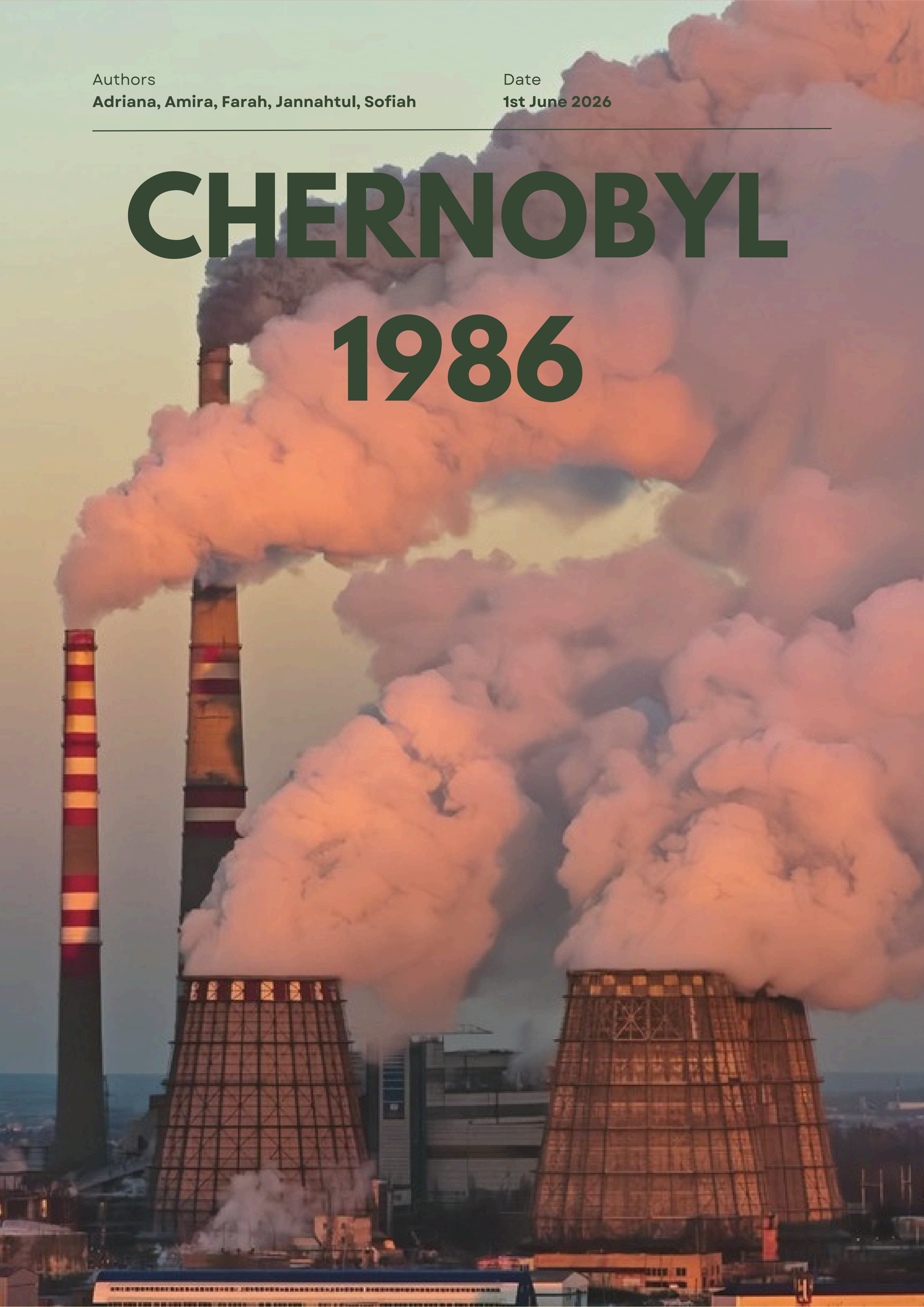
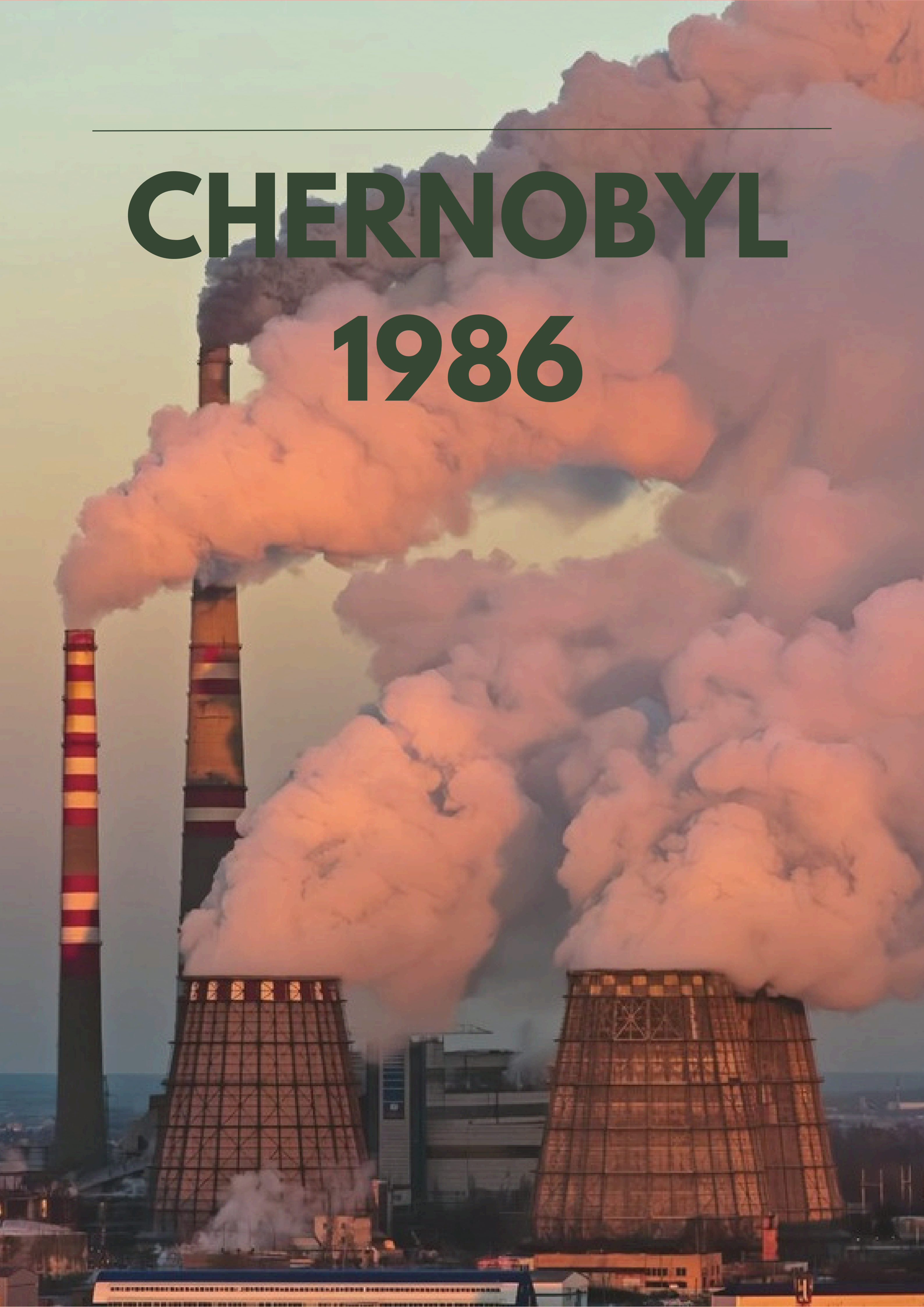
Authors
Adriana, Amira, Farah, Jannahtul, Sofiah

Date
1st June 2026

CHERNOBYL 1986



CHERNOBYL
1986



CHERNOBYL 1986

PUBLISHED BY:
Universiti Teknologi MARA (UiTM)
Cawangan Negeri Sembilan,
Kampus Kuala Pilah
Pekan Parit Tinggi,
72000 Kuala Pilah,
Negeri Sembilan
MALAYSIA

Phone : 064832383
Fax : 0648424493
Email : nursofiah@uitm.edu.my
Publication Date: 25 Jun 2026
e-ISBN: 978-967-25930-9-6
National Library of Malaysia

This e-book offers an analysis and reflective discussion on the Chernobyl 1986 tragedy, viewed through the lens of the authors. This e-book aims to provide a comprehensive understanding of the Chernobyl 1986, one of the world's worst industrial disasters, through factual accounts, critical analysis, and reflective commentary. Through this work, readers are invited not only to learn from history but also to apply its lessons in shaping safer and more responsible futures.

CHERNOBYL 1986

SYNOPSYS

On the night of April 26, 1986, at the Chernobyl Nuclear Power Plant in Soviet Ukraine, operators prepared for a routine safety test on Reactor No. 4. The goal was to determine if the plant's turbines could provide enough electricity to power coolant pumps during a power outage. However, due to a combination of fatal design flaws specifically the RBMK reactor's instability at low power and a series of operator errors that bypassed safety protocols, the reactor became dangerously unstable. At 1:23:45 AM, a massive power surge occurred. The emergency shutdown (the AZ-5 button) was triggered, but a design flaw in the graphite-tipped control rods caused an immediate spike in reactivity instead of dampening it.

Two explosions rocked the facility. The first blew the 2,000-ton biological shield (the roof) off the reactor, and the second released a plume of highly radioactive fission products into the atmosphere. This was not a nuclear explosion like an atomic bomb, but a steam explosion followed by an open-air graphite fire that burned for nine days. This fire acted as a chimney, lofting radioactive isotopes—most notably Iodine-131, Cesium-137, and Strontium-90—high into the atmosphere, where they were carried by winds across the USSR, Scandinavia, and Western Europe.

In the immediate aftermath, local firefighters (the Militan Fire Brigade) arrived without specialized radiation gear, thinking they were fighting a standard roof fire. Most of these first responders died of Acute Radiation Syndrome (ARS) within weeks. To contain the disaster, the Soviet Union mobilized over 600,000 "Liquidators"—soldiers, miners, and civilians. Their tasks were Herculean: shoveling highly radioactive graphite off the roof, tunneling under the reactor to prevent a "China Syndrome" meltdown into the water table, and eventually building the Sarcophagus, a massive steel and concrete tomb to encase the ruins.

