What We'll Discuss

TOPIC OUTLINE

Introduction

Time line events

Human Errors

Recommendation

Location

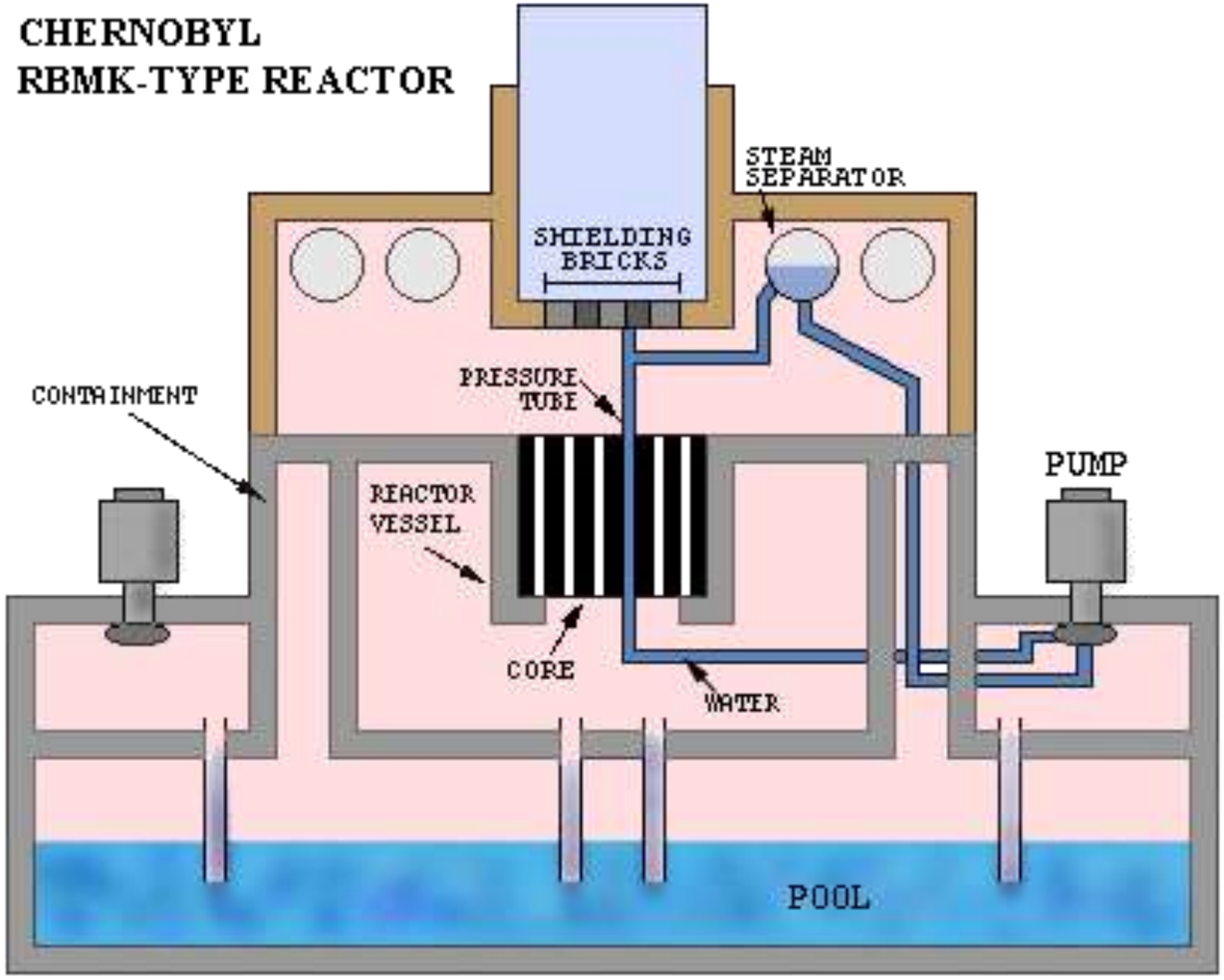

IBRD 31102
BELARUS
RUSSIAN FEDERATION
POLAND
SLOVAK REPUBLIC
HUNGARY
ROMANIA
MOLDOVA
BULGARIA
RUSSIAN FEDERATION
BLACK SEA
Sea of Azov
KYIV (KIEV)
U K R A I N E
UKRAINE
ROADS
SELECTED TOWNS AND CITIES
NATIONAL CAPITAL
INTERNATIONAL BOUNDARIES
RIVERS
SEPTEMBER 2000


