Chernobyl Disaster

Group 5

Presenter: Nisarg Shah

Report: Merhawit Mellse

Topics for Consideration

- **The Event**
- **The Effects**
- **Cause & Responsibility**
- **The Aftermath**
- **Mission Critical Software**
- **Conclusion**

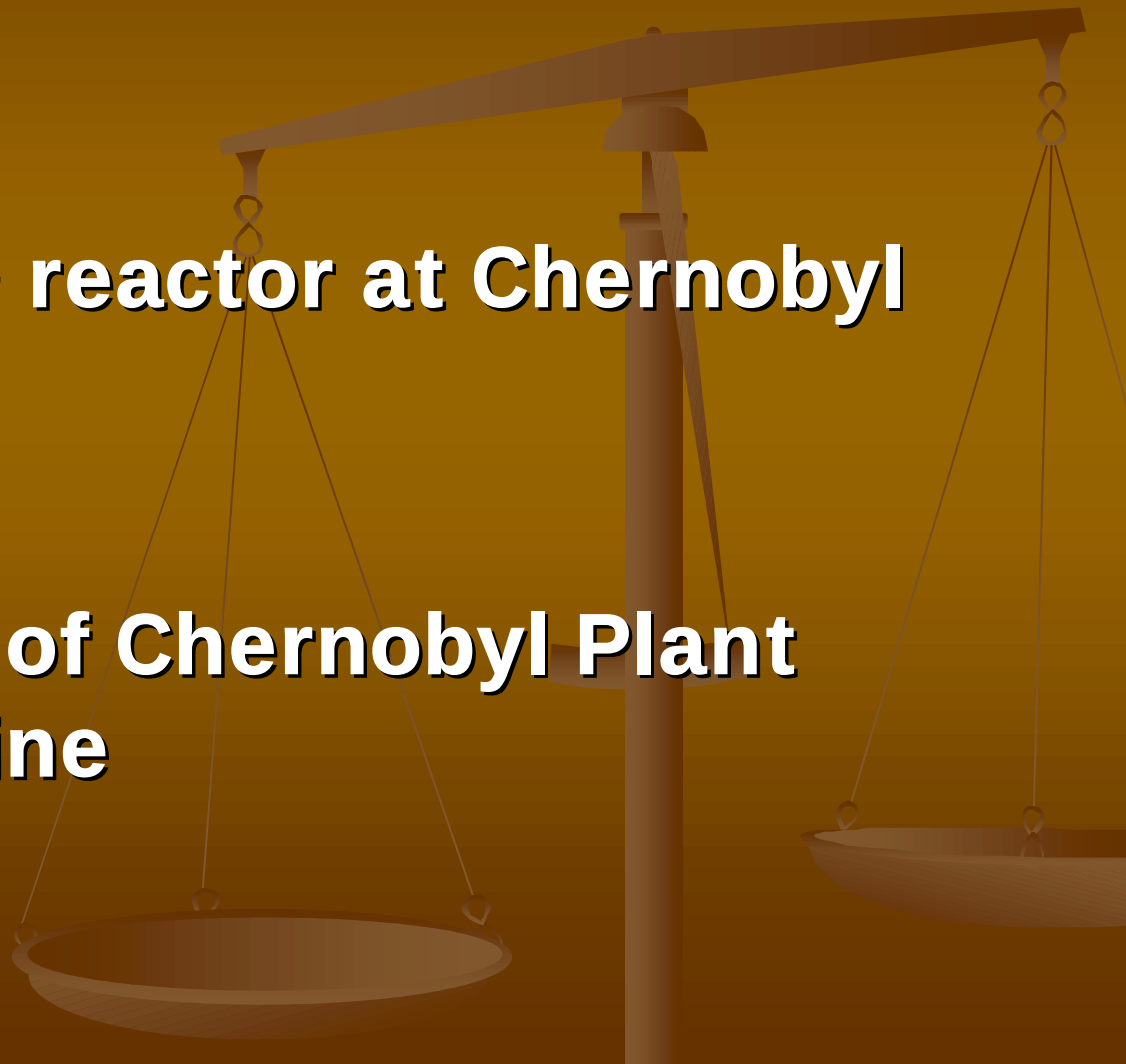
The Event

- **1978**

  Start of 1st reactor at Chernobyl

- **1983**

  Unit No. 4 of Chernobyl Plant comes online



The Event

- **26 April 1986**
  - Test how reactor 4 would cope with a loss of electric power and the subsequent reactions of the cooling systems.