The city of Pripyat, home to 50,000 people, was not evacuated until 36 hours after the explosion, leaving residents exposed to massive doses of radiation. Eventually, a 30-kilometer Exclusion Zone was established, which remains largely uninhabited today. While the official Soviet death toll remains at 31, the World Health Organization and other international bodies estimate that the long-term cancer deaths caused by the fallout range from 4,000 to over 90,000. The disaster accelerated the collapse of the Soviet Union and remains the worst nuclear accident in history, rated a Level 7 on the International Nuclear Event Scale.

EDITORIAL TEAM

CHIEF EDITOR

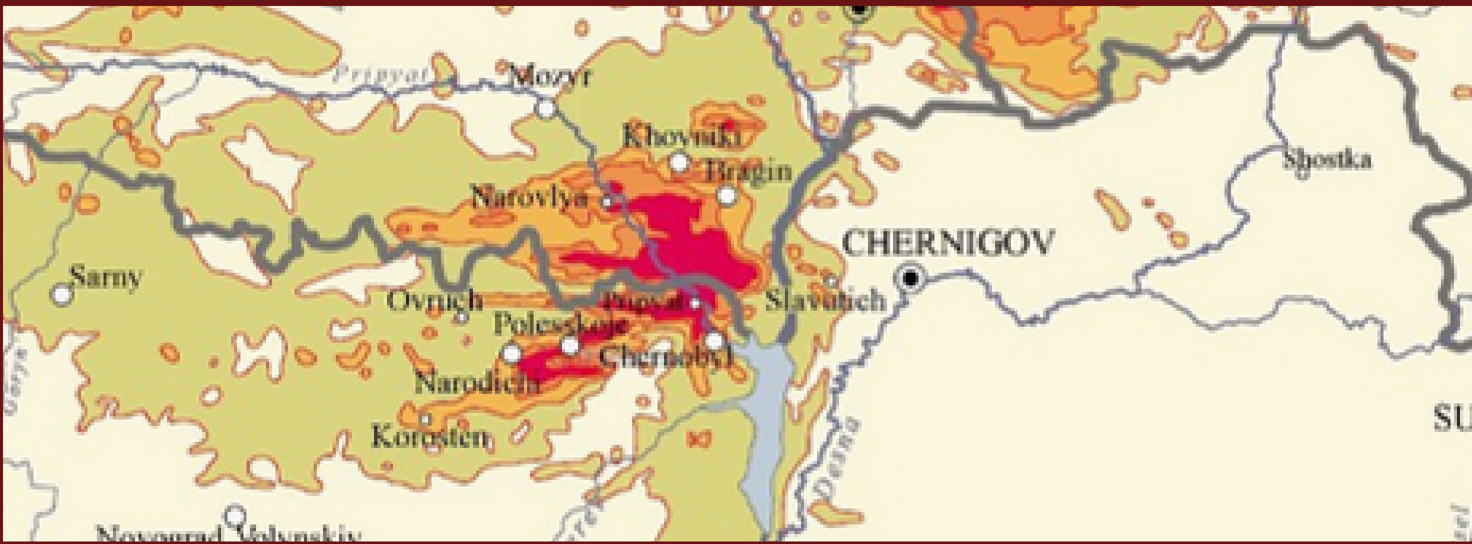
Dr. Nur Sofiah Abu Kassim

LIST OF AUTHORS

DR. NUR SOFIAH ABU KASSIM
ADRIANA SAFIAH BINTI MOHD ZAIDI
NURUL AMIRA SYAHIDA BINTI AZNAN
FARAH ADIBA BINTI ZAWAWI
NUR JANNAHTUL NAQIAH BINTI NORMAN

Table of Contents

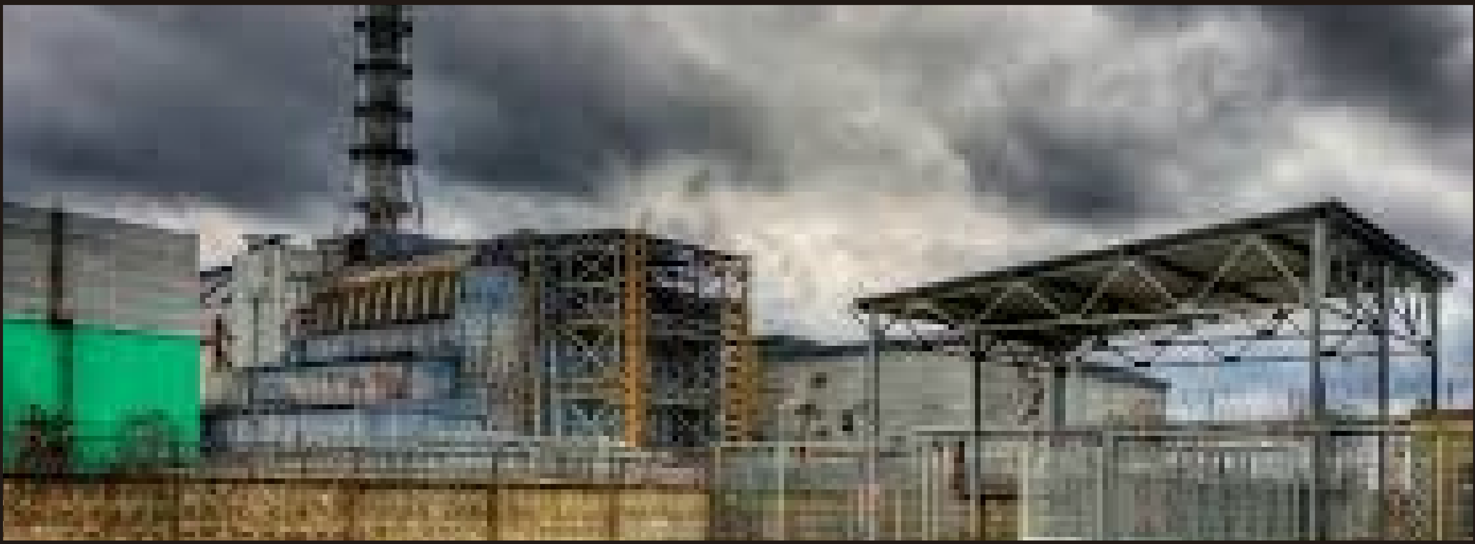
THE CHERNOBYL 1986



1.0 General background

Reactor 4 several months after the disaster

On 26 April 1986, the worst nuclear disaster and the most expensive disaster in history happened at Chernobyl Nuclear Power Plant, located near Pripyat, a city in the Ukrainian SSR, Soviet Union. This disaster happened while running a test to stimulate cooling the reactor during an accident in blackout conditions. On that day, prior to a routine shutdown, the team operating Reactor 4 at Chernobyl started getting ready for a test aimed at measuring the duration of turbine rotation and power provision to the main circulating pumps after the loss of the primary electrical supply. Unfortunately, the turbine's power diminished too quickly. Therefore, new designs for voltage regulators were set to be tested.



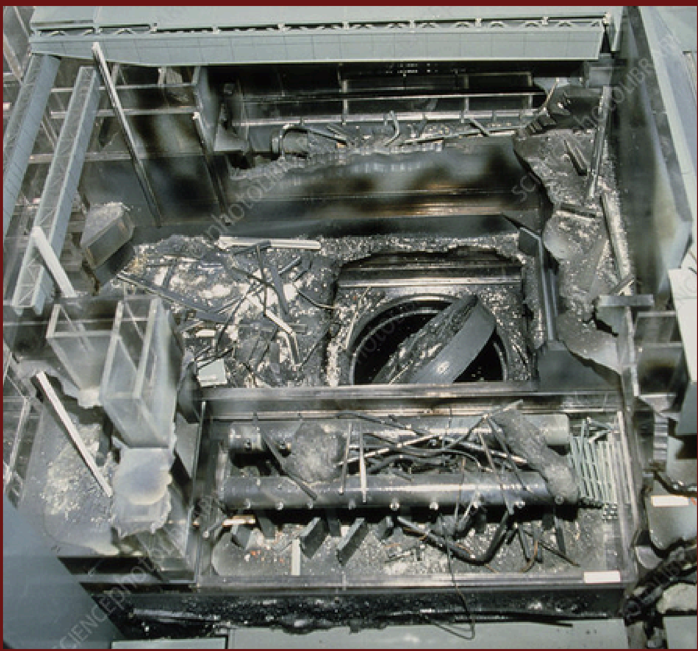
1.1 Chernobyl site

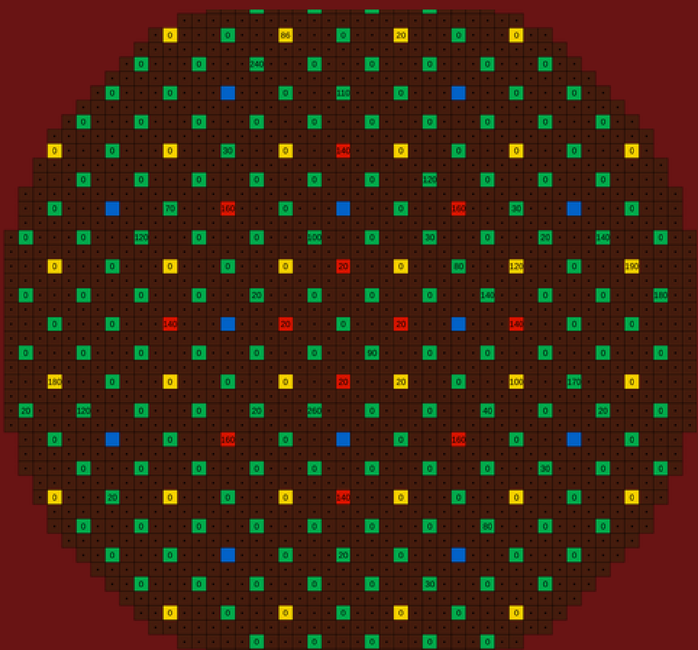
The Chernobyl Power Complex, located approximately 130 km north of Kiev Ukraine, and roughly 20 km south of the Belarus border, comprised four RBMK-1000 design nuclear reactors . Units 1 and 2 were built from 1970 to 1977, whereas units 3 and 4 of the same design were finished in 1983.

