

30 Years After the Accident: The Meaning of Chernobyl Today

FAS Forum April 26, 2016

Chernobyl's Dysfunctional Decisions

Edward A. Friedman

RBMK Reactor Design

- Chernobyl Reactor – a light water, graphite moderated reactor using 2% enriched uranium with boron carbide control rods. An inert gas mixture of nitrogen and helium surrounded the graphite blocks. Each of the 1661 fuel assemblies could be extracted independently. The reactor had been designed for production of bomb grade plutonium. 1000 Megawatt Electric output.

Two Major Design Flaws

- **No containment structure** – the Chernobyl RBMK Unit 4 reactor opened in 1983 enclosed only by an ordinary factory building. A result of overconfidence from 1970's experience with RBMK reactors and desire for cost savings.
- **Positive Boiling Water Feedback Loop** – In 1965 Dr. Ivan Zhezherun described how overheating of water in fuel assemblies could lead to steam bubbles and enhanced neutron fission interactions causing more and more overheating.
- This **critique** was **suppressed**.

Reactor Inauguration Premature

- Chernobyl Unit 4 went online December 20, 1983 – two days before annual recognition and award of bonuses day for energy workers.
- Emergency electrical backup system had not been tested.
- An emergency use of turbines, during slow down, needed to fill in electricity for cooling pumps for 1 minute prior to emergency generators becoming effective.

32 Yr Secrecy of Largest Nuclear Accident after Chernobyl & Fukushima

Kyshtym Disaster Secret for 32 years – a huge chemical explosion at a liquid radioactive waste (from plutonium processing) storage area in the Urals took place in 1957. More than 10,000 evacuated & land area greater than NYC contaminated. Number of deaths caused is unknown. This secrecy (to 1989) shielded public and professionals in USSR from knowledge about radiation and characteristics of fallout.

Operators Not Trained for Safety

- **Accidents at RBMK Reactors Kept Secret** – RBMK Reactors at Leningrad experienced accidents in 1975, 1976 and 1979 – with explosions, loss of coolant and cooling system rupture. At Kursk in 1980 there was a loss of external power. These were not reported. Operators were not informed of these events or trained to anticipate accidents. Their knowledge of reactors & radiation was limited.

Poorly Planned Test on April 26, 1986

- **Emergency Power Tests Failed in 84 & 85** – new electrical apparatus being tested with a visiting team of electrical engineers.
- Scheduled when fuel loaded with radioactivity.
- Complex test not fully coordinated among operators and managers. Operators were not aware of possible problems.
- Test scheduled for daytime was postponed by regional power authority to evening - leading to having less knowledgeable crew in charge.

Multiple Errors in Conduct of Test

- **First steps to implement test overshoot on reducing power level.**
- Operators failed to stop test.
- Operators did not understand problems, known as Xenon poisoning, that inhibited power increase and unduly withdrew control rods and shut off safety systems.
- Positive boiling point feedback kicked in.
- Defective control rod design further accelerated disaster – of steam and then hydrogen explosions.

Accident Not Revealed for Two Days

- Explosions Took Place at 1:23AM on April 26th
- 2000 ton covering of reactor blown off.
- Graphite moderator structure ignited.
- Fires for two weeks released 5% of radioactive material - fallout observed in Sweden on 28th
- Moscow TV had short announcement at 9PM on 28th of Chernobyl accident - stating that actions are being taken to “eliminate consequences”

Undue Exposure to Radiation

- Firefighters and other initial responders unprepared with knowledge or equipment to deal with radiation.
- Nearby Pripyat (50,000) not notified of dangers - not evacuated until 2PM on 28th.
- Kiev (2.5 million)- 63miles from Chernobyl received fallout but May Day celebrations held
- Kiev children not evacuated until mid May.

Flawed USSR Report to IAEA in 1986

- IAEA held international meeting in Vienna in August 1986 to review Chernobyl accident.
- USSR presentation by Academician Valery Legasov to IAEA stated accident entirely due to personnel at Unit 4 and hid other causes.
- Legasov regretted his actions and began writing a corrected version of events but committed suicide on second anniversary of the accident.
- Second conference by IAEA in 1992 held to revise the 1986 report which stated that USSR lacked a nuclear power “culture of safety.”

Show Trial Held in 1987

- The USSR placed blame entirely on staff of the reactor.
- In July 1987 a show trial held at small building in the exclusion zone of Chernobyl. Six individuals were sentenced to between 2 and 10 years in corrective labor camps. The charges were: “negligence of regulations and rules, carelessness, irresponsibility, ducking responsibility in the organization of work, the training of the plant’s operational staff and observance of safety rules.”
- These were the last of the show trials of the Soviet Union.

11 RBMK Reactors Operating Today

- Only the Soviet Union built RBMK reactors.
- Three other RBMK reactors at Chernobyl closed in 1991, 1996 and 2000.
- Two RBMK reactors in Lithuania required to close by European Union in 2000 and 2009.
- 11 RBMK are operating in Russia today. While upgraded and modified, they would not be allowed to continue operations in Western Europe or the United States. They provide one-third of the nuclear electrical power in Russia.