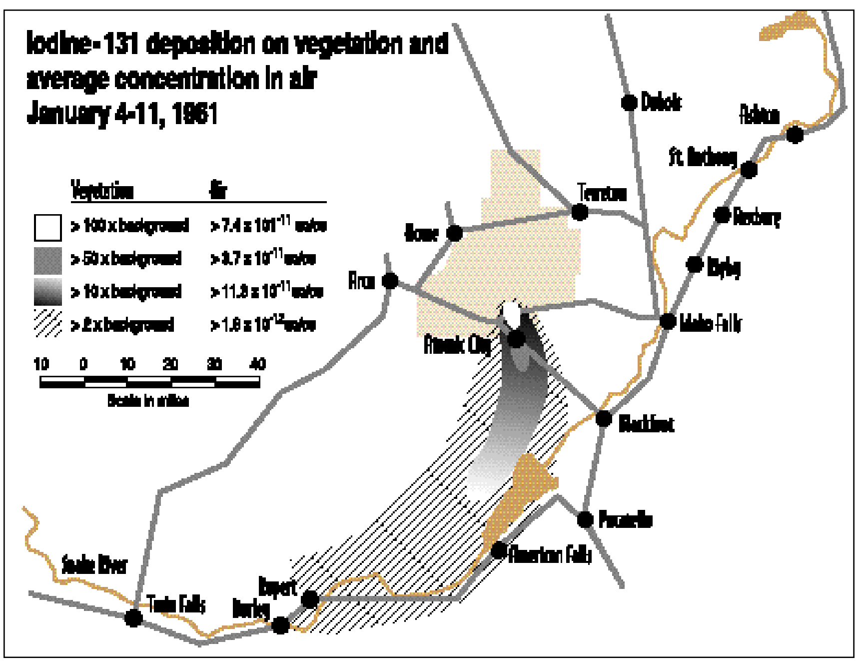
The Aftermath

The development of atomic energy will of a certainty continue to achieve for mankind's benefit new goals that now challenge the imagination... Distressing as this tragic occurrence surely must be, it is to be observed that it came under such circumstances of time and place as to make certain the prevention of a disaster that could be much worse... It [is] progress that should be generally recognized and accepted with fortitude...

–Editor, Idaho Daily Statesman, January 6, 1961–

Editorial comment in Idaho and other newspapers categorized the SL-1 accident as a regrettable mishap, an inevitable occurrence if society were to accrue the benefits of a new technology. A few by-lined reporters tended toward emotional metaphors, one characterizing the reactor as a "monster" that had "broken loose for only a moment and destroyed three of its keepers." But such excess was the exception. Some editors followed the emotional lead of southeast Idaho citizens. Wrote one, "The fact that citizens of Arco and other communities in that area of Idaho are sleeping undisturbed by worry over such accidents is a comfort to the rest of us."[1]

Boise's *Idaho Daily Statesman* mentioned other "atomic mishaps" at the NRTS—the EBR-I meltdown, an unplanned 1958 excursion in the HTRE-1, and a criticality at the Chem Plant in October 1959—and marked this as the first to cause loss of life. Later the *Statesman* instructed the reader on the distinction between nuclear and chemical blasts and described the mechanism of an excursion, or "runaway," and the role of control rods in controlling a chain reaction.[2]