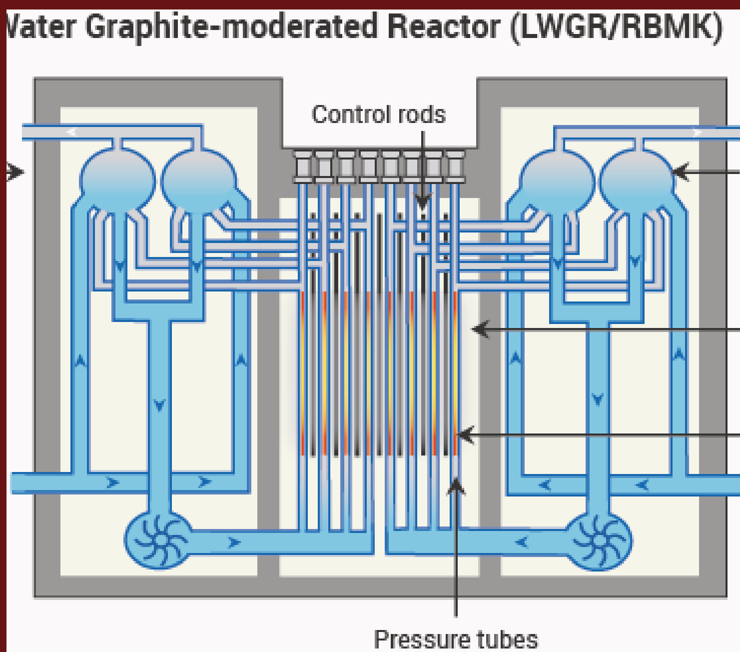
Reactor 4 room

At the time of the accident, there were two RBMK reactors being built at the site. In order to supply cooling water for the reactors, an artificial lake measuring approximately 22 square (km) was created next to Pripyat River southeast of the plant.

1.1.1 RBMK







- neutron detectors (12)
- control rods (167)
- short control rods from below reactor (32)
- automatic control rods (12)
- pressure tubes with fuel rods (1661)

1.2 Contaminate area

This region of Ukraine is characterized as a Belarussian-type forest with sparse population. The new city of Pripryat, located approximately 3 km from the reactor, housed 49,000 residents. Located approximately 15 km southeast of the complex, the old town of Chernobyl had a population of 12,500. Radioactive contamination released into the atmosphere as both particulate and gaseous radioisotopes. The Europe and the Soviet Union was affected, a 10 km (6.2 miles) exclusion zone was set up, leading to the initial evacuation of approximately 49,000 individuals. The exclusion zone was subsequently enlarged to a radius of 30 km (19 miles), leading to the evacuation of around 68,000 additional individuals.

2.0 Overview of Chemicals and Materials Involved

Picture of properties contaminated with chemicals

The Chernobyl nuclear accident in 1986 involved several hazardous chemicals and materials that are commonly used in the nuclear power generation industry. Under normal operating conditions, these materials are strictly controlled and regulated. However, during the accident, failures in reactor design and safety management led to the uncontrollable release of these materials. This led to widespread radioactive contamination and severe health and environmental consequences. The materials involved were uranium-235 nuclear fuel, radioactive fission products, graphite used as a neutron moderator, and water/steam used as a coolant.

2.1 Uranium-235 as Nuclear Fuel

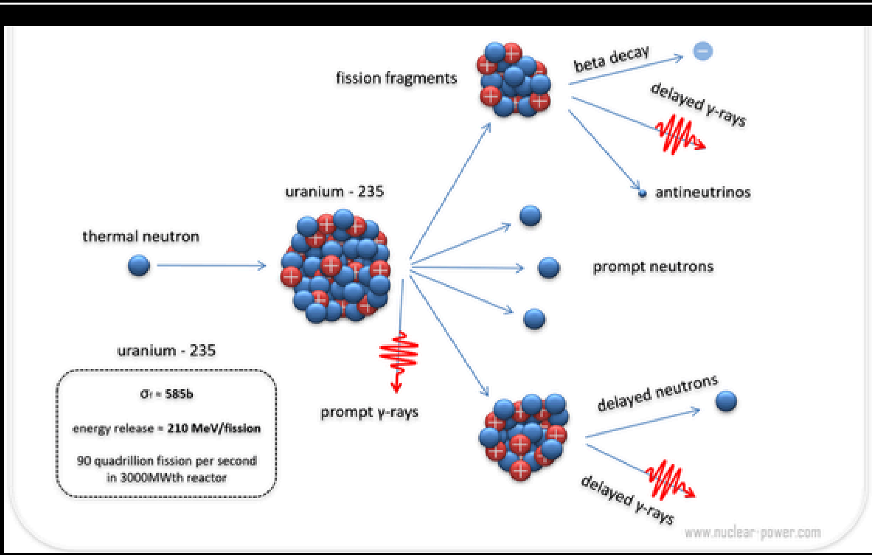
Uranium-235 (U-235) is a naturally occurring radioactive isotope and a critical fuel source for nuclear reactors due to its ability to undergo nuclear fission. When a U-235 nucleus absorbs a neutron, it becomes unstable and splits into smaller nuclei, releasing a large amount of energy, gamma radiation, and additional neutrons. These neutrons then sustain a chain reaction that produces heat, which is converted into electrical energy.

In the Chernobyl RBMK reactor, uranium dioxide (UO_2) fuel pellets enriched with U-235 were encased in metal fuel rods. Under safe conditions, this fuel remains isolated from the environment. However, during the accident, extreme temperatures and pressure caused damage to the reactor core, leading to fuel rod rupture. As a result, radioactive uranium particles and fission products were released into the atmosphere, posing serious radiological hazards to workers and nearby populations.

Physical Picture of Uranium-235

2.2 RADIOACTIVE FISSION PRODUCTS

Radioactive fission products are unstable isotopes formed when uranium-235 undergoes nuclear fission. These substances are highly radioactive and emit beta and gamma radiation. The explosion and subsequent fire at Chernobyl caused massive quantities of fission products to escape from the reactor core and spread over large areas.



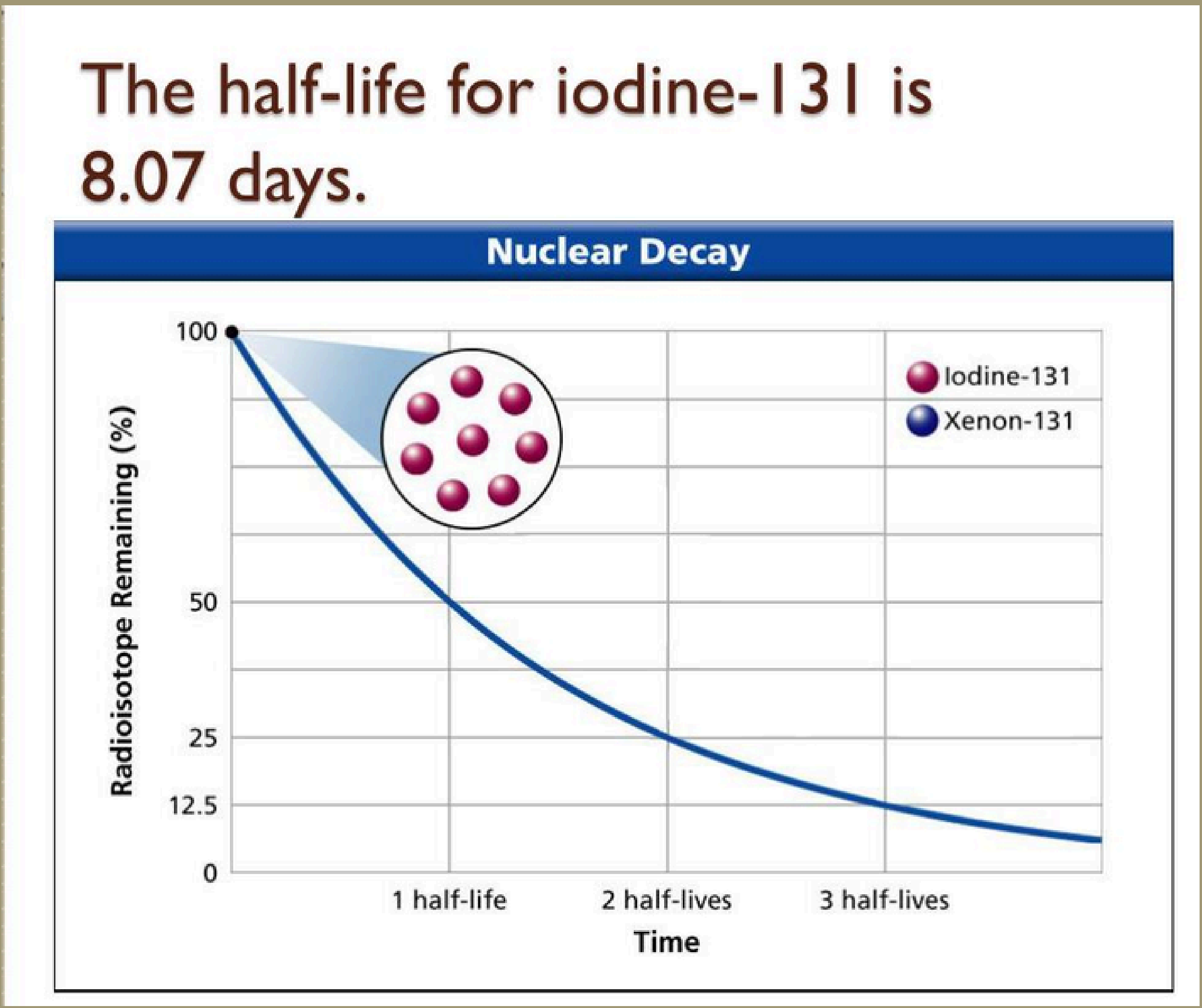
2.2.1 IODINE-131 (I-131)

Iodine-131 is a volatile radioactive isotope with a half-life of approximately eight days. Despite its relatively short half-life, it is one of the most dangerous fission products because it is easily inhaled or ingested through contaminated food and water. Once inside the body, I-131 accumulates in the thyroid gland, increasing the risk of thyroid cancer. Following the Chernobyl accident, elevated cases of thyroid cancer were reported, particularly among children who were more susceptible to iodine uptake.

