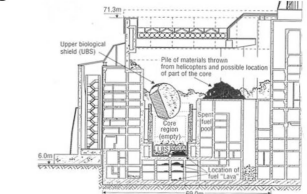


Chernobyl – Lasting Environmental Issues from the Worst Nuclear Disaster

Frederick Becker - CONS 387 Water & Wastewater Treatment, Dr. Adrienne Rygel - Spring 2023

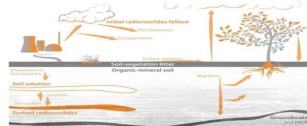
Background

- During routine safety testing on April 25th and 26th, 1986, reactor units at the Chernobyl Nuclear Power Plant were being sequentially powered down and powered up
- Unknowingly to the operators, this caused the fuel rods in the reactor to heat up to much higher levels than stable⁸
- Just passed midnight, the unit 4 reactor had a sudden loss of power with excess coolant being pumped into the reactor core
- Due to the coolant boiling when the emergency shutdown, a steam explosion occurred
- This explosion was powerful enough to lift the 1000t reactor cover and expose the core to air, as the roof had been blown open
- The initial explosion killed 2 operators and around 300t of graphite were set ablaze⁸
- Despite the severity of the incident, the surrounding areas were not immediately evacuated, only starting after about 12 hours due to people falling ill from exposure in Pripjat, Ukraine⁶



Above Right – Figure 1: A diagram showing a cross-section of the unit 4 reactor after explosion and open-air burning of the exposed core⁸

Below Middle – Figure 2: A graphic on the spread of radioactive particulates into the environment through both the air and groundwater



Below Right – Figure 3: A map of the radioactive clouds spreading across Europe from April 27th to May 6th (dates on map are in DD/MM format)¹



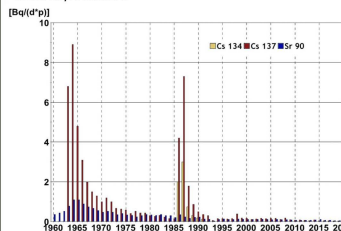
Immediate and Lasting Effects

- The explosion and fire had caused the release of radioactive emissions such as Cesium-137 and Iodine-131⁴
- Said to be “100 times as much radiation as the Atomic bombs dropped on Japan combined”⁴
- Initially a 30km (18 mile) area was closed off around the plant⁶
- In 1986 over 115,000 people were evacuated from regions with the most contamination, which grew to over 220,000 in the subsequent years⁶



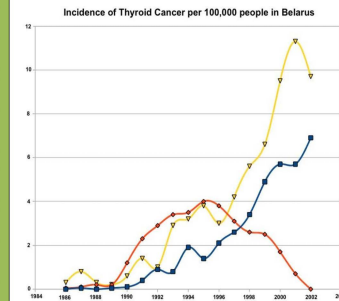
Above Right - Figure 4: A compilation of photographs of the now-abandoned Pripjat, with 50,000 residents evacuated from the city and another 60,000 from the surrounding regions of Ukraine and Belarus⁶

Below Left – Figure 5: A graph on the daily intake of Cesium-137, Cesium-134, and Strontium-90. The initial drop in the 1960s was due to the end of open-air nuclear testing, while the spike in the 1980s was due to the Chernobyl Accident¹



- In the first month, over 130 cleanup workers were diagnosed acute radiation syndrome (ARS), with 28 dying within three months²
- ARS sets in around 700 milligrays (mGy), with 5000-10000 mGy being considered universally fatal
- Many firefighters had doses in excess of 20000 mGy⁸

Legacy



Above Left – Figure 8: A graph of the incidence of Thyroid Cancer rates in Belarus. Yellow depicts the adult population, with adolescents in blue, and children under 14 in red⁴

- Over 300,000 people involved in the cleanup and region have tested between 30-120 millisieverts (mSv) of radiation, with a yearly safe dose being under 20 mSv²
- By 2005 over 6000 cases of thyroid cancer were reported in children from the region, the majority from those who consumed high levels of dairy products²
- By 1990, forest workers were reported to have radiation doses 3 times higher than local residents not in contaminated forests³

- Many European countries are still dealing with increased Cesium-137 levels in soil and produce¹
- The overwhelming majority of nuclear reactors in the US and Europe significantly increased safety regulations in reactor design⁵
- The accident is reported to keep the region unsafe for habitation for at least the next 100 years⁶



Above Right – Figure 9: The famous sarcophagus constructed over reactor unit 4 to help contain the spread of radioactive material

Cleanup Efforts

- Around 200,000 people known as ‘Liquidators’ were brought in from all over the Soviet Union for recovery and cleanup of the incident⁸
- Firefighters were first on the scene to control the radioactive graphite fire, these workers caught the brunt of radiation exposure
- Over the course of the next week, over 5000t of sand, lead, clay, boron and other materials were dropped onto the burning core while evacuations were underway⁸
- By October 1986, a large concrete shelter was built around the exposed reactor to further contain radioactive emissions⁸
- The condition of this shelter degraded over time, and a new sarcophagus was built around the old one, only completing construction in 2017⁸



Above Left – Figure 6: A vehicle graveyard containing contaminated vehicles left abandoned after being used for cleanup



Above Right – Figure 7: Chernobyl Liquidators removing contaminated debris from the roof of the reactor unit building

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