Section I.C. Experimental Reactors and Atmospheric Releases

The original name for INL was the National Reactor Testing Station (NRTS). The name more accurately characterizes the activities undertaken at the site. Idaho was the proving ground for military and commercial reactor designs. Reactors were deliberately run to high power levels (excursioned [sic] or melted down) to establish operating limit parameters and component durability under accident scenarios (loss-of-coolant). The power stability of different types of fuel, coolant (water, heavy water, nitrogen gas, molten metal sodium, the organic compound terphenl [sic] and their configuration inside the core were also the subject of many tests. "One set of reactors is devoted to finding out how much abuse a reactor can take. The chain reactor is deliberately allowed to get out of control, to see if the reactor will blow up. (One reactor was deliberately blown up , in a chemical, not an atomic explosion several years ago." 1

During INL's six decade + history, experimental nuclear projects contributed significantly to the site's radioactive emissions to the environment. Detailed information about these projects is still largely classified as secret and unavailable to the public. Therefore, the complete history of INL may await an executive order from the President. To his credit, former President Clinton released more information than the previous Presidents; however, the Defense Department (DOD) remains intransigent. Because most of the reactor and fuel reprocessing programs at INL were military related, DOD has claimed jurisdiction over DOE in the declassification decisions. The Air Force has claimed jurisdiction over some of the intentional radioactive releases from the Idaho Chemical Processing Plant (ICPP) now called INTEC during operation Bluenose. The Navy has also blocked information about its Naval Reactors Facility reactor operations, accidents, and environmental contamination. The Navy also claims jurisdiction over the Advanced Test Reactor (ATR) operations to include blocking Defense Nuclear Safety Board's safety reviews.

Attorney Mark Sullivan representing EDI petitioned the Defense Nuclear Facility Safety Board (DFNSB) to conduct a safety analysis of DOE's 60+ year old Advanced Test Reactor at the INL. DFNSB chairman Winokur's reply states: "It is the Board understands that currently the primary defense-related mission of ATR is research and testing of components in support of Naval Nuclear Propulsion Program. Navy nuclear propulsion activities are excluded from the Board's jurisdiction by 42 U.S.C. ss 2286g (1) (A)." 2 The DFNSB is the product of the Federal Facilities Compliance Act passed by Congress to end federal agencies immunity from compliance with environmental laws. Unfortunately, Congress granted the Nuclear Navy an exemption, even from the DFNSB review.

I.C.1 Aircraft Nuclear Propulsion Program

The US Air Force's Aircraft Nuclear Propulsion (ANP) program in the 1950's designed built, and flight tested a nuclear jet powered bomber which employed more than 10,000 workers. The plane was a modified B-36 (called NB-36) built by Convair and flight tested at Carswell Air Force Base in Fort Worth, Texas. Between 1955 and 1957, the NB-36 made 47 test flights. In 21 of these flights, the nuclear jets were operating. This particular prototype was powered by six conventional propeller engines and two nuclear jets powered by a reactor in the fuselage of the bomber. Considerable radiation was released by the unshielded reactor and by the exhaust resulting from the reactor driven jet engine nozzles, which meant the plane was radioactive after each flight. To protect the flight crew from radiation from the reactor, up to 2.5 inches of lead and 17 inches of special rubber were used to line the crew compartment. WFAA-TV's American Portrait program on the "History of the Nuclear Jet Engine" offers original Air Force footage of the NB-36 and related ANP programs including why INL was chosen. The INL hanger built at Test Area North is now used to manufacture depleted armor for tanks. The planed

1 *iNews*, November 7, 2000, pg. 9, a publication of DOE Idaho Operations Office, citing "This is a reprint from the January 1961 issue of Modern Montana, published by Adrian Allen of Missoula Montana. It offers a glimpse of the news media coverage of the INEEL from nearly 40 years ago."

2. Defense Nuclear Facility Safety Board (DNFSB) Chair, Peter Winokur letter to Mark Sullivan, 9/23/10. Also see EDI's Unacceptable Risk at INL's Advanced Test Reactor.

runway at TAN was never built because the program was abruptly canceled because it was considered too dangerous for crew and the region over which it flew in case of the high probability of accidents discussed below.

The Air Force was intent on building a bigger long-range nuclear powered bomber that could stay aloft indefinitely over the North Pole and deliver a nuclear attack on the Soviet Union. Pratt and Whitney, General Electric, and Lockheed were competing for contracts on reactor designs on this next generation of nuclear powered bombers. GE won the contract and proceeded to build and ground test the 44,000 horsepower nuclear jet engines at INL where a 20,000 foot runway was also slated to be built for the plane. The 8-foot concrete shielded hanger for the plane was built at INL's Test Area North where the runway was also to be built. This test program was called the Initial Engine Tests (IET), and it lasted from 1955 through 1961 when it was canceled by President Kennedy. By 1961, the ANP program consumed $4.6 billion. 3 Another analysis in 1995 included all related ANP activities and found the price tag to be over $6 billion. [Wald(b)] Other space related reactor testing programs at INL, however, continued with the SPERT, SNAPTRAN, and NASA's Light-bulb reactor tests.

"The power plant design concept selected for development by the General Electric Company was the direct air cycle turbojet. Air is the only working fluid in this type of system. The reactor receives air from the jet engine compressor, heats it directly, and delivers it to the turbine. The high-temperature air then generates the forward thrust as it exhausts through the engine nozzle." [Wilks]

One Initial Engine Test (IET) series at INL released from April to June of 1956 over 1.9 million curies of activity including significant amounts (453,350 Ci) of Iodides. 4 Between 1956 and 1970, fifty-nine ANP tests released an estimated 4,635,724 curies of radiation. 5 By comparison, the Three Mile Island reactor accident, generally considered this nation's worst nuclear incident, released 15 curies (Ci) of radioactive iodine to the environment. The Centers for Disease Control (CDC) years later years later found that the DOE's Historical Dose Evaluation dose in DOE/ID-12119 had underestimated several IET releases (and others) by a factor of 7, and inadequacies of the radiological release estimates continue to be discovered**.** 6

"The ANP Reactors were direct, open cycled air cooled. This means that air was driven into the jet engine, compressed, passed through the reactor fuel element where heat energy was extracted, and then discharged through the turbine and jet engine nozzle." ... "Any radioactivity leaking from the fuel elements was also discharged to the air stream." 7

Many deliberate fuel element failure tests that block reactor coolant, were conducted to test a full scale aircraft reactor accident. One of these tests went awry resulting in significant portions of reactor core to melt and considerable additional radiation to be released to the environment. [Ibid.] DOE publicly denies that any ANP reactors were buried at INL yet the literature specifically acknowledges that jet engines are buried at the Radioactive Waste Management Complex (RWMC) Subsurface Disposal Area (SDA). 8 The SDA does not meet the Environmental Protection Agency's Subtitle D garbage landfill standards let alone Nuclear Regulatory Commission greater than class C radioactive waste disposal standards. The IET series involved three reactor assemblies that were constructed at INL for the ANP program. "These three assemblies were designated HTRE No. 1, HTRE No. 2, and HTRE No. 3." 9 Though two ANP nuclear jet engine shells are on display at the Experimental Breeder Reactor-I, the disposition of the other engines and reactor cores for these engines was to the RWMC. The HTRE experiments included the following:

"HTRE-1. The HTRE-1 reactor operated a modified J47 turbojet engine exclusively on nuclear

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3 . American Portrait, produced by Dallas, TX WFAA-TV's. *American Portrait* program on the "*History of the Nuclear Jet Engine 1993.*

4. DOE-ID-12119@A-114.

5. DOE/ID-12119 @A55

6. See CDC.gov SCA-TR-TASK1-0005 and related documents

7. ERDA-1536@II-239

8. PR-W-79-001 @ 4-1

9. DOE/ID-12119@A-87

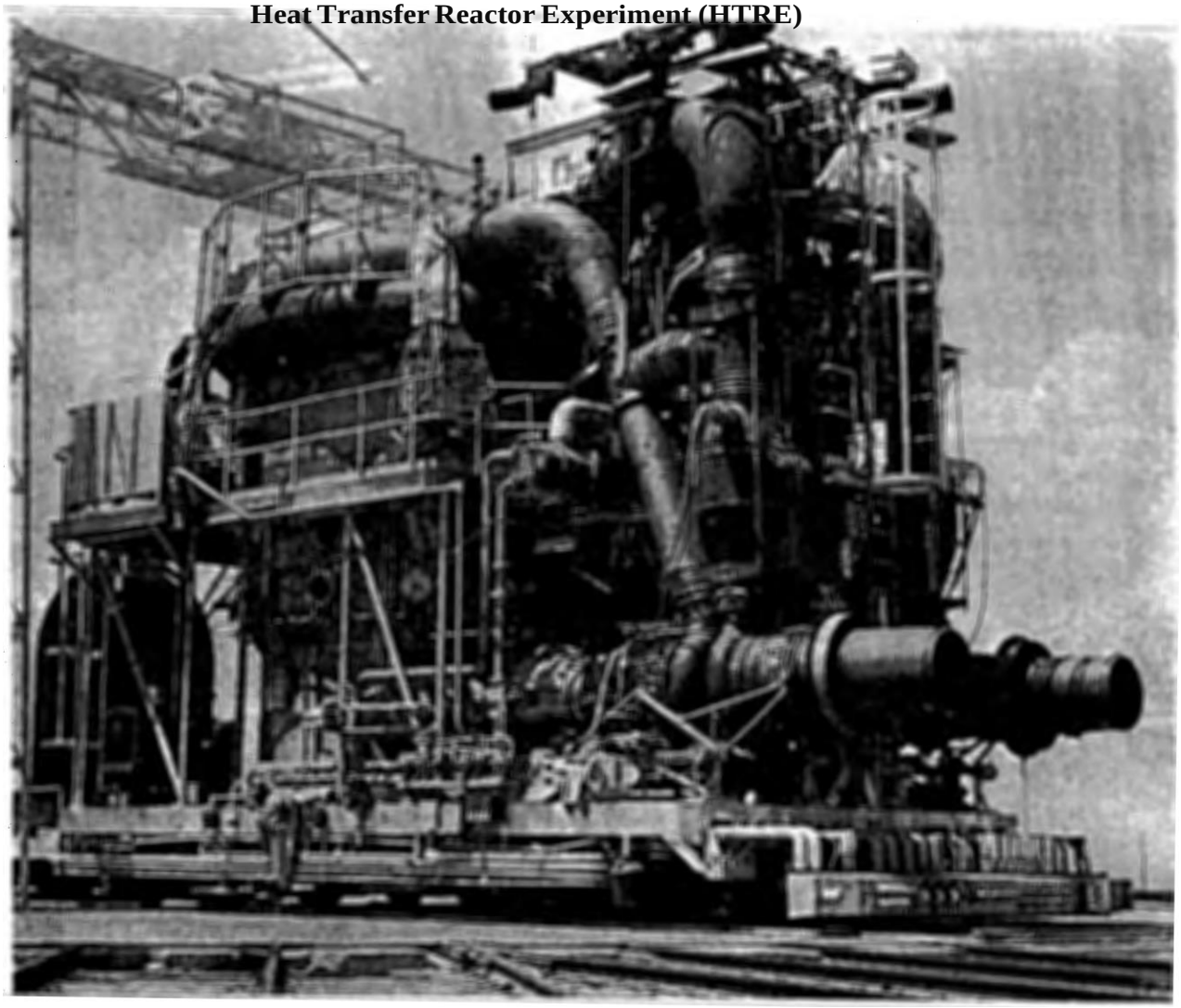
power in January 1956. It accumulated a total of 150.8 hours of operation at high nuclear power levels."