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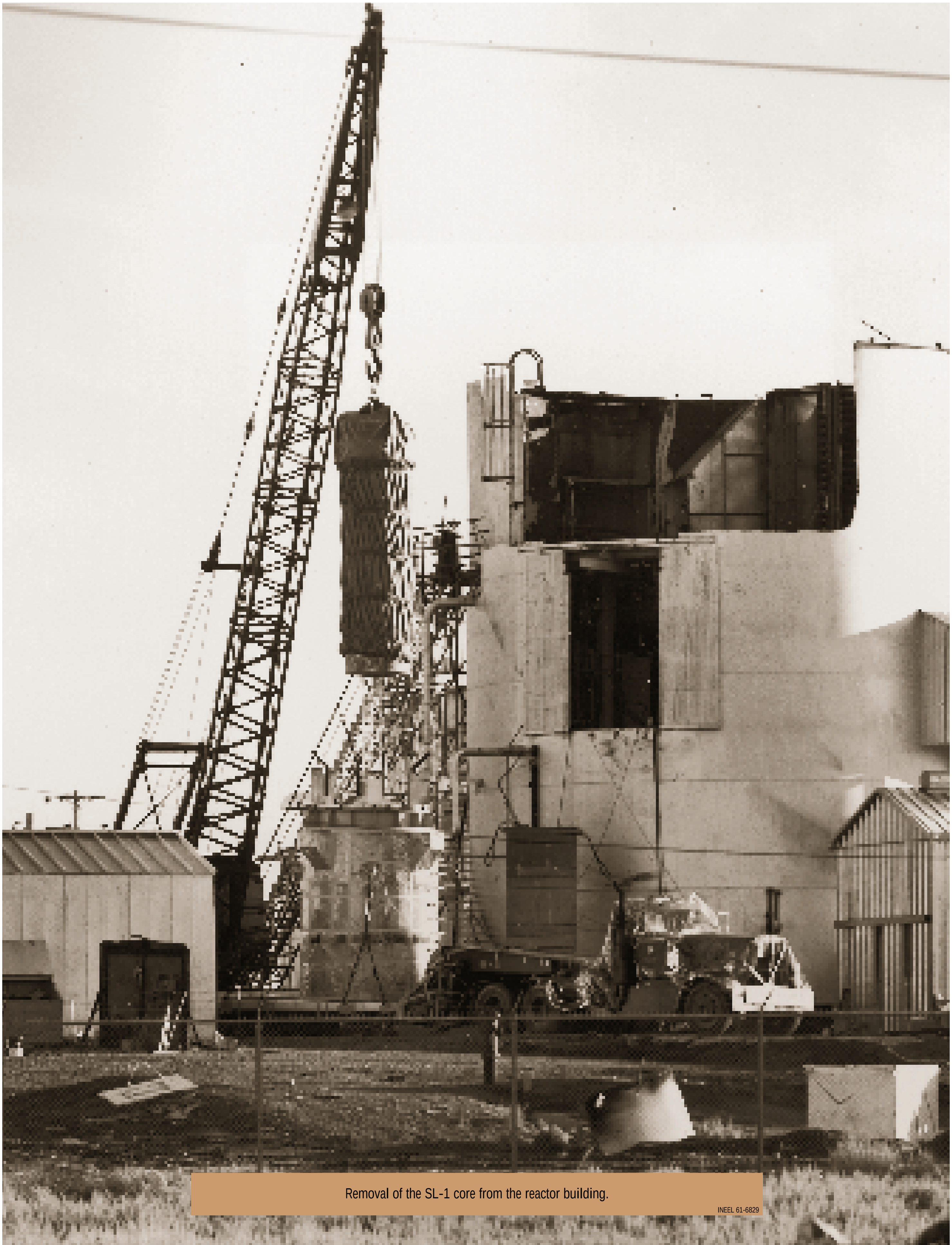
Dose reconstruction project in 1991 identified probable path of I-131 plume released by SL-1 accident.

Newspapers followed the story for about two weeks and then the articles trailed off. Reporters described the Army mission for the "new style" reactor, the location and extent of the radiation hazard, public safety, and the unfolding understanding that the accident was a nuclear excursion. As the bodies were identified and recovered, the reporters described the unique interment plans for the victims.[3]



Removal of the SL-1 core from the reactor building.

