatest of destructive forces can be developed into a great boon for the benefit of all mankind..." [that] would make the "deserts flourish..." A massive public relations blitz launched by the White House spread the good news. Two hundred thousand copies of the speech were printed in ten languages. The American press responded as requested with headlines like, FORESTRY EXPERT PREDICTS ATOMIC RAYS WILL CUT LUMBER INSTEAD OF SAWS and ATOMIC LOCOMOTIVE DESIGNED. [O'Neill, pp. 20-21].

The Atomic Energy Commission (AEC) perpetuated "atoms for peace" as a ploy to deflect public criticism away from the development of nuclear weapons. Scientists at the newly-commissioned national laboratories at Livermore, California asked for funds from the AEC to launch a project to use nuclear explosions to employ atomic blasts for a host of non-military purposes, such as creating canals and harbors.

> The AEC gave a provisional nod to the idea, but it cautioned that work on peaceful applications was not to interfere with weapons development. In November 1956 the AEC agreed to fund a classified conference at Livermore called the First Symposium on the Industrial Use of Nuclear Explosives [O'Neill, p. 23].

Participants in this 1957 secret symposium came from AEC laboratories at Livermore and Los Alamos, the Rand Corporation, Aerojet-General Nucleonics, Princeton University, and Sandia Laboratory. Not surprisingly, the conference reported enthusiastically on the prospects for peaceful uses of nuclear explosions. Attendees suggested that the campaign to find peaceful uses for nuclear power could distract from the public's growing concern about nuclear testing. One of the conference leaders noted in the unclassified version of the conference proceedings that "there is some kind of public relations problem here."

> Apparently mystified by worldwide apprehension over atmospheric testing, [the conference leader] groused, "In the past 12 years all kinds of *phobic public reactions* have been built about nuclear bombs." Peaceful use of the explosions "could provide a fine opportunity for people to gain a more *rational viewpoint*," and he suggested that those in the AEC with public relations responsibilities take note. [O'Neill, pp. 24-25, emphasis added].

So in the late 1950s, one of the leading scientists of the Atomic Energy Commission admitted that public concern about the dangers of radioactivity had begun as early as 1945 with the first atomic blast. But instead of listening and responding to the scruples of the people, these "Firecracker Boys" assumed that their own "rational viewpoint" was superior. They arrogantly dismissed the concerns of citizens as "phobic reactions." During the ensuing forty-three years, military, corporate, and governmental leaders continued along the path blazed by the nuclear policymakers of the 1957 secret symposium. Their deadly agenda has been carried out by regional commanders and public-relations officers, whose skills at deflecting public attention away from the facts does not allow them to know the truth themselves, nor save them from the ruthless dictates of National Security.

2. The SM-1 Family of Reactors

As World War II came to an end, Army tacticians were fostering cold weather military operations to train for potential battles in the Arctic. The government was planning to develop small nuclear weapons suitable for the battlefield to ward off any threats that might come from the Soviet Union (Norris & Cochran, p. 27). By the 1950s, plans were completed that made it possible for the U.S.

government to launch two programs, one to conduct proof tests for battlefield nuclear weapons and another to develop methods to produce special nuclear materials suitable for mini- and micro-nukes. A third program had already been initiated that served as a smoke screen for U.S. military goals-- the promotion of peaceful uses of atoms. Reactors designed to produce special nuclear materials for weapons could be disguised as power plants to produce electricity and heat.

In 1952, the Army Corps of Engineers requested that the Atomic Energy Commission design a nuclear reactor that could be transported by air, quickly installed, and operated under extreme environmental conditions. Enough fuel to operate the reactor for two years was to be transported by a single aircraft. In 1954, the AEC contracted with ALCO Products Inc. to produce a prototype nuclear power reactor at the Army's laboratory at Fort Belvoir, Virginia. By July 1957, ALCO completed the first reactor designated as SM-1. The Army chose Fort Greely, Alaska for construction of the reactor, because of the remote northern location. The SM-1 reactor at Fort Greely was designated as "A," because it was the first field installation of this SM-1 type. Construction on the SM-1A reactor began in 1958 and was completed early in 1962. First "criticality" (nuclear chain reaction) occurred in the Greely reactor on March 13, 1962.

Table 1. Designations for SM-1A

S	**= Stationary**
M	**= Medium power (1-10 megawatt electric)**
1	**= Based on the (SM-)1 prototype**
A	**= First field installation of this SM-1 type**

The basic SM-1 reactor was designed to be air-lifted to a remote location and then installed using whatever materials were available. This approach to construction was fashionable in the late 1950s and early 1960s, with one component serving several functions. For example, water from a local supply was used in the Greely reactor to slow neutrons, to provide advective cooling of uranium in the reactor control rods, and to provide a first layer of radiation shielding for personnel.

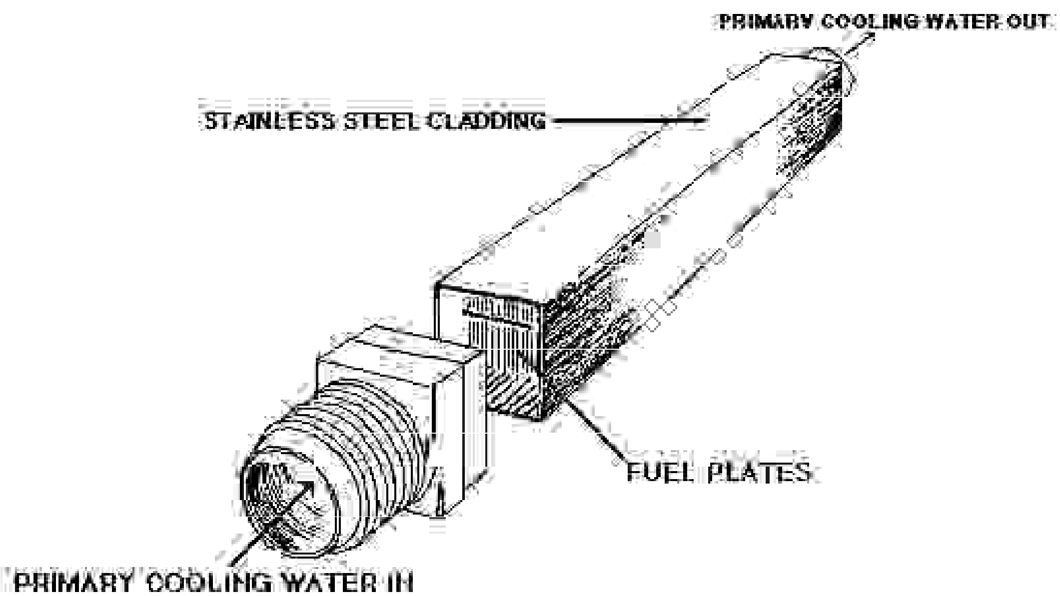
3. The Cooling System for the SM-1A Reactor

The reactor at Fort Greely was small. An ordinary commercial reactor is five hundred times the size of the Greely reactor. The SM-1A fuel-element was light weight but allowed exceptional power density, because of an unusual design in the cooling system for the reactor.

Water is used to cool nuclear reactors. Ordinarily this "primary cooling water" is kept free from nuclear contamination by cladding (piping) the uranium fuel that powers the reactor in stainless steel. In most nuclear reactors, the primary cooling water passes over the *outside* of the cladding. However, the SM-1 reactors were designed to pass the primary cooling water *inside* the cladding directly over the uranium fuel. (See Figure 1). This direct cooling method allowed exceptional power densities, but one compromise of this design was extravagant radioactive contamination of the primary cooling water. It produced an amazingly radioactive liquid waste stream, considering the small size (two megawatts electric) of the SM-1A reactor.

In the Greely reactor, the primary cooling water was pressurized to 1,200 pounds-per-square-inch absolute (psia) to prevent the water from boiling when it contacted the hot fuel. Then it was pumped into the reactor, and passed over the fuel plates of the thirty-eight stationary fuel elements of the reactor core. This unusual design exposed the primary cooling water directly to: uranium fuel; neutron-activation products in the fuel; neutrons, x-photons, and gamma-photons from the uranium fissions; cladding neutron-activation products; and other radioactive debris of the process.

Figure 1. Stationary Fuel Element for SM-1A Reactor: Primary Cooling Water Path



Note: "Cladding" is synonymous with "piping."

4. Cover Stories and Functions

The SM-1A was touted as a multi-purpose demonstration plant that provided the Army at Fort Greely with field operating experience in a "harsh" northern setting. The Army claimed that the Greely reactor provided opportunity for technological research and development. Unclassified information provided by the government states that the reactor offered the opportunity to examine the financial feasibility of operating a nuclear power plant in Arctic remoteness, as well as to provide electricity and heating for expansion of the Fort Greely post.

Until now, it has been difficult for civilians to differentiate the Army's cover-up stories from the true purpose of the Fort Greely reactor. The reactor performed the functions that the Army claimed for it. Although a preexisting diesel-fueled station produced electricity and heat for the base, the reactor also generated electricity and heat. In 1962, the 20.2 megawatt Greely reactor was the largest Army nuclear power plant in existence.

> The reactor was designed as a pressurized water plant. The warmth from the fission process heated pressurized liquid in a closed system. The pressurized system then acted to raise the temperature of another body of water high enough to generate steam. The vapor in turn operated a turbine which produced electricity. The plant also supplied heat for the post buildings. The steam itself was utilized directly, through a supply system, to serve as radiant heat [Johnson, pp. 66-67}.

Reports available to the public identify the amounts of electricity and heat produced by the reactor at Fort Greely. Reports identifying the amounts of special nuclear materials produced by the same reactor were not identified or released to the researchers for this study, when requested under the Freedom of Information Act. The SM-1A reactor outputs are shown in Table 2.

Table 2. SM-1A Reactor Outputs

Electricity	=	**2 megawatts, rated**
Post heating	=	**36,000 pounds/hour steam at 65 psig*, rated**
Special nuclear materials	=	**amounts produced are unpublished**

*pounds-per-square-inch gauge

B. The Covert Mission of the SM-1A Reactor

The particulars of design and operation of the Greely reactor show that its true mission was the production of special nuclear materials. Such a mission in the 1960s would have been highly classified, for public relations reasons and to keep secrets from the Communists during the Cold War. So it is not surprising that government documents omit reference to the true mission of the reactor. Nevertheless, a review of those documents that describe the SM-1A design and operation demonstrates that the Greely reactor was used to produce weapons-grade nuclear isotopes.

1. Highly-Enriched Uranium Fuel Suggests Covert Mission

Nuclear reactors are powered by fissionable (*fissile*) radioactive isotopes such as thorium, uranium, or plutonium. The Fort Greely reactor was fueled by highly enriched uranium.[9] Nuclear plants that simply produce electricity and heat do not need the expensive, highly enriched uranium that was used by the SM-1A reactor.

Highly-Enriched Uranium: An Expensive Fuel. Natural uranium is mined and separated from pitchblende and coffinite ores. Uranium hexafluoride has a high vapor pressure that allows separation of the uranium isotopes by their slightly different atomic weights through the process of gaseous diffusion. This process is performed at the Atomic Energy Commission's Oak Ridge, Tennessee operation. Natural uranium (U) consists of three isotopes: U-234 at 0.006% is a decay product of U-238 at 99.3%. The remainder is U-235 at 0.7% of natural uranium. In highly enriched uranium, the U-235 isotope has been enriched from the natural abundance of 0.7% to a range of 17-70%, and the U-234 may also be increased.

[9] W. A. Jacobs. *The Alaska District United States Army Corps of Engineers: 1946-1974*. 1976.

To produce highly enriched uranium, the U-235 is separated from U-238. Uranium-235 is only one percent lighter than U-238, so separation of the lighter U-235 atoms from U-238 is a difficult and costly process. To avoid the expense of such high-cost fuel, nuclear plants use uranium fuel with the least U-235 enrichment that will meet their requirements. The reactors at Hanford in Washington State, for instance, used natural uranium or slightly enriched uranium with U-235 at a low 0.9%. The proportion of U-235 is increased only to the degree that special objectives are important, as in nuclear propulsion reactors. Most commercial reactors use low-enrichment uranium fuel.

SM-1A Reactor Used Highly-Enriched Fuel. A government publication about the SM-1A nuclear power plant (1965)[10] discusses the fuel used by the reactor in a section entitled "Nuclear vs Conventional Fuel." The problems of supply and costs are addressed. Given the importance of keeping fuel costs as low as possible, the specification of a super-premium fuel for the SM-1A is inconsistent with the stated benign mission of the reactor.

