CHORNOBYL

DISASTER

KIRYAK NATALIE

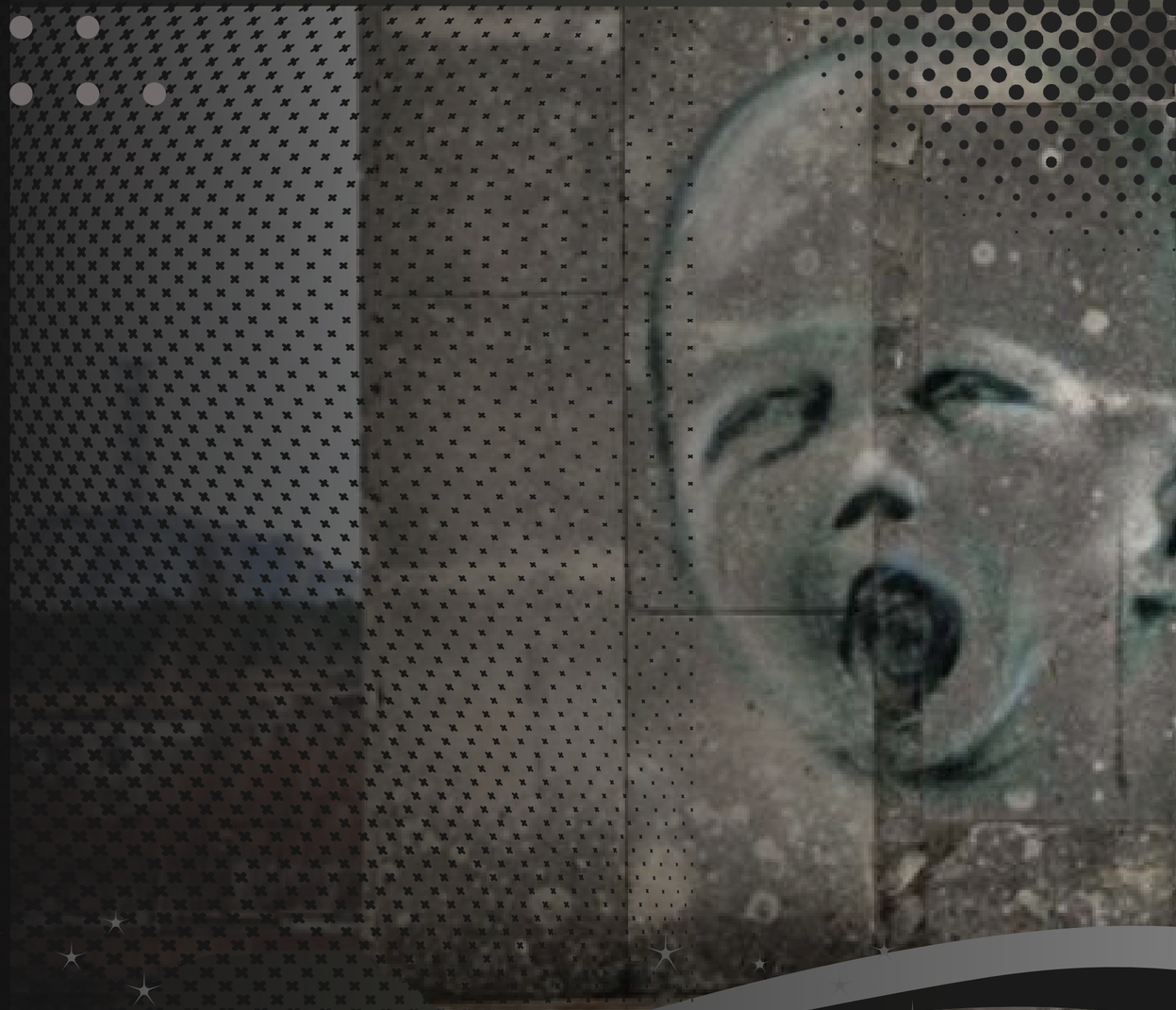
On April 26, 1986, Reactor No. 4 of the Chornobyl Nuclear Power Plant, situated near Pripyat in the Ukrainian SSR (then part of the Soviet Union and later Ukraine), exploded: The disaster resulted in dozens of immediate fatalities and thousands of subsequent health issues, cementing its place as one of only two nuclear energy incidents to be classified at the highest severity level on the International Nuclear Event Scale—the other being the Fukushima nuclear accident in 2011. The emergency response involved over 500,000 personnel and incurred an estimated cost of 18 billion rubles (equivalent to approximately US$84.5 billion in 2025). It remains not only the worst nuclear disaster in history but also the costliest, with long-term expenses projected to reach as high as US$700 billion.