2.2.2 CESIUM-137 (CS-137)

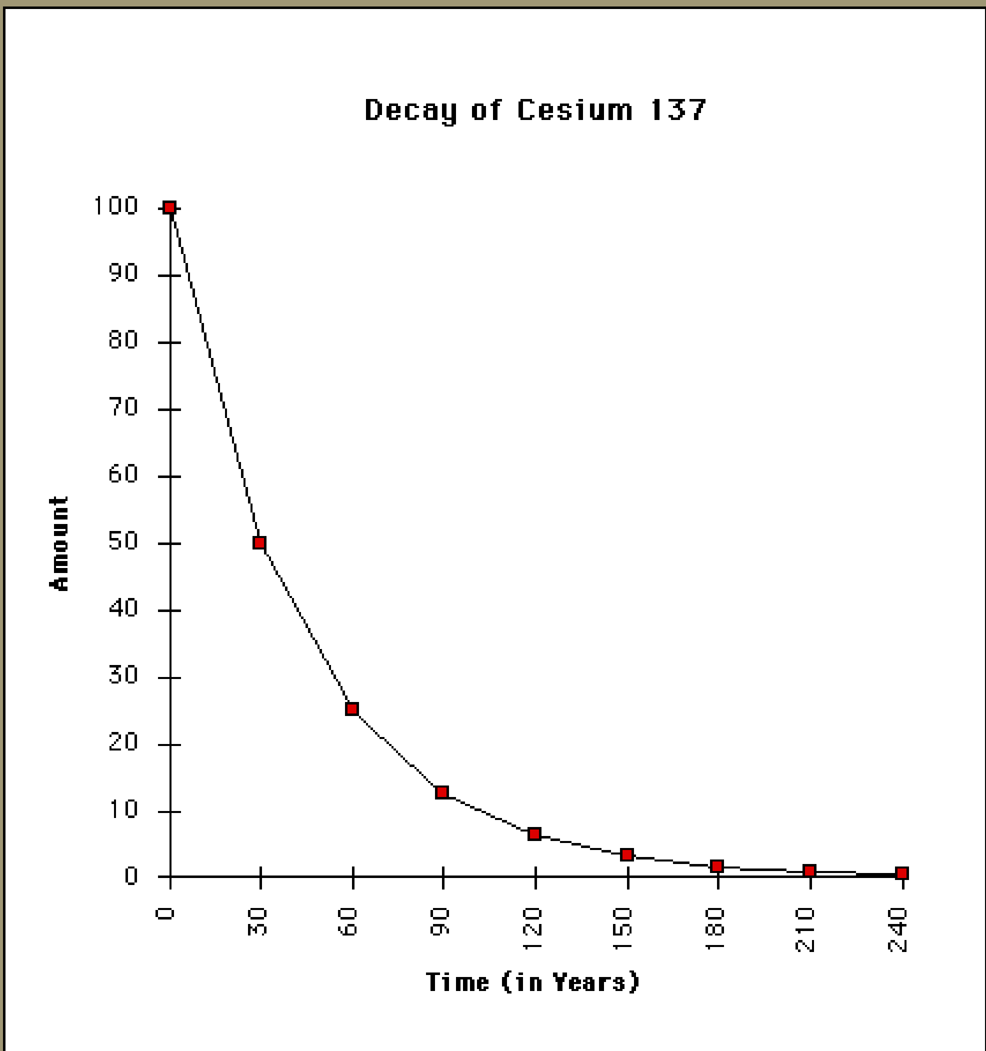
Cesium-137 is a long-lived radioactive isotope with a half-life of about 30 years. Chemically similar to potassium, cesium can be readily absorbed by plants and animals, allowing it to enter the food chain. Cs-137 emits strong gamma radiation, contributing to both external and internal radiation exposure. Its long persistence in the environment caused prolonged contamination of agricultural land, forests, and water systems, making it one of the most significant long-term contaminants from the Chernobyl disaster.

Picture of Iodine-131



Radioactive Graph of Iodine-131

Picture of Cesium-137 powder

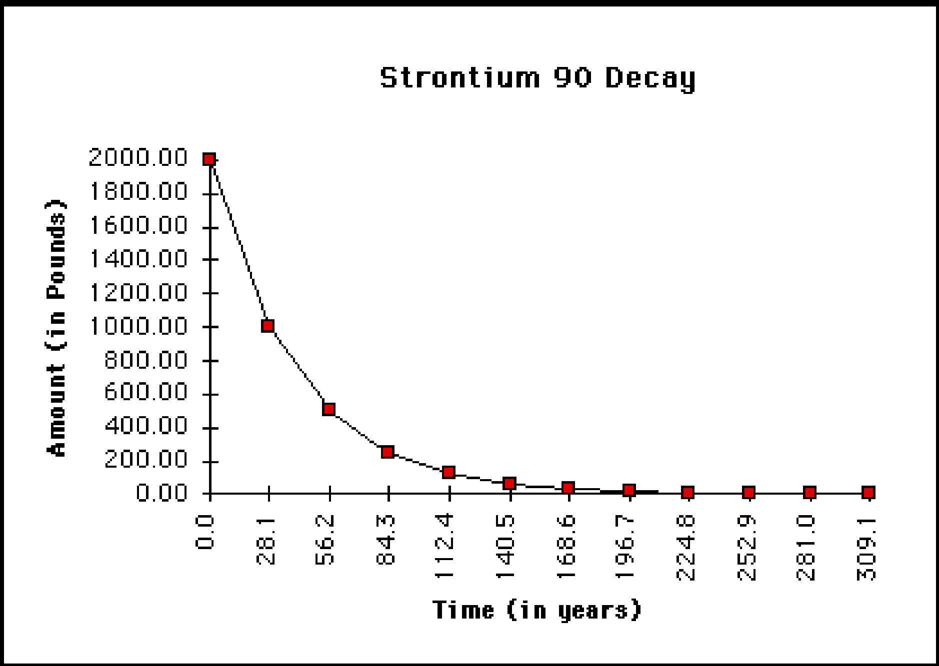


Radioactive Graph of Cesium-137

2.2 RADIOACTIVE FISSION PRODUCTS

2.2.3 STRONTIUM-90 (SR-90)

Strontium-90 is another long-lived radioactive isotope with a half-life of approximately 29 years. It behaves chemically like calcium and tends to accumulate in bones and teeth when ingested. This accumulation increases the risk of bone cancer, leukemia, and other blood-related disorders. Although Sr-90 is less volatile than iodine or cesium, its biological impact makes it particularly hazardous over long periods.



Radioactive Graph of Strontium-90

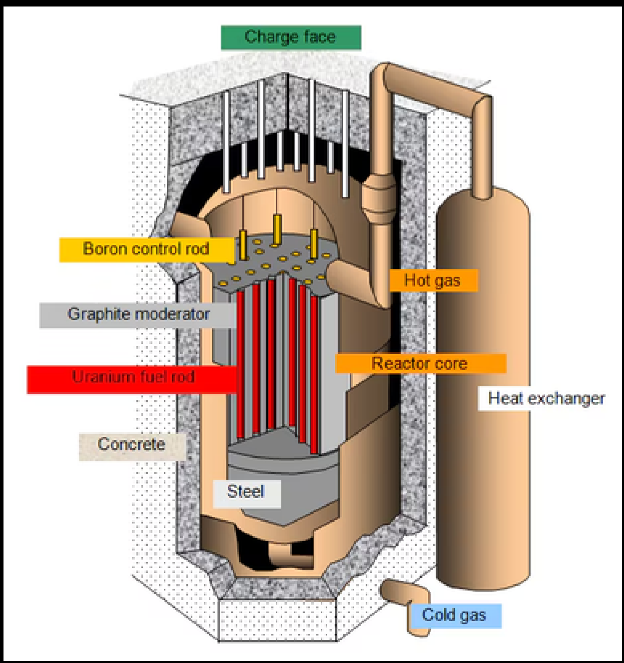
Picture of the bone condition affected by bone cancer

Picture of a body affected by leukemia

2.3 GRAPHITE AS NEUTRON MODERATOR

Graphite was used in the RBMK reactor as a neutron moderator to slow down fast neutrons into thermal neutrons, thereby sustaining the nuclear fission process. Graphite is effective for neutron moderation due to its physical structure and low neutron absorption properties. However, graphite presents significant safety risks if exposed to air at high temperatures.

During the Chernobyl accident, the reactor core was exposed following the explosion, allowing oxygen to come into contact with the hot graphite. This resulted in a graphite fire that burned for several days. The burning graphite acted as a mechanism for lifting radioactive particles high into the atmosphere, greatly increasing the spread of radioactive contamination across the Soviet Union and parts of Europe.