Highly-Enriched Uranium Fuels Neutron Activation. In *The Firecracker Boys*, Dan O'Neill offers his somewhat poetic description of a chain reaction of U-235 fission.

> The nucleus of U-235, an unwieldy glob of 92 protons and 143 neutrons, can barely hold itself together. If it absorbs one more neutron it will shudder wildly for a millionth of a millionth of a second, then burst apart into two nuclei with an appreciable release of energy: nuclear fission. Along with the energy release, the nucleus will also let go some of its 143 neutrons. These shoot off, colliding with and being absorbed by other uranium nuclei, which also shudder, split, and release energy and more neutrons. Because fission is initiated by neutrons and is responsible for the release of neutrons, the process may sustain itself, like a fire, so long as fuel is supplied. Each fission releases the binding energy that had held the atom together, and the explosive chain reaction will not stop until a great deal of energy has been released [p. 17].

At "criticality," neutrons released from the U-235 fission produces exactly one additional U-235 fission, on average. If most of the neutrons are lost from the fuel so that each fission causes less than one more U-235 fission, then the reaction is termed "sub-critical." If the neutron released from one U-235 fission produce, on average, more than one additional U-235 fission, the reaction is called "super-critical." If a fission goes super-critical very long, an explosion results. Nuclear reactors are designed to incorporate natural physical and engineered features so they remain at criticality. A controlled variable during sustained criticality is the output of thermal energy that comes from the fissioning.

Of the four or five neutrons left over from the fission of a U-235 atom, one neutron is used to maintain criticality by splitting another U-235 atom. One or two neutrons might be lost from the fuel core or caught in the control rod material that provides operational control and safety. The remaining one or

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10 Two versions of a seventeen-page booklet entitled *SM-1A Nuclear Power Plant, Fort Greely, Alaska* describe the SM-1A reactor at Fort Greely. The first version is dated March 1965 and the second version, while undated was produced between 1967-1969. These booklets are referenced throughout this report as the SM-1A Booklet Version I and II, respectively.

two neutrons from each U-235 fission attach to and "activate" U-235 or any other atoms present in the nuclear fuel. In this way, U-235 is neutron activated to U-236.

Uranium-236 has 92 protons, the same number as U-235 (92 = the atomic number of uranium). But U-236 has 144 neutrons, whereas U-235 has only 143. The activated U-236 produced in the fuel has a halflife of 23,420,000 years, so the activated U-236 becomes a new constituent of the reactor fuel.

The nucleus of U-236 is also neutron activated by the extra neutrons from the critically fissioning U-235. Consequently, the U-236 is neutron activated to U-237 which has 92 protons and 145 neutrons. This is where the reactor moves from merely a heat-production scenario to the production of nuclear materials. Uranium-237 has only a seven-day halflife, during which time it decays (by beta emission) to neptunium-237. Neptunium-237 has 93 protons and 144 neutrons. One beta particle (nuclear electron) plus some loose photons in the x- and gamma-ranges of energy are released in the decay of U-237 to Np-237.

The Np-237 has a halflife of 2,140,000 years, so neptunium accumulates in the fuel as the reactor runs, and it is available for neutron activation to Np-238. And so the process of neutron activation of radioisotopes, some of which have quick beta decays, provides the opportunity to produce special nuclear materials suitable for use in battlefield weapons.

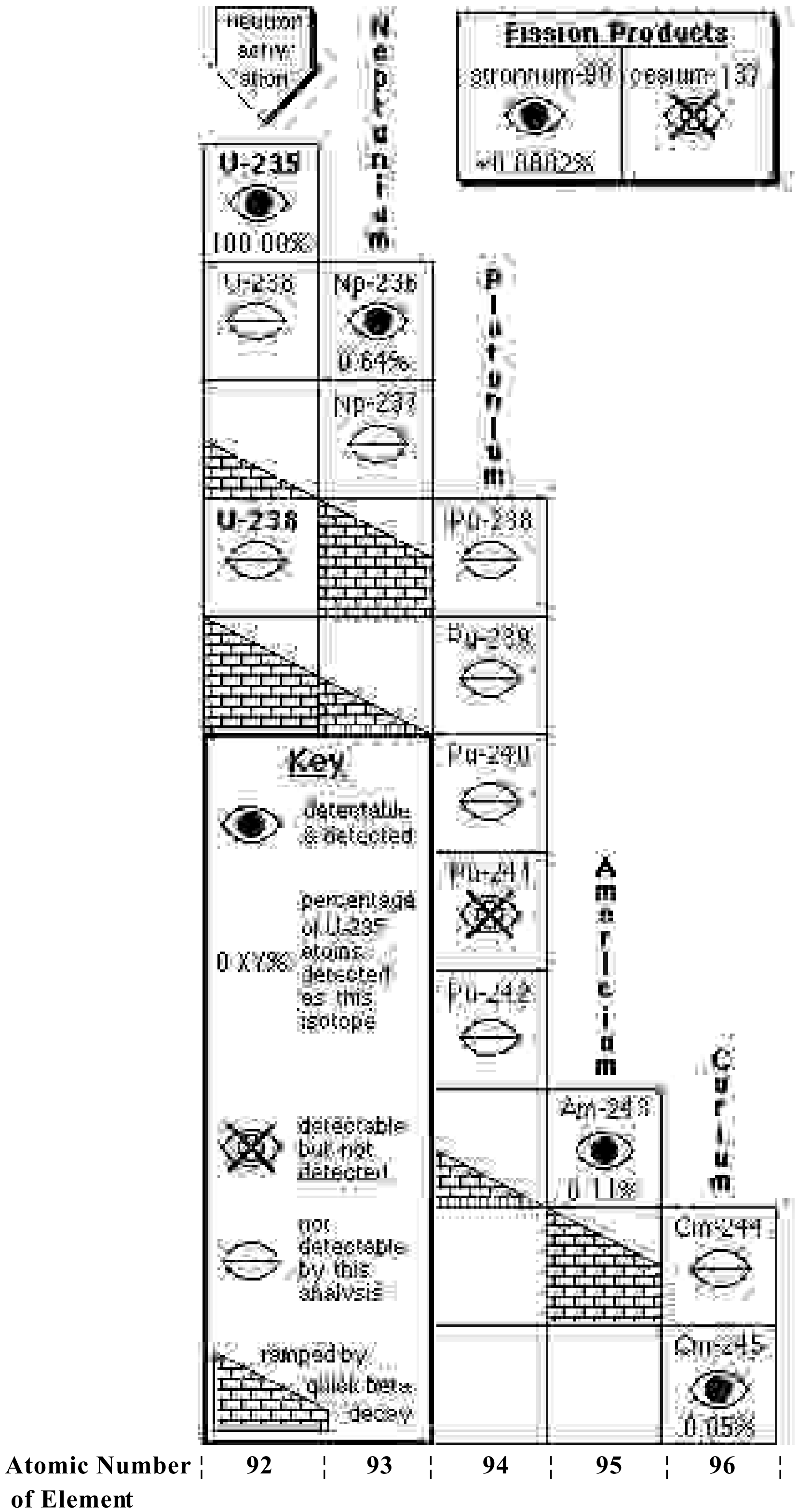
All elements having more than the 92 protons of uranium are called "transuranics" or TRU. Neptunium with 93 protons is the first transuranic; plutonium with 94 protons is the second; americium with 95 protons is the third, curium with 96 is the fourth, and so on. The isotopes of each transuranic element differ from one another by the number of neutrons they contain in their nuclei. Figure 2 is a simple neutron activation diagram depicted like a marble ramp toy. Imagine that neutrons are marbles that drop down through the fuel and occasionally kick an atom to the right (to higher atomic number) that quickly decay by beta emissions ("ramped by quick beta decay"). This diagram goes down to curium-245, but the special isotopes continue at least to curium-250.

2. Design Details Suggest Covert Mission

To produce special transuranic nuclear materials relatively free of decay byproducts, a reactor would usually be designed for exceptionally high power rates. There are two reasons for quick fuel burns and high neutron densities with high thermal power densities: 1) minimizing unwanted impurities that are formed in the fuel, which are costly to remove by chemical separation; and 2) bridging over those isotopes that decay quickly to obtain isotopes having exceptional fissile values.

Figure 2 shows only a few of the neutron activation products. In addition, there are dozens of U-235 fission products, their own radioactive decay products, and then the products of continuing neutron activation of these decay isotopes as the reactor continues to run. Many of the unwanted byproducts can be minimized by pushing the reactor to do its activation job before there is time for decays that allow unwanted materials to form. The SM-1 family of reactors were designed with the capacity for quick, hot runs that precluded the formation of most unwanted byproducts.

Figure 2. Simplified Neutron-Activation Diagram, and SM-1A Sewer Analysis



The design of fuel elements for the SM-1 family of reactors provided an exceptional cooling system to support quick, hot burns. Rather than cladding the fuel in rods to be cooled by water flowing over them, the cooling water was piped through the fuel tubes, passing directly over the uranium fuel (See Figure 1). Because water flows inside the cladding rather than outside, there is no barrier between the hot uranium fuel with its ingrowing radioactive materials and the water used for cooling. Such a design yields high contamination of primary coolant liquids and consequent problems that would not be acceptable, unless an important National Security mission was at stake. The covert mission for the SM-1A reactor demanded exceptional cooling of a core that was operating beyond normal neutron densities. The purpose of such a design was to create a reactor that produced pure transuranic materials that could be used in battlefield weapons.

3. Fast Burning Cores Suggest Covert Mission

Plutonium-production reactors often have core lives close to one year, while reactor cores dedicated to the production of electricity and heat usually live two or more years. Operating records show that the first two cores for the Greely reactor burned exceptionally fast.

There are two versions of the booklet produced by the Army describing the SM-1A reactor, one from 1965 and another later (undated) version circa 1968. According to the first page of the SM-1A Booklet (Version I), one of the requisites for the SM-1 family of nuclear power plants was that "a single aircraft would transport enough fuel to operate for two years." Thus one reactor core under normal load conditions for the SM-1A should last at least twenty-four months, which would serve as the expected base line for the life of each core at Fort Greely.

The first two cores for the Greely reactor burned in half the time published in the booklet, as demonstrated in Tables 3 and 4. In Table 3, operating conditions from the SM-1A Booklet Version I are listed in the column below under "Version I." Operating conditions from the later edition are listed in the column under "Version II." The last row of Table 3 indicates that early in the Greely reactor's operation, the cores lasted for twelve months, although the SM-IA booklet declared that a two-year core life was expected.

Although the SM-1A booklet indicated a two-year core life expectancy, such stated expectations were for the sake of covering up the true mission of the reactor. A two-year core life was usual for peaceful uses of a reactor, such as was touted for the SM-1A, so manuals had to adhere to that story. But the SM-1 family of reactors were designed for quick, hot burns so transuranic materials could be produced. If the SM-1A booklet had given a more accurate picture (that twelve-month burns were expected), it would have signaled the true mission of the Greely reactor to the Communists and to American critics. The core life was less than two years, because the SM-1A reactor was designed to operate beyond the ordinary, and then it was run at full capacity. This anomalously intense operation of the first two cores is most striking evidence of a covert production mission of the reactor.

Typically the first operating reactor of a new series would include many tests followed by some modifications before final evaluation of its capabilities. The Fort Greely reactor was atypical in that three months after it obtained first criticality, the plant was handed over to the U.S. Army Alaska Command, and "the pedal was put to the metal." The first two SM-1A cores had powered lives of about 10.5 months each. Table 4 calls attention to the short lives and exceptionally hot burns of the first two cores, both of which denote the production of transuranic materials.

Table 3. SM-1A Reactor Operating Conditions

Reactor Conditions	Version I	Version II
Full Load Thermal Power (MW)*	20	20
Rated Electrical Power (MWe)*	2.5	2.5
Coolant Pressure (psia)	1200	1200
Coolant Flow Rate (gallons/minute)	7400	7400
Coolant Inlet Temperature (°F)	430	430
Coolant Temperature Rise (°F)	20	20
Minimum Core Life: Full Load (Months)	9	18
Core Life: Normal Post Load (Months)	12	30

*MW=megawatts; MWe=megawatts electric

Table 4. Powered Lives of SM-1A Cores

Core No.	Approx. Power Dates (Mo/Yr)	Life (Mo)	Operating Capacity*	Powered Life (Mo)
I	6/62 - 8/63	15	70%	10.5
II	4/64 - 10/65	18	58%	10.4
III	1/66 - 6/67	16	~80%	(~12.8)
Two-year closure for repairs, after which Core III operation continued				
III	5/69 - 6/70	13	~85%	~24.
IV	8/70 - 3/72	terminated with shut-down		

*Averages of annual data for the years of core operation [11]

11 R. J. Fasnacht et. al. *U.S. Army Corps of Engineers SM-1A Nuclear Power Plant Historical Summary.* 1992. (p. 1-2).

4. Major Accidents and Early Decommissioning Suggest Covert Mission

The Greely reactor was the "first copy" of the SM-1 family of reactors. Pushing a first-copy nuclear reactor to exceptional thermal power and neutron densities would be expected to have severely adverse consequences reflected in major accidents and early decommissioning. These adverse consequences are evident for the Fort Greely reactor. There was a major accident after five years of operation, resulting in a two-year outage, and a second major accident after only three more years of operation. This second major accident involved a loss of radioactive, live steam producing local fallout. As a result, the reactor was closed ten years after first criticality and was quickly decommissioned. (These two accidents are examined later in this report.) Neither the magnitude nor the character of the accidents were admitted, and the facts continue to be covered up to the present day.