  - The local automatic control system was switched off, thus giving the operator manual control of the entire plant.
  - The reactor protection systems relying on the shutdown signal from the turbo generators were neutralised.
  - The reactor protection systems relying on the heat parameters were cut off.
  - The protections systems triggered by preset water and steam pressure were blocked.
  - The emergency power reduction system was disabled.

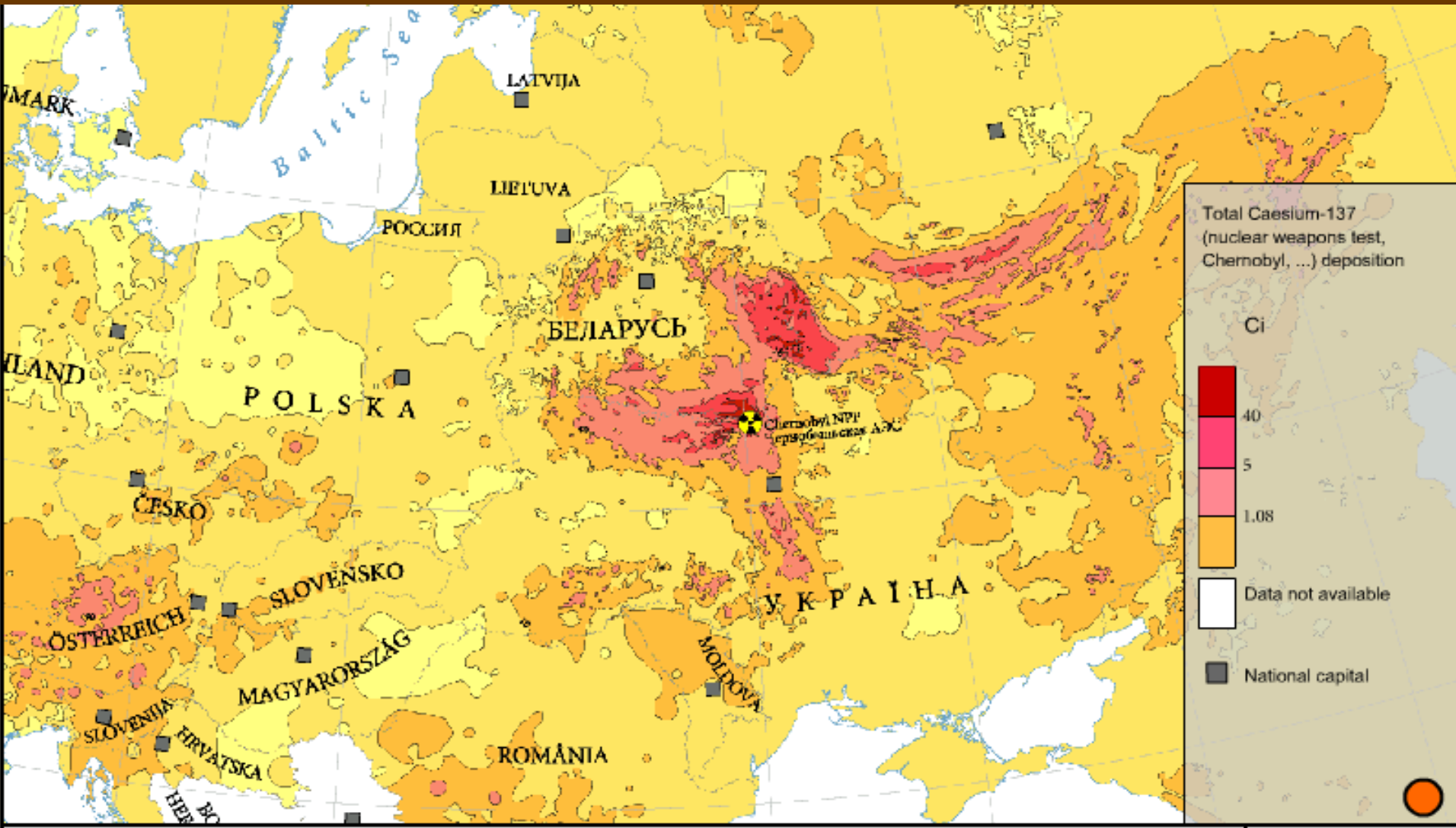
The Event

- **26 April 1986**
- **In the town of Pripyat, 3 km away, there were 45 000 people,**