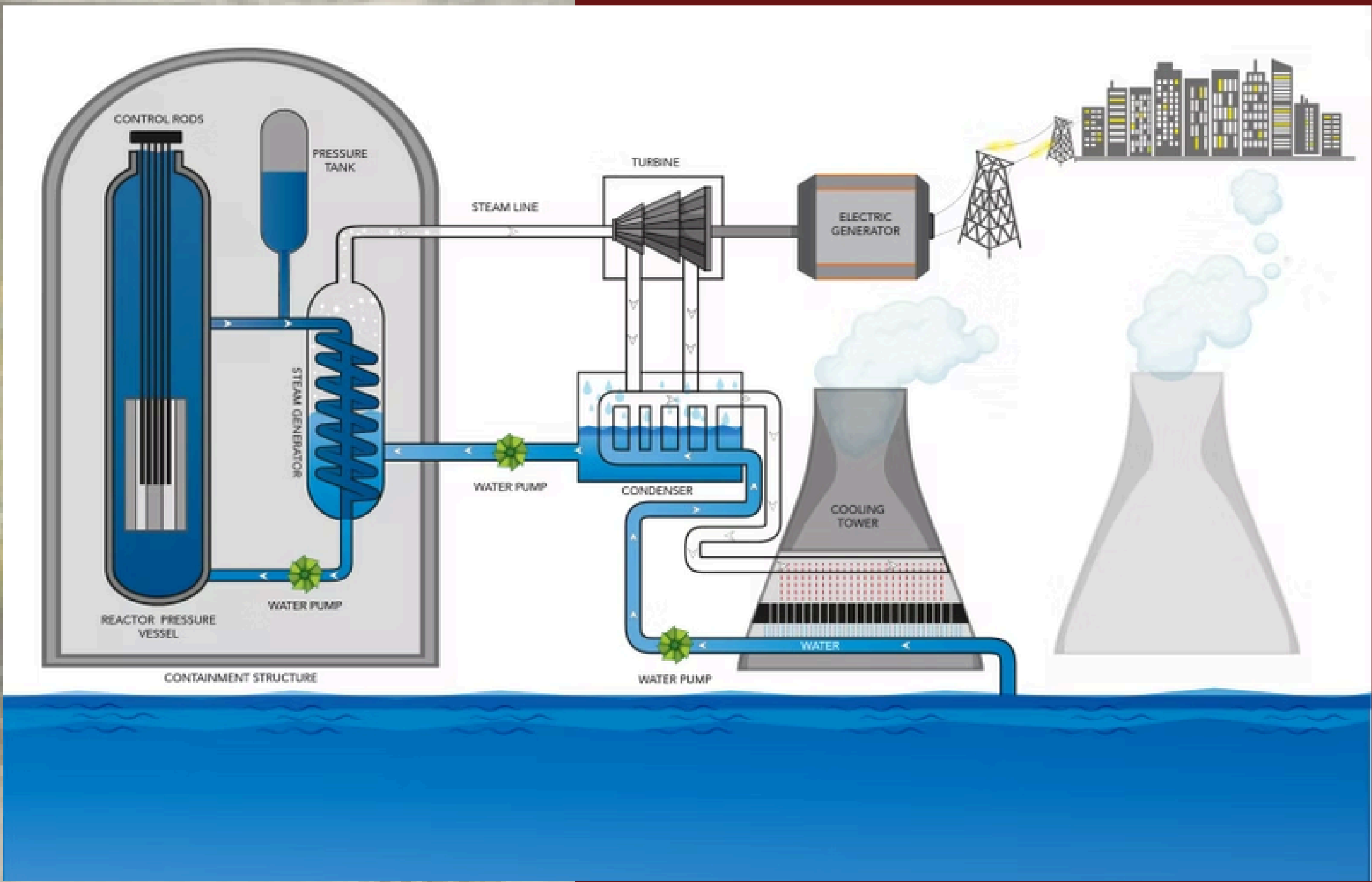
Picture of Nuclear Reactors

Picture of Physical Model Nuclear Reactor Graphite

2.4 WATER AND STEAM AS REACTANT COOLANT

Water played a dual role in the Chernobyl reactor as both a coolant and a neutron absorber. Its primary function was to remove excess heat from the reactor core and maintain stable operating temperatures. Under normal conditions, water absorbs neutrons and helps regulate reactor reactivity.

However, the RBMK reactor design had a critical flaw: when water turned into steam, its neutron-absorbing capacity decreased. During the accident, loss of coolant caused rapid overheating, leading to steam formation. The accumulation of steam increased reactor reactivity, rather than reducing it, resulting in a positive feedback loop. This ultimately led to a steam explosion that destroyed the reactor core and initiated the release of radioactive materials.

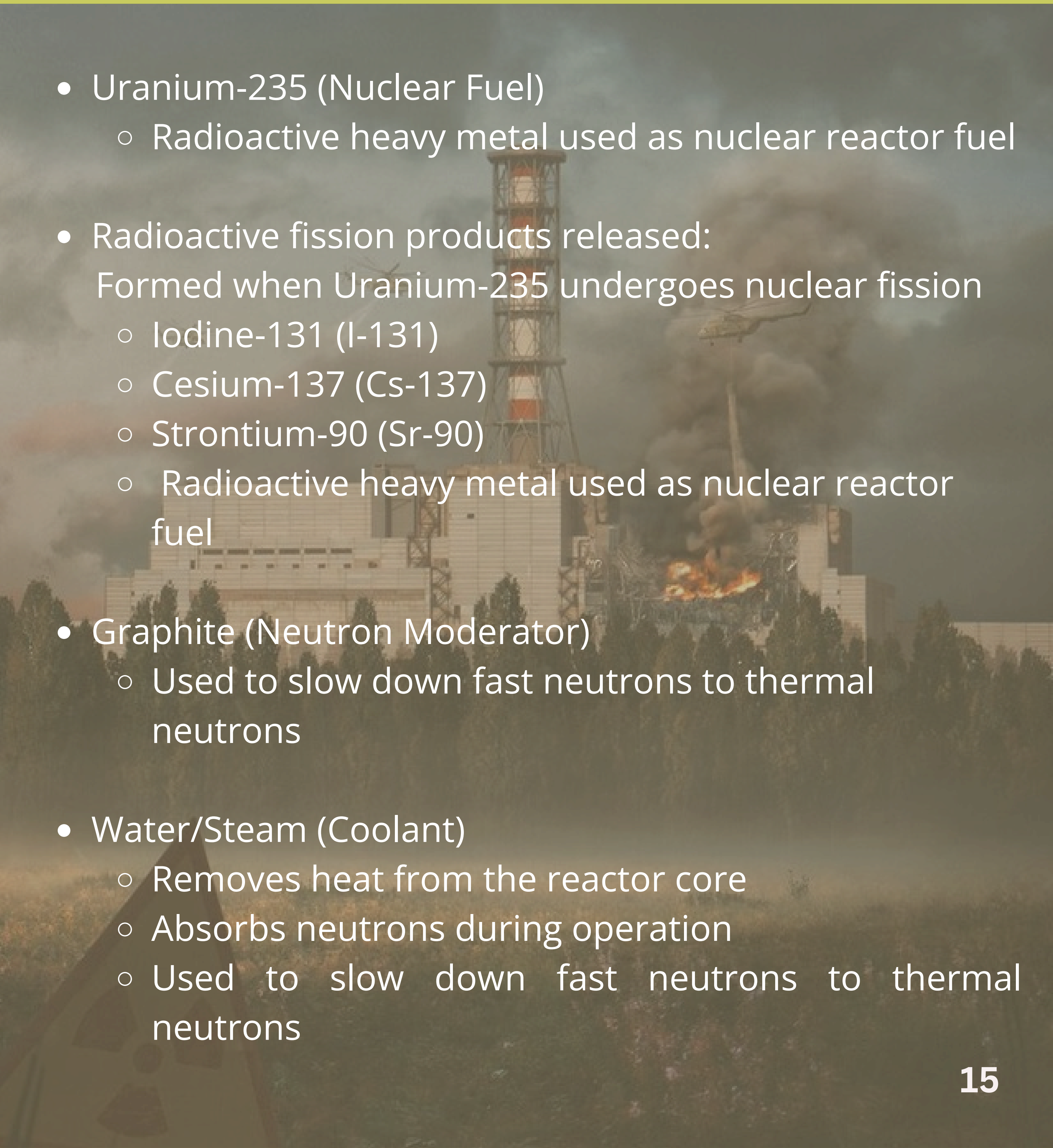


Picture of residential area in Chernobyl

3.0 Properties of Hazardous Materials

The severity of the Chernobyl disaster can be better understood by examining the physical, chemical, and radiological properties of the materials involved. These properties explain both the immediate dangers faced by workers and the long-term health and environmental consequences experienced by surrounding populations.

Properties of hazardous materials



- Uranium-235 (Nuclear Fuel)
  - Radioactive heavy metal used as nuclear reactor fuel

- Radioactive fission products released:
  Formed when Uranium-235 undergoes nuclear fission
  - Iodine-131 (I-131)
  - Cesium-137 (Cs-137)
  - Strontium-90 (Sr-90)
  - Radioactive heavy metal used as nuclear reactor fuel

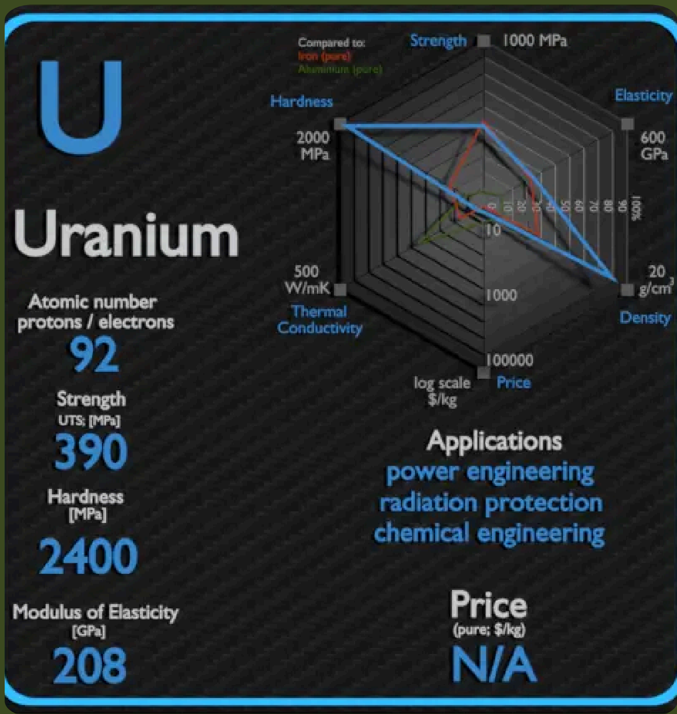
- Graphite (Neutron Moderator)
  - Used to slow down fast neutrons to thermal neutrons

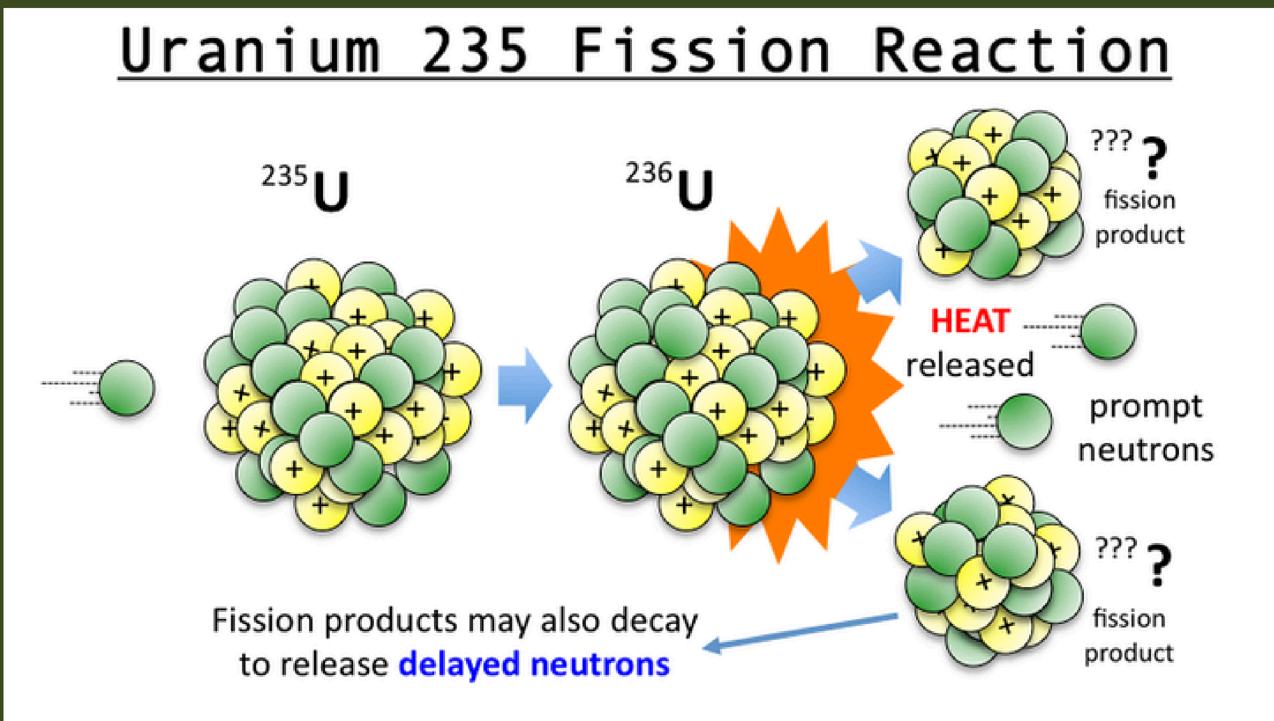
- Water/Steam (Coolant)
  - Removes heat from the reactor core
  - Absorbs neutrons during operation
  - Used to slow down fast neutrons to thermal neutrons

3.1 Physical and Chemical Properties of Uranium-235

Uranium-235 is a dense, silvery-grey radioactive metal that primarily emits alpha radiation. While alpha particles have low penetration power, uranium becomes extremely hazardous when particles are inhaled or ingested, leading to internal radiation exposure. Uranium also generates significant heat during nuclear fission, which can cause structural damage to reactor components if not properly controlled.