5. Unused Heat Production Suggests Covert Mission

The SM-1A reactor produced so much more heat than was necessary to generate electricity and heat for Fort Greely, that almost three-fourths of the heat from Cores I and II was simply pumped down a discharge well, neither generating electricity nor heating the post.

According to Section VIII entitled "Secondary System" in SM-1A Booklet Version I (p. 14), the maximum electrical output of the SM-1A nuclear power plant depended on the amount of steam extracted for heating the Army post. With steam being extracted for post heating, up to 2.5 megawatts of electricity (MWe) could have been generated from the turbines. Without this steam extraction for post heating, maximum electric power generation was limited to 1.4 MWe.

With steam entering the turbine at 377°F and a condenser temperature of 60°F, the ideal efficiency for electric power generation would be 38%. The overall thermal efficiency may have been close to 30%, slightly less than a commercial nuclear power plant. During the summer, when little post heating was required, the maximum useful heat output of the SM-1A reactor would have been slightly more than 1.4 MWe/30% = 4.7 MWt. The summer useful load would then only have been 23% of the rated thermal output of 20 MWt of the reactor. Because Cores I and II ran for two summers but only one winter, the requirements for steam heating the post were less than average during their burns.

The bottom line of Table 3 (SM-1A Booklet Version II) credits one reactor core with providing electricity and steam heat for thirty months with a normal post load. Table 4 indicates that the powered life of Core I was 10.5 months and of Core II was 10.4 months. Given that most of these core lives were during the relatively low-load summer months, it is clear from these numbers that less than 10.5 months/30 months = 35% of fission heat from the first two SM-1A cores generated electricity for the post and steam heat. That is, more than 65% of the reactor heat must have been simply dumped during the burns of the first two cores.

The Army claimed that the purpose of the reactor at Greely was to generate electricity and steam heat for the base. Dumping the heat produced by the reactor, rather than using it for the stated purpose, suggests that the SM-1A had a different, highly-valued mission that justified wasting the heat. Other nuclear plants that waste heat produced by fission (such as the first eight reactors at Hanford, Washington) are operated in order to produce transuranics. The Army failed to inform the public that the Greely reactor produced transuranics and continues to cover up information about radioactive contamination that affects the lives of workers and residents of the area.

C. Neutron Activation Products Washed Into Sewer

The mission of the SM-1A at Fort Greely was the clandestine production of transuranic materials for tactical weapons. This conclusion is based on the facts that the reactor 1) used highly enriched fuel; 2) passed cooling water directly over the uranium fuel, 3) burned nuclear cores quickly; 4) had major accidents; 5) caused a government cover-up; and 6) produced unused heat that was wasted and discharged into the groundwater.

In addition to showing a simplified diagram of how neutron activation produces transuranic materials, Figure 2 also shows the results of a sewer analysis for the SM-1A reactor at Fort Greely. (See boxes entitled: "Fission Products" and "Key.") A willow tree and saplings were growing in a protected area between the sewer outfall for the military base and the side of Jarvis Creek that flows through the base a mile east of the reactor. Because a willow would absorb radionuclides from sediments, a researcher for this study took samples of stems and leaves. Analysis of this willow sample, taken in 1998, confirms that neutron activation products washed into the sewer.

Table 5. Analyses of Willow Sample

Artificial Radionuclide	Activity (pCi/Kg)*		±2 Sigma Count Uncertainty	Halflife (years)
strontium-90	20.**	±	30.	29.1
technetium-99	0.**	±	9000.	213,000.
uranium-235	4.8	±	3.2	704,000,000.
neptunium-236	18.1	±	4.8	120,000.
americium-243***	50.1	±	10.8	278.
curium-245	20.7	±	12.8	8,500.

Notice that the strontium and technetium activities are only indicative, as they are below the minimum detection limit for the analysis. If these activities are multiplied by their halflives, the product is the relative abundance of atoms of each radionuclide.

*air-dried weights **This is below the detection limit. ***counted as the Np-239 decay product

Table 5 shows the results of the analysis of the sample, excluding any naturally occurring radionuclides. The willow sample was air dried to 725 grams. It was analyzed for strontium-90, technitium-99, and then counted in a liquid Marinelli geometry on a low-energy germanium detector for gamma emissions. A 2000-minute gamma count was replicated, and a standard and empty blank were counted. The gamma results were submitted to a data evaluation routine to identify all peaks and then reject false-positive and false-negative identifications.

Radiological analysis of the willow sample reveals uranium-235 which was used to fuel the reactor. Of the usual long-lived products of uranium fission (strontium-90, technetium-99, and cesium-137), only strontium 90 was detectable-- and that was barely detectable, if at all. While transuranics that are seldom reported in vegetation samples (neptunium 236, americium-243, and curium-245) were detected by gamma spectrometry.

The most straight-forward implication of these results is that the SM-1A reactor had operated in a mode that greatly enhanced production of transuranic, neutron-activated radioisotopes. Nuclear reactors designed to be a steady source of heat, say for generating electricity and heating of buildings, produce long-lived products of uranium fission. In the case of the Greely reactor, analysis of the willow sample suggests that the reactor mostly produced transuranics instead of heat. Transuranics that are relatively uncontaminated by fission products and low atomic number activation products are valuable materials for nuclear weaponry, so the willow sample implies that the Greely reactor produced nuclear materials for weapons on a pilot-plant scale.

D. Contamination From the SM-1A Reactor

Review of government documents, personal interviews, observations, and sample analyses reveal that the U.S. Army at Fort Greely was responsible for radioactive contamination through:

1. Control rod accident;
2. Radioactive steam heat to the post;
3. Liquid radioactive waste;
4. Radioactive fallout;
5. Solid radioactive waste disposal;
6. Long-lived radioactivity in reactor.

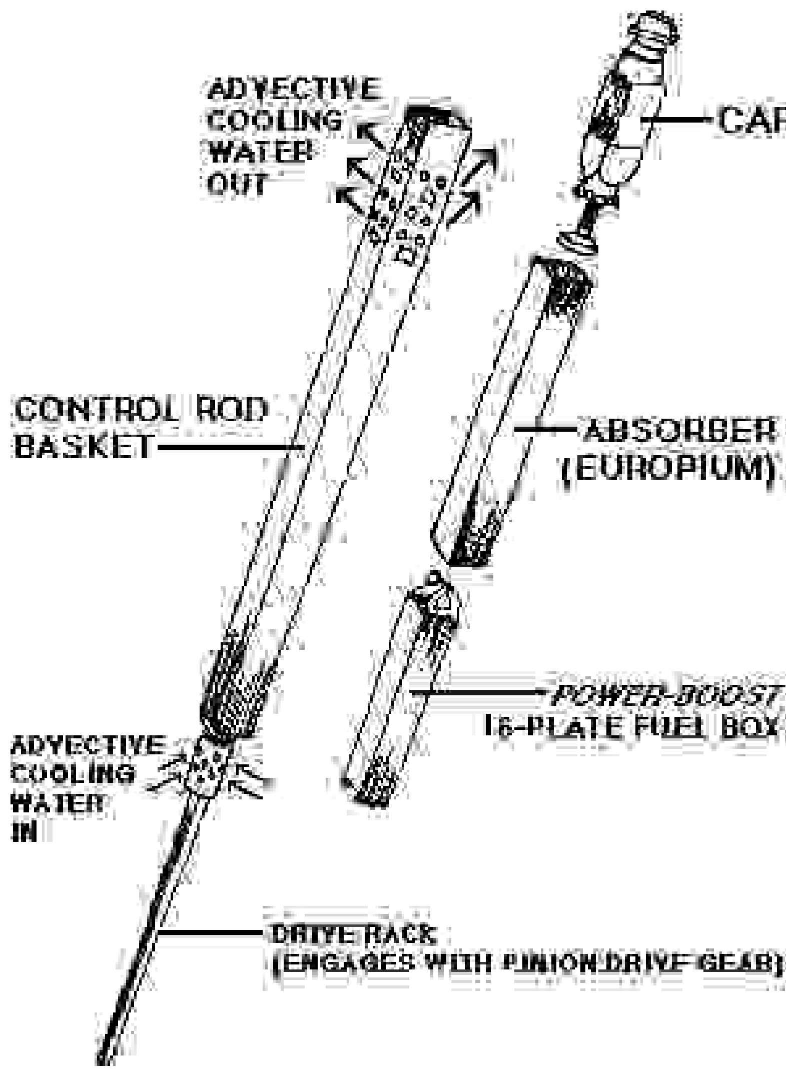
The Army is covering up the facts of contamination and tries to divert attention away from the facts that the reactor near Delta Junction, Alaska is responsible for environmental and human health problems. The Army is still painting a rosy picture of success for the SM-1A reactor.

1. Control Rod Accident

The probable cause of the abrupt shut down of the Fort Greely reactor in June 1967 is a boiling coolant, near-melt accident involving the control rods. This accident emerged from a fundamental error in reactor design, requiring redesign of the control rods, manufacture, and refitting of the new control rods during the two-year outage from 1967 to 1969. The basic problem involved inclusion of fuel plates into the lower portion of the reactor control rods without provision of any substantial cooling for these fuel plates. This problem is described below in more detail.

Inadequate Cooling System. There were seven control rods which were driven vertically by rack and pinion gearing. The control rods are sketched in a disassembled view in Figure 3, taken from the SM-1A Booklet Version I. To slow the rate of nuclear fission and heat production in the SM-1A, the control rods could be lowered into the reactor. In the event of an emergency, the drive was clutched and the control rods simply dropped all the way down, with the neutron absorber section (europium) of the control rods thus inserted into the core.

Figure 3. SM-1A Control Rods Design Before 1969 Repair Work



A peculiarity of this control rod design is that the absorber material could be racked up out of the core, and what is here termed "a power-boost fuel element" brought up into the core. The control rods could thus deliver added fuel, speeding the reactor and producing more heat both within the fuel rods and within the power-boost fuel in the control rods.

But the speeded-up, heated-up reactor needed to be cooled. As seen in Figure 1, the stationary fuel elements were cooled by primary cooling water which was pumped through them, and Figure 4 shows that the heat was then exchanged through the steam generator and carried out of containment by the secondary coolant steam. On those occasions when the control rods were racked nearly to their top position, the power boost fuel elements within the control rods were cooled only by advection as the water in the pressure vessel was heated by the fissioning fuel in the control rods (See Figure 3). The water in the pressure vessel was cooled mostly by reverse thermal advection to the stainless steel cladding on the fuel elements. In other words, there was really no substantial cooling system for the power-boost feature of the control rods.

The SM-1A reactor specification was that the mean temperature of primary cooling water passing over the fuel in the fuel rods was 440^0 F. The water was pressurized to keep it from boiling. At the 1,200 psia pressure maintained in the primary coolant loop, the water in the pressure vessel would boil at 567°F. As long as the water within the hottest cooling rod did not exceed 567°F, there would be no steam produced within the reactor. The difference between the 567°F boiling temperature in the primary loop and the 440°F average temperature of primary coolant in the fuel rods is only 127°F.

This temperature difference was split between 1) advective cooling of the fuel in the control rods and then cooling of this water in the pressure vessel by thermal advection on the outside of the fuel rods; followed by 2) convective cooling through the stainless steel cladding of the fuel elements followed by the same efficient forced-flow cooling that cooled the fuel inside the fuel rods. Unfortunately, this passive method of cooling proved inadequate for the reactor at Fort Greely in June 1967.

Poor Geometric Arrangements for Control Rods. Overheating of the control rods was also fostered by the particular geometry of the SM-1A core. There was no simple way to place seven control rods symmetrically in a square core, which is necessary for equal distribution of the heat in a reactor. Because of this geometrical limitation, one or two of the seven control rods had to run hotter than the other control rods.