Iceland
Faeroe Is.
Norway
Sweden
Finland
Est.
Latvia
Lith
Belarus
Russia
Denmark
United Kingdom
Ireland
Neth
Belg
Lux.
Germany
Poland
Czech
Slovakia
Ukraine
Guernsey
Jersey
France
Liecht
Switz
Aust
Hungary
Romania
Moldova
Italy
Yug
Bulgaria
Georgia
Monaco
Andorra
Spain
Portugal
Vatican
Slovenia
San Marino
Alb
Mac
Greece
Turkey
Gibraltar
Malta
Bosnia-H
Croatia
Cyprus

Location

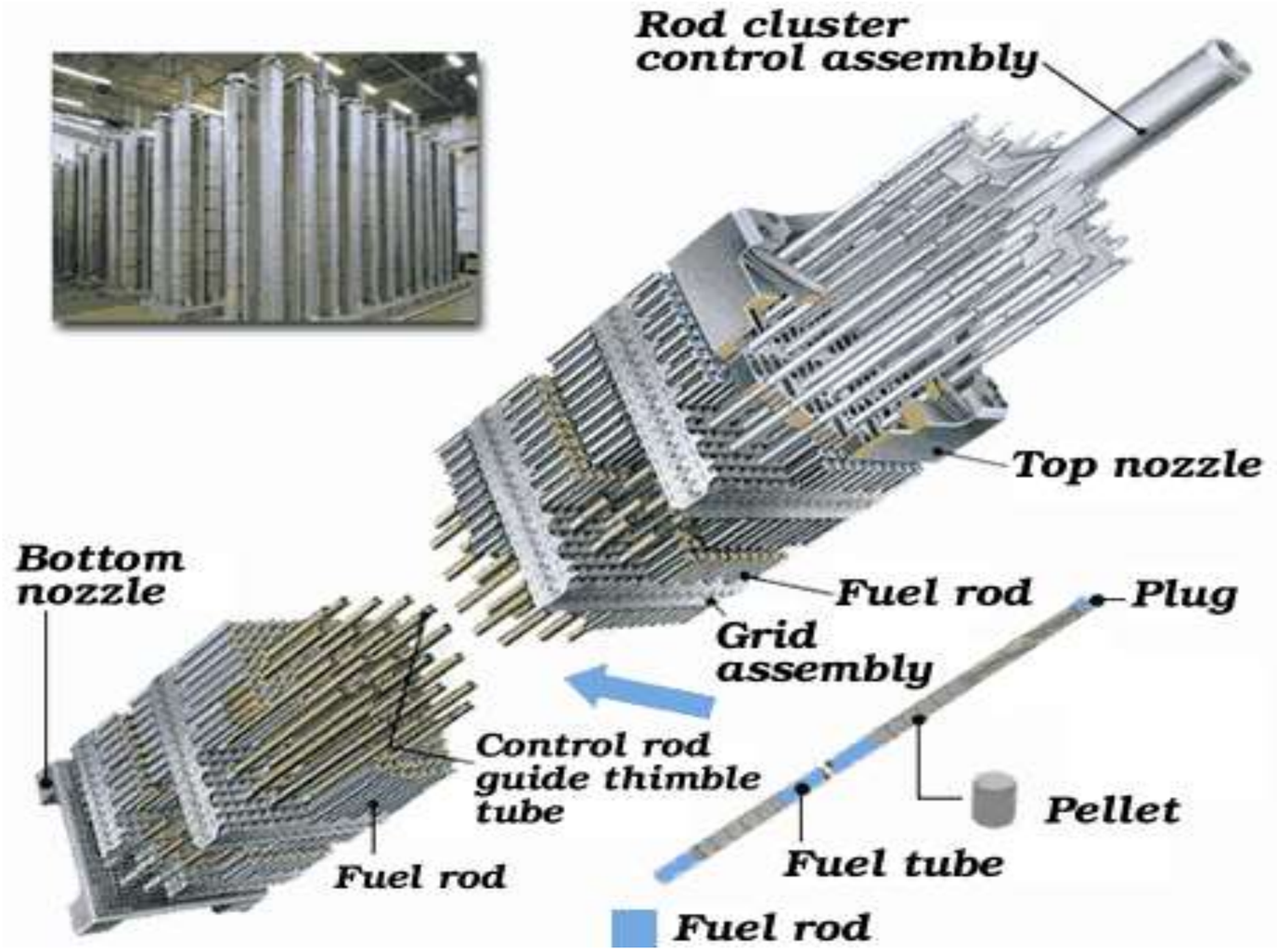
- Reaktor Bolshoy Moshehnosty Kipyashiy
- RBMK, a Russian acronym translated roughly means “reactor (of) high power (of the) channel (type)”
- reactor cooled by water and moderated by