The catastrophe unfolded during a test designed to simulate cooling the reactor under blackout conditions. Operators proceeded with the test despite an unintended drop in reactor power. A combination of operator error and a critical design flaw led to a dramatic power spike when they attempted to shut the reactor down. This caused the reactor's components to rupture, resulting in a loss of coolant. The ensuing steam explosions and meltdown devastated the reactor structure, followed by a core fire that released radioactive contaminants across vast regions, including the Soviet Union and Europe.

An initial 10-kilometer exclusion zone was established 36 hours after the explosion, prompting the evacuation of about 49,000 residents. This zone was later expanded to a 30-kilometer radius, forcing an additional 68,000 people to leave their homes.

The explosion killed two workers and severely injured others on-site. Emergency crews rushed to extinguish fires and stabilize the reactor. Among the 237 workers admitted to hospitals, 134 showed signs of acute radiation syndrome (ARS), and 28 died within three months due to intense radiation exposure. Over the following decade, another 14 workers passed away, though most deaths were unrelated to radiation. Remarkably, this incident remains the sole case in commercial nuclear power history where radiation directly caused fatalities. By 2005, approximately 6,000 cases of childhood thyroid cancer had been reported among affected populations, with 15 proving fatal. According to the United Nations Scientific Committee on the Effects of Atomic Radiation, fewer than 100 deaths can be directly linked to the disaster. However, estimates of long-term fatalities vary significantly. For instance, a World Health Organization study from 2006 suggested as many as 9,000 cancer-related deaths could eventually be attributed to the radiation in Ukraine, Belarus, and Russia.

The nearby city of Pripyat was permanently evacuated and replaced with Slavutych, a specially constructed town for displaced residents and workers. In December 1986, a structure known as the Chornobyl Nuclear Power Plant sarcophagus was erected around Reactor No. 4 to limit radioactive emissions and protect workers operating other reactors from exposure. Many years later, between 2016 and 2018, a new protective enclosure called the Chornobyl New Safe Confinement was installed over the original sarcophagus. This structure is intended to enable the safe dismantling and removal of radioactive debris, with cleanup operations expected to continue until at least 2065.



The 1991 report by the State Committee on the Supervision of Safety in Industry and Nuclear Power examined the root cause of the accident and shifted its focus away from solely blaming the operators. It acknowledged that, while the operators undoubtedly placed the reactor in an extremely unstable and dangerous state—essentially creating conditions that almost assured an accident—they had not technically violated critical operating policies or principles. This was because such policies and principles had never been clearly defined. Furthermore, the operating organization had not been adequately informed about the critical safety implications of maintaining a minimum operating reactivity margin, nor were they made aware of the RBMK reactor's specific reactivity characteristics, which rendered low-power operation particularly hazardous.

The accident led to the largest uncontrolled release of radioactive materials into the environment ever recorded during a civilian operation. For approximately 10 days, significant amounts of radioactive substances were dispersed into the atmosphere, resulting in severe social and economic impacts on large segments of the population in Belarus, Russia, and Ukraine. Among the radionuclides released, iodine-131 (short-lived) and caesium-137 (long-lived) were particularly notable for their significant contribution to radiation exposure experienced by the public.

It is believed that the incident released the entirety of the xenon gas, roughly half of the iodine and caesium, and at least 5% of the remaining radioactive elements contained in the Chernobyl Reactor 4 core, which had a total fuel mass of 192 tonnes. While much of this material settled nearby as dust and debris, light particles were carried by wind across Ukraine, Belarus, Russia, and, to a lesser extent, parts of Scandinavia and Europe.

The human toll included firefighters who responded to the initial blazes on the turbine building roof. Though these fires were extinguished within a few hours, exposure to high radiation levels on the first day caused 28 deaths by the end of July 1986, six of whom were firefighters. These individuals, along with power plant workers, received radiation doses strong enough to induce acute radiation syndrome (ARS), which occurs when an individual is exposed to more than 700 milligrays (mGy) in a short period of time (typically minutes). Symptoms of ARS frequently include nausea, vomiting, headaches, burns, and fever. Radiation doses of 4,000 to 5,000 mGy administered quickly can be fatal to 50% of those exposed, while doses ranging from 8,000 to 10,000 mGy are universally lethal. The firefighters who succumbed to radiation were estimated to have received doses as high as 20,000 mGy.