  including 16 000 children

Time	Event
1:23:00	A test of the cooling system begins in unit no. 4 of the Chernobyl power plant
1:23:40	The emergency shutdown fails
1:23:44	The reactor in Unit No. 4 runs out of control and explodes

(http://www.chernobyl.info/en/Facts/MainOverview/Overview)



European map of caesium-137 deposition (1986)

60 %

The Event

- **27 April to 5 May 1986**
  - **About 1800 helicopter flights deposit around 5000 tonnes of extinguishing materials such as sand and lead onto the burning reactor.**
  - **The inhabitants of the Pripyat power plant settlement are evacuated**
  - **Over the ten days following the accident, 130000 people are evacuated from a 30-km zone around the reactor**

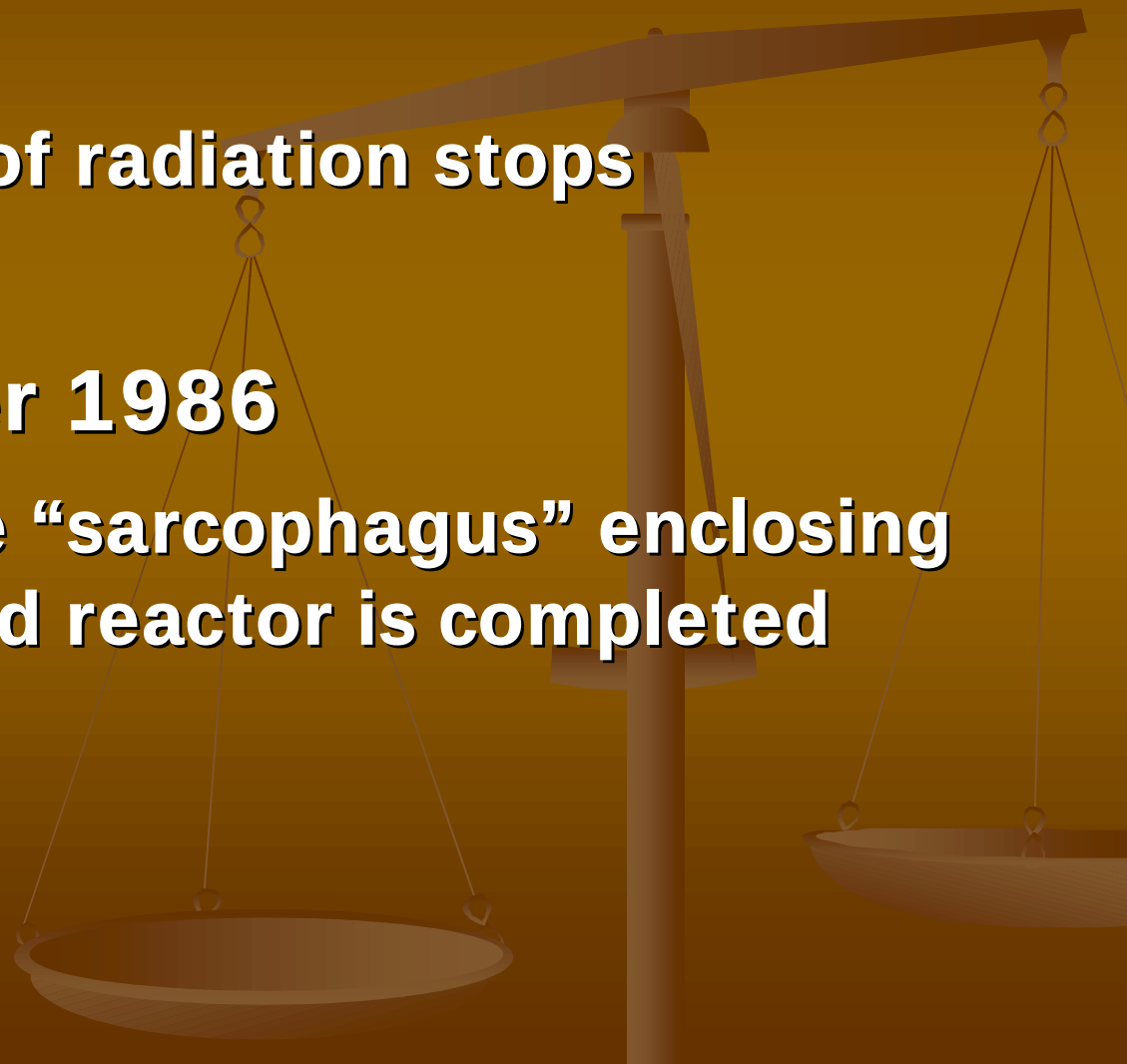
The Event

- **6th May 1986**

  The release of radiation stops

- **15th November 1986**

  The concrete “sarcophagus” enclosing the destroyed reactor is completed



The Effects

- **Environment**
  - Measurements from 1996 show that 90 per cent of the radioactive contamination was still present in the five centimeters of soil immediately below the surface.
  - Within a 10 km. radius, high doses of radioactivity wiped out the coniferous trees and small mammals in the ecosystems.