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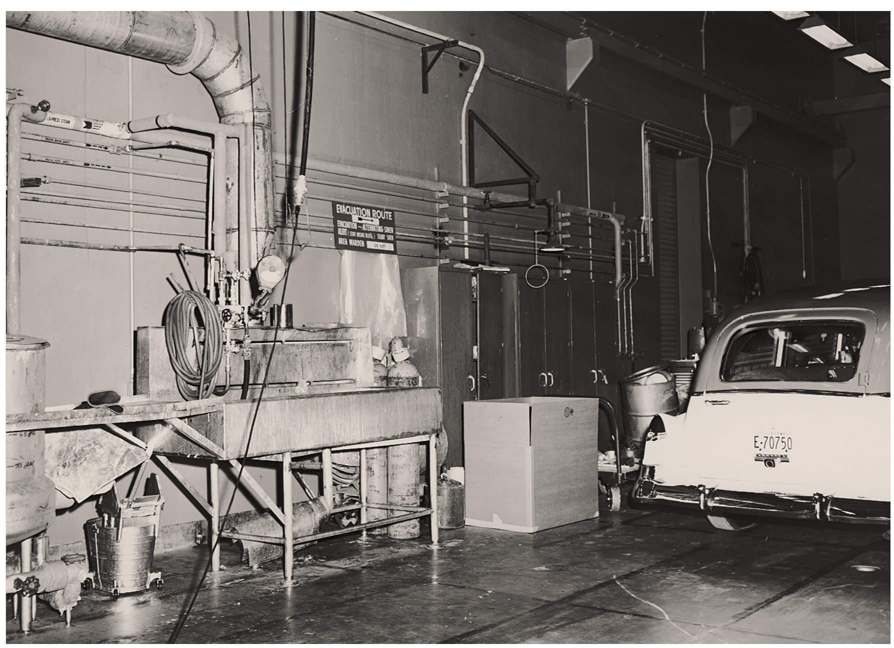
In Washington, D.C., commentators wondered about long-term repercussions on the AEC's atomic power program. The AEC and the JCAE were in the midst of deciding how close to metropolitan areas nuclear reactors could be situated. GE and Westinghouse spokesmen worried that the accident might set back public acceptance of nuclear reactors for years.[4]

In this connection, Walter Reuther, president of the United Auto Workers (UAW) and the Industrial Union Department of the AFL-CIO, was quick to exploit the accident. The UAW was in court—by now the case had gone to the U.S. Supreme Court—challenging the AEC's recent decision permitting the Fermi fast-breeder reactor to locate near Detroit. It was not safe, the union claimed. The union had a list of forty purported reactor accidents that demonstrated why the Fermi reactor was a mistake. Reuther said the SL-1 accident confirmed the validity of the union's position, pointing out that Fermi was three hundred times larger than the SL–1. "It is clear from Tuesday night's accident that thousands of people would have been overexposed to radiation if the SL-1 reactor had been built near populated areas." Ultimately, the union failed to stop the Fermi plant. Some answered Reuther by noting that the SL-1 evidence refuted his argument because even without an engineered containment structure, radioactivity had remained mostly within the building.[5]

In Idaho Falls, the Oil, Chemical, and Atomic Workers International Union Local 2-652, expressed more credible complaints in a letter to Senator Henry Dworshak. To the concern that the reactor had been permitted to operate despite sticking control rods, the union added a list of items that patently had not been considered in emergency plans—the inadequate dispensary, the lack of proper lead caskets, the non-existent shift disaster teams, and instruments unable to read high radiation fields. Further, health physicists had been called from all over the Site, leaving their own areas vulnerable. The autopsy physicians, said the unions, received enough exposure to make them less available for future emergencies. People who had responded early and received heavy radiation exposures were, in general, less available or more vulnerable in the event of any future emergency. The union asked for a Congressional investigation, that workers be compensated for over-exposures resulting in loss of pay, and for a public airing of all the facts.[6]



Ambulance used at SL-1 was decontaminated at the Chem Plant and returned to service.

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The AEC defended itself, telling Dworshak that the public had received all available information, excepting medical, about the event. It agreed that the accident had exposed weaknesses in its emergency plans, but that the IDO had executed the plans that were in place.[7]

The JCAE scheduled hearings for June 12-15 on the broader subject of Radiation Safety and Regulation and invited AEC testimony on the accident. AEC commissioner Robert Wilson said that reactor design would henceforth not allow a reactor to go critical upon the motion of only one control rod. He blamed the contractor for allowing operating decisions by unqualified personnel. The AEC, he said, should assign independent groups to do periodic appraisals of every AEC or licensed reactor. The discussion averted a Congressional investigation specifically on the SL-1. The JCAE apparently was satisfied with the reports of the SL-1 Investigating Board, which by June was wrapping up its work.[8]

The board had listened to scores of witnesses. With no evidence that the cadre's actions had caused the accident, the board absolved it of responsibility. The board said that an "unusual movement of the central control rod" was more plausible as the cause of the accident than other hypotheses. Then the board pried open the layers of administration surrounding the reactor, and here it spoke assertively, sparing no one a share of blame.