Chemically, uranium readily forms oxides such as uranium dioxide (UO_2), which was used as reactor fuel. These oxides are stable under controlled conditions but can become chemically toxic and radiologically dangerous when dispersed into the environment as fine particles.





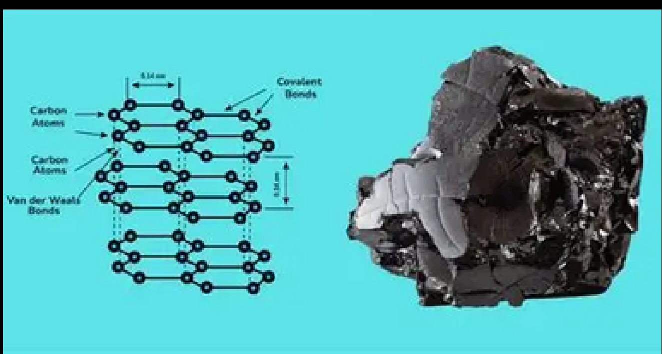
3.2 PROPERTIES OF MAJOR RADIOACTIVE FISSION PRODUCTS

Radioactive fission products are characterized by their instability and emission of ionizing radiation. Iodine-131 emits both beta and gamma radiation and selectively accumulates in the thyroid gland. Cesium-137 emits high-energy gamma radiation and is highly mobile in environmental systems. Strontium-90 emits beta radiation and concentrates in bone tissue, leading to prolonged internal exposure.

These properties make fission products particularly dangerous because they can cause both external radiation exposure and internal contamination through inhalation or ingestion.

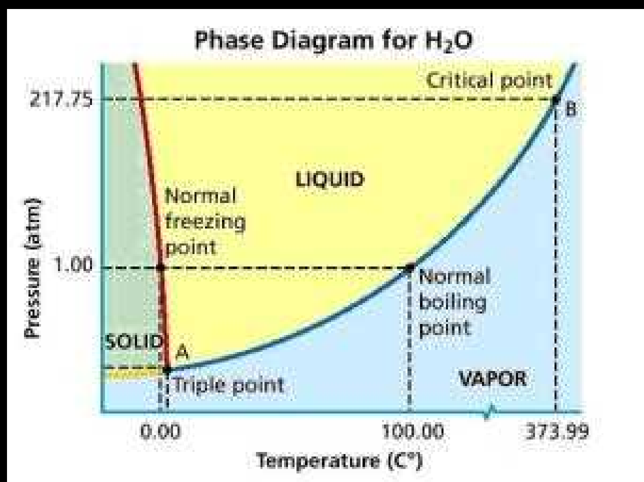
3.3 NUCLEAR AND THERMAL PROPERTIES OF GRAPHITE

Graphite has excellent neutron moderation properties and a very high melting point, making it suitable for reactor use. However, graphite is combustible under extreme temperatures when oxygen is present. During the Chernobyl accident, the ignition of graphite significantly worsened the disaster by sustaining high temperatures and enabling continued release of radioactive materials into the atmosphere.



3.4 PROPERTIES AND FUNCTION OF WATER AND STEAM

Water has a high specific heat capacity, allowing it to absorb large amounts of heat efficiently. It also serves as a neutron absorber in nuclear reactors. In contrast, steam has a much lower neutron absorption capacity. In the RBMK reactor, this difference created a dangerous condition where increasing steam formation led to increased reactivity. This design flaw played a crucial role in the rapid escalation of the accident.



3.5 Safety Data Sheet (SDS)

Radioactive materials (U-235, I-131,Cs-137,Sr-90)

- **Hazard classification: Radioactive substances**

- **Main exposure routes:**

1. Inhalation of radioactive particles
2. Ingestion via contaminated food or water
3. External radiation exposure

- **Health effects:**

1. Acute Radiation Syndrome at high doses
2. Long-term cancer risk
3. Genetic and cellular damage

- **Required control measures:**

1. Shielding and containment
2. Restricted access and controlled zones
3. Radiation monitoring and dose limits

- **Emergency response:**

1. Evacuation procedures
2. Decontamination
3. Medical surveillance

Safety Data Sheet (SDS)

Graphite

- **Identification**

1. Carbon-based solid (graphite)
2. Used as neutron moderator

- **Physical and Chemical Properties**

1. Solid, black/grey material
2. High melting point
3. Chemically stable under normal conditions

- **Hazard Identification**

1. Low chemical toxicity
2. Dust may cause respiratory irritation
3. Combustible at extremely high temperatures
4. Fire hazard under accident conditions

- **Exposure Routes**

1. Inhalation of graphite dust
2. Skin and eye contact (minor irritation)

- **Fire and Explosion Hazards**

1. Can burn at very high temperatures
2. Graphite fire is difficult to extinguish
3. Fire can facilitate dispersion of radioactive materials

- **Handling and Storage (Normal Conditions)**

1. Controlled environment
2. Dust control measures
3. Fire prevention systems

- **Special Consideration in Chernobyl**

1. Graphite combustion significantly worsened the release of radioactive contaminants

3.6 Regulations Related to Use of Chemicals/Nuclear Safety in Industry

A. Nuclear Safety Regulations and International Frameworks

- **International Nuclear Safety Standards:**

Before Chernobyl, international safety standards for nuclear plants existed under the International Atomic Energy Agency (IAEA), but enforcement and harmonization were limited, especially across the Eastern Bloc. The accident highlighted serious gaps in regulatory oversight and safety norms.

- **Role of IAEA and Regulatory Reports:**

The IAEA's Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident (INSAG-1) and its later update (INSAG-7) examined regulatory, safety, and design issues in detail. These reports noted not only operator actions but also deficiencies in safety standards enforcement and safety culture at the plant and industry level.

C. Post-Chernobyl Regulatory Improvements

- **New International Conventions:**

In direct response to the accident's regulatory failures, the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency were adopted under IAEA auspices later in 1986, establishing formal international obligations for nuclear accident reporting and cooperation.

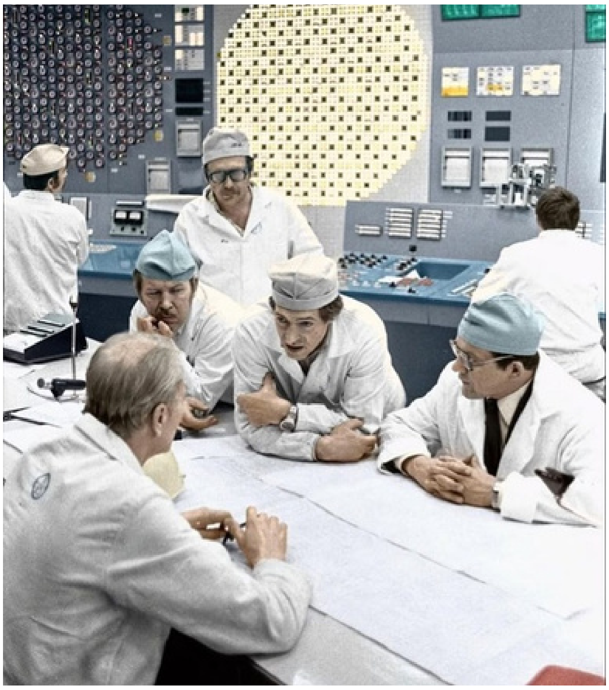
B. Regulatory Requirements for Operations and Testing

- **Lack of Clear Operational Approval Requirements:**

Investigations indicated that the test conducted to assess turbine-powered core cooling did not require approval by the chief design authority or a nuclear safety regulator under the regulations in place at the time — revealing a regulatory gap in how hazardous operations were controlled.

- **Safety Culture and Regulatory Compliance:**

International reviews after the accident emphasized that a key regulatory weakness was the absence of an effective safety culture, meaning operators, designers, and regulators did not prioritize safety management and compliance as essential to preventing severe nuclear accidents



3.7 Failures in Safety Management That Led to the Chernobyl Accident

A. Poor Safety Culture

The official accident investigations (INSAG reports) identified a lack of safety culture throughout nuclear plant operations, engineering, design, and regulation. This meant that safety was not systematically integrated into decision-making, risk assessment, and everyday practices at the plant.

This systemic weakness allowed operators to deviate from procedures during a test without fully appreciating the risk or ensuring proper approval and safety measures

C. Operational Decisions and Test Mismanagement

The test undertaken on 26 April 1986 involved disabling key safety systems (e.g., emergency core cooling) and operating the reactor at low power under conditions outside the normal safety envelope, without adequate regulatory approval or risk assessment.

Communication failures and lack of coordination between teams responsible for the test procedures and those responsible for reactor safety contributed to unsafe conditions.