"HTRE-2. The HTRE-2 reactor was a modification of HTRE-1. Testing began in July 1957. The reactor accumulated 1,299 hours of high-power nuclear operation."

"HTRE-3. The HTRE-3 reactor was built in a full-scale aircraft reactor configuration. Two modified J47 turbo jets engines were operated by this reactor. Full nuclear power was achieved in 1959 and the system operated for a total of 126 hours." 10

Aircraft Nuclear Propulsion

Heat Transfer Reactor Experiment (HTRE)



Plane reactor tester. This core test facility at the National Reactor Testing Station, Idaho, was used to carry out the United States first successful ground operation of an airplane jet, engine on power from a nuclear· reactor. At right in picture are modified jet engines which are connected by ducts to the direct-cycle reactor located in the large central tank. Air is passed through the compressor of the jet engine, then to the reactor where it is hented directly by the reactor fuel elements. The heated air then is passed through the engine turbines and out through the engine nozzles at extreme right. The ground test; equipment, is mounted on a dual fln.t car so that, it can be drawn between test and maintenance areas by a shielded locomotive, shown at the extreme left . [USAEC-July-December 1958]

10. RE-P-82-053 p.2 See Reference for full citation.

Knowing full well how hazardous the emissions from these reactors would be, the IET managers built a remote test site called the IET Core Test Facility some distance north of TAN's Technical Support Facility. The two sites were connected by a 4-rail track on which the reactors were moved on rail dollies between test series. The Technical Support Facility Hot Shop assembled and disassembled the reactors. The Core Test Facility (CTF) is where the reactors actually operated. CTF consisted of an underground bunker control building where personnel ran the reactors, and a 214 foot-exhaust duct connected to a 150-foot exhaust stack. The reactors were rolled up to the exhaust duct using a shielded locomotive. When the reactors were operating, a plume rose from the exhaust stack to a height of over 1,200 feet. Jackrabbit thyroids sampled downwind from the IET in March 1958 showed radioactivity at 293,700 disintegrations per minute per gram (d/m/g). 11

The HTRE-2 and 3 were disassembled in the IET Hot Shop where the highly radioactive plug shield and core assembly were removed and shipped intact to the RWMC. Radiation levels (300 R/h) were too high to allow further disassembly of the reactor vessel and its shielding. Then the reactor vessels were moved back out to the IET test pad where the 200 ton HTRE-2 (with dollies) and the 90 ton HTRE-3 (w/o dollies) were jacked up off the rail tracks and a special 350-ton transporter was moved under for shipment to the RWMC burial grounds at INL. Bridges between TAN and the RWMC had to be blocked up to take the heavy transporter, and special ramps made into the trench where they were buried. 12 The 106,000 pounds of radioactive mercury used in a tank for shielding around the HTRE-3 and considerable volumes of related radioactive parts were dumped at the RWMC. [See below Section IV(D)] These dumping practices are another reason why the RWMC is a Superfund cleanup site today.

2. Timberwind INL Nuclear Jet Engines

The Strategic Defense Initiative Organization (SDIO) revived the nuclear jet engine project for use in the space program. This new Black Budget program's (code name Timberwind) purpose is to develop the technology and demonstrate the feasibility of a high-temperature particle bed reactor propulsion system to be used to power an advanced nuclear rocket engine. The Strategic Defense Initiative involves orbiting space platforms that theoretically will have the capacity to shoot down missiles launched at the USA. To build these platforms, heavy payloads would have to be launched - requiring powerful rockets. SDIO believes that the nuclear rocket offers a greater thrust to weight ratio than conventional rocket designs.

SDIO generated a secret Environmental Impact Statement (EIS) on Timberwind in 1990. When the existence of this EIS was discovered by the Federation of American Scientists, they demanded that it be released. A declassified Environmental Impact Statement (EIS) was released in 1991, however most substantive (classified) sections have been blacked out (redacted). This violates the intent of the National Environmental Policy Act which requires full disclosure of the environmental impacts of proposed federal activities. The Environmental Defense Institute received a copy of the EIS and commented on it. 13

The Timberwind program was later officially transferred to the Air Force and a new EIS was released in 1992. The 103rd Congress, however, eliminated funding for nuclear rocket program in the FY-1994 budget after spending $464 million. Black Budget projects rarely survive the light of day. The 104th Congress revived the SDI program so Timberwind may also be revived under programs called "Prometheus." Since INL was originally selected as the Timberwind ground test site, it is possible that Idahoans will again be subjected to massive radioactive emissions if the nuclear propulsion part of

11. IDO-12082(58)@74
12. PR-W-79-001 @4-3
13. Comments on Space Nuclear Propulsion Program Environmental Impact Submitted on Behalf of Environmental Defense Institute By Chuck Broscious September 21, 1992 Updated November 2012

SDIO's program is built and tested. The Draft EIS EDI received from SDIO was nearly completely blacked out (redacted). For a more detailed assessment of Timberwind, the Environmental Defense Institute's written comments upon the EIS are available on request.

In other nuclear aircraft related tests, General Electric conducted two open air burning tests on March 20, 1957 of reactor fuel rods to see how much radiation would be released in a nuclear powered plane crash. These tests, called Operation Wiener Roast because of the live animals used to test radiation exposure, also released over 78.3 curies of radiation to the air. [DOE/ID-12119 p. A-55]

US still has plans for nuclear powered planes

According to the *Guardian and The Turkish Weekly* the US still has plans for nuclear powered planes. "The United States is planning to build nuclear-powered drones, which will allow an increase in flying time from days to months without refueling, leaving more power available for operating equipment. The project, developed by the U.S. government's principal nuclear research and development agency Sandia National Laboratories along with defense contractor Northrop Grumman, has not yet reached the building or testing phase, the Guardian has reported."

"The report said the work had been temporarily halted, due to worries that public opinion would not accept the idea. Such a potentially hazardous technology would have the potential hazard of effectively turning into a so-called dirty bomb in the event of a crash, or of its nuclear propulsion system falling into the hands of militants or unfriendly powers. According to a summary of the research published by the Federation of American Scientists, an independent think-tank, computer-based projections were used to test the concepts.

"The summary also stated that the results "were to be used in the next generation of unmanned air vehicles used for military and intelligence applications. It added that "none of the results will be used in the near-term or mid-term future," due to political constraints. The report also compared the future drones with the existing aircraft such as the MQ-9 Reaper, which is used extensively in Afghanistan and Pakistan in operations against insurgents. The Reaper can presently carry nearly two tons of fuel in addition a similar weight of munitions and other equipment and can stay airborne for around 42 hours, or just 14 hours when fully loaded with munitions. Using nuclear power would enable drones not only to remain airborne for far longer, but also to carry more missiles or surveillance equipment, and to dispense with the need for ground crews based in remote and dangerous areas." 14

2. Fission Products Field Release Tests at INL

The US Air Force conducted the Fission Products Field Release Tests (FPFRT) between July and September 1958. "The tests were performed to obtain information for evaluating the release of radioactivity from potential accidents involving nuclear powered aircraft using metallic reactor fuel." 15 These open air, furnace induced hot burns of reactor fuel rods released 502.7 curies of radiation to the atmosphere. 16 [Ibid. p. A-54] "The experiments at Idaho using 'fresh' fuel elements were cooled from 21 days before meltdown, thus losing essentially all of the short lived isotopes of iodine." [Dunning (b)] The Atomic Energy Commission put a limit on the ANP individual releases of iodine at 1500 rads. [Dunning (b)] See ANP Test Table.

3. Special Power Excursion Reactor Tests (SPERT)

The Special Power Excursion Reactor Test (SPERT) reactor test series were "planned integral core destructive tests to investigate the consequences of reactor accidents." [DOE/ID-12119@79] 17 "The accident scenarios tested included reactors suddenly being made greatly supercritical and undergoing a severe power excursion or transient. In just hundredths of a second the power, or fission rate, could leap from zero to billions of watts, with the potential for severe core damage." [Norton]

SPERT-I: Each of the four SPERT reactors was different. "SPERT-I, built in 1954 was the simplest

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14. *US Plans Long Flights with Nuclear-Powered Drones*, Wednesday, 4 April 2012 Turkish Weekly reporting on UK's The Guardian.

15 . DOE-ID-12119 @A-176. See reference at Guide end.

16 . DOE-ID-12119 @ p. A-54.

17. DOE/ID-12119@79

of the four, with a large open tank containing the core and moderator. Before it [SPERT-I] was shut down in 1967, seven different cores had been used in it and more than two thousand power excursions conducted."... "In 1962, it was decided to conduct the ultimate test on SPERT-I. Blow it up, deliberately. It would be an answer to ... how far could you push a highly enriched core in a power excursion?" [Norton] The November 15, 1962 SPERT-I experimental reactor "destruct" test resulted in a release of 240,000 Curies including Iodine. 18 The reactor was placed in an open tank 16 feet deep and 5 feet in diameter. Coolant water was spewed 100 feet in the air in less than one hundredth of a second after the 2 and a half billion watt power surge. Gross reactor damage occurred. Wind direction and the arrival of a monitoring airplane were factors in the timing of the meltdown. [Norton] SPERT-I site would later be used for the Power Burst Facility at INL Auxiliary Reactor Area.