Combustion Engineering had permitted substandard conditions to develop in the reactor, the board said, yet continued to operate. The responsibility for safety appraisals belonged to the IDO and AEC Headquarters, but the criticism was broad:

There appears to have been some lack of clear definition of assignments, within the AEC, of responsibility for insuring continuing reactor safety appraisals and inspections... It is conceivable that clearer definition of these aspects of AEC staff responsibilities might also have prevented the SL-1 accident.[9]

Early in December 1961, Allan Johnson ended his nearly eight-year career as IDO manager. He said it was for personal reasons, a desire to return to private life. Around the Site, however, people wondered if the AEC had forced the resignation as a way to signify that blame had settled somewhere and a price paid.[10]

The AEC called for change elsewhere as well. Immediately after the accident, it surveyed all the nation's licensed reactors, then numbering forty-seven. Licensees were asked for information on shut-down procedures and control components. The AEC modified some of the licenses, limiting certain operating parameters. The AEC ordered its own reactor managers to review shut-down margins and to assure that control systems operated fully within design specifications. Maintenance and operation were to take place only under fully qualified supervisors.

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A mockup of the SL-1 reactor top. Analysts tried to determine where the three cadremen were standing at the moment of the accident.

For low-power critical facilities, including the ones at the NRTS, the AEC ordered that all operating and shutdown procedures be written in detail. Joe Hensheid, supervisor of the ETR Critical Facility, recalled:[11]

The SL-1 accident was a big watershed point. Up until then, our detailed procedures weren't much, but we were able to get a lot done in a short amount of time. After SL-1, the reactor [I worked with] was shut down, and we had many, many reviews of procedures. Some reactors at the Site went two years before starting up again. There were committees, and everyone was reviewing procedures and developing formalized sign-offs. It turned into a totally new way of doing business with reactors. Procedural documents that originally had been two pages long were expanded into thick books, and all activity became rigidly prescribed...those years of committee meetings with no experiments were hard on everyone.[12]

The accident inspired the AEC's Advisory Committee on Reactor Safeguards (ACRS) to continue its strong interest in learning more about the type of destructive accident represented by the SL-1. The SPERT program particularly received strong support. The ACRS was looking toward the future when power reactors would contain far more fuel and a bigger inventory of fission products than the SL-1. It requested that safety researchers look for a way to build large reactors so that a neutron disturbance or excursion in one region of fuel could not propagate to the rest of it. In such an event, the ACRS hoped that "destruction of more than a small part of the reactor is demonstrably impossible."[13]

The SL-1 disaster had no apparent impact on the Army's plans for small nuclear power plants. In the immediate aftermath of the accident, it ordered its Portable Medium-Power reactor, operating on the Greenland ice cap, to shut down pending a review of its control rods and operating procedures. The Army continued its experiments in Idaho. Work at the GCRE had produced the data for a pin-type fuel design for the Army's "mobile" prototype. A month after the accident, Aerojet-General in Downey, California, loaded the prototype ML-1 onto an Army semi-trailer and hauled it to Idaho for field testing.[14]

The little reactor went critical for the first time later in 1961 and ran as a power plant for the first time on September 21, 1962, making history as the smallest nuclear power plant on record to produce electricity. It reached full-power operation on February 28,

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Left. ML-1 Test Building at Army Reactor Area-IV. Power conversion component faces the door. Top of circular reactor component is behind it. Below. Aerial view of ML-1 test area. Control trailer is in lower center behind shielding berm. Reactor was in Test Building in upper center of view.

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1963, and this first run continued until March 4, 1963. Despite these benchmarks, the ML-1 proved disappointing, typically operating only a few days or hours before shutting down because of leaks, failed welds, and other problems. After its four-day March 1963 run, for instance, the crew found that the coolant, nitrogen gas, had been leaking into the moderator water. By the time of its final shut-down on May 29, 1964, the ML-1 had accumulated only 664 hours of operation.[15]

At the end, Aerojet disassembled the ML-1 reactor at the TAN Hot Shop to discover the reason for its last failure. Temperatures over 1,200°F had corroded the steel pipes containing the gas. The ML-1 concept was too advanced for the materials available.