RBMK Reactor



Reactor 4 Chernobyl NPS. Covered with Sarcophagus since accident in 1986.
0.96.07.02.17 DEC 1995
CHERNOBYL UKRAINE D
© Greenpeace/Shirley

Fuel Assembly



Reactor Plant Scenario

1. As the reaction occurs, the uranium fuel becomes hot
2. The water pumped through the core in pressure tubes removes the heat from the fuel
3. The water is then boiled into steam
4. The steam turns the turbines
5. The water is then cooled
6. Then the process repeats

Timeline of Events - 25 April 1986

01:00 The preparation for the test

13:47 Lowering of the reactor power halted at 1,600 MW

14:00 The ECCS was isolated

23:10 The power reduction resumed

Timeline of Events - 26 April 1986

24:00 Operation shift change

24:28 Power level is now 500 MW and kept decreasing to 30 MW

24:40 The operator withdrew some control rods

01:00 Power had risen to 200 MW

01:03 Connecting the fourth main cooling pump to the left loop of the system 200 MW

01:07 Connecting the fourth main cooling pump to the right of the loop system - this was a violation of NOP

Timeline of Events - 26 April 1986

01:19 Increased feed water flow to the steam drums and removed more control rods - violation of NOP

01:23 The test was started

01:23:10 Automatic rods withdrawn from the core

01:23:21 Two groups of automated control rods were back to the core

01:23:30 Power kept increasing

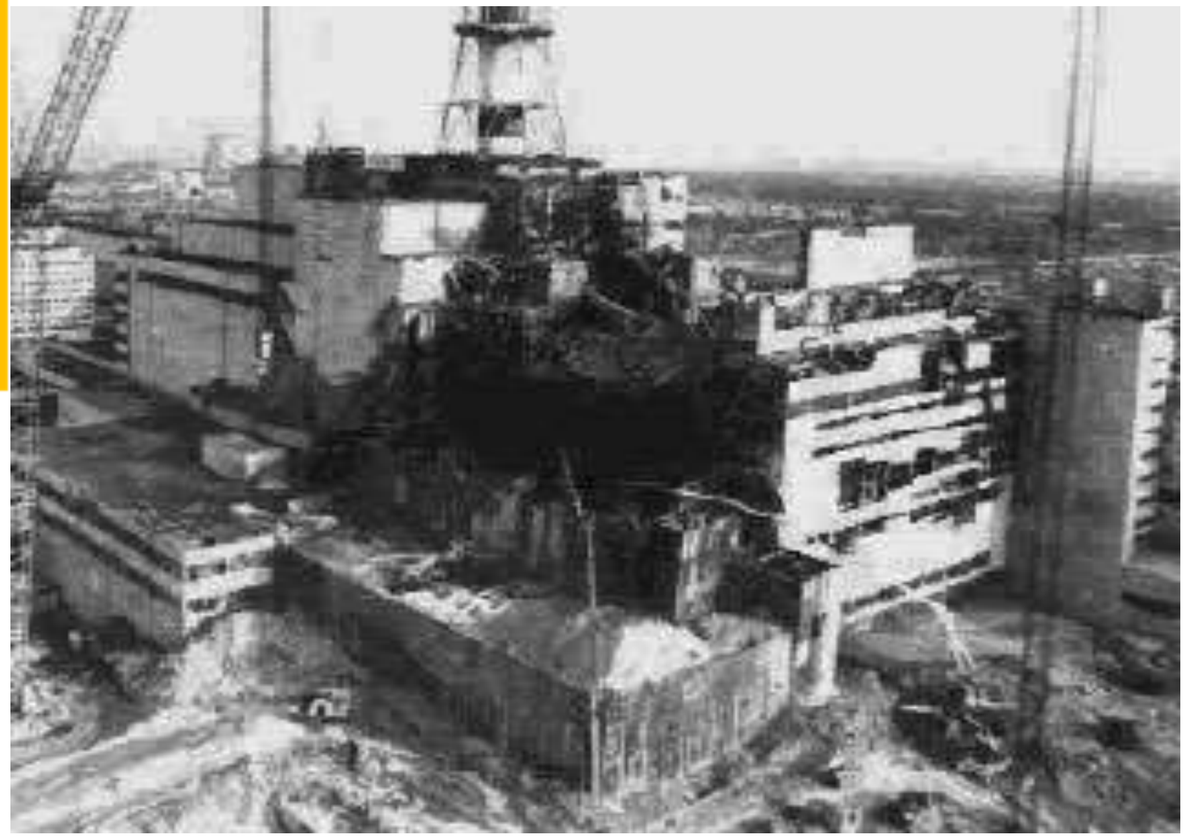
01:23:40 Emergency button pushed

01:23:44 Power is at 300000 MWhr

01:23:48 1st thermal explosion

01:23:55 2nd explosion

Time line of Events



Human Errors

- Isolation of the emergency core cooling system
- Unsafe amount of control rods withdrawn