SPERT-II was a scale prototype of a modern nuclear power plant except that it used low pressure and heavy water as a moderator. SPERT-II first went critical in 1959, performed tests for five years, and was retired in 1964. The reactor was remotely controlled from a control center one half mile away. The SPERT-II reactor "destruct test" experiment on November 10, 1963 produced 24,000,000 curies; 530 curies were released including iodine. This was a pressurized heavy water reactor.

SPERT-III was a high temperature; pressurized (2,500 psi) light water reactor built in the late 1950's, went critical in 1958, and was placed on standby in 1968. The April 14, 1964, SPERT-III test released 1900 Ci. to the atmosphere producing a radioactive cloud that was tracked for 2.5 miles. The reactor surged in one hundredth of a second from zero to thirty billion watts. [Norton] Using different cores the reactor continued to run until an accidental melt-down in 1968. [Norton] The SPERT-III site was later to be used for the WERF incinerator.

SPERT-IV, constructed in 1960, and was called a swimming pool reactor; was immersed in a 30 foot diameter tank and was placed on standby in 1970. These tests demonstrated reactor instability and power oscillations. SPERT project manager Boyd Norton acknowledges "...that it got pretty scary in the control room when the power began oscillating out of control and threatened to blow the thing apart. Being at the reactor console was ... a total exercise in sphincter control. SPERT-IV was later converted to the Capsule Drive Core, forerunner of the Power Burst Facility, which was built a few years later." [Norton] What was left of the SPERT reactors and components were buried at the RWMC. [ERDA-1536,p.II-244-246]

4. Space Nuclear Auxiliary Power Transient Tests

SNAPTRAN, The Space Nuclear Auxiliary Power Transient destructive reactor tests were part of the space nuclear power program. A SNAPTRAN reactor was actually launched in 1965. It operated just 43 days before an electrical failure caused it fail and crash in Canada spreading radioactive contamination over a large area. Three SNAPTRAN tests were conducted at Test Area North's IET site. These reactors lacked shielding because of the added weight limitations. 19 The tests were "designed to provide information on the radiological consequences of accidental immersion of a SNAP 2/10A reactor in water or wet earth such as could occur during assembly, transport, or a launch abort." The tests also assessed the "dynamic response fuel behavior, and inherent shutdown mechanisms in an open air environment." [ERDA-1536,@II-247] The SNAPTRAN series in Idaho involved the following tests:

- "A series of tests aimed at providing information about beryllium-replicated reactor performance under atmospheric conditions and assessing hazards during reactor assembly and launch;
- "Nuclear excursions resulting from immersion of the reactor in water or wet earth;
- "Non-destructive tests including static tests and those kinetic tests in which minor damage to the reactor occurred, and
- "Destructive tests in which the reactor was destroyed". [RE-P-82-053,p.3]

The first April 1, 1964 SNAPTRAN destructive reactor test had an energy release of 45 MW-sec. "More than 99% of the fission products were retained in the environmental water and reactor fuel remains" according to ERDA's EIS. 20 [ERDA -1536, p. II-248]. Iodine was assumed to be retained in the

18 . DOE/ID-12119 @ p.79
19 Tami Thatcher, SNAPTRAN research notes 3/12/16.
20 ERDA -1536, p. II-248

water and "only 3% the noble gases" were released, 24,000 curies. Of the 10,000 gallons of water originally in the tank, 9,500 gallons of the highly contaminated water blew out of the test tank when the operators intentionally allowed the reactor to blowup during this underwater test. The radioactive cloud was followed by an airplane for 21 miles before it dissipated. Estimated dose at INL boundary was 10 mRem. Reactor debris was buried at RWMC. [ERDA-1536, .@II-248] The prompt critical, complete destructive test conducted April 1, 1965 with most of the water ejected must have released more radioactivity than stated.

The SNAPTRAN open air destructive test on January 11, 1966 released an energy of 54 MW-sec and exploded spreading reactor fuel 700 feet around the site and released 600,000 curies (Ci) of noble gases including 0.1 Ci I-131. It also created widespread heavy contamination of beryllium on the surrounding ground. The radioactive cloud was followed by aircraft for 19 miles before it was no longer visible. Estimated radiation dose at INL boundary was 10 mRem. Again, reactor debris and 300 cubic yards of contaminated soil were buried at RWMC. [Ibid@II-249] The reported activity of the noble gases included the reduction of assumed radioactive decay during transport from the point of release to the INEL site boundary, thus yielding a reported 4800 curies of release rather than the 600,000 curies of noble gases released. [DOE/ID-12119, p. A-55]

Sometime between the two full destructive SNAPTRAN tests of April 1, 1964 and January 11, 1966, a partial destructive of a third SNAPTRAN core occurred in open-air and unshielded and releases unaccounted for. In the Human Radiation Experiments collection for the SNAPTRAN tests, there is an unsigned draft press release for the middle test which is dated July 1965. The SNAPTRAN tests were conducted at Test Area North (TAN) only a few miles downwind of the Monteview and Mud Lake communities. The SNAPTRAN releases as are other INL releases included in the Human Radiation Experiments collection of documents because of public exposure to radiation without their knowledge or consent.

Former DOE Idaho Operations manager John Horan later worked as a consultant to the site contractor in the 1990s and authored a report of external radiation exposures. In the report he claims he thinks it was an error that so many workers got over 5 rem in the 1960s but then on closer examination can't find an error. He was in charge of safety in the 60s, including keeping tabs on worker radiation doses. So his claimed surprise at the high recorded doses is "incredible." [EGG-CS-11143, 1993] [21]

So worker exposure from the SNAPTRAN tests (and other tests) is an issue which the CDC's organization charged with the radiation compensation for DOE Energy Employees, NIOSH, tries to approach from looking at the INEL HDE created for offsite dose evaluation. But the INEL HDE hides much of the problem.

Tami Thatcher reports, following the January 11, 1966 SNAPTRAN-2 test, the reactor dolly was dismantled and the reactor structure and components were removed to the burial ground. "Forty-seven truck-loads of contaminated soil were removed from around the IET area to the CFA burial ground." If you understand how DOE is really not that particular about soil contamination, you know that the soil contamination had to be extraordinarily high even by the monitoring standards of the time. After all, around the BORAX I reactor debris from intentionally blowing it up, later, a few rocks were scattered over the top of it. Decade's later CERCLA reviews found unacceptably high soil contamination problems persisting at TAN where the SNAPTRAN and initial engine tests took place, among others. Coincidentally, the US Geological Survey stopped well water monitoring for the entire north end of the INL from NRF to TAN after 1963 for about a decade**."** [22]

"The discrepancy between the 2000 curies and the 600,000 curies is said to be due to the decay of

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21 J. R. Horan, 'Occupational Radiation Exposure History of the Idaho Field Office Operations at INEL", EGG-CS-1143, October 1993.

22 US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE-ID-12119, August 1991. See Table E-5 on p. E-36 for mystery milk and see Table C-21 for the public annual dose summary. Volumes 1 and 2 can be found at https://www.iaea.org/inis/inis-collection/index.html, reported by Tami Thatcher.

very short-lived noble gases. The INEL [Historical Dose Evaluation] (HDE) (p. A-64) for SNAPTRAN, says they predicted the release of 75 percent of the noble gases, 70 percent of the iodine, 45 percent of the tellurium, 4 percent of the "solids" this being alpha emitters like uranium and plutonium that they would not have monitored and only 21 percent of the fission product inventory**."** 23

While a large fraction of the curies are short-lived. How reliable were the release fraction estimates? And how reliable was the monitoring in the 1960s given the extensive contamination?

ERDA EIS says "only slight ground contamination" plume followed 21 miles but no iodine, only noble gases with only 10 mrem 6 miles at boundary of INL was recorded. [ERDA-1536 p. II-248] 24If the ground contamination was only "slight" then why the multiple truckloads of soil hauled away? And excessive soil contamination found years later in CERCLA reports?

There's the mystery milk in SE Idaho in the 1965 and 1966 documented in Table E-5 of the INEL HDE. But the elevated concentrations of iodine-131 in milk that were not found to be caused by INL or global fallout from nuclear weapons testing may actually be due to weapons testing at the Nevada Test Site that continued despite the 1963 partial weapons testing ban. 25

"There is reporting of fuel processing at the "chem. plant" for two SNAPTRAN tests, but we know there were three. A report of fuel reprocessed at ICPP, later called INTEC, lists the fuel processed at ICPP. In addition to MTR fuel, Hanford fuel, "Zirconium" [likely naval propulsion fuel], Borax, EBR-I, EBR-II, ATR, ETR, Borax IV, SL-1 scrap, SL-1 (fuel not in the reactor at the time of the accident), SPERT, SNAPTRAN 2/10A-3 core debris, SNAPTRAN 2/10-2, and many others. 26

But nothing about the whereabouts of SNAPTRAN 2/10-1 reactor, which operated in the 1964 to 1966 timeframe but was supposedly only slightly damaged but radioactive. In the book "Atomic Accidents" by James Mahaffey, he says he could not find any record of the whereabouts of the 2/10-1 reactor. Confirming its whereabouts would be somewhat helpful but may not help know the extent of understatement of worker and public exposures. 27

Tami Thatcher found in "Susan Stacey's "Proving the Principle," she describes the fact the Idaho tested three SNAP reactors. So there are multiple issues:

- "There is the likely underestimation of the amount of fission products actually released from the two SNAPTRAN destructive tests and the third fuel damage test. Worker and public exposures have likely been underestimated. The 2000 curie vs 600,000 curies is explained by DOE's using only the long-lived noble gases they say blew offsite. But the assumed release fractions are subject to question and the extensive soil contamination decades after the tests speak volumes about DOE's radiation monitoring.
- The worker external as well as internal exposures, especially alpha and beta exposures were likely to have been inadequately monitored and likely not well represented by NIOSH feeble attempts to argue, as they have in person in Idaho Falls, that all radioactivity was timed to blow offsite, so that workers were not exposed.
- The amount of soil contamination that had to be trucked away for disposal points to the

23 US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE-ID-12119, August 1991, pg. A-64. Reported by Tami Thatcher.

24 ERDA-1536 p. II-248

25 US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE-ID-12119, August 1991. See Table E-5 on p. E-36 for mystery milk and see Table C-21 for the public annual dose summary. Volumes 1 and 2 can be found at https://www.iaea.org/inis/inis-collection/index.html, reported by Tami Thatcher.

