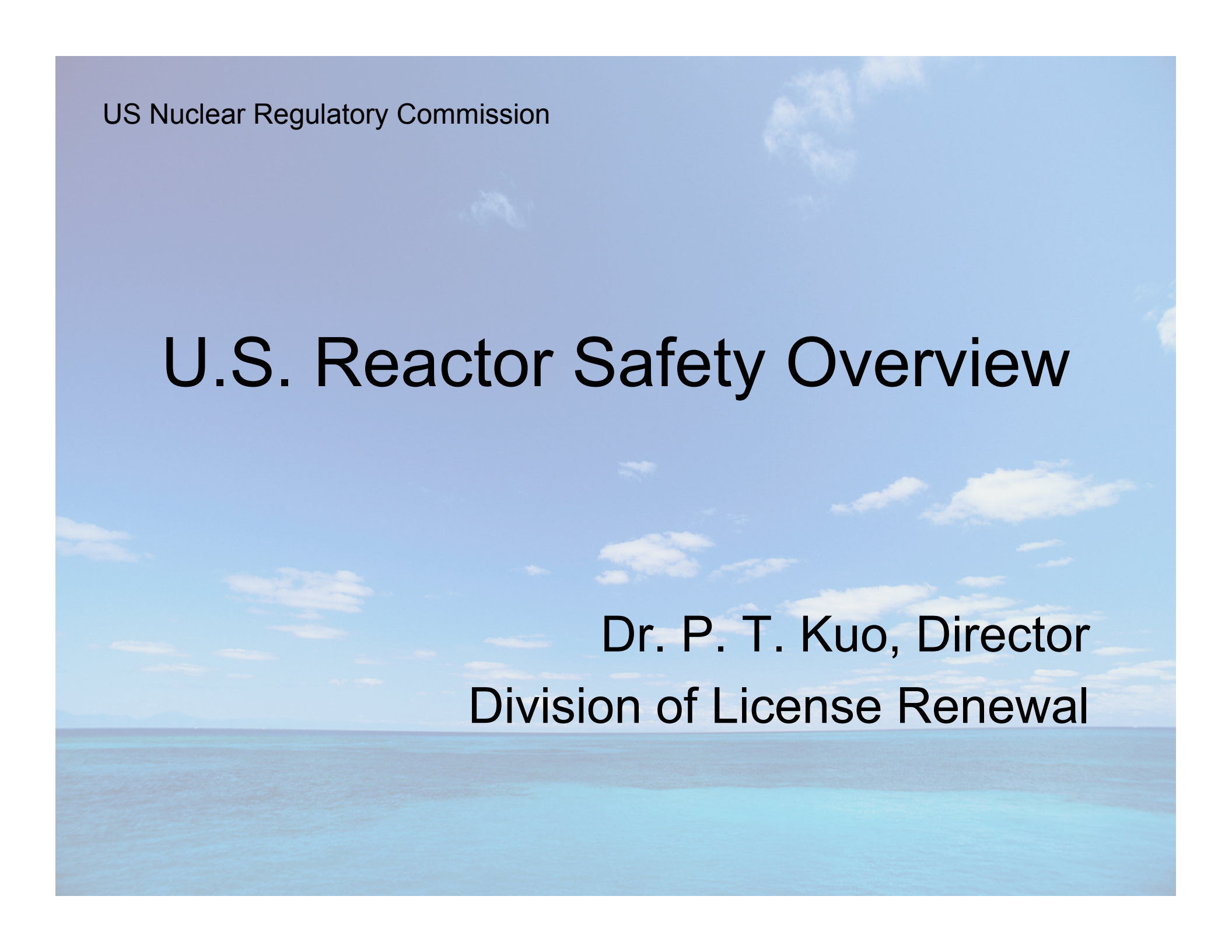




US Nuclear Regulatory Commission

U.S. Reactor Safety Overview

Dr. P. T. Kuo, Director
Division of License Renewal

Acronyms

AEA	Atomic Energy Act
B&W	Babcock & Wilcox Company
CFR	Code of Federal Regulations
INPO	Institute of Nuclear Power Operations
NSSS	nuclear steam supply systems
RCP	Reactor coolant pump
TMI	Three Mile Island

