INL/EXP-22-68367-Revision-0

Nuclear Qualms Intern Poster

July 2022

Alana M Haack, Christa Dawn White

Changing the World's Energy Future

INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance, LLC

INL/EXP-22-68367-Revision-0

Nuclear Qualms Intern Poster

Alana M Haack, Christa Dawn White

July 2022

Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Nuclear Qualms

The Integral Fast Reactor Story

INL Archives and Special Collections,
Cultural Resource Management Office

Christa White & Alana Haack
Austin Schulz, mentor

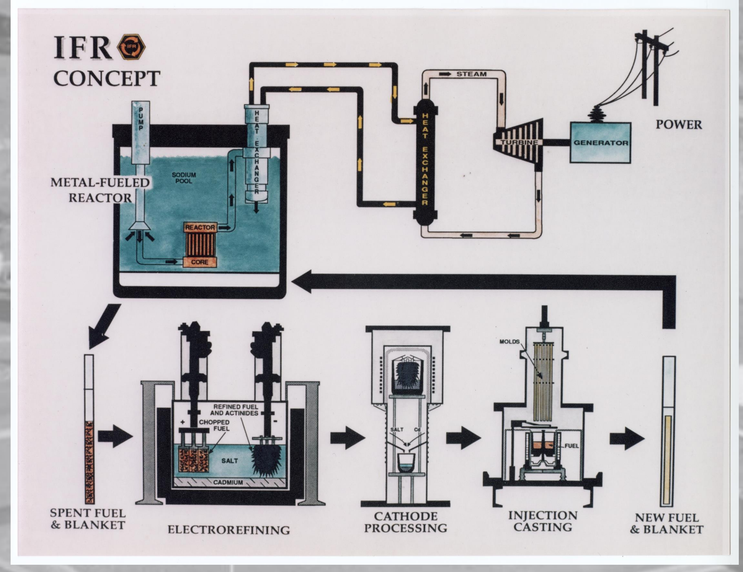
EMPORIA STATE UNIVERSITY
SJSU SAN JOSÉ STATE UNIVERSITY

Objective & Methods A 2022 Reuters poll found that 45% of Americans support nuclear power, 33% oppose it, and 20% are unsure, with opposers primarily concerned about meltdowns and nuclear waste.[1] Establishing trust with the public has historically been a challenge for the nuclear energy development community. Technical jargon, specialized concepts and popular fictional portrayals are among the barriers to reassuring the public of modern reactor designs' safety. Using ten letters sent in 1993 to Congress by interest groups and other archival sources, we demonstrate how the public's misguided nuclear qualms contributed to Congress cancelling the promising Integral Fast Reactor (IFR) project at Argonne National Laboratory-West's (later INL) EBR-II reactor in 1994.[2] The decision halted the completion of a groundbreaking technology that cost the world 28 years and counting in lost time to validate and commercialize IFR technology.

Background By the time IFR was in development at EBR-II in 1984, light water reactors (LWRs) were already commercialized in the U.S.[3] IFR was developed to resolve safety and sustainability challenges with LWRs. The program centered around a plant in which a reactor and reprocessing facility were connected. IFR was so efficient that it utilized nearly all its fuel, could be fueled with spent fuel from LWRs, and was so safe that a meltdown was impossible.[4]

The Public and Politics Interest groups, including the Sierra Club and the League of Conservation Voters, sent letters to Representatives in 1993 representing the opposition of their members to IFR. Clinton's administration believed people did not want nuclear reactors and in his 1994 State on the Union Address, he promised to "…terminate unnecessary programs in advanced nuclear development."[5] Since the cancellation, efforts to license a commercial size IFR-style sodium-cooled fast reactor in the U.S. have been unsuccessful.

Anti-nuclear protest, Wall Street, New York City, 1979-1982.[6]



Interest Group Arguments

The interest group letters were representative of member opposition to IFR. Their arguments, shown below, did not accurately reflect the IFR concept.

Safety *"…using liquid metal reactors to fission radioactive wastes is neither a safe nor feasible means of waste disposition."*[8] Even nuclear developers are divided on which reactor designs are safest and best meet energy needs. This makes the issue increasingly unnavigable for non-specialists.