26 INEEL Site Report on the Production and Use of Recycled Uranium, L.C.Lewis, D.C.Barg C.L.Bendixsen J.P.Henscheid D.R.Wenzel B.L.Denning, INEEL/EXT-2000-00959, September 2000 http://www.osti.gov/scitech/servlets/purl/768760, reported by Tami Thatcher.

27 Tami Thatcher SNAPTRAN notes 3/12/16

mess and overall monitoring problems. I say this because later CERCLA investigations required hauling more contaminated soil away from TAN. Where was the soil trucked to? DOE's 1960s report says to a CFA landfill. But was it actually trucked to CFA or to RWMC? Some later soil cleanup was hauled to TRA. The soil mess points to lousy overall monitoring especially in those early years which is a public and a worker issue because public roads cross the northern part of the INL near where the SNAPTRAN tests and other ANP tests took place. Soil contamination is also transported by wind to public roads on southern INL site.

There is also the mystery milk high iodine levels in Idaho Falls in 1965 and 1966 documented in the INL HDE. The elevated iodine-131 levels in milk could be because of the Department of Energy's weapons testing at the Nevada Test Site after the 1963 partial test ban. But the insufficient monitoring and deliberate actions to hide the contamination from the DOE's continued weapons testing may have also hidden excessive radiological releases from the INL fuel testing releases. Theoretical estimates of the radiological releases have generally not been verified by reviews conducted years later." 28

SNAPTRAN Tests

Tami Thatcher writes; "There were three SNAPTRAN tests at INL in the 1960s all conducted at TAN. The INL was given three SNAPTRAN reactors to play with. These were designed as an experimental reactor to launch into space. A SNAPTRAN reactor was actually launched in 1965. It operated just 43 days before an electrical failure caused it (to be shut down?) (Google wiki SNAPTRAN)

These were U-235 cores, 15.6 in. long by 8.8 inches in diameter. (Contrast this to ATR's 4 ft. long, 4 ft. diameter core?) These were thermal power of 30 kW contrast to the Advanced Test Reactor is 250 MW thermal but usually operated at only about 100 MW thermal.
But what matters is the total amount of fissionable material in the core, not the rate at which it was designed to produce power. These had beryllium reflectors and were sodium-potassium Nak cooled.

One of the three did not dismantle or disassemble the reactor core so there's no plume of it mentioned in the ERDA-1536 document or INEL HDE. But apparently it did go critical, become radioactive, and I found somewhere it said "it was only slightly damaged." I can't find where I read that. The thing is that all three would have also been a worker exposure source for TAN workers in the 1960s. And John Horan's report of external radiation exposures in the 1990s, he claims he thinks it was an error that so many workers got over 5 rem but then on closer examination can't find an error. He was in charge of safety in the 60s, including keeping tabs on worker radiation doses. So his claimed surprise at the high recorded doses is "incredible." So one issue is the worker exposure from the SNAPTRAN tests which NIOSH tries to approach from looking at the INEL HDE created for offsite dose evaluation. 29 Thatcher wrote:

"Following one SNAPTRAN test, the plume was tracked 21 miles by plane. Subsequent monitoring in Monteview, a farming community near TAN at the near end of the INL included cow's milk and alfalfa concluded that the release wasn't above allowable standards but never told residents. The DOE's 1966 report [1] concluded that the release was 20 percent of the total inventory, but it doesn't say what the total inventory was. The INEL Historical Dose Evaluation listed the release on January 11, 1966 as 2000 curies but the DOE's waste document said 600,000 curies. [2] They proceed to say "The SNAPTRAN-2 Reactor Dolly was dismantled and the reactor structure and components were removed to the burial ground. Forty-seven truck-loads of contaminated soil were removed from around the IET area to the CFA burial ground." If you understand how DOE is really not that particular about soil contamination, you know that the soil had to be hotter than hell. Around the BORAX I reactor debris from intentionally blowing it up, later, a few rocks were scattered over the top of it. Decade's later CERCLA reviews found unacceptably high soil contamination problems at TAN where the SNAPTRAN and initial engine tests took place, among others. Coincidentally, the

28 Tami Thatcher, Nuclear Accident Risks at INL, http://environmental-defense-institute.org/inlrisk.html#Nuclear Accident History at INL.pdf

29 J. R. Horan, "Occupational Radiation Exposure History of the Idaho Field Office Operations at INEL," EGG-CS-11143, October 1993.

US Geological Survey stopped well water monitoring for the entire north end of the INL from NRF to TAN after 1963 for about a decade." 30

The discrepancy between the 2000 curies and the 600,000 curies is said to be because the 2000 curies is the long-lived curies that blew offsite. They are saying that the short-lived curies stayed on-site. And p. A-64 SNAPTRAN, they say released 75 percent of the noble gases, 70 percent of the iodine, 45 percent of the tellurium, 4 percent of the "solids" this being alpha emitters like uranium and plutonium that they would not have monitored for, likely, and only 21 percent of the fission product inventory." Yes, a large fraction of the curies are short-lived. But the longer-lived fission product inventory – how reliable is the 21 percent estimate? How reliable is the solid's 4 percent estimate? Well, these questions take more research and are harder to answer, especially without the environmental monitoring data.

ERDA-1536 p. II-248 says "only slight ground contamination" plume followed 21 miles but no iodine, only noble gases. 10 mrem 6 miles at boundary of INL. If the ground contamination was only "slight" then why the multiple truckloads of soil hauled away? And excessive soil contamination found years later?

4/1/1964 SNAPTRAN-3 Underwater, but steam ejected. 45 MW-sec of nuclear fission. Said to be a fireball. Prompt critical. "Blew up."

1/11/1966 SNAPTRAN-2 54 MW-sec of nuclear fission. Open air test, so no chance of iodine scrubbing from water. But DOE says "once again, the total integrated rad exposure at the nearest boundary was less than 10 mrem."

So, there is an issue about what was actually released by the two destructive SNAPTRAN tests. There's the mystery milk in SE Idaho in the 1965 and 1966 documented in Table E-5 of the INEL HDE. 31

There is an unsigned press release that is part of the DOE's Human Radiation Experiments collection dated July 20, 1965 of a destructive SNAPTRAN test. Why was this press release part of the Human Radiation Experiments collection, since acknowledged tests were not on this date? 32

There is reporting of fuel processing at the "chem. plant" for two SNAPTRAN tests, but we know there were three. This report below has Table V that lists all the fuel processed at ICPP.
In addition to MTR fuel, Hanford fuel, "Zirconium" which is naval propulsion fuel I think, it lists Borax, EBR-I, EBR-II, ATR, ETR, Borax IV, SL-1 scrap, SL-1 (fuel not in the reactor at the time of the accident, I suppose) SPERT, SNAPTRAN 2/10A-3 core debris, SNAPTRAN 2/10-2, and many others. 33

But nothing about the where-abouts of SNAPTRAN 2/10-1, which operated in the 1964 to 1966 timeframe but was supposedly only slightly damaged but radioactive. It makes sense for them to have reprocessed it. In an interesting but unreliable book "Atomic Accidents" by James Mahaffey, he says he could not find any record of the whereabouts of the 2/10-1 reactor. But it is

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30 EDI's website here: http://www.environmental-defense-institute.org/publications/TopTenINLR2.pdf

31 US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE-ID-12119, August 1991. See Table E-5 on p. E-36 for mystery milk and see Table C-21 for the public annual dose summary. Volumes 1 and 2 can be found at https://www.iaea.org/inis/inis-collection/index.html

32 See the Department of Energy Human Radiation Experiments documents collection (of the small subset publicly accessible) including J. R. Horan, "Annual Progress Report 1963, Idaho Operations Office of the US Atomic Energy Commission," 1964, and INEL-HRE-TO70228 and the SNAPTRAN collection; http://www4vip.inl.gov/library/searchreadingroom2.shtml

33 INEEL Site Report on the Production and Use of Recycled Uranium, L.C.Lewis, D.C.Barg C.L.Bendixsen J.P.Henscheid D.R.Wenzel B.L.Denning, INEEL/EXT-2000-00959, September 2000 http://www.osti.gov/scitech/servlets/purl/768760

not impossible for them to have shipped it in a shielded cask to another NASA research facility. But unless that facility had a hot cell or spent fuel pool, its seems very unlikely. Confirming its whereabouts would be somewhat helpful but may not help know the extent of understatement of worker and public exposures.

There was an ans.org dinner meeting presentation about SNAP 10A by Schmidt. He says "test shutdown at 10,000 hours in 1966." Was he talking about SNAPTRAN 10A-1, the reactor not blown to smithereens?

Susan Stacey's "Proving the Principle" describes the fact the Idaho tested three SNAP reactors. So, there are multiple issues:

- There's the likely underestimation of the amount of fission products actually released from the two SNAPTRAN destructive tests that exposed the public. I say this because of the mystery milk high iodine levels in Idaho Falls in 1965 and 1966 and because of the likely underestimation of the fraction of inventory released from the fuel by the tests. The 2000 curie vs 600,000 curies are explained by DOE's using only the long-lived fission products they say blew offsite. But the assumed release fractions are subject to question.

- The worker external as well as internal exposures, especially alpha and beta exposures were likely to have not been adequately monitored and likely not well represented by NIOSH feeble attempts to argue, as they have in person in Idaho Falls, that all radioactivity was timed to blow offsite, so that workers were not exposed.

- The amount of soil contamination that had to be trucked away for disposal points to the mess and overall monitoring problems. I say this because later CERCLA investigations required hauling more contaminated soil away from TAN. Where was the soil trucked to? DOE's 1960s report says to a Central Facilities Area (CFA) landfill. But was it actually trucked to CFA or to RWMC? Some later soil cleanup was hauled to TRA. The soil mess points to lousy overall monitoring especially in those early years which is a public and a worker issue.

- Where did the third SNAPTRAN reactor (INL had three of these reactors to play with), where did it end up? My conjecture is that at least one of the destructive tests resulted in no core to reprocess. So it is only conjecture on my part to wonder if the missing SNAPTRAN-10A-1 was actually reprocessed even though the official records say that -2 and -3 were reprocessed."