The problem with geometry is demonstrated by comparing the SM-1A at Fort Greely with the SM-1 prototype at Fort Belvoir, Virginia. The SM-1A Booklet Version I (p. 2) shows that the Fort Greely reactor had twice the rated heat output of the SM-1 prototype at Fort Belvoir. Taking geometry into account, the prototype probably had five control rods, one in the center and four in a square. (The sequence of the number of control rods that can be arranged in a square is: 1, 4, 5, 8, 9, 12, 13, 16, 17, etc.) To scale the SM-1 up by a factor of two from a five-by-five square of fuel rods to a seven-by-seven square of fuel rods, the symmetry of control rod placement had to be lost. The SM-1A reactor not only produced twice the heat of its prototype at Fort Belvoir, the Fort Greely reactor also had one or two control rods that ran relatively hotter than the others.

Preventing Control Rod Melt Down. The inadequate passive cooling system and asymmetry of the control rods in the Fort Greely reactor introduced the prospect of a full-power accident late in a core burn, by which the pressurized water in one or two of the control rods would have begun to boil at 567°F, producing steam and displacing water in the pressure vessel.

The list of events for which there were emergency procedures is outlined in Fasnacht et. al (p. 4-10) and in the SM-1A Booklet Version I, and summarized here in Table 6. Nothing in the Army documents suggests any procedure in the event of water boiling in control rods.

Table 6. Types of Events Leading to Emergency Response Procedures

Line break: primary, steam, or feedwater
Loss of flow: primary or feedwater
Loss of site power: AC or DC
Release of radioactivity
Reactivity excursion (--escalating neutron flux)
Reactor over-power (120% full-power)
Fire
Personnel injury
Reactor scram failure
Earthquake
Release of total thermal inventory into containment

Usual design practice would assure that the reactor could equalize pressure between the fuel rods and the pressure vessel, and between the pressure vessel and the shield tank (Figure 4), unless there was an emergency situation that forced the water level in the pressure vessel below the advective cooling water outlets of the control rods. In which case, their advective cooling would fail and the fuel in the rods would melt at about 2070°F. To prevent meltdown, the reactor would have to be shut down. The design of the SM-1A incorporates neutron monitoring instruments in the primary shielding, near the top of the reactor, so it is likely that the plant operators would have had at least one indication of such a boiling-water malfunction, and thus shut the reactor down before the control rods could melt (SM-1A Booklet Version I, figure 3, p. 7).

Such a managed event suggests a steam-generation incident within the pressure vessel. It would have been managed by shutting the reactor down, venting the steam to atmosphere, and determining what corrective measures were required. It is likely that this scenario for the SM-1A occurred in June 1967 requiring an abrupt shut down and extensive repairs lasting two years.

According to the evidence provided by the SM-1A Booklet Version II, when the reactor was restarted in 1969 the corrective measures included the following:

- The power boost feature was mitigated by control rod redesign;
- Permissible SM-1A thermal power was reduced by 50%, which doubled core life but likely eliminated production of super fissile transuranics;
- The pressure vessel may have been vented to allow better advective cooling of control rods;
- The steam generator in the reactor compartment was replaced.

The repaired reactor operated at a slower and cooler pace, more in line with the cover missions of creating electric power and steam heat.

Endangering Workers to Expedite Cleanup. Core III was cooled and removed from the reactor to allow repairs. Inasmuch as the Army was attempting to conceal the control rod accident, the need to get the reactor fixed must have been urgent. But before repair could begin near the reactor, sixty days would have been required for Core III to cool enough to remove the fuel elements to the spent fuel pit.[12] The primary concern here is with the exposure of workers to radioactivity in the expedited repair work on the Greely reactor. In 1971 at Amchitka Island, Alaska, the government had no compunction about sending unknowing workers to re-drill after the Cannikin blast allowing them to be irradiated by the venting pathway.[13] The researchers for this study are concerned that a similar scenario may have occurred in the summer of 1967 at Fort Greely, Alaska.

2. Radioactive Steam Heat

Steam heat for the Army post was obtained from some of the water used to cool the reactor. Primary cooling water pumped through the SM-1A reactor (see Figure 1) was heated to 450°F in the reactor and pressurized to 1200 psia to keep it from boiling. This primary cooling water passed through the tubes in the steam generator shown in Figure 4. Treated feedwater was pumped into the jacket of the steam generator at 250°F, and this water boiled upon contact with the tubes which produced steam at 381°F and 200 pounds per square inch gauge (psig). The generation of the secondary-loop steam thus cooled the primary water to 230°F, which was then ready to be sent back for another pass through the reactor. The secondary-loop steam was used to drive the turbine-generator, producing up to two megawatts of electricity, and to provide steam heat for the Army post and steam to the post laundry.

Leaky Steam Generator Tubes. Fasnacht et. al state that in 1969 the steam generator was replaced due to leaky tubes (p. 1-3). The SM-1A Booklet Version II indicates that the steam generator was the last repair undertaken during that two-year outage. Clearly, failure of the steam generator did not cause the 1967 shut down, but the leaky tubes in the steam generator demanded attention. Table 6 shows that primary loss of coolant due to leakage from the tubes in the steam generator is not and would not be listed as a type of occurrence requiring any emergency response. On the other hand, leaking tubes could lead eventually to a tube rupture, which would be a major reactor accident requiring emergency response. The steam generator was probably replaced finally in 1969 as a safety measure to avoid a major reactor emergency due to loss of coolant.

The pressure and radiation containment system for the SM-1A is sketched in Figure 4 with fluid-flow paths through containment shown. All of the spaces inside the vapor container in Figure 4 were filled with water, which provided part of the radiation shielding. The shield tank consisted of forty-two inches of reinforced concrete inside a half-inch thick steel shell. The pressure vessel functioned to contain pressure as shown in Figure 4 and described in SM-1A Booklet Version I before the two-year closure, but when the nuclear reactor was restarted in 1969, the later version of the SM-1A Report lacked any indication that the pressure vessel actually contained pressure.

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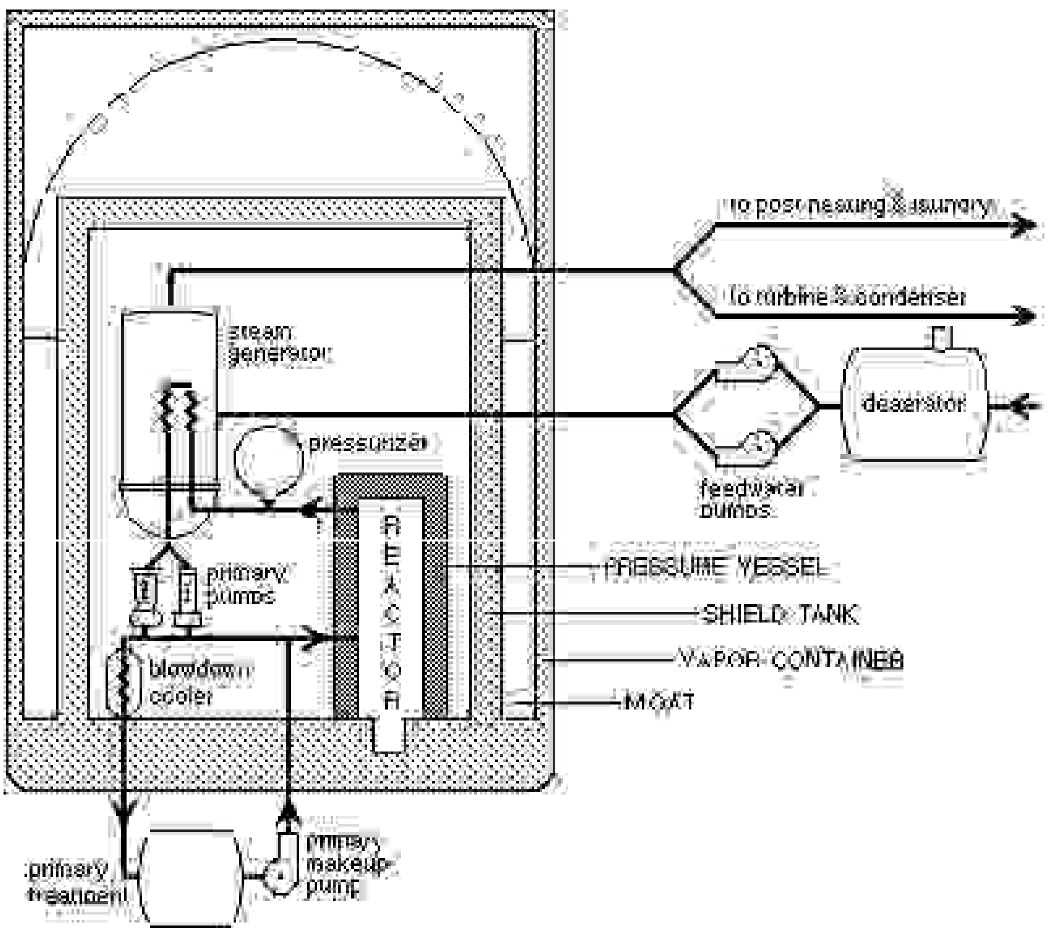
12 *Preliminary Assessment, Fort Greely, Alaska.* 1992. (p. 3-93)

13 Buske, Norm and Pamela K. Miller. *Nuclear Flashback: The Return to Amchitka.* Greenpeace USA. 1996. And *Nuclear Flashback Part Two: The Threat of the U.S. Nuclear Complex.* Alaska Community Action on Toxics. February 1998.

The changes from the first to the second versions of the SM-1A Report reflect a change in the function of the shield tank beginning in June 1969. The pressure vessel might have been intentionally breached allowing the shield tank to serve as the only pressure containment.

Figure 4. Simplified Flow Diagram and SM-1A Containment



The highly radioactive water coming from the reactor was inside the tubes at 1,200 psia, inside the steam generator. Outside these tubes was supposedly uncontaminated, secondary-loop water which was boiled to produce steam at 215 psia. Thus there was 985 pounds per square inch more pressure inside the leaky tubes than outside them. So the primary coolant water at about 430°F blew out through the leaks, vaporizing into steam in the secondary-loop jacket of the steam generator. This is how the secondary steam was contaminated with radioactivity. The secondary steam used for post heating, in the post laundry, and in the turbine that generated electricity became radioactive. Only the turbine was in a radiologically controlled area.

Before the steam generator was replaced, the reactor was operated with leaky tubes, and the Army continued to use the steam in the laundry and for heating, as shown by post-closure surveys that revealed hot spots. The secondary steam used in the laundry and for heating buildings was not considered by workers and residents to be contaminated, but was viewed merely as "steam." The fact that the reactor was operated with leaky tubes only until they threatened the reactor itself is another indication that the mission of the Greely reactor was so important that contamination of steam in unrestricted areas was accepted as operational, both by design and by actual practice.

Radioactive Steam Heat Used for Extended Period of Time. A 1973 Army report of a radiological survey reveals that radiation was detected from three ceiling or wall heaters on the post.[14] As the control rod accident occurred in June 1967 when there was little need for post heating, this spread of radioactivity suggests that leakage in the steam generator was more likely an on-going condition than an effect of the event that caused the two-year outage of the SM-1A. The implication is that radioactive steam was used for post heating over an extended period of time.

Health Risks from Contaminated Steam Heat. The primary health risk of radioactive steam is to breathe air containing released steam, or from ingestion of steam condensate. There were health risks for those at Fort Greely who lived or worked in areas kept warm by contaminated steam heating, as well as the post laundry, which used contaminated steam directly. Furthermore, there would be yet unknown health risks for workers who handled materials in whatever process the Army used (and failed to document) for disposing of the secondary-loop steam contaminated by primary coolant.

As heating steam passed around bends in pipes and in the corners of heaters, contaminated particulates were centrifuged to the outside of the bends and corners and collected there. Some of these locations were reported in radiological surveys, and the offending plumbing was presumably removed. But it is likely that much of the steam heating system still remains out of sight and may be inaccessible to radiological survey. As Fort Greely turns over many of its structures to civilian operations, the steam heating system is likely to be repaired or replaced. Army or civilian construction teams involved in working on the heating system would be at risk of contamination.

Sample Analysis Indicates that Steam Heat Was Radioactive. The documented pathway for radioactive contamination of the heating steam at Fort Greely was from primary coolant through the steam generator which was replaced in 1969 "because it developed numerous leaks" (*Preliminary Assessment*, p. 3-93). The radiological inventory of the steam heating system would thus be expected to correspond to the inventory of primary cooling water, with the shorter-lived radionuclides decayed out.