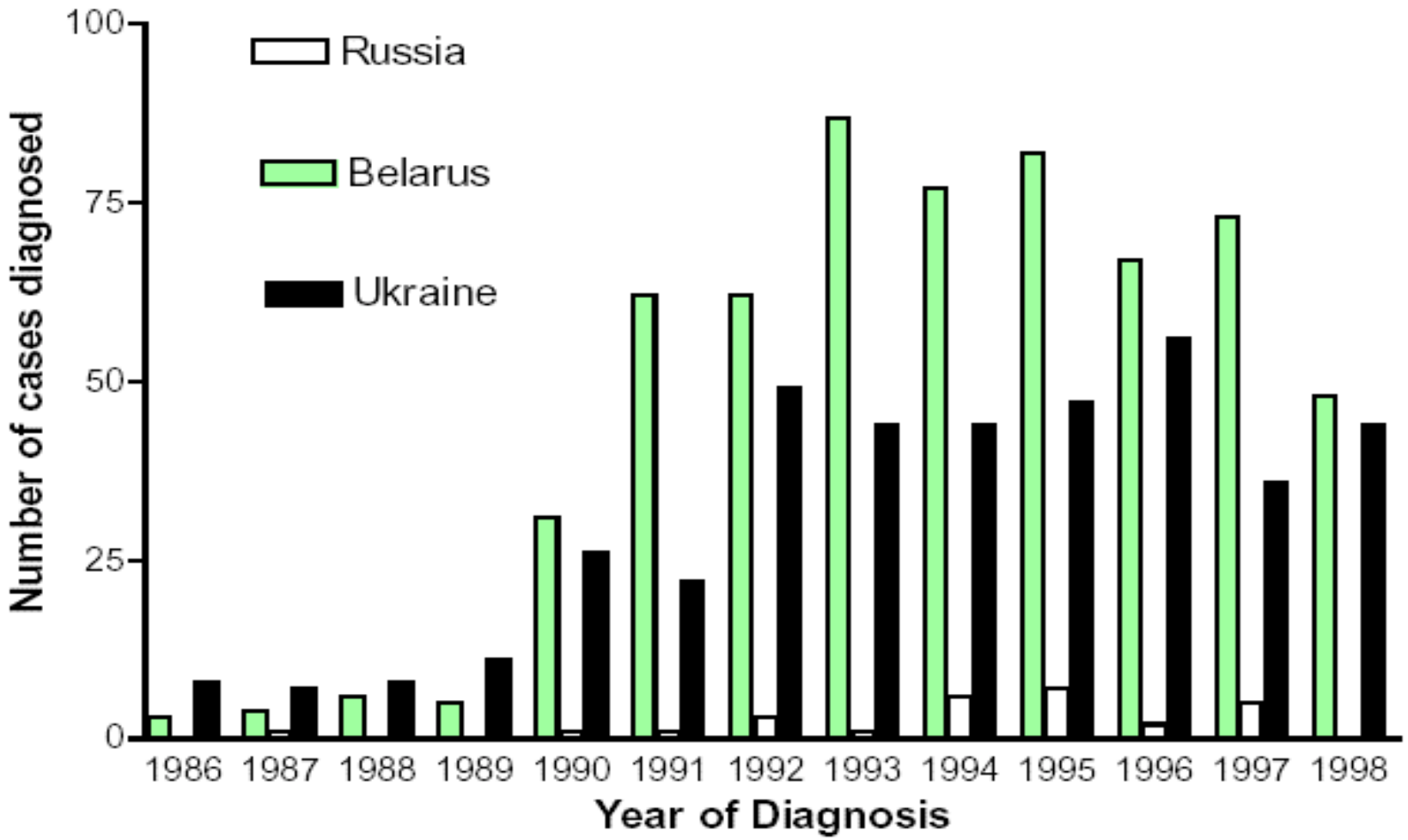
The Effects

- **Health**
  - Acute effects of high dose radiation predominantly on
  - 600 power station employess and firefighters involved in immediate control
  - 800,000 soldiers carrying out clean up operations at the reactor complex in the years following the accident

(www:Medicine Worldwide, Tschernobyl, p. 2)

The Effects

Figure 4.1: Thyroid cancer in children under 15 years of age at diagnosis.



The Effects

- According to a report by United Nations Scientific Committee on the Effects of Atomic Radiation