5. Summary Aircraft Nuclear Propulsion Program and Experimental Reactor INL Tests 1956 to 1969

ANP/Experimental Reactor Test Number	Test Date	Release Quantity (Curies)	Source
IET # 3 HTRE-1	2/11 – 2/24/56	132,000.00	D @ ES-11
IET # 4			
# 4-A-1	5/1 – 5/23/56	7,264.00	D @ ES-13
# 4-B-2	5-24 – 6/29/56	205,772.00	D @ ES-13
# 4-C-3	6/29/56	689,886.00	D @ ES-13
IET # 6	12/18/56	9,000.00	B @ A-202
IET # 8 HTRE-2	7/31 – 8/28/57	1,700.00	B @ A-121
IET # 10-A			
# 10-B	12/20/57 – 2/25/58	2,220,000.00	D @ ES-16
# 10-C	3/1 - 3/6/58	2,740,000.00	D @ ES-16

IET # 11	3/20/58 to 4/14/58	4,635.00	B @ A-128
IET # 12 "Boot"	4/21/58 to 5/7/58	29,070.00	B @ A-132
FPFRT-1	7/25/58	9.80	B @ A-201
FPFRT-2	8/4/58	9.30	B @ A-201
FPFRT-3	8/6/58	9.90	B @ A-200
FPFRT-4	8/14/58	9.60	B @ A-200
FPFRT-5	8/27/58	140.00	B @ A-200
FPFRT-6	9/4/58	115.28	B @ A-200
FPFRT-7	9/17/58	90.79	B @ A-200
FPFRT-8	9/18/58	102.48	B @ A-200
FPFRT-9	9/26/58	10.08	B @ A-200
IET # 13	10/8/58 to 11/18/58	9,730.00	B @ A-137
IET # 14	4/24/59 to 5/19/59	13,456.00	B @ A-139
IET # 15	5/27/59 to 6/24/59	3,178.34	B @ A-199
IET # 16	7/28/59 to 10/28/59	294.42	B @ A-199
IET # 17	11/2/59 to 12/12/59	6,202.00	B @ A-147
IET # 18 "HTRE-3"	12/23/59 to 2/8/60	14,157.30	B @ A-153
IET # 19	2/9/60 to 4/30/60	11,381.00	B @ A-153
IET # 20	5/1/60 to 6/13/60	10,249.00	B @ A-155
IET # 21 "Feet # 1"	6/20/60 to 8/8/60	3,752.00	B @ A-158
IET # 22	8/12/60 to 8/25/60	10,526.80	B @ A-160
IET # 23 "Feet #2"	9/1/60 to 10/14/60	2,890.00	B @ A-163
IET # 24 "Lime"	10/17/60 to 10/26/60	7,725.90	B @ A-165
IET # 25	11/15/60 to 12/16/60	10,171.26	B @ A-197
IET # 26	12/22/61 to 3/31/61	12,110.00	B @A-173
SPERT-1	11/5/62	240,000.00	B @ A-79
SPERT-2	11/10/63	530.00	A @ II-246
SPERT-3	4/14/64	1,900.00	A @ II-244
SNAPTRAN-2-10-3	4/1/64	24,000.00	A @ II-248
SNAPTRAN-10A-1	7/20/65?	?	?
SNAPTRAN-2-10-2	1/11/66	600,000.00	A @ II-249
7 Module # 1168 to # 1183	1967 to 1968	?	C @ 29 to 116
3 Module # 1185 to # 1192	1969	?	C @ 165 to 179
Total # Tests > 59		**Total Curies* 7,021,878.25**	
Total Uranium Released		**1,635.82 grams**	

Acronyms: IET = Initial Engine Test; FPFRT = Fission Product Field Release Test; SPERT- Special Power Excursion Reactor Test; SNAPTRAN = Special Nuclear Auxiliary Power Transient; Modular - NASA's Modular Cavity or "Light Bulb" Reactor.

* Only hot run tests are listed in the table above, therefore, missing test numbers indicate cold runs. Curie content of uranium released is not included in the total curies released. Releases for the 7 &3 Module are not yet fully

analyzed. Between 1956 and 1966 the ANP reactors operated in excess of 3,064.24 hours. During this time the reactors were operated at high power for 1,575.8 hours.

Resources for above table: [DOE/ID-12119] [PG-WM-85-008 @2-3] Table sources: [A - ERDA-1536]; [B - DOE/ID-12219]; [C - IN-1376]; [D - Critical Review of Source Terms for Select Initial Engine Tests Associated with the Aircraft Nuclear Propulsion Program at INEL, CDC, 7/03.

Other nuclear jet engine projects that impacted INL were ground tested in Nevada. [Times News10/15/90] The nation's first nuclear-powered rocket engine, Kiwi-A, first fired for five minutes in July 1959 at the Nuclear Rocket Development Station about 100 miles northwest of Los Vegas. Several Kiwi-A's were test fired throwing smoke and dust hundreds of feet into the air. In a 2012 news article about *US Plans Long Flights with Nuclear-Powered Drones* it states*:*

> "Hoping to keep drones in the air for a longer period of time in order to leave more power available for operating equipment, the US plans to build nuclear-powered drones that can fly for months.
>
> "The United States is planning to build nuclear-powered drones, which will allow an increase in flying time from days to months without refueling, leaving more power available for operating equipment. The project, developed by the U.S. government's principal nuclear research and development agency Sandia National Laboratories along with defense contractor Northrop Grumman, has not yet reached the building or testing phase, the Guardian has reported.
>
> "According to the report, the project sets out to solve three problems associated with drones: insufficient "hang time" over a potential target, lack of power for running sophisticated surveillance and weapons systems, and lack of communications capacity. The research team found that nuclear drones were able to provide far more surveillance time and intelligence information per mission compared to other technologies, and also to reduce the considerable costs of support systems, eliminating the need for forward bases and fuel supplies in remote and possibly hostile areas." 34

6. **ROVER Reactor Tests at** Nevada Nuclear Rocket Development Station; "The remains of the reactors from the development project collectively called the ROVER project are among the highly radioactive wastes stored at the INL's ICPP." [Ibid.] ICPP also had a ROVER fuel reprocessing building that has been identified in DOE's Highly Enriched Uranium vulnerability report as having criticality problems. Also see Section I.D.2 Post RaLa ICPP Releases pg. 12 for more Rover discussion.

In 1972, after the ROVER program had shut down, 26,000 fuel elements were shipped from Jackass Flats, Nevada to INL. About 18,000 rods of ROVER program fuel were eventually processed at the ICPP between April 1983 and June 1984 removing about 3,200 kilograms of highly enriched uranium.[Times News10/15/90]

The reprocessing of ROVER fuel was discontinued because burning the graphite off the fuel plugged up the off-gas systems and dissolved fuel raffinate plugged up process lines. These plugged lines remain today as they were left at the end of the program. "For the contractor slated to deactivate the ROVER Facility...criticality risks are of paramount concern. The ROVER Facility which was shut down in 1984, houses a substantial amount of uranium in its processing lines, vessels, and related equipment." [EM Progress, Winter 1996]

Workers attempting to decontaminate the ICPP ROVER fuel burn cells in 1984 received significant exposures because the graphite plugged face masks and seeped into protective suits. Management refused to provide workers with pressurized air lines and suits so the workers refused to reenter the ROVER cells. After a dozen years and a belated commitment of over $23 million, DOE is finally willing to address this lingering criticality hazard.

The NERVA (Nuclear Engine for Rocket Vehicle Application) - engine, later developed by Aerojet-General and Westinghouse Electric, was designed to propel a rocket or space vehicle once it escapes the earth's atmosphere. The heart of the engine is a little reactor that uses small ceramic-coated fuel pellets imbedded in graphite. The reactor heated liquid hydrogen, causing it to expand and turn to

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34 *US Plans Long Flights with Nuclear-Powered Drones*, Wednesday, 4 April 2012 Turkish Weekly

gas. The rapid expansion provided the propelling force of the engine. [Times News10/15/90] [Also see Timberwind]

Centaurus Program: Budget disputes in 1991 over the Strategic Defense Initiative revealed a secret program called Centaurus at INL. Bill Thielbahr, director of DOE Idaho's energy technology division, acknowledged the difficulties of gaining continued Congressional funding for the $3 million annual requirements of the project. Thielbahr described the Centaurus as a "nuclear-pumped laser" testing program. The work could include studying methods to recover safely some space debris and new systems to produce electrical power. This INL research team consisted of about 20 workers. The $4 million total proposed for INL research is uncertain, since both chambers of Congress have voted to cut the 1991 SDI budget by at least $1 billion. [AP (k)]

The basic SDI concept is a space-based network of nuclear powered lasers that could shoot down missiles launched at the United States. This secret program has never had any publicly available environmental monitoring data, which is a repetition of decades of non-accountability fostered by classified Black Budget projects.