That finding came in 1965. The escalating war in Vietnam forced the Army to evaluate its spending and research priorities. The Army's prototype reactors in Greenland and elsewhere had acquitted themselves well, and it appeared that the life-time cost of a nuclear power plant was lower than that of a conventional plant. But the initial cost was far higher. As it set war-time budgets, the Army opted for low first-cost alternatives. Economists suggested that this was false economy, but the Army canceled its program in 1965 and never restored it. The reactor skid, control rod shields, and other ML-1 parts ended up in the NRTS Burial Ground.[16]

The remains of the SL-1 building did not go to the Burial Ground. After abandoning early thoughts of restoring the building, GE concluded that hauling the contaminated debris to the Burial Ground, a distance of sixteen miles and partly on Highway 20/26 would subject laborers to too much avoidable risk. Instead, it built two large pits and a trench about 1,600 feet away from the SL-1 compound. The walls of the silo, the power conversion and fan-floor equipment, the shielding gravel, and the contaminated soil that had been gathered during the clean-up all went into the pits. Three feet of clean earth shielded the material. An exclusion fence with hazard warnings went up around the area, the only monument to the reactor.[17]

The IDO completed its film, which included the reenacted crisis response, an animated segment explaining the water hammer, and lessons learned about emergency planning. Planners and operators at other AEC labs and commercial nuclear power plants used it as a training device for years after the accident. Manufacturers of detection instruments increased the upper limit to 1,000 R/hr. Makers of respirators

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Right. Foundation piers and gravel were all that remained by 1962. Debris went to a special SL-1 burial ground. Below. Dismantling the SL-1 foundation piers required the use of shaped charges. Here crew wires caps to charges.

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learned that their equipment had to work in sub-zero temperatures. The IDO continued to concern itself with emergency planning, developing techniques and equipment to reduce personnel exposures and save equipment losses in accident responses.[18]

In connection with its continued work on emergency planning, the NRTS became identified as the major source—only source, in fact—of experience with the execution of emergency plans. C. Wayne Bills, one of the IDO managers of the recovery, said later:

I averaged a call a month on SL-1 for over twenty years. Nuclear accidents are rare! Years later, after the accident at Three Mile Island, they quickly looked for decontamination, photography, dosimetry, environmental monitoring, and other techniques from the SL-1 accident and reactor safety program to apply to their recovery.[19]

Twenty-two of the people who had responded to the SL-1 alarm received radiation exposures in the range of three to 27 Roentgens total body exposure. Three of them received more than 25 R. The exposure guide that had been set up by IDO's prior emergency plan allowed rescue personnel a 100 R dose to save a life and 25 R to save valuable property.[20]

In March 1962 the AEC awarded Certificates for Heroism and other recognitions to thirty-two SL-1 participants at a ceremony at the Idaho Falls High School Little Theater. Among them were the military men, the nurse Hazel Leisen, doctors Voelz and Spickard, and the many others from IDO, Phillips, and other contractors who had performed "special acts of service" or attempted a rescue at great risk to themselves.[21]

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The SL-1 complex in 1962. The dirt road leads to the SL-1 burial ground.

To the surprise of GE and Westinghouse, the accident failed to have an immediate impact on the public's acceptance of nuclear power. However, the accident's long-term impact on the progress of the industry might be measured by the frequency with which it appeared in nuclear-protest literature, a genre that flourished in the 1970s and 1980s. Several books listed nuclear accidents, near-accidents, and mishaps, describing them in language aimed to outrage or frighten the reader. The accounts of SL-1 were often inaccurate, and authors sometimes gave more-trivial events equal weight. The accident became part of a litany of events employed in these attempts to erode pubic confidence in the safety of nuclear power.[22]

For the NRTS people involved, the experiences of the crisis and the recovery were the kind that permanently etched themselves in the memory. Nearly a thousand people were involved in the crisis and clean-up. People at the periphery of events heard stories and retold them. Over the years, the stories gave the SL-1 accident a quality of legend, and these co-exist with thousands of facts describing the event, the results of the investigation, and the scientific analysis.

Much of the legend grew up around the question of cause that the investigation could not answer: did one of the cadremen deliberately withdraw the control rod, and if so, why? Or did the control rod stick, causing over-exertion and a sudden release? All of the science at the NRTS was unequal to this most perplexing question.

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A 1961 photograph of the damaged top of the SL-1 reactor vessel was reused in 1981 to convey a safety message.