No analyses of either primary coolant or the radioactive contaminants in the steam heating system have been found in Fort Greely reports. But a willow collected from the sewer outfall, obtained in 1998 for the present study (See Table 5), provides analytical evidence that waters having been in contact with SM-1A fuel were primarily contaminated with highly enriched uranium and transuranics. Some still contaminated plumbing should be analyzed to determine the inventory of the remaining radiological hazard.

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14 R. R. Bowers and N. Holland, *Final Radiological Survey of the SM-1A Nuclear Power Plant Facility and Site*. 1973. (pp. 72-75).

3. Liquid Radioactive Waste

Table 7 lists four operating periods for the SM-1A reactor. The first period involved most of the production of radioactivity at Fort Greely. The second period was for major, unscheduled repair and refitting. The third period was after the repairs for derated operation until the end-of-life of the reactor. The fourth period involved the decommissioning of the SM-1A. While each of these four periods saw its own unique, liquid radioactive waste streams from the SM-1A plant, the first period probably produced the bulk of liquid radioactive waste at Fort Greely.

Table 7. Four Operating Periods of SM-1A Reactor

Dates	Years	Character	Total of Four Cores (I - IV)
6/62 - 6/67	5.0	Operation	I-Burn, Refuel; II-Burn, Refuel; III-Interrupted
6/67 - 5/69	1.9	Repair/Redesign	No power; Unfuel and Refuel-III
5/69 - 3/72	2.8	Operation	End of III; IV-Interrupted
3/72 - 6/73	1.3	Decommissioning	Unfuel IV

After the accident of June 1967, the Engineer Reactors Group installed a decontamination skid, a system for evaporation and deionization of the liquid waste. When it was installed in March 1968, the skid heralded new radioactive waste treatment and disposal procedures for the SM-1A plant. According to McMasters et al. (p. 3-1)[15] and a 1974 report[16] on the final decommissioning of the reactor (p. 15), there were only 0.001 curies (not counting tritium) of beta-gamma liquid radioactivity disposed at Fort Greely during the remainder of the repair period, the end-of-life operation period, and the decommissioning period. This was less than a tenth of one percent of what has been calculated to have been discharged during the first operation period and the beginning of the repair period. Because of these facts, only the first period of SM-1A operation and the beginning of the repair period are considered here in regard to liquid radioactive waste streams to the Fort Greely environment.

Source of Cooling Water. To operate the hot quick-burn reactor at Fort Greely, the Army needed sufficient water to cool the SM-1A reactor core at maximum burn rate. Availability of large amounts of water was an important consideration for situating the reactor. According to McMasters et al., the Fort Greely cantonment is located over a twelve-mile long, south-north tongue of flood plain alluvium with a potential groundwater supply mapped in the 1,000 to 3,000 gallons-per-minute (gpm) range. The Army was thus assured of a reliable 1,000 gpm cooling water supply for the SM-1A reactor cores.

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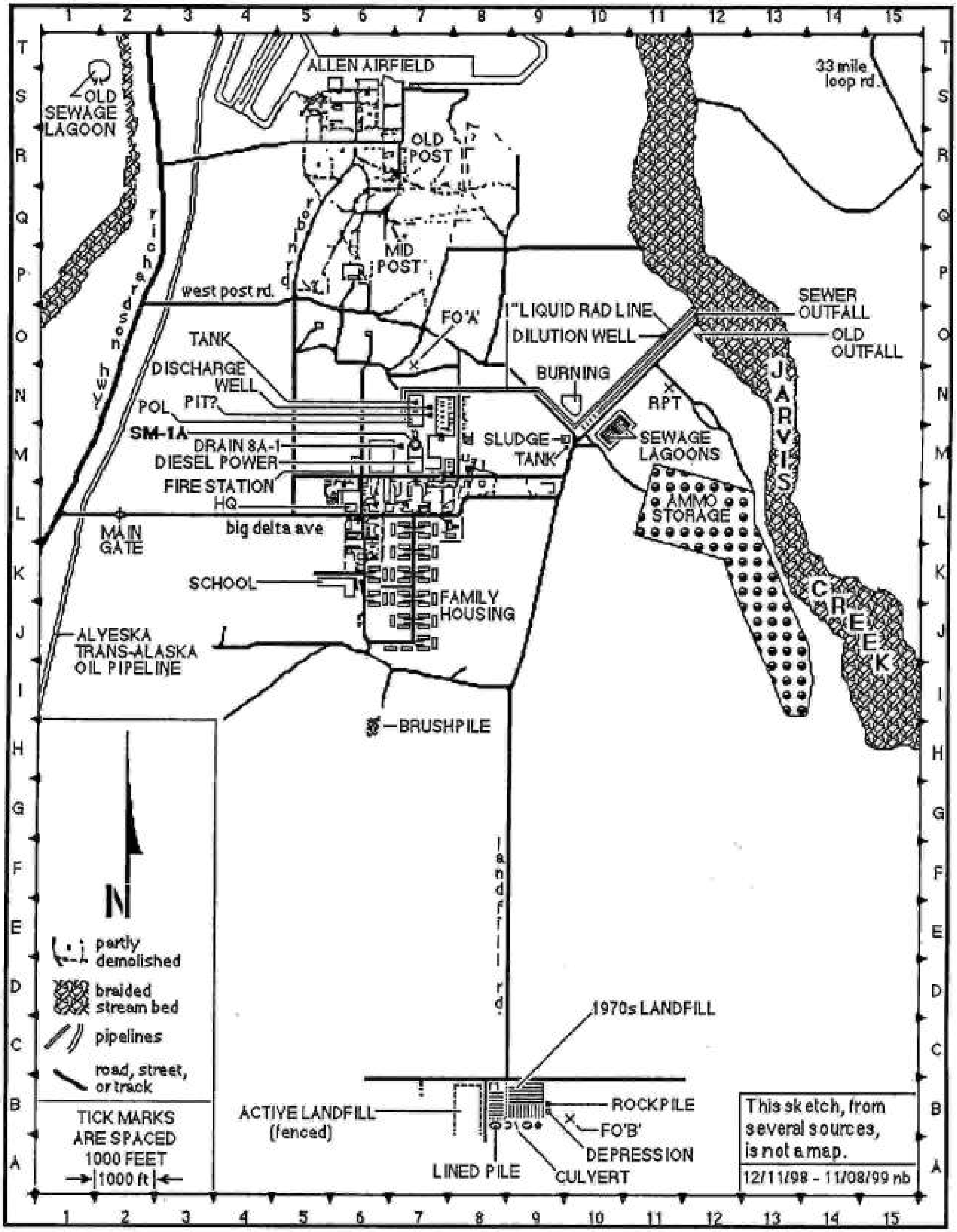
15 B. N. McMasters, et. al., *Installation Assessment of the Headquarters, 172D Infantry Brigade (Alaska), Fort Greely, Alaska.* 1983.

16 John W. Van Norman. *SM-1A Nuclear Power Plant Final Decommissioning Report.* 1974.

Figure 5. Sketch of Location of Reactor within Fort Greely Base



The 20 MWt heat produced by the reactor at full power was exchanged from the uranium fuel plates, in which it was generated in the reactor core, into pressurized water passing directly over the fuel plates in the primary coolant loop. Secondary cooling was provided by steam which was heated from the pressurized primary coolant tubes in the steam generator within the shield tank of the reactor. Some of the secondary loop heat was used as steam in the post laundry and for steam heating in buildings on the post, and some was used for electricity generation.

The remainder of the heat that originated in the reactor was exchanged from the steam in the secondary loop to tertiary water passing through the condenser at the turbine. This tertiary water was pumped from either of two borehole wells rated at 1,000 gpm. Considering potential losses in the system and possible derating of pump feed, it appears the tertiary cooling system was designed to deliver unused heat from the SM-1A core back to the unconfined aquifer under Fort Greely somewhat below the groundwater boiling temperature of about 210^{o}F.

This condenser-cooling water loop was available throughout the life of the SM-1A reactor. Discharge of primary blowdown cooling water into this loop required minimal in-plant piping, so it was not shown in the SM-1A booklet. However, the existence of such piping from the blowdown cooler or waste tank to a well line is confirmed by McMasters et. al (Appendix E). The plant plumbing allowed disposal of radioactive, primary coolant to the discharge well.

Discharge Well: Primary Means of Disposal. In his description of how nuclear waste was handled for the Fort Greely reactor, Johnson draws on a United States Geological Survey publication[17] to demonstrate risks from contamination by liquid radioactive waste discharged from the reactor. Johnson states that the flow of the aquifer beneath Fort Greely is to the northeast,

> until it contacts the Tanana River at which point it either flows west and northwest or it "probably discharges... in the Clearwater Lake Area." Either way, the water of Delta is directly downstream. The USGS also concluded that there is an "overall high transmissivity for the alluvia water." In other words water moves through the aquifer quickly and the radioactive material would quickly be spread throughout the system [Johnson, pp. 71-72].

Johnson refers to McMasters et al. (Appendix E) to describe the 250 foot discharge well which was on the base, about 800 feet northeast of the reactor site at N7 in Figure 5 (63° 58' 32"N, 145° 42' 54"W). McMasters et al. report on a discharge of 446,400 gallons of contaminated primary blowdown cooling water to the discharge well in August 1963, confirming that plumbing was used to dispose of liquid radioactive waste to the discharge well from the earliest days of the Greely reactor operation. One of the Delta Junction residents interviewed for this study also indicates that this discharge well was the *primary* disposal site for liquid radioactive waste "from day one" of SM-1A operation.

Reviews for this study of the pathways of liquid radioactive waste disposal from the SM-1A reactor support the conclusion that the discharge well was the primary means of disposal, until a decontamination skid was installed in March 1968. The general connection for this pathway was pumpable piping from the primary blowdown loop to the (tertiary loop) that lifted about 1,000 gpm from wells near the reactor and disposed this water again into the groundwater at the discharge well.

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17 Dorothy E. Wilcox, *Geohydrology of the Delta-Clearwater Area, Alaska.* 1980. (pp. 8-11).

The August 1963 disposal along this pathway was reported to be 0.01 curies (Ci) of radioactivity (See Table 8).

Core II was removed from the SM-1A reactor at the end of 1965. The Army did not document how they disposed of the large volume of liquid radioactive wastes attending this refueling of the reactor. Based on the pumpable nature of these liquid wastes, it is likely that one disposal pathway was the discharge well. The information collected for this study suggests the bulk of liquid radioactive waste from the SM-1A reactor was piped down the discharge well without any radiological accounting. The main radioactive contamination of this discharge water would have been short-lived reactor products plus tritium, uranium and transuranics, as well as long-lived fission and activation products.

Two other releases to the discharge well are important: heat and potassium chromate used to inhibit corrosion from the water held in the reactor vapor container moat (Figure 4) and in the primary coolant (Bowers & Holland, p. 15; and *Preliminary Assessment,* p. 3-31). The heat is important because contaminated hot water that was discharged while the SM-1A reactor was operating would have floated on the water table of the groundwater. The chromate is important because hexavalent chromium in such corrosion inhibitors is extremely toxic.

Geohydrological predictions of groundwater travel times, such as pathways at U.S. nuclear military facilities, have proven so unreliable as to offer no assurance of route or emergence times of contamination. (For examples see Buske & Miller, 1996 and 1998). Other means are needed to evaluate the pathways of contaminated water from the discharge well at Fort Greely. According to the Army's historical summary, tracer dyes were put down the discharge well.

> Prior to discharge of any liquid radioactive waste to the [discharge well], tests were conducted using tracer dyes to prove that there was no connection between the [discharge well] aquifer and aquifers at other levels used for wells. The environmental sampling program of other wells at Fort Greely and in the local community *confirmed that there was no contamination of the water supply* [Fasnacht et. al, p. 4-1; emphasis added].

In asserting that the dye test confirmed that there was no contamination of the water supply, the Army researchers made a serious error in logic. One cannot scientifically prove a negative. The only scientific claim the Army can make from this exercise is that if dye appears, then there is evidence for potential contamination of that particular water supply that became dyed. All that the Army researchers proved by this exercise was that they did not locate the pathway at the relevant travel time.

Another way to understand the error the Army made with conclusions about this dye test is to imagine people at the beach on a bright sunny day. If they cover their eyes and cannot see the light, can they then claim that they will not get a sunburn? The absence of dye in the Army's eye-closing exercise could not indicate that the drinking water was safe, and the Army report is simply another example of the Army practice of attempting to placate public concern.

