Summary

CHERNOBYL

Serhii Plokhy

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Summary of «Chernobyl: The History of Nuclear Catastrophe» by Serhii Plokhy

Written by Lea Schullery

The perfect book to learning the inside scoop on the events leading up to and following one of the most disastrous events in history.

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Introduction

Following the story of how technological disaster led to the complete collapse of a superpower, Serhii Plokhy details the events that led up to one of the most disastrous events in history. Beginning with fatal design flaws and human errors, the events leading up to the explosion were a concoction of deadly mistakes. From incompetent plant workers to leaders who chose to protect their reputation over their citizens, Chernobyl experienced a tragedy that could have been prevented.

Throughout the book, you'll learn about the heroes of Chernobyl including first responders and engineers that risked their lives to prevent further catastrophe. While there were many heroes among the tragedy, you'll also see government leaders who used their power to protect themselves leading to a corrupt society that citizens no longer trusted. Mistrust and corruption which finally led to the downfall of the Soviet Union, one of the biggest government collapses in history.

The Race to Becoming an Economic Powerhouse Leads to Shortcuts

In Mikhail Gorbachov's 1986 speech to the twenty-seventh Communist Party Congress, his first as general secretary, he lamented the zastoi (stagnation) of the Soviet Union economy and called for a speedy shift from fossil fuels (coal, oil, and gas) to nuclear power. In other words, Mikhail Gorbachev planned to change the direction of the USSR and participate in the long-standing arms race to become an economic powerhouse. How was he going to do this? By building nuclear power plants, of course. However, as you're about to find out, Gorbachev was so concerned with building the power plants in a near-impossible time frame, that many shortcuts were taken, causing one of the most disastrous events in history.

The first place that the Soviet Union cut corners was on price. To save money, authorities chose to implement a reactor that belonged to a type designated as RBMK. RBMK reactors were much cheaper to create than the rival type VVER which is the type of reactor used in the rest of the western world. This cut in costs would prove to be fatal on April 26th, 1986, but to understand how, you must first know about the differences between the RBMK reactor and the VVER reactor.

While the VVER reactors use water as a moderator inside the core, RBMK reactors use graphite which is far less safe. However, RBMK reactors also use graphite on the tips of their control rods, a major flaw in their design, and here's why. You see, graphite is reactivity-increasing material, and the purpose of a control rod is to decrease reactivity. See the irony? While these tips were designed to allow operators more control over their reaction, the designers couldn't have prepared for how disastrous this type of control rod would become.

Not only did these reactors have a serious design flaw, the designers argued that even more costs could be cut by building the reactors without the concrete structures that could contain the radiation in the event of reactor fail-

ure. Can you imagine? Nuclear power plants are being built with zero concern for the safety of their workers or citizens. Of course, there was much opposition to building such a plant within European Russia, but living under the regime of the USSR proved that opposition was not welcome, so the plans went forward and Chernobyl received reactors without any concrete containments.

How Nuclear Reactors Work

Before discussing how the Chernobyl reactors exploded, it's important to understand that by 1986, the Chernobyl Nuclear Power Plant in Soviet Ukraine was the third most powerful power plant on earth. Needing somewhere to contain the workers of Chernobyl, Prypiat was built just two kilometers from the power plant. With a population of 45,000 people, this "nuclear town" was an idyllic place with all the luxuries one would ever need, from meat and dairy farms to swimming pools and ice skating rinks, the town seemed to have it all.

But before diving any deeper, let's talk about how reactors work. You see, power plants are made to produce electricity, so how do they do that? First, reactors create heat which then vaporizes water into steam thus powering the turbines which create the electricity. But to create heat, they must go through a process called fission.

Fission is when the nucleus of an atom splits into smaller components. When this happens, neutrons are released. Fission can be produced by forcing a neutron to collide with another atom's nucleus. Now, the nuclei of some atoms are extremely unstable, like uranium-235. These unstable nuclei want to go through fission naturally to split into smaller, more stable parts. This natural fission creates a chain reaction which nuclear reactors try to replicate. This process is replicated when uranium-235 is packed close together in fuel rods. But neutrons travel incredibly fast, so sometimes they need to be slowed down to increase the reactivity. So nuclear plants utilize substances like water and graphite to slow down the neutrons.

Combined with graphite rods meant to increase the reactivity, nuclear plants also have control rods. Control rods are typically made from materials like boron which absorb the neutrons. These rods are inserted into the core of the reactor which regulates the power of the reaction. However, if you remember the design flaw from the previous chapter, you'll remember the control rods at Chernobyl had graphite tips, not boron. As you can see,

these graphite tips would create a reaction that no one could have prepared for.