  - "...caused the deaths, within a few days or weeks, of 30 workers and radiation injuries to hundred others. It also brought about the immediate evacuation of about 116,000 people from areas surrounding the reactor, and the permanent relocation of about 220,000 people from Belarus, the Russian Federation, and the Ukraine. Moreover, the accident caused serious social and psychological disruption in the lives of those affected."

(Lars-Erik Holm, M.D., Ph.D.
Chairman of UNSCEAR)

Cause and Responsibility

- Primary Causes of this disaster
  - Faults in the concept and its implementation of the reactor
  - Failure to understand the man-machine interface

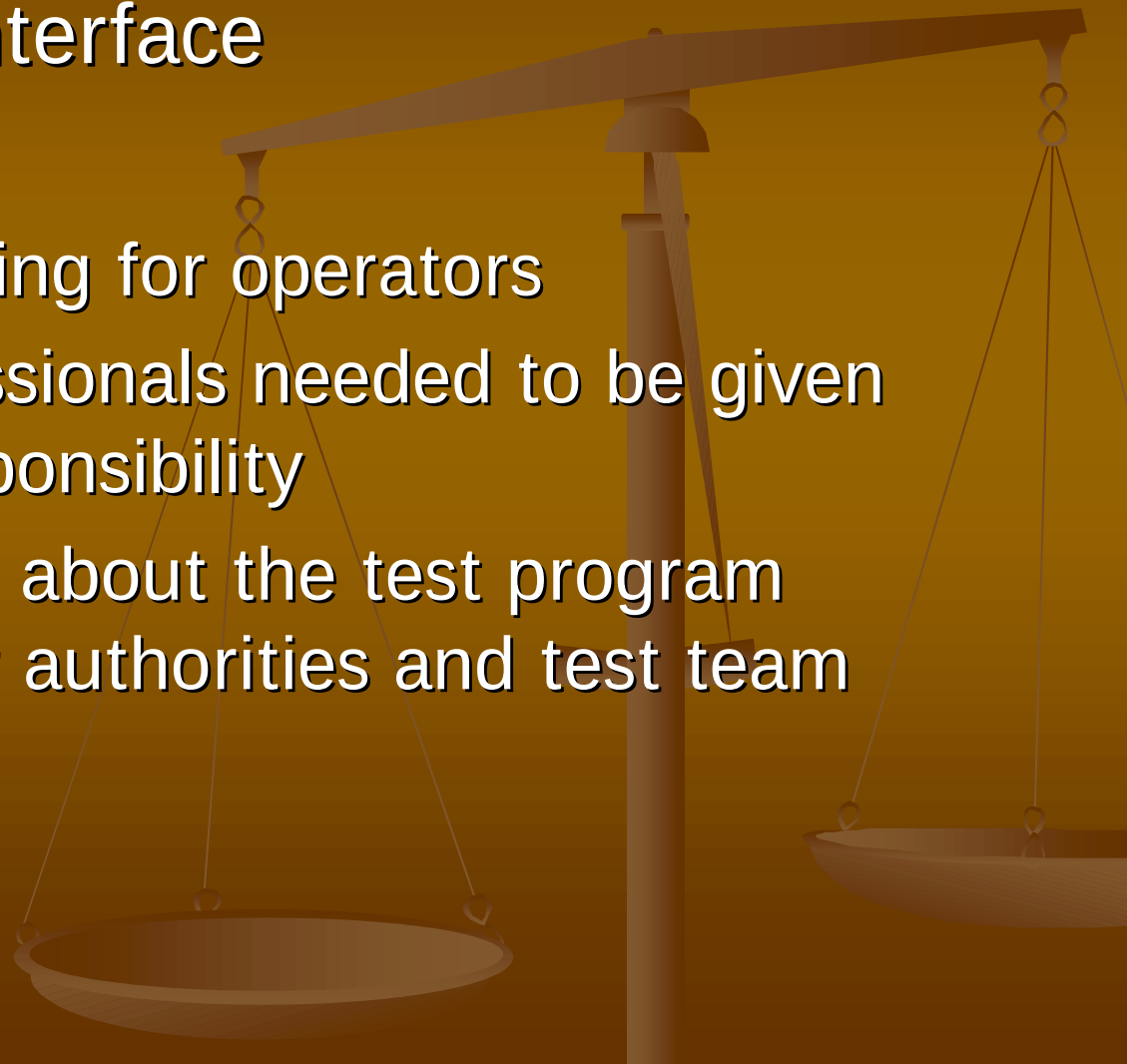
(Findings in the report of United Kingdom Energy Authority)