- Connection of the four main cooling pumps to the right and left of the system - Mental model
- The operator did not have a good mental model of the system itself
- Overconfidence
- By having an electrical engineer on site for an electrical test
- No confirmation of cues obtained from the system
- Beta too high
- Many missed signals before the accident

System Analysis

- Use of graphite as a moderator
- Lack of a well-built containment structure
- Inadequate instrumentation and alarms for an emergency situation
- There were no physical controls that prevented the operators from operating the reactor in its unstable state

Summary of Facts

- April 26, 1986:
  - Chernobyl nuclear power plant
    - Operator errors cause a reactor explosion
    - Explosion releases 190 tons of radioactive gasses into the atmosphere
    - Fire starts that lasts 10 days
- People:
  - 7 million lived in contaminated areas; 3 million were children
- Wind:
  - Carries radiation far distances

Iodine - 131

- 5.5 million people still live in contaminated areas
- 31 people died in 3 months of radiation poisoning
- 134 emergency workers suffered from acute radiation sickness
- 25,000 rescue workers died since then of diseases caused by radiation
- Cancer afflicts many others
- Increased birth defects, miscarriages, and stillbirths

Recommendations

- Have proper Standard Operating Procedures (SOP) for both normal and emergency situations
- Have scheduled trainings and practices for normal and emergency situations
- Always have a reactor expert on site
- Have operators confirm any cues from the system before making hypothesis or take action
- Have a team work kind of environment such that every body is involved

THANK YOU