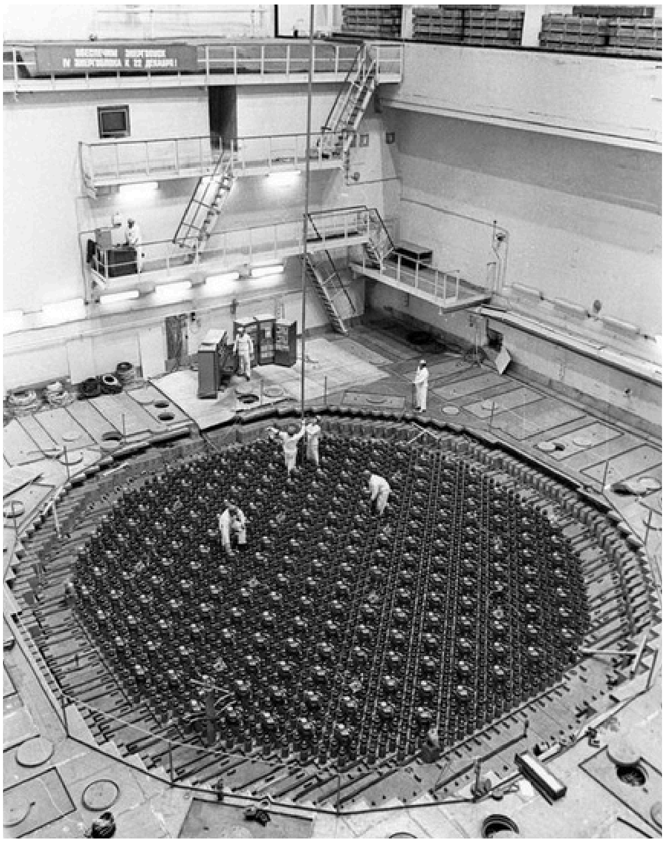
D. Inadequate Regulatory Enforcement

The investigation highlighted that regulatory enforcement was weak, particularly concerning enforcement of safety documentation, design flaws, and operational boundaries. Regulatory bodies did not identify, analyze, or ensure corrective actions for deviations from safety standards during design, construction, and operation phases

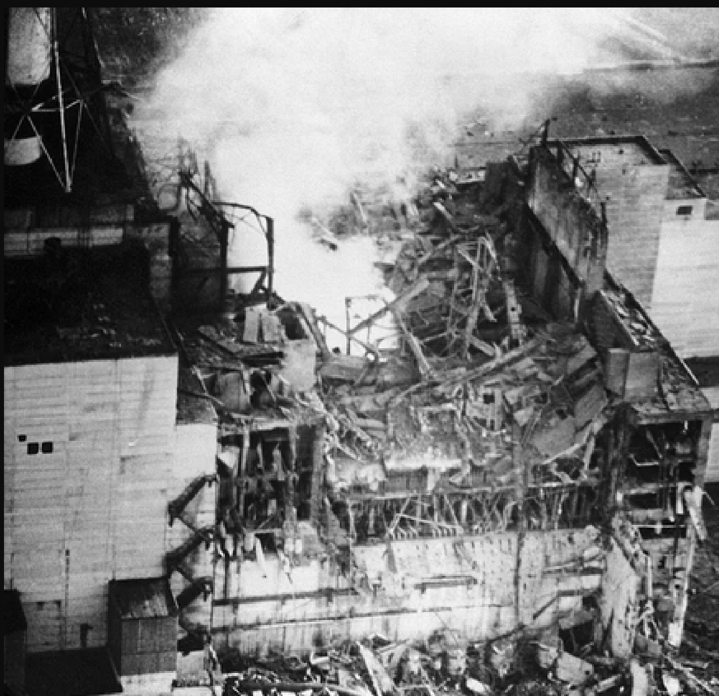
B. Reactor Design and Regulatory Oversight Failures

The RBMK reactor design used at Chernobyl had fundamental safety flaws, such as a positive void coefficient and a control rod design that could exacerbate power surges. These design features were not clearly communicated to operators nor were compensatory safety improvements mandated through regulation.

According to IAEA and independent analyses, violations of existing safety standards occurred because operating policies and principles lacked clear articulation, oversight, or enforcement



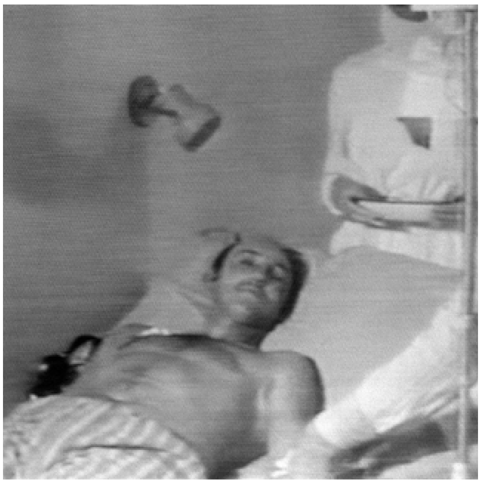
4.0 Impacts of the accident on people, property, and the environment.



Impacts of the accident on people, property, and the environment.

The Chernobyl accident that occurred on 26 April 1986 led to widescale radioactive contamination of territories in Belarus, Ukraine and the western part of Russia. The accident resulted in the release from the damaged reactor of many radionuclides into the atmosphere, including the radiologically significant short-lived Iodine-131 (131I), Tellurium-132 (132Te), Iodine-133 (133I), and long-lived Caesium-134 and Caesium-137 (134Cs and 137Cs) (Drozdovitch, et al., 2021). The Chernobyl accident causes massive significant impacts on people, property, and the environment.

4.1 Impacts On People



The year 1986 is marked by one significant global event which is the Chernobyl Nuclear Disaster (CND). The failure of Reactor No. 4 at the Chernobyl Nuclear Power Plant released significant amounts of radioactive materials into the atmosphere. This has led to significant contamination across various European nations, including Ukraine, Russia, and Belarus. The immediate health effects, including acute radiation syndrome and the mandatory evacuation of over 300,000 people (about half the population of Wyoming), initiated a prolonged global response to this unprecedented nuclear disaster (Yap, et al., 2025).

The CND resulted in a rise in cases of radiation-54-related malignancies, thyroid disorders, psychological distress, and possible genetic anomalies, thereby raising substantial public health concerns. In addition, the CND had a disproportionate impact on children and pregnant women, resulting in long-term psychological trauma for survivors, which requires continued epidemiological research and healthcare support. Survivors, particularly those who have experienced displacement or high radiation exposure, exhibit persistent mental health challenges.

The health consequences of CND are both immediate and long-term. Acute radiation syndrome resulted in the deaths of 28 emergency workers, with a total of 64 fatalities directly associated with the disaster. Longitudinal studies indicate increased incidences of thyroid cancer, leukemia, and other malignancies, especially in children exposed to radiation. Mental health disorders such as anxiety, depression, and post-traumatic stress disorder are prevalent in public health issues affecting survivors and workers. Documented secondary health effects include cardiovascular diseases, cataracts, and endocrine disorders among individuals exposed to lower radiation doses (Yap, et al., 2025).

This undated picture, sent by Soviet television, show a man injured in the blast of No. 4 reactor of Ukrainian Chernobyl nuclear plant.

At Moscow's No. 6 clinic, which specializes in radiation treatment, a patient recovers after a bone-marrow operation. A doctor examines the patient in a sterile room. The examination is carried out in an individual, air-conditioned chamber via specially created openings to avoid direct contact and contamination.

4.2 Impacts on Property and Infrastructure.

At 01:23 on April 26, 1986, a powerful steam explosion destroyed the unit 4 RBMK reactor at the Chernobyl nuclear power plant (NPP), located in the Polissa region of Ukraine (then still part of the Soviet Union). The accident was caused by gross breaches of the operating procedures by staff and technical inadequacies 1n the safety systems. The subsequent raging fire, which burned for 10 days, ruined much of the building and resulted in a vast release of radioactive debris onto the surrounding area and radionuclides into the atmosphere.

There was a largescale explosion at the Chernobyl Nuclear Power Plant, which was located near the city of Pripyat in the former Soviet Union. This area currently belongs to the Kyiv Region in Ukraine. Because of the accident, radioactive materials in large quantities were scattered throughout the territory of Ukraine, Belarus, Russia, and other areas of Europe. Because the soil was contaminated by radioactive materials, people who lived in those areas, and who were expected to be exposed to excessive radiation if they remained, had to be evacuated. The nuclear power plant accident area was a 2-h bus ride from Kyiv. The zone within a radius of 30 km (about 18.64 mi) of the nuclear power plant was designated as a restricted area and has a checkpoint at its entrance (NAIKI, et al., 2020).

The meltdown, explosions, and nuclear fire that burned for 10 days injected 80 petabecquerel of radioactivity into the atmosphere and contaminated >200,000 km2 of Europe and Eurasia. The highest levels of contamination, and hence radioactivity, are found within the Chernobyl Exclusion Zone of Ukraine and Belarus, but hazardous areas can be found as far away as Scandinavia, Austria, and the UK. There are now many accounts of the disaster and its aftermath (Mousseau, et al., 2021).

The 'exclusion zone' surrounding the Chernobyl NPP is an evacuated space, a vast tract of land that was emptied by its human contents because of radioactive contamination after the accident. This mass movement of people resulted in a dramatically changed landscape of abandoned and, in some cases, completely razed dwellings and sediments. Architectures and spaces designed for habitation and framing the activities of daily life were completely emptied of their human. The village street, the field, the highway- all of it without any people. A highway to Nowhere. Radioactivity has rendered its buildings, streets, squares, and parks mortally perilous. Deserted dolls and teddies, overturned furniture, rotting detritus, smashed windows, scattered contents of drawers and shelves, rusting bed frames, torn fabrics, peeling wallpaper, disintegrating objects, spreading mold and gathering dust are not conventional objects of 'beauty.'

A bulldozer digs a large trench in front of a house before burying the building and covering it with earth. This method was applied to entire villages that were contaminated after the Chernobyl disaster.

Permanent residents in the devastated Chernobyl zone are animals, including hundreds of stray dogs, descendants of those left behind when residents evacuated, were told they'd be back in three days, and to leave their pets. Officials tried to shoot them all, but were not successful. Today, workers and others try to keep the offspring healthy and fed. They love people and look so sad when you leave.

4.3 Impacts on the Environment

The release of radioactive materials contaminated land, water, and air throughout Europe

Nuclear energy poses ethical challenges due to potential risks to human life and the environment. Nuclear energy can meet the global demand for clean energy; however, the risk of catastrophic events, exemplified by Chernobyl, necessitates an assessment of whether the benefits outweigh the risks. The environmental consequences were significant, affecting soil, water, and ecosystems, with detrimental impacts on biodiversity and food security, necessitating restoration and mitigation efforts (Yap, et al., 2025).