7. Atmospheric Release Experiments

OMRE Solvent Burning Experiment on November 16, 1960 was conducted to "determine the feasibility of open-air burning of contaminated solvents accumulated at the Organic Moderated Reactor Experiment (OMRE) facility. 400 gallons of radioactive solvents were placed in an open vessel and ignited." [DOE/ID-12119 @A-173]

CERT Tests: Other "human guinea pig" experiments were carried out just to see how Iodine-131 is absorbed in humans and disperses in the surrounding ground. Twenty-nine Controlled Environmental Radio-iodine Test (CERT) between May 1963 and December 1977 released over 32.72 Ci including 26 Curies of Iodine-131 to the environment. [ERDA-1536@II-250]& [DOE/ID-12119]

"On three of these CERT releases, human subjects were deliberately exposed. The general design was that radioactive iodine was released in gaseous form, and prevailing winds took the iodine over an area designated the 'hot pasture.' Monitoring devices in the pasture determined the radioactivity deposited. A herd of cows was then led to the pasture to graze for several days. The cows were milked and the milk monitored for Radio iodine. Humans were exposed either by drinking the milk or by direct exposure to the released iodine gas. During CERT-1, conducted in May 1963, one curie of radioactive iodine was released into the hot pasture. Six cows were placed in the contaminated pasture. Cows were milked twice a day and the milk from one cow saved for human ingestion. Seven human subjects each drank 0.5 liter of radioactive milk over a period of 18 days. Radioactive iodine uptake was determined by counting the radioactivity absorbed in the thyroid of each subject." [IDO-12053]

CERT-2 was conducted in September 1964. Approximately one curie of radioactive iodine was again released over the hot pasture. Milk samples were again tested, but were not consumed by humans. Instead, three human subjects were placed on the pasture during iodine release, and the radiation accumulated in their thyroids was counted after exposure. This was not a food chain experiment, but was designed to measure the direct iodine dose from inhalation. During CERT-6 conducted in the summer of 1965, several vials of Radio iodine were broken and the contents (2-6 curies) released to the environment. [IDO-12053, 8/66 @2] "Several individuals were inadvertently exposed to airborne Radio iodine from the leaking and broken containers, and efforts were made to obtain data on the retention of this form of iodine in humans." [Ibid. @2]

These CERT exposures occurred over a four-day period, and a few people received multiple exposures; radiation accumulation in the thyroids of these individuals was counted. CERT-7 was conducted in November 1965; 1 curie of I-131 in the gaseous molecular form was released over the pasture at the INL Experimental Dairy Farm. Six cows grazed, and milk samples were counted. In addition, seven human 'volunteers' were placed seated on the pasture area. Uptake of radioactive material was determined by counting the subject's thyroids. "DOE reported to the Subcommittee that no medical follow up of the experimental subjects in the CERT tests was performed." Through the course of the CERT tests, twenty one individuals were exposed. [Congressional Research Service, 5-156 @ 22- 24]

8. Human Radiation Experiments

"From 1963 to 1965, at the Atomic Energy Commission National Reactor Testing Station in Idaho, [now called Idaho National Laboratory] radioactive iodine was purposely released on seven separate occasions. In one of these experiments, seven human subjects drank milk from cows which had grazed on iodine-contaminated land. This experiment was designed to measure the passage of iodine through the food chain into the thyroids of human subjects. In a second experiment, three human subjects were placed on the pasture during iodine release, and seven subjects were placed on the pasture in a third experiment. In addition, 'several' individuals were contaminated during yet another experiment when vials of radioactive iodine accidentally broke. Cows grazed on contaminated land and their milk was counted in four of the experiments; in the remaining three, radiation measurements were made only in the pasture." 35

"Between 1965 and 1972, 8 individuals were involved in 13 different human experiments. All eight were employees of the Idaho Division of the Atomic Energy Commission. In four experiments, subjects inhaled Argon-41; in nine experiments, subjects swallowed capsules containing micro curie amounts of radioactivity. These experiments were funded and carried out by the Atomic Energy Commission. The objective of this experiment was to calibrate instruments that measure radioactive substances inside the human body; such instruments are usually used to examine workers accidentally exposed or hospital patients receiving radioactive material for diagnostic purposes. A second objective of the experiments was to examine the metabolism of radionuclides ingested or inhaled by humans. In the first set of experiments, one subject was fed one micro curie of Manganese-54; another subject was fed an unspecified amount of Iodine-131. In a second set of experiments, individual subjects were fed 3.5 micro curie of Cesium-132, 1.9 micro curie of Potassium-42, or 1.1 micro curie of Manganese-54. In addition, 4 subjects inhaled Argon-41 in amounts of 1.3 to 2.2 micro curie. In a third experiment, one subject was fed 1.5 micro curie of Cobalt-60 and Cesium-137. The Department of Energy reported there was no medical follow up of any of these experimental subjects." [Congressional Research Service, 5-156 @ 35-36]

Intentional releases of Iodine-129 into the environment referred to as the Iodine-129 Technology Studies took place in August 1964. The studies were a collaborative effort of the US Weather Bureau Research Station at the INL and the Nuclear Science and Engineering Corporation of Pittsburgh, PA. The Iodine-129 Technology Studies were conducted to examine the atmospheric mixing and dilution of gases and particles containing small amounts of Iodine-129. There were a total of five tests: two with particles, one with gases, and two more with particles and gases combined. The first three tests were sampled to distances of about 10 miles over a densely instrumented grid located in the center of the INL site. The last two tests were sampled at distances of 25 to 35 miles in off-site areas to the north-east of the point of release. One mill curie of iodine-129 was released during the experiment. [DOE News, 7/31/95]

The 17-million year half-life of Iodine-129 plus its ability to enter the food chain and subsequently concentrate in the thyroid makes this isotope especially toxic for perpetuity.

The Atomic Energy Commission (AEC) also collected human body parts that were used in radiation experiments from hospitals in the Idaho Falls area. Between 1954 and 1955, five samples of human bone obtained at surgery or autopsy from local hospitals were analytically compared with measurements of radioactivity in animals located at the INL.

According to the US General Accounting Office report titled "*Information on DOE's Human Tissue Analysis Work*", the human bone samples appear to have been analyzed for two radioactive elements, strontium and yttrium. In other studies between 1968 and 1970 skin from amputated limbs and other surgical procedures was obtained from various hospitals in the Idaho Falls area. The study's ultimate objectives were to apply radioactive iodine to the human skin to evaluate the hazards caused by iodine permeation. The principal goals of the program were to establish procedures for making accurate predictions of the thyroid dose that would result from an accidental iodine exposure. Other goals were to help in selecting iodine impermeable materials for protective clothing and to develop improved decontamination procedures. In both of these studies informed consent was **not** obtained from the

35 Congressional Hearings On Radiation Experiments**.** For Briefing Book Volume 1, February 10, 1994. http://www2.gwu.edu/~nsarchiv/radiation/dir/mstreet/commeet/meet1/brief1/br1n.txt

patients and/or family by the researchers. [GAO/RCED-95-109FS@39]

Long Distance Diffusion Tests (LDDT) included three between March 1971 and August 1972 were conducted by the National Oceanic and Atmospheric Administration and the Health Services Lab at INL. These tests released 1000 Ci of Krypton-85 and 12.3 Ci of Iodine-131 into the atmosphere. The stated purpose of these tests was to see how these radionuclides disperse in the atmosphere. [DOE/ID-12119@A-59] For perspective, the Three Mile Island nuclear accident released more than 15 curies of Iodine-131.

Experimental Cloud Exposure Study included 9 tests, appropriately named EXCES, released between May 1968 and April 1970, 987 Ci of Xenon-133 and Sodium-24.[DOE/ID-12119.@A-61]

Relative Diffusion Tests: Another air dispersion testing series called Relative Diffusion Tests (RDT) released 10.4 Ci of Iodine-131 between November 1967 to October 1969. [Ibid]

Army Gas Cooled Reactor Experiment: The U.S. Army built support structures and reactors at the INL Auxiliary Reactor Area (ARA) between 1957 and 1965 when the program was phased out. ARA was divided into four areas (I through IV). ARA-I acted as support facility for the other ARA sites. ARA-III originally housed the Army Gas Cooled Reactor Experiment (AGCRE), water moderated, nitrogen-cooled reactor that generated heat but no electricity and was finally placed on standby on April 6, 1961. After the Army vacated ARA, the buildings were used for various INL projects such as sensor fabrication, experimental instrumentation, and a metallurgical laboratory for nuclear reactor experiments. In 1965, the U.S. Army built the ARVF in the center of INL. "The facility consisted of a test pit, an underground bunker, and a system of pulleys and cables. The steel-lined, open-top test pit was filled with water into which nuclear fuel elements were placed." [DOE/EH/OEV-22-P @2-39]

Presumably, the tests were done to create an accident scenario of a nuclear plane or satellite crash and the resulting radioactive releases to the crash site. In 1974, "four drums of radioactively contaminated NaK from ERB-1 were placed in the bunker, where they remain today. In 1980, a protective shed and crane were built above the pit, and in 1980-81 a series of explosive tests were conducted in the pit." [DOE/EH/OEV-22-P @2-39]

Loss-of Fluid Tests (LOFT): INL has a long history of intentional reactor melt-downs that were conducted to test the operating parameters of military and civilian reactor designs. The Loss-of Fluid Tests (LOFT) were conducted at INL's Test Area North (TAN) beginning in late 1977 and ending in 1985 costing over $350 million.[Norton] As the name suggests, the purpose of LOFT was to test the effects of loss of coolant to a reactor, damage to fuel, and related reactor systems. DOE acknowledges eight LOFT test series over this period. [DOE-ID-12119@A-57]

The main components of the LOFT facility were the Mobile Test Assembly that was a large four rail dolly capable of moving the reactor between the TAN Technical Support Facility (TSF) Hot Cell and the test pad containment vessel. The Hot Cell assembled the reactor on the rail dolly, which then transported it to the test pad.

The LOFT test pad containment structure is 70 feet wide and 129 feet high with huge doors to allow the reactor and rail dolly to move in and out. As with the ANP, the tests were conducted at a site removed from the main TAN support area because of the known hazards. After the test run, the rail dolly was moved by a shielded locomotive back to the TSF Hot Cell for disassembly and inspection. After the reactor components were inspected, they were transported to INL's RWMC burial ground for shallow disposal. [ERDA-1536 @II-123]

A "blow-down emission suppression system" in the LOFT containment structure was intended to catch steam and water ejected during the intentional melt-downs resulting from loss of coolant. A 150-foot stack was used to exhaust the effluent into the atmosphere. ERDA's "conservatively estimated airborne radioactivity releases from LOFT experiments" were 941,912 Ci per year which includes stack emissions and containment structure leakage. [ERDA-1536 @II-118] Annual solid radioactive waste generated by LOFT contained 27,000 Ci. [Ibid @ II-124] The last LOFT experiment (LP-FP-2) on July 9, 1985 released 8,800 Ci plus 0.09 Ci of Iodine. [DOE/ID-12119 @A-52]

These releases were done with full knowledge of the implicit hazards of radioactive emissions. "In 1950 the 'destructive force of the atom and the harmful effects of radiation' were basically understood." [DOE-ID-12119@A-50] Yet, no public announcements or warnings were ever given to the public so that they could take

some measure of precaution.

Indeed, INL operations were shrouded in absolute secrecy. Only recently have public interest groups had some limited success in gaining access to historical records through the Freedom of Information Act. Today, the vast majority of the most revealing documentation is still classified, technically unavailable in contractor files, or intentionally destroyed. DOE and Department of Defense's (DOD) claims of national security concerning the declassification of fifty-year old radiation release documents is not justified. DOE and DOD have yet to offer guarantees to agencies of the US Health and Human Services conducting health studies at INL that all operating history documents will be declassified. Moreover, DOE delayed for two years granting security clearances to CDC/NIOSH public health agency researchers after destroying documentation needed to assess the radiation effects in the INL Dose Reconstruction Study.