Informants for this study from Delta Junction reported that borehole wells were used in the town throughout the reactor operational era, because the groundwater is too deep to access by dug wells. They mentioned underground rivers through the effluvium, and described pronounced variations in well water quality from one well to the next. The borehole wells in the Delta Junction and Fort Greely area were typically about 200 feet deep, which enabled them to draw water from below the surface of the unconfined aquifer. This is good news for the residents of Delta Junction, as they probably did not drink water contaminated with radioactivity from the Greely reactor.

On the other hand, the residents of the Clearwater area may not have escaped drinking radioactive water. The water table approaches ground level at Big Delta (eight miles to the north) and at Clearwater to the east. The authors of the *Preliminary Assessment* suggest that the groundwater from the vicinity of the discharge well might emerge as springs into Clearwater Lake (p. 2-18). One informant reported a second-hand anecdote of "effervescent water" from a shallow well in Clearwater. An aggressive radiological and chemical study is needed to determine the extent of contaminated groundwater affecting dug wells in Clearwater. Once the likely underground river from the reactor to residential wells is located, one or two indicators of its presence can be identified, and then the extent of contamination can be mapped.

Radioactive-Waste Pipeline to Jarvis Creek. The early record of liquid radioactivity releases to the Fort Greely environment is summarized in Table 8. Johnson (p. 70) indicates that under the approval of the Atomic Energy Commission, the Army initially disposed of its secondary liquid waste from the reactor by dumping it into Jarvis Creek, a glacier fed stream that flows northward through the base one mile east of the reactor.

Later disposal to Jarvis Creek was along a one-inch pipe buried about two-feet underground, running north, then east and southeast, then northwest, a total of 1.25 miles. The discharge into Jarvis Creek is shown at P12 (63° 58' 43"N, 145° 41' 19"W) on Figure 5. Considering that the mean January temperature is minus 2°F at Fort Greely, this radioactive-waste pipeline would have been expected to freeze and break-up. The one-inch radioactive waste line was clearly never designed or used as a reliable avenue for liquid radioactive waste disposal.

Drawing from the SM-1A Booklet Version I (Part V, p. 15), Johnson discusses another "obvious flaw" in the plan. Jarvis Creek freezes over for five to six months a year, and when it is not frozen the flow of the stream is not constant.

> It is quite low in the early spring and late fall because the glacier is not melting and supplying runoff. In practical terms this meant that it was only possible to utilize the creek as a nuclear waste dump for three to four months out of any given year [Johnson, p. 70].

At first the Army built holding tanks near the creek to utilize Jarvis Creek during its periods of maximum flow, but there was too much waste. A discharge point that was available the entire year was necessary. The decontamination skid solved this problem in 1968 by using evaporation and deionization to remove radioactivity from the effluent (Johnson 71).

According to the data in Table 8, about 0.6 curies (Ci) of beta-gamma radioactive liquid was disposed when Core I was removed and again when Core III was removed from the reactor. It is likely that the one-inch radioactive waste pipeline was a disposal route for the unfueling waste stream, but when Core II was unfueled, only 0.1 curies was reportedly released along that pipeline to Jarvis Creek. These data suggest that some releases of liquid radioactivity were measured, disposed to Jarvis Creek, and included in reports; while the bulk of radioactive liquids were routinely disposed elsewhere--some of which were reported and some not.

Table 8. Early SM-1A Radioactive (Rad) Release and Refueling Reports

Period	Date Mo/Yr	Rad Release Curies	Disposal Point	Fueling
03/62				Fuel Core: -> I
	09/62	0.009	Jarvis Creek	
	07/63	0.012	Jarvis Creek	
	08/63	0.012	Discharge Well	
08/63-04/64				Refuel Cores: I -> II
	10/63	0.033	Jarvis Creek	->
	07/64	0.267	Jarvis Creek	->
	08/64	0.330	Jarvis Creek	-> 0.63 curies
	09/64	0.064	Jarvis Creek	
	07/65	0.053	Jarvis Creek	
	08/65	0.094	Jarvis Creek	
	09/65	0.048	Jarvis Creek	
10/65-01/66				Refuel: Core II -> III
	07/66	0.022	Jarvis Creek	->
	08/66	0.078	Jarvis Creek	-> 0.10 curies
07/67...				Unfuel: Core III removed
	07/67	0.167	Jarvis Creek	->
	08/67	0.262	Jarvis Creek	->
	09/67	0.176	Jarvis Creek	-> 0.60 curies
	03/68	0.000	Discharge Well	<- Decontamination Skid

Sources: McMasters et al., p. E-1; SM-1A Booklet Version II

Sewer Line to Jarvis Creek. In addition to the one-inch, radioactive-waste pipeline that reportedly released radioactive liquids to Jarvis Creek, the sewer system from Fort Greely also emptied into this Creek upstream (south) of the one-inch radioactive pipeline. (See Figure 5). Liquids drained to the sewers were held in a tank and chlorinated before disposal into Jarvis Creek. Floor drains in the power plant were used for radiological waste disposal, which traveled through the sewer system along with sewage from the military base. Investigators for the present study using Geiger counters detected above normal radioactivity at the eight-inch-sewer outfall, 250 feet upstream of outfall from the one-inch, radioactive-waste pipeline.

Background radioactivity in Jarvis Creek differed from Fort Greely generally, and had hot spots associated with fine brown sediments, presumably due to naturally occurring uranium and thorium decay products in silts washed out of the mountains. Although background radioactivity at Jarvis Creek is variable, the area of the eight-inch-sewer outfall measured about twenty-five percent above local background with survey instruments. Another six-inch-sewer outfall (63° 58' 42"N, 145° 41' 24"W) 350 feet farther upstream had been abandoned, and did not measure above background with radiological survey instruments. The area near the end of the one-inch, radioactive-waste pipeline into Jarvis Creek measured approximately twenty percent above local background.

Analysis of a sample of a willow tree taken at the eight-inch-sewer outfall (Table 5.) shows that transuranics were present in the sewer draining from the reactor. These radiological results suggest the source material for these transuranics was primary cooling water and/or wash water used to clean spent fuel from the SM-1A. Apparently radioactivity entered the Fort Greely sewer, migrated through the sewage treatment system, and emerged into public access at the eight-inch sewer outfall at Jarvis Creek.

These results raise concern because the Army did not admit that the sewer system was a radioactive waste disposal pathway, although it was clearly used as such. No evidence has been found of pathway analysis or comprehensive, radiological pathway management.

4. Radioactive Fallout

The Army states "there was no significant" radioactive fallout from the SM-1A reactor (Fasnacht et. al, p. 4-2). Although the Army reported as few as five and as many as sixty-eight plant operation malfunctions each year that the Greely reactor was in operation, the published record is incomplete (Fasnacht et. al, Appendix A and p. 4-10). The researchers for this study found evidence that an accident with the steam turbine caused radioactive fallout around the reactor on March 13, 1972.

Radioactive Fallout from Steam Turbine Accident. The SM-1A reactor was shut down suddenly on March 13, 1972, because

> Problems with the steam turbine caused an interruption to normal operation of the plant. Major repairs to the turbine would have been necessary to resume normal operation [*Preliminary Assessment*, p. 3-93].

After the SM-1A reactor was shut down, Bowers and Holland conducted a final radiological survey in 1973. This independent survey discovered cesium-134 (810 pCi/Kg wet) and cobalt-60 (3600 pCi/Kg wet) in grass collected on site, west of the reactor buildings. V). These authors concluded that their grass sample "did show activities of [SM-1A] plant origin" (p. 75). Cesium-134 has a 2-year halflife and cobalt-60 has a 5.2-year halflife. Neither of these radionuclides is detected in atmospheric fallout from nuclear weapons tests. The presence of radioactive cesium and radioactive cobalt in grass clippings points to a fallout pathway from the reactor.

Cesium-134 derives primarily from used or in-use reactor fuel, and cobalt-60 primarily from steel in piping and containment structures. In the Fort Greely reactor, primary cooling water flowed past stainless steel surfaces and directly over the highly enriched uranium fuel. Cesium-134 and cobalt-60 would have been eroded and corroded from these materials and carried in primary cooling water, both in dissolved and particulate fractions. With the reported leaks in the steam generator (See Section 2. Radioactive Steam Heat, above), Cs-134 and Co-60 would have migrated from the primary cooling water into the secondary steam system as well. In their Final Radiological Survey, Bowers & Holland reported that cesium-137 was also found in the on-site grass clippings at 1300 pascal per kilogram, in addition to the Cs-134 and Co-60.

A review of SM-1A schematic flow diagrams, the Bowers & Holland 1973 report, and the 1998 on-site investigation by researchers for this study indicates that the most likely release mechanism for the described fallout was an unplanned, uncontrolled escape of live steam from the secondary loop at the turbine. The accident probably released live, radioactive steam to the SM-1A plant and to the reactor's environs.

Date of Radioactive Fallout. Nuclear reactors produce Cs-134 and Cs-137 in the ratio 0.4 to 0.6 for Cs-134/Cs-137[18] The Chernobyl reactor accident in Russia in 1986 yielded a radiocesium ratio of Cs-134/Cs-137 = 0.5. Cesium-134 has a short 2.1-year halflife in comparison to the 30.2-year halflife of Cs-137. As soon as cesium is released from a reactor, the ratio of Cs-134/Cs-137 begins to decline from its initial value in the range of 0.4 to 0.6. If the initial value of the radiocesium ratio is known, then the elapsed time passed since a release of radiocesium can be calculated by measuring the Cs-134/Cs-137 ratio in a sample of material that originated from that release.

Considering the Cs-134 and Cs-137 in the grass clipped from Fort Greely in June 1973 as having a single fallout origin, the reported one sigma counting errors of 14% and 8%, respectively, are indicative of the uncertainty of the measured ratio of Cs-134/Cs-137. In June 1973 when the grass samples were taken, the Cs-134/Cs-137 ratio was nominally 0.62. Assuming the last operating day of the SM-1A reactor was March 13, 1972, fifteen months had elapsed since the last day this radiocesium clock could have begun to run down. On March 13th the radiocesium ratio in this sample would have been 47% higher or nominally Cs-134/Cs-137 = 0.91. That value is far above the radiocesium range typical of nuclear reactors, which indicates that the event releasing this fallout to the Fort Greely environs could not have occurred much before the day the reactor was closed. Thus, the date of the fallout event is probably the closure date: March 13, 1972.

Impact of Radioactive Fallout. The primary impact of this March 1972 nuclear fallout accident at the Fort Greely reactor would have been limited to plant operating personnel and other individuals within the generating station. Secondary impact would have been limited to particulate fallout on persons within a few thousand feet of the reactor. Radionuclides of primary concern would probably have been transuranics (neptunium, plutonium, and curium); followed by radioiodine (I-125, I-131, I-132, I-133,

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18 M. Eisenbud, *Environmental Radioactivity. Third Edition.* 1987. (p. 414).

and I-135); and other fission products (strontium-89 and -90, and cesium-134 and -137). Affected persons or their survivors should be advised and made eligible for medical treatment and compensation.

No Radioactive Hot Spots Found at the School. Radioactive fallout from the final SM-1A accident probably had substantial impacts only on the post at the time of the accident. Researchers for this study conducted a general survey of the site in August 1998. Long counts on old moss substrate were obtained at Points FO'A' and FO'B' at N7 and B10 in Figure 5. The school and grounds (at J6) were checked with a Ludlum Model 44-9 survey detector. Construction materials were found to be below local background radioactivity. No radioactive hot spots were found in the school or on the grounds.

5. Solid Radioactive Waste Disposal

Floor drains in the power plant allowed radiological liquids to be discharged into the base sewer system. Liquids drained to the sewers were collected in a 150,000 gallon Imhoff tank. Sewage was held in the tank and then aerated in lagoons. In 1966, two lined sewage lagoons were constructed, which provided aeration and two-weeks retention before chlorination and disposal into Jarvis Creek. The sludge was dried in beds and disposed on site (*Preliminary Assessment*, p. 3-50). Figure 5 shows the locations of the "TANK" and "SLUDGE" dry beds at M9 and "SLUDGE LAGOONS" at M10.

In addition, about fifty cubic yards of wet sludge were reportedly removed from the Imhoff tank each year and put on six unlined drying beds. This process yielded about four cubic yards of dried sludge cake that was disposed to the Fort Greely landfill (*Preliminary Assessment*, p. 3-50; and McMasters et. al, p. 2-17). Because the sludge was radioactive, a contractor hired by the Army recommended in 1992 that any future investigation of the sludge drying beds should include radiological screening (*Preliminary Assessment*, p. ES-3). The soil column under the drying beds should also be screened, as the drying beds were not lined until 1990.