So, how did the explosion occur? Well, despite the design flaws, there was also much incompetence among the operators that were conducting a safety test on this exact system.

Safety Test Incompetence Leads to Disaster

Throughout the hours leading up to the explosion at Chernobyl, the employees were undergoing a safety test that would determine if the steam turbines would produce enough electricity to make up for a 45-second delay after a sudden power loss. During this test, much incompetence and human error were surrounding the events preceding the disastrous explosion.

At 4:00 p.m. on Friday, April 24th, Yuri Tregub took over his usual evening shift. However, Yuri didn't know the procedures for the test, so the chief engineer Anatoly Dyatlov was dispatched to oversee the safety test.

Hours later, Unit 4 was told to begin their safety test, and by midnight, the young and inexperienced night crew had come to take over. Dyatlov, who didn't arrive at unit 4 until 11:00 p.m., scolded the crew for their lack of efficiency since the test was supposed to begin hours prior. He ignored the fact that the crew didn't quite know what they were doing and told them to continue the safety test anyway. So by midnight, Tregub had reduced Unit 4's output to 760 megawatts thermal (MWt), as was required to perform the test.

As they performed the test, the power within the reactor began to decline rapidly, and by 12:28 a.m. the reactor was emitting just 30 MWt far below the required 760. By removing the control rods, the employees were able to get the temperature to rise, but they were unsure whether or not to continue with the safety test. In the end, Dyatlov ordered the test to continue and raise the MWt to 200, still far below the 760 requirements. However, even raising the MWt to 200 proved to be difficult and since the reactor had been operating at low power for a long period, reactions within the fuel rods slowed significantly. To keep power at 200 MWt, Leonid Toptunuv (an inexperienced shift leader) kept removing the control rods, eventually removing all but 9 of the 167 rods by 1:22 a.m.

It was around this time that the reactor's water-based cooling system boiled into steam causing a spike in temperature that initiated the fuel rods to begin working again. This spike in power caused the reaction to become uncontrollable and at 1:23 a.m. Toptunuv pressed the AZ-5 button. What's the AZ-5 button? Imagine a big red button that says STOP, like the button on a treadmill when you find yourself losing control and needing to slow down ASAP. The AZ-5 button was pressed, thus activating an emergency shutdown procedure that immediately inserted all the control rods into the reactor. The control rods that were tipped with reactivity-increasing graphite, not boron, created a series of explosions that ripped through the reactor and halls of Chernobyl's Unit 4. Thus sparking one of the worst disasters in history. But, it seemed it would only get worse from here.

Moments Following Disaster Met with Denial

Not quite knowing what to do, the Specialized Military Fire Department was called in to immediately assess the situation and put out the fires. Fires were popping up everywhere and Unit 4 was in complete ruins.

Using only their normal protective gear, firefighters began walking along the roof of the building to put out the fires that seemed to be the biggest problem. As they walked along the roof covered in extreme radioactive heat, their boots began to melt. They witnessed graphite rocks all along the roof, and kicked them with their boots, not realizing that those rocks were emitting extremely deadly amounts of radiation.

The stories of first responders only worsened when, within mere minutes, they began complaining of nausea, headaches, and a metallic taste in their mouth. Soon, they were vomiting. Firefighters had no idea they were experiencing radiation poisoning and were never told of the extreme effects the area could have on them. For instance, Petr Shavrei removed metal debris from the tires of a truck immediately melting the skin off his fingers.

How could this have happened? How could they have allowed firefighters to enter one of the world's most toxic areas without proper protection? Well, not only were plant workers in denial about the explosion, but the government was as well. Chief engineer AnatolyDyatlov believed that only the turbine hall was damaged, and even after workers began vomiting due to radiation poisoning, workers attributed the sickness to mere shock.

But the denial didn't stop there. The director of the power plant and senior administrator, Viktor Bryukhanov, immediately drafted a memo to party leaders stating that only the roof of unit 4 had been damaged and reported that radiation levels were only at 1,000 micro-roentgen per second. However, Bryukhanov didn't take into account that the instrument used to measure radiation levels maxed out at 1,000. When confronted by a plant work-

er who measured 55,000 micro-roentgens, Bryukhanov dismissed him. He failed to report that radiation levels were too high to measure, and instead reported false figures.

The following morning was met with more denial as the government worked swiftly to suppress information about the explosion. Refusing to accept the gravity of the situation and causing panic among citizens in the surrounding areas, the government kept quiet allowing children to freely roam the streets of Prypiat while radioactive dust was settling over the city. In fact, the following day was a seemingly normal sunny spring day where seven weddings took place, people tended their gardens, and children played in the streets, nothing seemed wrong.