Bluenose Releases

In the late 1940s and 1950s a U. S. Atomic Energy Commission (AEC) and U.S. Air Force secret program code named Operation Bluenose attempted to determine Soviet plutonium production levels by analysis of fission product gases released during the reprocessing of reactor fuel. To test the instruments in their U-2 spy planes, the Air Force requested that large amounts of radiation be released from the Hanford, Washington and Oak Ridge, Tennessee process facilities. The Hanford Education Action League (HEAL) received a DOE document through the Freedom of Information Act (FOIA) describing the releases. "The April 1949 report obtained by HEAL recommends that another test be conducted at Hanford that would release more radiation and also suggests that the plant filters be disconnected. This was done for the Green Run experiment." [HEAL (d)]

The CDC managed Hanford Environmental Dose Reconstruction Health Study determined that the Green Runs released 740,000 curies of Iodine-131. The Richland Washington Tri-City Herald offered the following interpretation:

"In the 1940s Walt Singlevich headed a classified program known as Operation Bluenose whose object was to determine soviet plutonium production by analysis of fission product gases given off during the reprocessing of reactor fuel." "The 340,000 curies intentionally released [from Hanford] in 1949 were part of this test program. This release was achieved by hauling 'green' irradiated fuel from the 100 area over to the 200-B Plant were it was dissolved in nitric acid and 'some purple iodine was vented up the stack'. It was later found that I-131 was not an accurate indicator of plutonium processing through-put. The noble gas Krypton-85 was found to be the only isotope which could not be removed from the off-gases and that is what Francis Gary Powers was sampling in 1960 when he was downed by the Soviets. His U-2 spy plane had a Cold Finger sampler in-take on its wingtip to sample air at 100,000 feet over the USSR for its Kr-85 content." [Tri-City Herald]

Michael D' Antonio's book *Atomic Harvest* notes a series of articles in the Portland Oregonian newspaper that interviewed Carl Gamertsfelder, a retired Hanford radiation control manager who was at the site during the infamous "Green Runs." Gamertsfelder seems to corroborate the above *Tri-City Harold* article. According to D' Antonio, Gamertsfelder's characterization of the "Green Runs" in the following way.

"It had related to the intrigue and espionage of the Cold War. The United States had been trying to spy on Soviet weapons factories from the stratospheric perspective of exotic surveillance aircraft. The aircraft, and monitoring stations at sites bordering the Soviet Union, could be equipped with devices that would measure the pollution coming out of Russian plutonium plants. But in order to know how the emissions related to the volume of uranium being processed, the Americans needed to simulate Soviet manufacturing methods. To do this, they ran the [Hanford] T-Plant Soviet style, shortening the cooling period and allowing higher levels of pollution. They then measured off-site radiation and worked out a formula that would turn readings from monitoring devices into estimates of the enemy's bomb-production rate. Since the Soviets processed green uranium, in order to stay competitive in the arms race, Hanford had to conduct a Green Run too. Of course, without documentation, no one could be sure that this explanation was accurate. Years later, HEAL would continue to suggest that there was more to the story. Jim Thomas theorized that the US scientists have to perform the Green Run in the way they did because

their instruments were not sensitive enough to detect the small emissions." [D' Antonio@125]

Secret document titles obtained during the Hanford Environmental Dose Reconstruction suggest that the INL's ICPP was involved in this Bluenose program in the 1950s. The focus on Kr-85 is confirmed in a United States Government Office Memorandum titled Bluenose and Other Matters that was the transmittal document conveying the attached "Critique of Possible Methods of Computing the Amount of American Kr-85 in the Atmosphere." [HAN-40477]

The INL Research Bureau (IRB) submitted a Freedom of Information Act (FOIA) request to both Hanford and INL for release of these documents. 36 Though Hanford did send copies of some of the formerly secret documents, INL refuses to declassify these forty-year-old documents because of "national security." In a formerly secret memorandum from Paul G. Holsted, Chief of Planning and Reports Branch, Hanford Operations Division, titled "Review of Bluenose Program" dated May 26, 1955, Holsted notes the following:

> "General Electric Company has been requested by the [AEC] Division of Research to make release calculations to cover operations of the ICPP at Arco. This work has not yet started although many Kgs of U-235 have been recovered. GE had indicated that it would be willing to do the calculations but that further information would be necessary before it could start. This program was discussed briefly and GE is now ready to start the work." [HAN-59174@4]

The Bluenose program precisely irradiated U-235 slugs under highly controlled reactor conditions by AEC prime contractor General Electric Hanford Atomic Products Operation. [HAN-58767] The slugs were shipped from Hanford to other sites where the slugs were dissolved in nitric acid and the gases allowed to escape. These other sites identified are Savannah River, Oak Ridge, Argonne National Laboratory, Knolls Atomic Power Laboratory, Brookhaven National Laboratory, and National Reactor Testing Station (now INL). [HAN-59174@][HAN-401931

Hanford has the INL release data related to the Bluenose program but refuses to release the documents, referring the Environmental Defense Institute (EDI) to INL who also refuses to release the documents. Dr. Charles Miller, Centers for Disease Control, Environmental Health Physicist, has a Q-security clearance and was shown a secret Bluenose document at INL. Dr. Miller's security cleared characterization of the document is that it had nothing to do with releases but was related to shipping of nuclear materials between sites. Verbatim transcript of the May 25, 1994 meeting of a CDC INL Health Advisory Board meeting states the following exchange between CDC's Charles Miller and the author:

> "Mr. Miller: Let me tell you what I can tell you legally, I'm reading my notes very carefully because they have been approved. Bluenose was a measurement program, measurement of analytical samples. It did involve the shipment of what are called limited quantities. Now that is not a judgment [sic] on the part of anybody, that's a legal definition as defined by the U.S. Department of Transportation, a limited quantity of radioactive material. And it did involve the shipment of these limited quantities between DOE sites. There were no releases associated with the project. It was not a release project. INEL has been involved since 1970 and everything else was classified."
>
> "Mr. Broscious: Was it [Bluenose] the Air Force that was involved in it?"
>
> "Mr. Miller: I can't answer that."
>
> "Mr. Broscious: so are they going to declassify that information?"
>
> "Mr. Miller: I would say absolutely no way."
>
> "Mr. Broscious: No way?"
>
> "Mr. Miller: No way." [CDC (d)@175]

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36 The INL Research Bureau (IRB) was a coalition of 12 environmental groups formed by EDI to challenge DOE, DOT and the Air Force refusal to release environmental, health and safety documents on the grounds that "It was not in the public interest." IRB appealed and DOE was ordered to release the documents. Having lost their appeal, DOE then tried to charge the IRB over $2 million for copy/costs but again lost IRB's appeal were forced to deliver the documents.

Dr. Miller concluded that the Bluenose program was not a relevant issue to the INL Dose Reconstruction Study because he was convinced no releases occurred. It is entirely possible that the Bluenose document Dr. Miller was shown only dealt with transporting the Hanford irradiated U-235 slugs to INL. However other declassified documents released under FOIA to EDI clearly show the Bluenose program objectives for releases at numerous chemical processing sites around the country including INL. For instance a document titled "Reporting Bluenose Releases" from S. G. English, Chief, Chemistry Branch, Division of Research, and Washington to G. Victor Board, Director, Health and Safety Division, Idaho Operations Office, Idaho Falls states: "Enclosed for your information are the November reports on the dissolving at the ICPP." [HAN-64357]

Another declassified March 18, 1955 memo between AEC Washington, D.C. and Hanford titled Preparation of ICPP Release Data states: "Your wire of January 27, 1955, requested a review of the feasibility of having General Electric perform calculations on krypton releases from the ICPP plant at Arco." [HA-58488]

Jim Thomas, then with a law firm involved in a Hanford Downwinders class action suit against DOE still believes that the U.S. efforts to determine Soviet plutonium production rates first tried iodine releases and switched to Krypton-85 because it was more reliable. They used atmospheric inventories of Kr-85 through known U.S. and Allied releases and subtracted that sum from the global total to determine the Soviet production levels.

It appears that through ineptitude or conspiracy, CDC has allowed DOE to hide relevant information needed to establish radioactive releases from INL. These Bluenose revelations strike at the very core of public confidence in CDC's political will to conduct good science. Before a scientific finding can have any credibility in the real world the methodology and supporting data must be reviewed and the method replicated by other independent scientists. As long as information remains classified, independent researchers cannot review the source information that CDC relied on to do the INL Dose Reconstruction health study, and therefore cannot replicate the science. The public will remain justifiably skeptical as long as fundamental scientific method is not followed.

The INL Research Bureau (IRB), a coalition sponsored by the Environmental Defense Institute, filed a Freedom of Information Act (FOIA) request to DOE Richland Operations Office in September for copies of documents identified during the Hanford Dose Reconstruction. The Department's October 24th response was: "We have conducted a thorough search of the Department of Energy's Richland Operations Office (RL) and contractor offices and the following documents were not located." "Therefore, this portion of your request must be denied." Twenty seven documents were listed as lost.

The IRB's appeal to DOE's Office of Hearings and Appeals in Washington, DC notes that "if indeed the requested documents are no longer in existence, the more serious implications of document destruction raises issues of Department non-compliance with United States Code, Title 44 Chapter 31 "Records Management by Federal Agencies"; Chapter 33, "Disposal of Records"; Code of Federal Regulations, 36 CFR, Chapter XII, Subchapter B, "Records Management"; 41 CFR Chapter 201, "Agency Programs"; DOE Order 200.1; and Secretary of Energy memorandums dated March 26, 1990, and January 13, 1994 mandating the retention of epidemiological and other related health study records. The IRB requested that DOE stipulate the fate of these 'not located' records."

The reason these INL documents were at Hanford is both sites were involved in Operation Bluenose. In the 1950's, the Air Force 's U-2 spy plane would fly over the Soviet nuclear production sites, take pictures and take air monitoring samples. In order for the air samples to be useful, the instruments had to be calibrated. As previously noted, intentionally large amounts of fission products including Iodine-131 and later Krypton-85 were released from Hanford, INL and other US production sites and over flown by the U-2 planes. Since The US throughput (production rate) was known, the air sample instruments could be calibrated.