The location of the disposal of the dried sewage sludge needs to be determined, the dried sludge located, and the radiological hazard of the material analyzed. The dried sludge is presumably in the 1970s "LANDFILL" at B9 in Figure 5. The volume of located sludge should be matched to records and to estimates of volume disposed. This will provide a scoping indication of the potential on-site hazard. Other pathways and waste materials from the post sewage treatment system need to be assessed and checked by sampling and analyses. Exposures of workers to radioactive contamination need to be assessed.

6. Long-Lived Radioactivity in Reactor

The nuclear reactor at Fort Greely was closed on March 13, 1972 and a decommissioning plan was approved at the same time.[19] Johnson refers to the 1972 plan and a 1974 report (Van Norman) to describe the procedure used by the Army to deal with the radioactive materials in the reactor:

> [The plan] called for the removal of all highly radioactive material to special [Atomic Energy Commission] licensed disposal facilities in either Richland, Washington or Beatty, Nevada; encasement of everything left behind; and a final dismantling in the year 2023, after all potential danger from those radioactive materials that would be left on site had passed. The encasement structure was designed to last 150 years and to pose no danger of "significant spreadable radioactive contamination" [Johnson, p. 76].

19 *Plan for the Decommissioning of the SM-1A Nuclear Power Plant.* 1972.

Johnson notes that a 1990 environmental assessment[20] of the SM-1A determined that there was "major structural damage" of the encasement building eighteen years later in a structure that was supposed to last 150 years. Mentioning that the SM-1A was the first nuclear reactor in the United States to be decommissioned, Johnson concluded that the Army learned from mistakes made in 1972 and successfully repaired and rebuilt the encasement structure in 1992. Nevertheless, Johnson opines that "the potential environmental problem of radiation cannot be dismissed."

> When the SM-1A reactor was decommissioned, the United States Army estimated that it would leave approximately seventy thousand curies of radiation encased on site. Because of the halflife of the material, this would be reduced to some two thousand curies within twenty-five years. What the Army does not say is that this remaining 3 percent of radioactive material will take anywhere from 300 years to 500,000 years before it decays [Johnson, pp. 79-80].

The researchers for this study share Johnson's concern about the remaining radioactive material. After the fuel and other wastes were removed from the decommissioned SM-1A reactor in 1972, 48,300 curies of cobalt-60 were estimated to remain within the shield tank (Figure 4). The other remaining radionuclides are credited by the Army as being relatively short-lived in comparison to the 5.27-year half-life of cobalt-60 (*Preliminary Assessment*, p. 3-96).

By 1998 after twenty-six years, 4.9 halflives of cobalt-60 had passed, and the amount of cobalt-60 radioactivity remaining within the shield tank was reduced by a factor of thirty (= 2 to the 4.9 power). So about 1600 (= 48,300/30) curies of cobalt-60 would remain. Yet in a historical summary of the same twenty-six years, the Army gives itself credit for decay through 6.9 halflives of cobalt-60 (=36 years) and reports only 389.52 curies of residual Co-60 (Fasnacht et. al, p. 4-8). The concern here is not so much that the Army miscalculated (figuring thirty-six years between 1972 and 1998). The concern is the failure of the Army even to consider the truly long-lived radioactivity that remains in the SM-1A shield tank.

The actual, relative abundance of various radioactive isotopes depends on the particular construction and operational history of an individual reactor. The Nuclear Regulatory Commission has analyzed much of the hardware from the Shippingport Station, for the purpose of characterizing radionuclides in decommissioned reactor wastes.[21] The U.S. Navy has also analyzed the radioactive inventories of five classes of naval reactors.[22] These studies show that cobalt-60 is definitely the radionuclide of concern immediately after decommissioning, largely because of the penetrating gamma radiation from cobalt-60 decays (at 1173 and 1332 KeV). These studies also show that particular components can have unusual radioactive inventories which demand special attention.

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20 *Report for SM-1A Environmental Surveillance.* 1990.

21 D. E. Robertson; et. al. *Radionuclide Characterization of Reactor Decommissioning Waste and Neutron-Activated Metals.* 1993.

22 *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants.* 1996.

It is important to realize that with the fairly rapid decay of cobalt-60, the encased SM-1A reactor at Fort Greely remains highly radioactive. The remaining radioactivity merely becomes difficult to detect with the disappearance of the gamma rays from the cobalt-60, when the Co-60 has decayed to stable nickel-60. The long-lived radionuclides of primary concern are pure beta emitters, or they decay by electron capture.

Cobalt-60 is produced by activation of natural cobalt-59, which is in steel components that are bombarded by neutrons next to a nuclear reactor. Nickel (Ni) in the steel is similarly neutron activated. Nickel-58 comprises sixty-eight percent of naturally occurring nickel and is neutron activated to Ni-59, which is radioactive through capture of an orbital electron (by the nucleus) with a halflife of 76,000 years. The decay product of Ni-59 is stable Co-59. Likewise, natural Ni-62 comprises four percent of natural nickel and becomes Ni-63 upon neutron bombardment. Nickel-63 has a halflife of one-hundred years and decays with beta emissions forming stable copper-63. Nickel-59 and Ni-63 have longer halflives than cobalt-60 and are more abundant than cobalt-60 in steel reactor components.

Without suggesting that the usual ratios of reactor hardware isotopes are directly applicable to the reactor encasement at Greely, it is instructive to apply typical ratios to the SM-1A at the time of decommissioning (1972). These ratios are Ni-59/Co-60 = 0.02 and Ni-63/Co-60=2.0 (see Table 9).

Table 9 shows that by one-hundred years after decommissioning, the cobalt-60 is almost decayed away. By 2072, the residual radioactivity within the encasement, however, would still be about one-third of the initial radioactivity. But it is likely that it would be primarily in the difficult-to-detect form of electron capture decays of Ni-63.

Notice that in 2072, the Ni-63 radioactivity would be about 48,300 curies. Which just happens to be the total initial radioactivity credited by the Army as Co-60 in 1972. That is to say, from a total residual radioactivity standpoint, the situation a hundred years after shut-down is probably about as bad as the Army credited immediately. (Whereas, a hundred years after shut-down, the Army says the problem is only 0.094/48,300 = 1/100,000 which is what it was at shutdown.) By a thousand years, in 2972, less than 1% of the initial radioactivity would remain. But it would be in the form of relatively difficult-to-detect beta decays of Ni-59. The Ni-59 radioactivity will persist for hundreds of thousands of years.

The fact that radionickel (especially Ni-63) is relatively difficult to detect does not make it innocuous if it gets into the food chain. Not wishing to be alarmists about the Ni-59 and Ni-63, the researchers for this study observe that these are two of the serious-problem isotopes for decommissioned nuclear reactors. The Army has not bothered to mention them with regard to the decommissioned SM-1A, and failed to disclose the long-lived radioactivity that will be around for thousands of years. Any respectable decommissioning study would offer an inventory of what is actually present--radiologically, chemically, massively, structurally, etc. These failures by the Army are yet more evidence of the cover-up surrounding the true mission of the SM-1A reactor. At the present time, the public has no reliable, independent way to determine the extent of radioactivity that remains at the Fort Greely reactor.3

Table 9. Reference Radionuclide Inventories for the SM-1A By Year

	Cobalt-60	Nickel-59	Nickel-63
Halflife (years)	5.27	76,000	100
Decay Emission	gamma	beta	electron-capture
Relative Initial Radioactivity	1	0.02	2
*Thus:			
1972 radioactivity (curies)**	48,300.	966.	96,600.
1998 radioactivity (curies)**	1,600.	965.8	80,700.
2072 radioactivity (curies)**	.094	965.1	48,300.
2972 radioactivity (curies)**	.000	957.3	94.3

* These values assume the relative, initial radioactivity inventories, which may not accurately reflect the SM-1A. See text.

** One curie = 37,000,000,000 disintegrations per second.

The comparison in Table 9 shows that: 1) the Army's assurance of diminishing radioactivity per Co-60 decay is not indicative of the true long-term problem that will persist at Fort Greely; and 2) greater attention is necessary to determine the actual SM-1A radioactive inventory remaining at Fort Greely. This evaluation affects the scheduled dismantling and removal of the reactor in 2023, reported in McMasters et. al, (p. 2-11).

VI. Comments: Truth and Consequences

A. Army Conceals Problems with SM-1A Reactor

The SM-1A was a small reactor, but it was capable of causing great harm. Throughout this report, the authors identify instances where the Army concealed the truth about contamination released by the reactor at Fort Greely. This section expands on three of those cover-up situations:

1. Glossing over the two-year outage of the reactor that occurred from 1967-1969;

2. Denying the existence of radioactive steam in the heating system and the laundry;

3. Offering a red-herring to distract the public from the truly dangerous sources of radioactive pollution.

1. Glossing Over the Two-Year Outage

Within two months after the U.S. Army Alaska Command took over initial operation of the Fort Greely reactor on July 1, 1964,

> the plant completed a record power run of 2750 hours on the line, supplying heat and/or electrical power to the post [SM-1A Booklet Version I, p. 2].

This is the major operational record credited to the SM-1A. The Army has not blemished its official record of nuclear reactor operation by admitting any substantial or out-of-control problems. In a 1992 historical document by the Army Corps of Engineers, the Army summarizes *all* SM-1A problems this way:

> The plant had an excellent operating history... The unplanned outages that occurred on an infrequent basis were short in duration. Plant recovery to full power from these unplanned outages was achieved in a time period that was far shorter than today's industry standards [Fasnacht et. al, p. 4-11].

In that document the Army claims a record of almost continuous SM-1A plant availability, with data for each year except 1968, for which availability is described as "poor" (p. 1-3). However, the SM-1A Booklet Version II written circa 1968, states that the reactor was offline from July 1967 to May 1969 to repair damage caused from neutron bombardment and to replace the steam generator due to leaky tubes.

> On July 1, 1967 the operation and maintenance responsibility was returned to [the U.S. Army Engineer Reactor Group]. Subsequent to that time two major maintenance projects were undertaken. First the pressure vessel was successfully annealed to repair damage caused by neutron bombardment. During the period 1 Jan 1969 - 15 May 1969 the steam generator was replaced due to leaky tubes. The SM-1A went back on the line in May 1969 [SM-1A Booklet Version II, p. 4].

In the 1992 publication (Fasnacht et al.), the Army simply glosses over this two-year outage that occurred in 1967-1969. When reporting about "any accidents or emergencies" during the SM-1A operation, this report states (pp. A-1 to A-4) that there were "minor nuclear incidents," one in

1971 and three in 1972. The Army in 1992 was yet unwilling to describe the event that caused the two-year outage reported in the SM-1A Booklet Version II. An earlier Army publication produced in 1983 also puts an upbeat valuation on the two-year outage:

> In 1967 and 1968, the nuclear plant was shut down for research and development purposes, then put into service again in 1969 [McMasters et al., p. 1-7].

It is difficult to imagine that after sixteen months of Core III operation (See Table 4), the reactor was abruptly shut down for "research and development." Research and development are two stated missions for the Greely reactor's operation, not for its shut-down. Investigators for this study have demonstrated that the SM-1A was shut down abruptly in June of 1967 to prevent control rod melt down (See Section III.D.1. above).

The nature of the work accomplished in this mid-burn, two-year outage suggests that the repairs made were profound. The repair work completed by the Army nuclear engineers was impressive, including the:

- o First-ever in-place annealing of a reactor pressure vessel;
- o First-ever replacement of a reactor steam generator;
- o Redesign of the reactor control rods and manufacture of new control rods (according to the changes in SM-1A Booklet Version II); and
- o Installation of a skid-mounted, liquid radioactive waste decontamination system in March 1968 (McMasters et al., p. 2-10).

These extensive repairs are indicators of serious design and operation problems for the SM-1A reactor. Nevertheless, Army publications released sixteen and twenty-five years after these repairs were made (McMasters et. al and Fasnacht et. al, respectively) deny the existence of problems, thus concealing the truth about contamination released by the Fort Greely reactor.

2. Denying Existence of Radioactive Steam Heat for Post Heating

The practice of using radioactive steam for post heating and in the laundry is evidence of the National Security mission of the reactor at Fort Greely. When the Army command learned that leaky tubes in the reactor were creating contaminated steam, they failed to inform and protect those people who were at risk of contamination. They simply concealed the problem.

In a historical summary of the SM-1A nuclear power plant, the Army (Fasnacht et. al) presents a series of questions and responses concerning the disposition of radioactive materials. The fourth question (Section 4, Page 5) in this 1992 document is:

> During plant operations, were there any "spills" or releases of radioactive materials? When? How much? What was done to clean up?