Causes and Responsibility

- Concept and Implementation of Reactor
  - Better implementation and planning of critical control systems
  - Disable control of excessive parameters to the operator at any stage
  - Need for inherent built in safety and safeguard systems

Causes and Responsibility

- Man Machine Interface
  - More rigid training for operators
  - Qualified professionals needed to be given such major responsibility
  - Communication about the test program between higher authorities and test team



Causes and Responsibility

- Question the Ethics of...
  - Shift foreman Aleksandr Akimov
  - Sr. reactor control engineer Leonid Toptunov
  - Designers of RBMK reactors
  - V.S. Konviz, a hydroelectric power station designer, in charge of Nuclear Safety Institute, the Gidroproyekt Institute

(RBMK - "Reactor Bolshoi Moshchnosti Kanalni“)

(Report by Merhawit Mellse)

Ethical Issues

- “Perform services only in area of their competence”
- “Negligence”
  - Shift foreman and Sr. reactor control engineer not properly trained.
    - Paid with loss of life
  - V. S. Konviz specialised in a different field.
    - Paid with loss of position and membership to Communist Party.

The Aftermath

- From 1986 – 1990
  - 22 December 1988
    - Sarcophagus with lifetime of only 20-30 years.
  - 1989
    - Second Resettlement Phase
    - 100,000 leave villages in Ukraine, Belarus, Russia

The Aftermath

- From 1990 until today
  - From 1990
    - Collaboration between western and local experts begins.
  - November 1997
    - USD 350 million pledged to stabilize the “Sarcophagus” at an international conference.
  - 12th December 2000
    - Chernobyl Reactor Complex shut down

Mission Critical Software

- Design flaw fundamental to all engineering professions.
- Careful design by rigid standards and even more rigid testing in cases of such nature.
- Enforce responsibility and ethics on the software engineer.
- Clear set parameters on access to critical systems based on experience.