Hanford, being the older AEC sibling, was also involved in INL's start up. INL's original name was the National Reactor Testing Station which more accurately characterizes its five decade mission. No other site has had a more diverse range of reactor operations. Because of this diversity, documents

needed for a dose reconstruction study are spread out over the country at different sites and archives. Preservation of these records is essential until after the dose reconstruction studies are completed and all challenges resolved.

Missing documents are not the only problem researchers face. DOE's response to a June INL Research Bureau Freedom of Information Act request was to black out the important parts of the report. These documents quantified the amount of krypton-85 that was released from INL in support of the 1956 Bluenose project. DOE justified deleting the amount of krypton that was released by stating that:

"The Atomic Energy Act of 1954 prohibits the disclosure of information concerning atomic energy defense programs that is classified as Restricted Data pursuant to the Atomic Energy Act. The portions deleted from the subject documents pursuant to exemption 3 contain information about nuclear weapons design that has been classified as Restricted Data. Disclosure of the exempt data could jeopardize the common defense and the security of the nation." [DOE-9/23/97]

The only credible aspect of national security in jeopardy is the American public's confidence in its government to tell the truth. It is ludicrous to suggest that a person could figure out how to make a bomb from knowing how much iodine and krypton INL released over forty years ago. People living downwind or downstream have a right to know the truth about how these government activities affected their lives.

9. Incomplete Summary of INL Radioactive Releases to Atmosphere

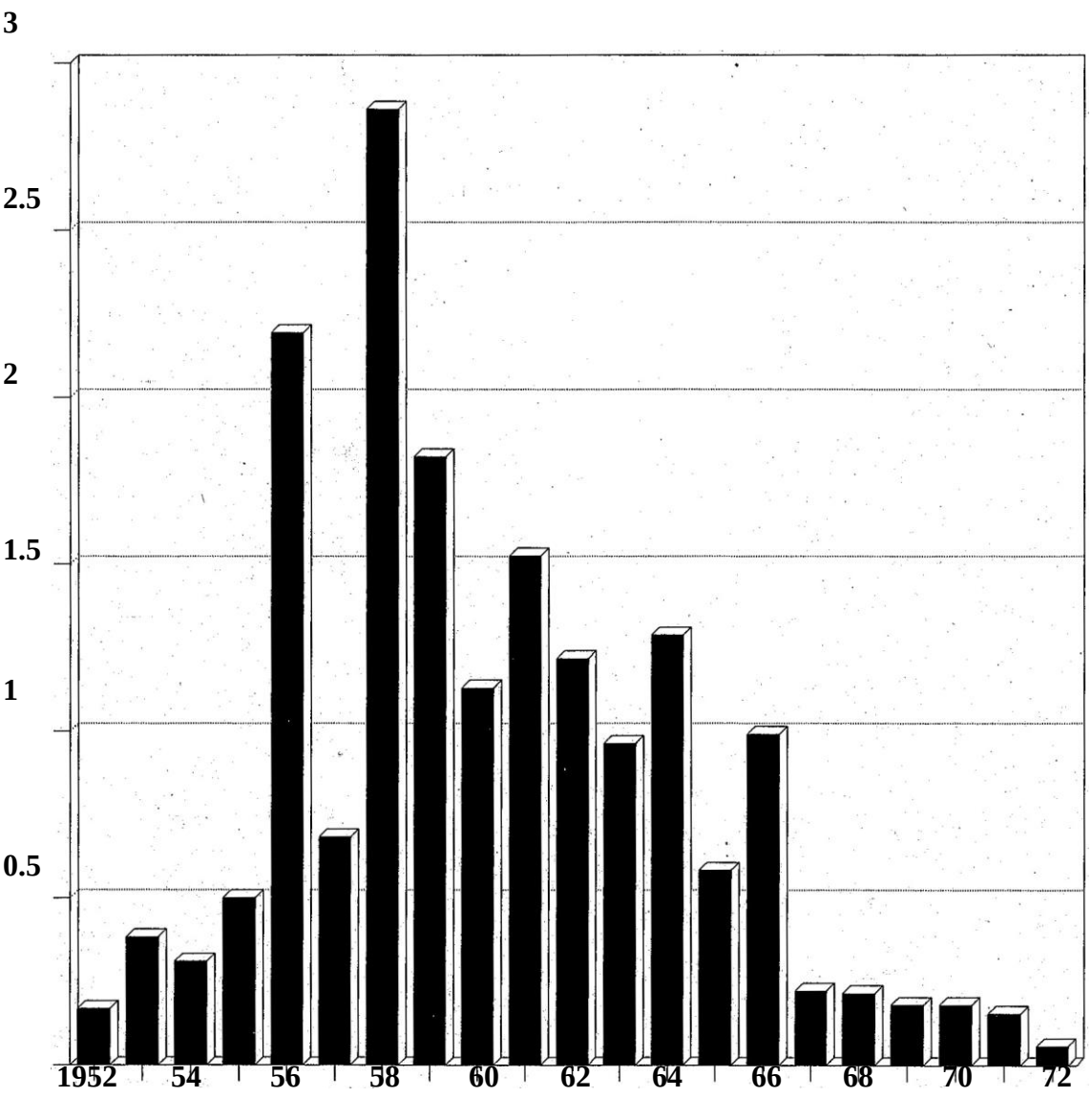
Facility	Date	Curies Released	Source
Naval Reactor Facility*	6/18/55	305	A @ A-203
ERB-1	11/29/55	single excursion	LA-13638
INTEC/ICPP*	10/58	1,200	B @ C-3
INTEC/ICPP*	10/16/59	367,717	A @ A-99
INTEC/ICPP*	1/25/61	5,200	B @ C-5
SL-1*	1/3/61	1,128	A @ A-196
BORAX-1*	7/22/54	714	A @ A-203
Aircraft Nuclear Propulsion*	1956-66	4,635,724	see ANP table
Other INL Operational Release	1952-89	13,552,880	A @ A-189
Total Air Release	1952-98	18,564,868	

Sources: (A) DOE/ID-12119; (B) ERDA-1536; Los Alamos National Laboratory, LANL LA-13638

* ICPP is now called INTEC. Significant episodic releases not included in general INL operational releases to the atmosphere. Curie releases less than 0.1 were not added in this summary and are considered understated due to lack of information.

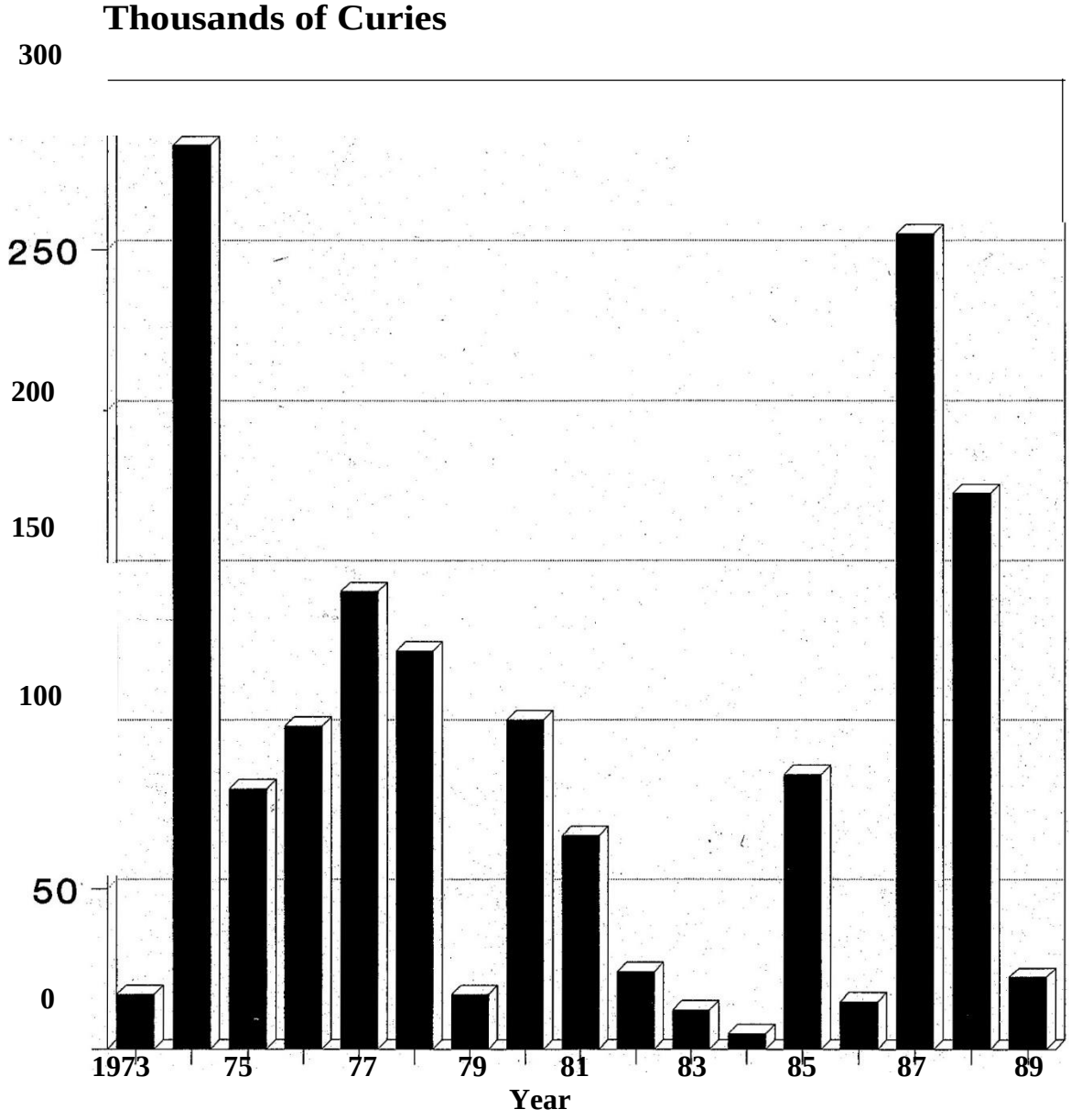
See Section I.D below for more details on INTEC/ICPP spent nuclear fuel reprocessing called RaLa Runs.

INL Air Releases
1952 to 1972



Sources: DOE/ID-12119 and ERDA-1536

lNEL Air Releases
1973 to 1989



Sources: DOE/ID-12119 ERDA-1536