One man took advantage of the sunny day by sunbathing on the roof of his apartment. He mentioned to a neighbor how easy it was for him to get a tan that day and had never seen anything like it. His skin smelled of something burning, and he was soon taken away by the ambulance after experiencing nausea and vomiting from radiation poisoning. “The radioactive shower would cost him his life.”

Acceptance of Damage

In the hours following the explosion, plant workers and firefighters were arriving at the hospital in droves displaying signs of radiation poisoning. Authorities couldn't ignore the seriousness of the situation anymore but continued to wait for party leaders to tell them what to do for fear of inciting panic among the citizens of Prypiat.

Finally, after 36 hours of chaos and confusion, the citizens of Prypiat were ordered to evacuate. They were told the evacuation would be temporary, but as we know now, those citizens would never see those homes again. But now what? The reactor was still spewing out dangerous levels of radiation, so the leaders needed to figure out how to contain the reactor, and soon.

The first order was to drop 5,000 tons of sand, lead, clay, and boron onto the reactor. Helicopter pilots maneuvered aircraft above the radioactive reactor, but with a dangerous mixture of flames and radiation, many pilots lost their lives in the process. And unfortunately, these pilots wouldn't be the only ones sacrificing their lives for the sake of mankind.

Chief scientific advisor Valery Legasov feared the worst, believing a more powerful explosion could be imminent. With a reactor that was still aflame, Legasov feared the flames would burn the concrete separating the reactor from a pool of water that acted as a coolant for the powerplant. This mixture of radiation and water could cause a nuclear explosion that could contaminate water supplies that served over 30 million people and create an uninhabitable Ukraine for more than a century.

When firefighters launched a mission to pump out some of the water, there were still several gallons of radioactive water that remained. So, three brave engineers volunteered to dive into the radioactive- contaminated water to find the valves that drained the rest of the water out and prevented a second explosion. It was a suicide mission. The three heroes dove in with wetsuits and successfully found the valves before losing their lives.

Many other measures were taken to prevent further worldwide catastrophes, including digging new chambers to prevent the spread of contaminated water into the oceans. Were these necessary? No one knows, but we do now that further catastrophes never occurred.

Time to Cleanup

Finally realizing the magnitude of the situation, Soviet officials attempted to begin one of the biggest cleanups in history. Needing to decontaminate thousands of square kilometers, the Soviets enlisted the help of 600,000 men, also known as liquidators, and gave them little information and no protective clothing.

Soldiers were initially drafted for the clean-up at Chernobyl, usually consisting of men between 18-20. These soldiers were so-called “biorobots” showcasing how little the Soviets cared about their wellbeing, they were simply used for cleanup and disposed of when no longer necessary. Many were recruited from central Asian republics since a large portion of them had limited knowledge of the Russian language and lacked an understanding of the dangers involved. They were regularly exposed to almost double the safe limit for radiation. In the end, between 1986-1989, close to 340,000 members of the military took part in the clean-up.

Their jobs ranged from demolishing buildings and burying them under concrete to finding and killing animals that were contaminated from the radiation. The cleanup essentially consisted of destroying an entire city, encasing it in concrete, and burying it underground. Not only did they demolish and bury the buildings, cars, etc., but they razed an entire Red Forest and buried it underground once the trees showed signs of radiation absorption.

The most harrowing job of the biorobots though was cleaning the graphite off the roof of unit 3. First attempted by actual robots, the robots eventually melted and became destroyed to the extreme heat and radiation. Biorobots came into play once they realized they needed human beings to tackle the job. Given respirators and lead protective gear, 3,000 biorobots shoveled radioactive graphite from the roof, only working in shifts of mere seconds to prevent extended exposure.

Eventually, the first victims of radiation poisoning began to die. To prevent further spread of radiation, the corpses had to be disposed of within the confines of the exclusion zone. Corpses were wrapped in plastic and then placed in plastic-wrapped coffins which were then placed in zinc caskets. The caskets were then lowered into deep graves that were covered by cement tiles. 28 corpses were disposed of, buried along with the remains of a forbidden city, never able to receive visitors, flowers, or a proper burial.

Finally, the biggest part of the cleanup involved constructing a giant 400,000-ton concrete sarcophagus enclosing unit 4's reactor. 200,000 workers were selected to complete this feat and were exposed to the most dangerous area of the entire Chernobyl cleanup site. After building a six-meter thick concrete wall around the site of unit 4, concrete pourers filled the area by enclosing the reactor in a concrete tomb never to see the light of day again.