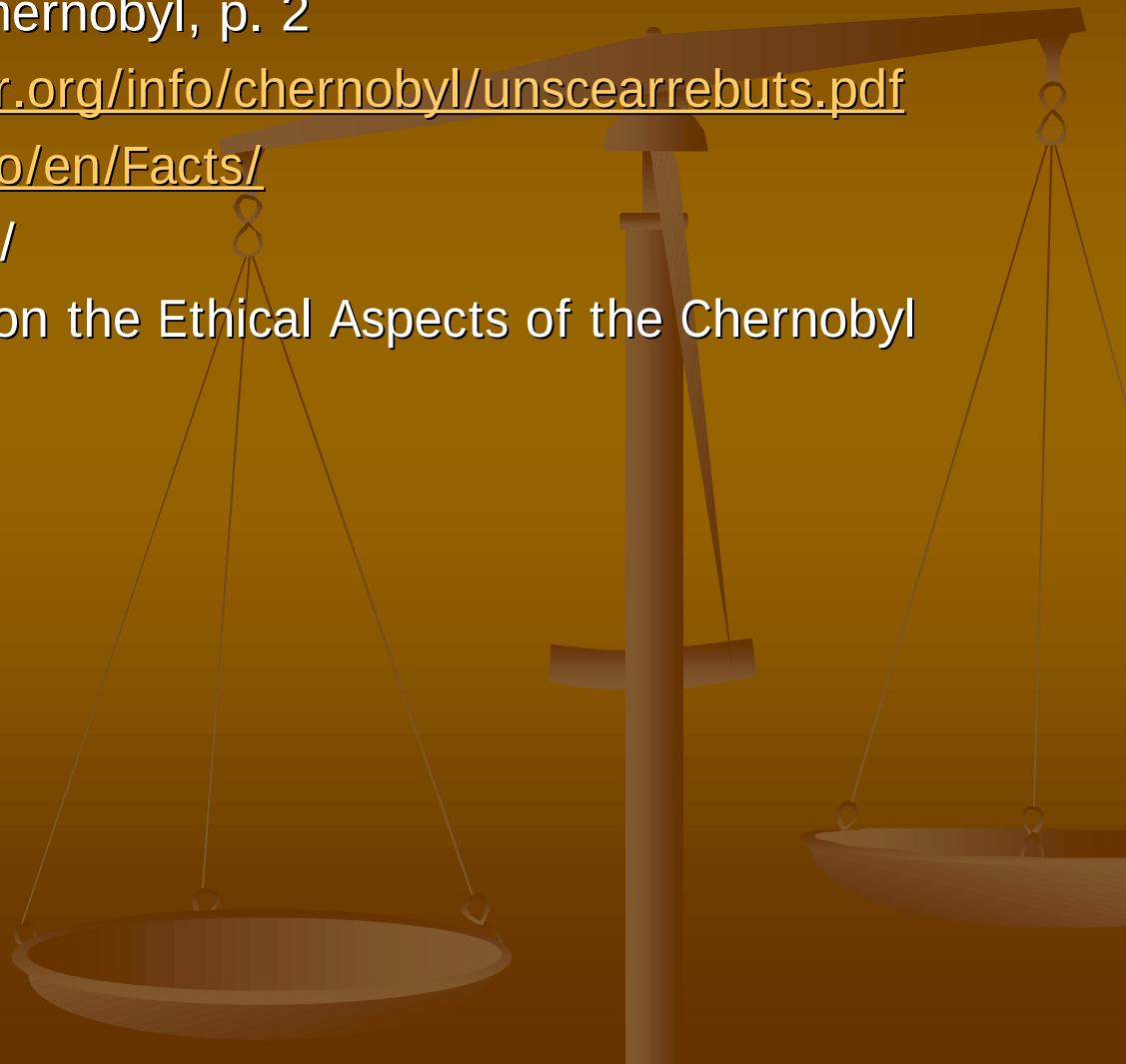
Conclusion

- Nuclear power: Important source of energy.
- Necessity for stringent safety checks in such an advanced engineering artifacts.
- Better planning and training to handle such calamity.

- Use of mission critical software with rigid safety parameters to control such risky control systems.

References

- Medicine Worldwide, Tschernobyl, p. 2
- http://www.world-nuclear.org/info/chernobyl/unscearrebuts.pdf
- http://www.chernobyl.info/en/Facts/
- http://www.ukaea.org.uk/
- Merhawit Mellse's report on the Ethical Aspects of the Chernobyl Disaster



Thank you