Among the responses to this question, the Army referred back to a 1973 Final Radiological Survey (Bowers and Holland) and stated that contamination levels were within permissible limits.

> During the final site survey, independent measurements of all accessible areas in the SM-1A facilities were made. It was determined that there were no residual surface contamination levels above the NRC limits [Fasnacht et. al, 1992: p. 4-6].

In reality, the *Preliminary Assessment* produced for the Army in 1992 identifies an area of beta surface contamination above permissible limits (p. 3-96). Although further decontamination efforts brought this radioactive area within the established limits, the Fasnacht et. al document stated that there were no such contaminated surfaces. These authors for the Army simply ignore and deny the facts, thus concealing the truth that contamination was released by the Fort Greely reactor.

3. Offering a Red Herring

During SM-1A operation and after decommissioning, public attention has been directed to the one-inch, radioactive-waste pipeline to Jarvis Creek (See P12 in Figure 5). Liquid radioactive wastes disposed to this pipeline were monitored and reported, to assure the public that the Army was behaving responsibly concerning radioactive waste disposal at Fort Greely. In these public assurances no other liquid radioactive waste disposal pathway is flagged for most of the SM-1A operating life, before the decontamination skid arrived in 1968.

The total liquid disposal to Jarvis Creek was 1.3 curies of beta-gamma radioactivity, excluding tritium (See Table 8). This reported, liquid radioactive waste disposal to Jarvis Creek seems to have been mostly from unfueling of spent Core I and the partly-used Core III (following the 1967 accident). For comparison, when the SM-1A reactor was unfueled of partly-used Core IV in 1972, the liquid radioactive waste was processed through the decontamination skid, releasing only 0.000009 curies of beta-gamma radioactivity and 30 curies of tritium to the discharge well. But the decontamination skid recovered *34 curies of beta-gamma radioactivity* (primarily cobalt-58 and cobalt-60) which was shipped in barrels from the site. (The transuranic waste recovered by the decontamination skid is not reported.)

This suggests that a single unfueling operation generated about 34 curies of beta-gamma activity, 30 curies of tritium, and an unspecified quantity of alpha-emitting fuel erosion and transuranic waste. Thus the total liquid radioactive wastes generated by the unfueling of the first three SM-1A cores would have been three times (for three cores) 34 curies of beta-gamma activity, equal to 102 curies of beta-gamma activity. Assuming that there were additional, unquantified liquid radioactive waste streams (such as the one through the post sewer system and the main dump down the discharge well), the 1.3 curies of beta-gamma activity reportedly discharged through the one-inch pipeline to Jarvis Creek is seen to be only about one percent, or possibly even less, of the total liquid radioactive waste discharged locally from the reactor.

Given that one percent of the liquid radioactive waste from the Greely reactor was discharged along the one-inch pipeline to Jarvis Creek, the attention called to this pathway over the years demonstrates that the Jarvis Creek radioactive pipeline is a “red herring.” The Army uses this pipeline to draw attention from the real problems with the SM-1A reactor. Ninety-nine percent of the liquid radioactive waste did not go through the red-herring pipeline. Almost all of the liquid contamination went into a discharge well or through the base sewer system both of which lead eventually through (undefined) pathways into the underground aquifer that flows northeast from Fort Greely.

Signifying its red-herring function, the remaining pipeline was bounded by an orange fence with numerous radioactive warning signs that were there at the time of the 1998 field investigation for this report. The Army offers a great show of how dirt from the area was treated most carefully. Hundreds of cubic yards of almost uncontaminated dirt were hauled to distant radioactive waste disposal sites. As one informant put it, the Army is "moving dirt from Point A to Point B."

Meanwhile, before the Army presented this show to the public, vegetation was cleared from the area and placed in a pile. These plants would have taken up some of the radioactivity from roots next to the one-inch pipeline where it had been ruptured. Such vegetation would have been difficult to manage once it was identified as contaminated material, so the Army simply removed the brush before erecting the fences and warning signs. (See BRUSHPILE at H6 in Figure 5). This brushpile was open to civilian access and was being cut for domestic firewood in August 1998. A Geiger counter survey conducted at that time by a field investigator for this study did not reveal any above background readings, which would have demanded immediate action.

The fact that Army scientists did not check this vegetation for contamination suggests that either they 1) knew about the minimal danger actually presented by the one-inch pipeline to Jarvis Creek and were promoting it as a red herring; or 2) believed the brush to be contaminated while callously allowing the public to use it for firewood. With regard to the brush cleared from the area of the ruptured one-inch pipeline to Jarvis Creek, researchers for this study have demonstrated that the first option is valid. With regard to the disposal of other more seriously radioactive contaminants from the Fort Greely reactor, researchers for this study have demonstrated that officials from the Department of Defense and Department of Energy have callously placed their concerns about National Security above the safety of the public.

During August 1998, one investigator for this study asked Fort Greely personnel, contractors, former employees, family members, and others in Delta Junction about the SM-1A operation. The interviewer indicated that the discharge well was known to be the major liquid disposal pathway, and that the sewer system must have been used to dispose of liquid radioactive waste, as the outfall was radioactively above background. Then the interviewer asked these various informants to explain why the one-inch line was being used as a red herring. They consistently responded that the Army is seeking community acceptance. The red herring is an attempt to appease dissenters and assure the community that the Army is keeping them safe from any risk from the reactor. The true mission of the Greely reactor (the production of special nuclear materials) remains a topic too sensitive and too secret to discuss.

Although there was some small amount of hazard from the 1.25-mile long, one-inch pipeline to Jarvis Creek and it was appropriate for the Army to clean it up, it is also apparent that the Army pumped very little of the radioactive waste from the reactor through that pipeline. Rather, this one-inch pipeline to Jarvis Creek has become a show piece for the Base Realignment and Closure activities at Fort Greely.[23] Removal and remediation of the one-inch pipeline and the almost uncontaminated dirt draws attention away from areas of truly serious concern.

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[23] *Total Environmental Restoration. Site Investigation/Limited Remedial Investigation, Removal of Radioactive Waste Pipeline, Fort Greely, Alaska.* 1997.

In November 1999 as this report was being produced, statements from Colonel Sheldon Jahn of the Army Corps of Engineers were aired on a daily statewide news program on Alaska Public Radio Network. The broadcast was about formerly utilized military sites in Alaska, and Jahn claimed that although there are some areas yet to be cleaned up, the Army has a good track record for responsible remediation of toxic sites. He then waved the red herring in front of the listening public by citing the one-inch pipeline to Jarvis Creek at Fort Greely as an example of the Army's successful efforts at cleanup. The Army's effort would be applaudable if only it represented an honest effort at true cleanup. This study demonstrates, however, that public servants such as Army commanders and officials of the Department of Energy can be relentless in their efforts to fool those they serve.

B. Propaganda Ploys are Failing

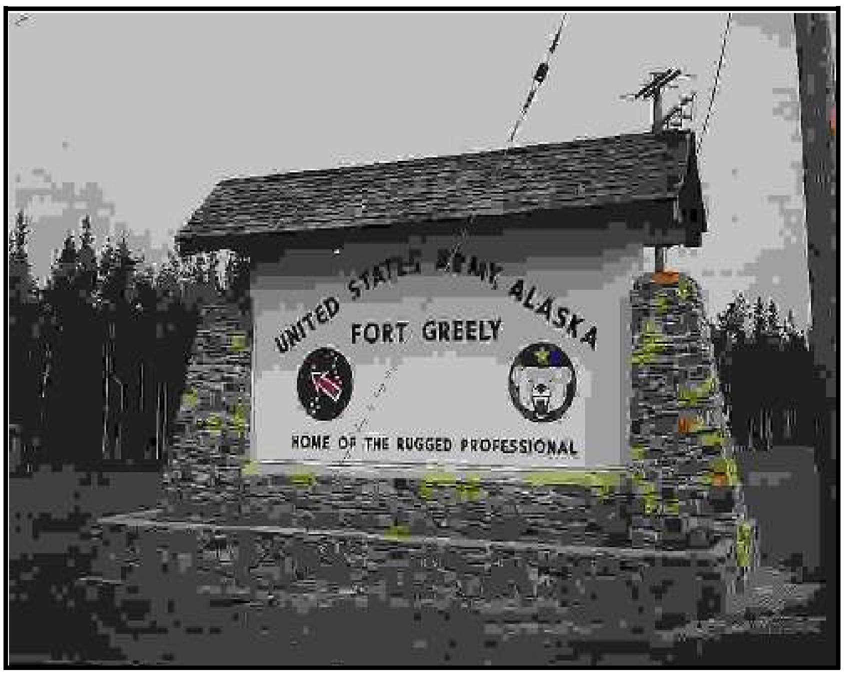
Although the Fort Greely reactor was shut down in 1972, the U.S. government has not stopped producing transuranic materials for small nuclear weapons suitable for the battlefield. The true purpose for this pilot reactor in Alaska remains a military secret because other reactors elsewhere in the U.S. continue with the same mission. Furthermore, the reasons for classifying production of micro-nukes are the same as they were fifty years ago. Those in the U.S. who want to produce nuclear weapons must do so clandestinely in order to avoid the outrage of the American public. Anti-nuclear advocates and the outcry of concerned citizens could pressure the government to shut down military nuclear operations permanently elsewhere in the U.S.

The propaganda ploys of those who promote nuclear energy have been gradually failing. The first anti-nuclear sentiments began when the American public learned of the nature of the devastation wrought on the Japanese people by the atom bombs dropped on Hiroshima and Nagasaki during World War II. One of the researchers for this study recalls engaging in church youth group discussions in the early 1950s about the morality of having dropped the atom bomb. And since that time, the American public has become disenchanted with nuclear energy because of deaths from nuclear reactors (such as Three-Mile Island and Chernobyl), problems with disposal of nuclear contaminants, and illnesses caused by depleted uranium weapons used by the U.S. in the Gulf War.

Government leaders avoid admitting to problems caused by nuclear contamination, if for no other reason than the financial burden it could place on their budgets. Nevertheless, the Department of Energy did capitulate to pressure from advocates from Alaska Community Action on Toxics, Nuclear-Weapons-Free America, Alaska labor unions, and the Aleutian and Pribilof Islands Association. In October 1996 the Secretary of Energy first agreed to the declassification of requested materials and has been steadily releasing information since then in response to public pressure (Buske & Miller, 1996 and 1998). In January 2000, the DOE released fifty boxes of documents about the nuclear-test-site workers at Amchitka Island, Alaska. These were the men who were exposed to radioactive contamination in the late 1960s and early 1970s when the U.S. conducted three nuclear blasts, including Cannikin the world's largest underground nuclear explosion.

On the other hand, government leaders have demonstrated repeatedly that they will withhold classified documents and cover up potential radioactive contamination, when they deem that a National Security mission might be threatened by public exposure. One of the researchers for this study is a civilian member of the Restoration Advisory Board for the formerly-utilized Naval installation at Adak Island. For the past four years, whenever the civilian advisors ask about the possibility of radioactive contamination from an abandoned nuclear submarine installation on the Island, they are stonewalled by the Naval members of the committee who respond by saying, "We will neither confirm nor deny." The Navy plans to relinquish control of Adak to civilians who have recently moved onto the Island, even as the U.S. government refuses repeatedly to inform the public of possible radioactive contamination in the area. Similarly, it may be especially difficult for concerned citizens to get valid information about the Fort Greely reactor, because National Security takes precedent over the health and safety of U.S. citizens.

This report about the Greely reactor presents a challenge to leaders from the Department of Defense and Department of Energy. Will they work toward releasing classified information about the reactor and assist those who may have been contaminated? Or will they continue to block public access to information that may save lives? The investigators for this study urge officials of the U.S. government to respond to this report with complete candor about the Fort Greely reactor.



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Actions to Take

To urge the Department of Defense and Department of Energy to take action about the Fort Greely reactor, contact:

The Honorable William Cohen, Secretary of Defense
The Pentagon; 1000 Defense
Washington D.C. 20301

The Honorable Bill Richardson, Secretary of Energy
United States Department of Energy
1000 Independence Avenue S.W.
Washington D.C. 20585

See this report (Section IV. Recommendations) for specified courses of action to suggest.

Please send copies of your letters to Alaska Community Action on Toxics.

For more information about the Fort Greely reactor and actions to be taken, contact:

ALASKA COMMUNITY ACTION ON TOXICS
135 Christensen; Suite 100
Anchorage, AK 99501

Phone: (907) 222-7714; Fax: 222-7715
E-mail: info@akaction.net
http://www.akaction.net