The Death Toll and its Inaccuracies

Not only did the explosion at Chernobyl result in the deaths of several people, but many environmental costs affected thousands of people. Since the events of Chernobyl, it's been difficult to gauge just how many people were affected by the radiation. However, scientists and scholars have tried their best to research and prove the Soviet's original reportings inaccurate.

The official Soviet death toll from Chernobyl is a mere 31 and is still recognized in Russia today. But what about those that have died in the years following the explosion? The Soviet's toll fails to include the number of people that were affected in the decades following the incident. According to Vyacheslav Grishin of the Chernobyl Union, who advocates for former liquidators, 60,000 liquidators have already died and 165,000 are permanently disabled. Scholars estimate the long-term death toll to rise to 93,000, much higher than the 31 still recognized by Russia.

While the liquidators were exposed to long-term high amounts of radiation, people that lived in Prypiat and the surrounding cities were also likely affected by long-term radiation due to the Soviet's failure to evacuate immediately and efficiently. Tens of thousands of people were relocated, but they brought along their contaminated belongings like clothing. Additionally, thousands of buses were used to evacuate them. Where did these buses come from? Kyiv, a city of around 2 million people who housed thousands of contaminated evacuees. Those same buses returned to Kyiv, working their regular routes throughout the major city and spreading high levels of radiation to an unsuspecting population.

The events following Chernobyl also affected the lives of those involved, including the imprisonment of six plant managers among those Viktor Bryukhanov and Anatoly Dyatlov. Perhaps even worse were the events leading to the chief scientific advisor, Valery Legasov's suicide. By including details about the RBMK reactor design in his report, Legasov still noted the explosion of the reactor was caused by the plant workers, but he divulged secrets

of the Soviet's nuclear designs. After being passed up for a promotion, Legasov committed suicide just two years after Chernobyl's explosion.

Political Costs

While there were several human lives lost due to the Chernobyl's explosion, there was also great political fallout in the years that followed. In fact, Chernobyl is probably one of the main factors responsible for the collapse of the Soviet Union in 1991.

Days following the explosion, no newspaper published the story. Kyiv, the capital of Ukraine, was 130 km away but still radiation levels soared. However, the party kept the seriousness of the explosion a secret and the city promptly held the May Day parade through its streets, risking the lives of many innocent people. Even general bulletins on what to do in case of radiation sickness had to be cleared by the Ukrainian politburo. The first televised address on the signs and symptoms of radiation was aired ten days later, by which time the people no longer trusted the party and the government.

As if not being informed of the immediate danger the citizens were in was enough, their trust was completely broken when journalists and reporters took action to prove that the government was lying to its citizens. For instance, journalist Alla Yaroshinskaya reported that 80 percent of children in the Narodychi district of Ukraine had enlarged thyroid glands which is a clear result of high radiation exposure. Learning about the long-term effects of Chernobyl, citizens quickly realized how much the government was censoring and could no longer trust the Soviet Union.

In 1990, it became clear that many republics of the Soviet Union wanted national independence and denuclearization. With a change in elected deputies, Lithuania eventually declared independence and Gorbachev immediately imposed an economic blockade on the country, he knew that he was losing control of the republics. The following August of 1991 resulted in the Ukrainian parliament declaring independence subject to a public vote. The independence referendum held on December 11, 1991, resulted in the majority voting to declare independence. Just nine days later, the Soviet Union was dissolved.

Author Serhii Plokhy ends the novel with a warning about nuclear reactors that are under construction today. Most new reactors are being built outside the western world: twenty-one in China, nine in Russia, six in India, four in the United Arab Emirates, and two in Pakistan. He worries that these autocratic regimes won't learn from Chernobyl and sacrifice the safety of the world to ensure rapid economic development. How can we be sure Chernobyl won't happen again?

Final Summary

One of the major disasters in history, Chernobyl was a deadly combination of human error and design flaws that sacrificed safety for economic development. Additionally, with a government that aimed to protect itself over its citizens, Chernobyl resulted in exposing millions of innocent people to the dangers of radiation. Causing loss of life, sickness, and an increase in permanent disabilities and cancer, the citizens of the USSR quickly lost trust in their government causing the Soviet Union to fall.

From building reactors that had fatal design flaws to continuously denying the effects of the explosion, Chernobyl was a tragedy that the world can learn from. But have we learned? With nuclear reactors continually being built in similar autocratic societies, it's hard to trust governments to not make the same deadly mistake again.

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