Waste *"Fuel reprocessing...produces large amounts of radioactive and toxic waste..."*[9] Pop culture influences like the Simpsons often serve as the primary interface for the public's understanding, instilling fear of nuclear waste. One EBR-I museum guest commented that they expected to see "green slime out of the cannisters."[10]

Proliferation *"[IFR] is a breeder reactor that could increase stockpiles of deadly plutonium…"*[11] Plutonium is associated with WWII and nuclear weapons development. Breeder reactors gained a poor reputation because they require reprocessing, which separates plutonium from spent fuel, increasing proliferation risks.

Light Water Reactor

LWRs generate all the U.S.'s nuclear generated electricity today.[12] However, their designs are inferior for the following reasons.

– Meltdowns Light water reactors are responsible for every major nuclear accident including SL-I (1961), Three Mile Island (1979), Chernobyl (1986), Fukushima (2011), etc. due to loss-of-coolant.[13]

– Nuclear Waste LWRs are only capable of using about 1-3% of the fissionable material in their fuel which generates 2,000 metric tons of waste each year.[14]

– PUREX Reprocessing Currently there are no operating U.S. reprocessing facilities for spent fuel from LWRs because the traditional PUREX method produces weapons grade plutonium, making the shipments attractive for bad actors intending to build weapons.[15] All spent nuclear fuel is stored on-site.

Integral Fast Reactor

IFR's reactor and plant design were superior to current LWRs and increased safety and efficiency.

+ Passively safe coolant The reactor's molten sodium coolant and metallic fuel enabled the reactor to power itself down even as all computer and operator safety systems fail. An Inherent Safety Demonstration in EBR-II on April 3, 1986, successfully proved this feature.[16]

+ Metallic Fuel The IFR method redesigned fuel rods to achieve a higher burnup (traded ceramic for metal cladding, adjusted pin and rod dimensions, used Uranium-Plutonium Zirconium alloy fuel) and increase heat-conduction, maximizing the fast neutrons' energy. The peak tested burnup with IFR was 18.5%, utilizing almost all the fissionable material in the fuel.[17]

+ Integral Pyroprocessing "Integral" onsite reprocessing drastically reduces proliferation risks. The reprocessed fuel is utilized in the reactor so efficiently that it leaves only trace amounts of low-grade plutonium in the spent fuel.[18]

Conclusion A global research collaboration reported in 2002 that the sodium-cooled reactor with metallic fuel and pyroprocessing design was one of the six most promising advanced reactor designs.[19] According to a ANL nuclear reactor physicist, "In aborting the IFR program…the U.S. abdicated its role as the leader in the technology of nuclear power."[20] Interest group letters showed that the public's opinions, influential in Congress's decision, were misinformed. These communication barriers ended a demonstrated solution to ongoing energy, safety, and sustainability issues, and delayed commercialization of IFR, an effort still pursued today.

1) Gardner, T. "Americans split on nuclear energy as safety worries linger - Reuters/Ipsos poll" Reuters. June 6, 2022. 2) L. Koch. *EBR-II,* 2003, 1-8. 3) Till and Chang. *Plentiful Energy.* Create Space: (2011), 2. 4) Chang, Y. "Progress and Status Report of the Integral Fast Reactor (IFR) Development Program," *American Power Conference*, 1992, 1; Stanford, G. S. "What is the IFR?" Argonne National Laboratory, 2013, 1. 5) McCracken, J.E. US energy policy under President Clinton, Germany: Inforum-Verl, 1993; Till and Chang, 2011, 48. 6) Anti-nuclear protest, Wall Street, New York City, 1979-1982. Library of Congress. 7) INL Archives. IFR Concept Graphic. COM-2022-001, 7/4. 8) Letter, Safe Energy Communication Council, 1993. 9) Letters, League of Conservation Voters, 1993; Sierra Club, 1993. 10) INL Archives. EBR-I Guest Comment Log, COM-2022-001, 1/4. 11) Letter, League of Conservation Voters, 1993. 12) U.S. Nuclear Regulatory Commission. "Power Reactors." March 31, 2022. 13) Till, C. in *Pandora's Promise*, 2013, 1:08:34. 14) Office of Nuclear Energy, "5 Fast Facts About Spent Nuclear Fuel." March 30, 2020. 15) Till and Chang, 42. 16) DOE, *Breeder in the Desert: EBR-II*, 8:35. 17) *Integral Fast Reactor,* Argonne Video and Film Group, 3:05; Stanford, 2013, 5. 18) Stanford, 2013, 5. 19) U.S. DOE Nuclear Energy Research Advisory Committee and the Generation IV International Forum. "A Technological Roadmap for Generation IV Nuclear Energy Systems," Dec. 2002. 20) Stanford, 2013, 6.