The environmental impact of CND was extensive and multifaceted. The release of radioactive materials contaminated land, water, and air throughout Europe, significantly impacting Belarus, Ukraine, and Russia.

The 30-kilometer exclusion zone surrounding the reactor is uninhabitable; however, it has unintentionally transformed into a wildlife sanctuary due to the lack of human presence, despite ongoing high radiation levels. Although biodiversity experienced significant declines, certain species have adapted to the radioactive conditions, while others display genetic mutations. Additionally, radioactive isotopes have contaminated water systems, including significant rivers in Ukraine, presenting enduring risks to human and ecological health. The persistent environmental challenges highlight the need for continuous monitoring and global cooperation in tackling nuclear contamination (Yap, et al., 2025).

A worker wearing a protective overalls and mask works with boxes of contaminated vegetables on the landfill in Berlin in May 1986. These vegetables were banned by local authorities.

In October 1989, a local woman holds up a disabled newborn pig, victim of the radioactive fallout.

Firefighters in protective suits clean cars at the German border in May 1986. The cars were coming from Poland and were largely contaminated.

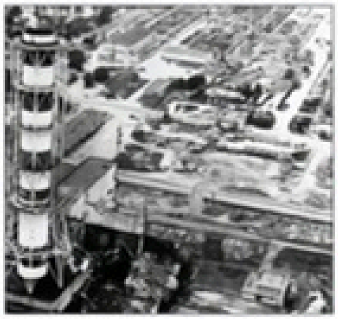
The evacuation of 47,000 inhabitants of Pripyat, in 1,200 buses and 200 trucks, only took a few hours. Locals believed they would be returning several days later. Instead, it became a ghost town.

5.0 Lessons Learned from the Chernobyl Accident

In conclusion..

Secure, low-carbon energy sources are crucial; however, the CND disaster underlines the importance of stringent safety standards and preparedness for emergencies within the energy sector (Yap, et al., 2025). The Soviet government's inability to deliver timely information and effectively manage the crisis exacerbated its consequences, highlighting the importance of robust institutions, international dialogue, and revised nuclear safety regulations to avert future disasters (Yap, et al., 2025). Accurate measurement of radiation exposure is crucial for public health and safety, enabling suitable medical interventions and minimizing long-term health risks for populations exposed to radiation (Yap, et al., 2025).

Aftermath of the Chernobyl disaster



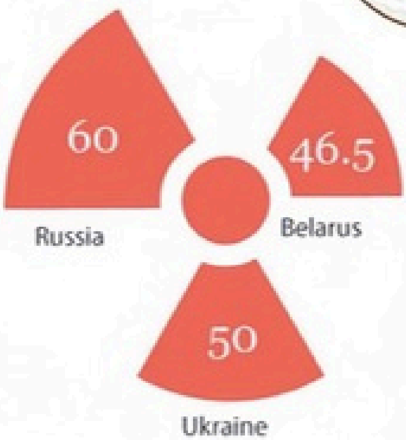
On April 26, 1986, an explosion occurred at the fourth reactor of the Chernobyl Nuclear Power Plant in the Ukrainian SSR, now Ukraine

- *Number of people killed in the first three months after the disaster:* ***31***
- *Number of people killed due to the long-term effects of radiation (15 years):* ***60-80***
- *Number of people who survived acute radiation syndrome:* ***134***
- *Number of people involved in clean-up operations:* ***Over 600,000***

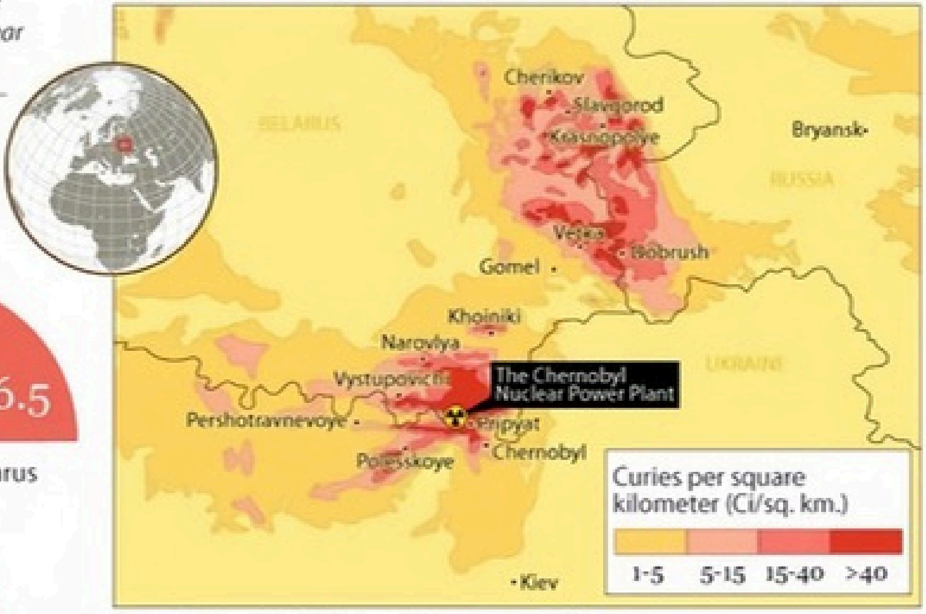
Ground contamination

- *Five million hectares of farmland were taken out of use*
- *Radius of the exclusion zone around the Chernobyl Nuclear Power Plant: 30 kilometers*

Total area of affected regions, thousands of square kilometers



Map showing radioactive contamination with cesium-137, a harmful substance with a long half-life that formed in the disaster



The curie (symbol Ci) is an off-system unit of radioactivity. In addition to the curie, radioactivity can be measured using the becquerel (Bq), which is equal to one decay per second. Therefore: 1 Ci = 3.7×10^{10} Bq

Average radiation doses received by different areas of the population

Clean-up workers 600,000 people	1986—1989	~100mSv
Evacuees 116,000 people	1986	33mSv
Residents of restricted areas 270,000 people	1986—2005	>50mSv
Residents of other contaminated areas 5,000,000 people	1986—2005	10—20mSv

The millisievert equals one-thousandth (0.001) of one sievert. The sievert (symbol: Sv) is a unit measuring the biological effect of radiation on the body. One sievert equals one joule per kilogram. The level of natural background radiation averages about 2.4 millisieverts per year

The Abandoned Ferris Wheel in Pripyat

The Abandoned Bumper Cars

The Polissya Hotel is a prominent, abandoned, multi-story building in the center of Pripyat

Use to serve visiting scientists, engineers, and officials working at the Chernobyl Nuclear Power Plant.

The front page of the Erie Daily Times 40 years ago


Tuesday, April 29, 1986

Erie Daily Times

INSIDE

PHYSICAL FITNESS: A SPECIAL SECTION /INSIDE
THE TIMES TUESDAY MONEY PAGE /PAGE 5A
TOM HULCE GOES FROM MOZART TO PIZZA MAN /PAGE 5B

Disaster called meltdown

By KEN OLSEN

History scrapbook

Fallout could reach U.S.

Scientists say health hazards minimal outside accident area

By LAURA KING

"If it gets high enough into the atmosphere so that it gets into the jetstream, the normal path it follows is across the northwest part of the country."

U.S. offers to help deal with accident

Ambassador to Chile uninjured in bombing

CHERNOBYL 1986

Post- apocalyptic

CHERNOBYL 1986

"A catastrophic incident that altered a peaceful region of Eastern Europe into an abandoned and eerie zone."

CHERNOBYL 1986

A catastrophic nuclear accident that transformed a once-peaceful region in Eastern Europe into an abandoned and haunting landscape. The Chernobyl disaster of 1986 resulted from a reactor explosion that released vast amounts of radioactive materials into the environment, contaminating air, soil, and water systems. The long-term effects of radiation exposure led to severe health consequences, environmental degradation, and the permanent evacuation of nearby communities, making Chernobyl a critical case study in nuclear safety and risk management.

References

Drozdovitch, V. (2021). Radiation Exposure to the Thyroid After the Chernobyl Accident. Frontiers in Endocrinology, 11, 569041. https://doi.org/10.3389/fendo.2020.569041

Mousseau, T. A. (2021). The biology of Chernobyl. Annual Review of Ecology, Evolution, and Systematics, 52(1), 87-109. https://doi.org/10.1146/annurev-ecolsys-110218-024827

NAIKI, M. (2020). The impact of the Chernobyl Nuclear Power Plant accident: 32 years on. Health Emergency and Disaster Nursing, 7(1), 71-72. https://doi.org/10.24298/hedn.2019-0009

Yap, C. K., & Al-Mutairi, K. A. (2025). Chernobyl nuclear catastrophe: Lessons for sustainability and UNSDGs in health, energy, and environmental recovery. Frontiers in Public Health, 13, 1552122. https://doi.org/10.3389/fpubh.2025.1552122

International Atomic Energy Agency. (2018). *The Chernobyl accident: Updating of INSAG-1*. https://www.iaea.org/publications/3786/the-chernobyl-accident-updating-of-insag-1

World Health Organization. (2006). *Health effects of the Chernobyl accident and special health care programmes*. https://www.who.int/publications/i/item/9241594179

United Nations Scientific Committee on the Effects of Atomic Radiation. (2008). *Effects of ionizing radiation: UNSCEAR 2008 report*. *https://www.unscear.org/unscear/en/publications/2008_1.html*

References

World Nuclear Association. (2023). *Chernobyl accident 1986*. *https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident*

U.S. Nuclear Regulatory Commission. (2022). *Backgrounder on the Chernobyl nuclear power plant accident*. https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/chernobyl-bg

Centers for Disease Control and Prevention. (2021). *Radiation and health effects*. *https://www.cdc.gov/radiation-health/index.html*

Chernobyl Accident 1986 - World Nuclear Association. (n.d.). https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident

The Chornobyl accident. (n.d.). United Nations: Scientific Committee on the Effects of Atomic Radiation. https://www.unscear.org/unscear/en/areas-of-work/chernobyl.html

The Chernobyl Accident: Updating of INSAG-1. (1993b, January 11). IAEA. https://www.iaea.org/publications/3786/the-chernobyl-accident-updating-of-insag-1

Chernobyl Accident 1986 - World Nuclear Association. (n.d.). https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident

CHERNOBYL 1986

eISBN 978-967-25930-9-6

Universiti Teknologi MARA Cawangan Negeri Sembilan

(online)