Regulations

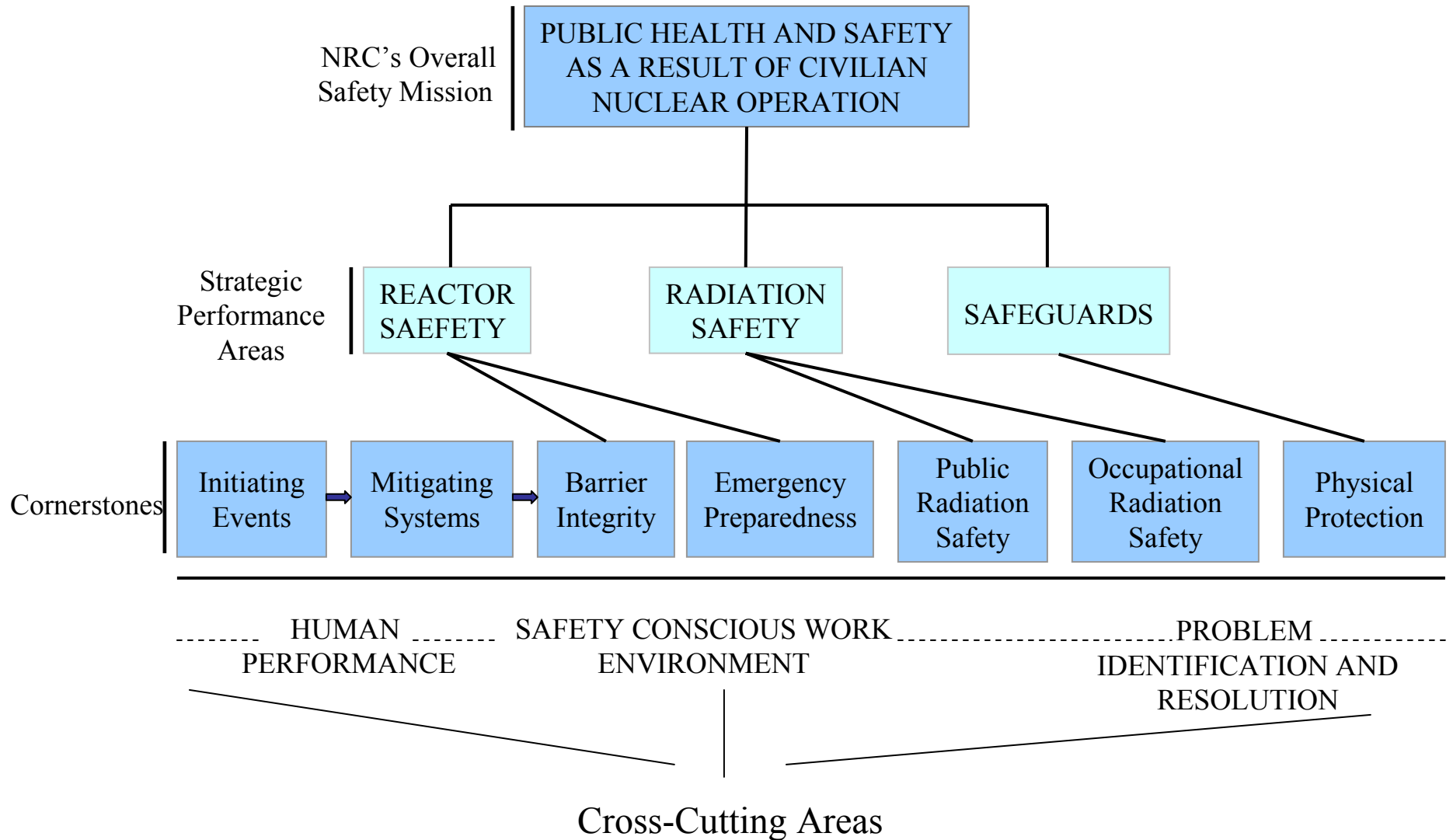
- 10 CFR 50
 - Domestic licensing of production and utilization facilities
- 10 CFR 52
 - Early site permits; standard design certifications; and combined licenses for nuclear power plants
- 10 CFR 54
 - Requirements for renewal of operating licenses for nuclear power plants

Operating Reactors

- Authorize safe use of nuclear energy
 - Power reactors
 - Research and test reactors
- Regulates operations through
 - Regulations, guidance, and communications
 - Licensing
 - Oversight
 - Operational experience



REGULATORY FRAMEWORK

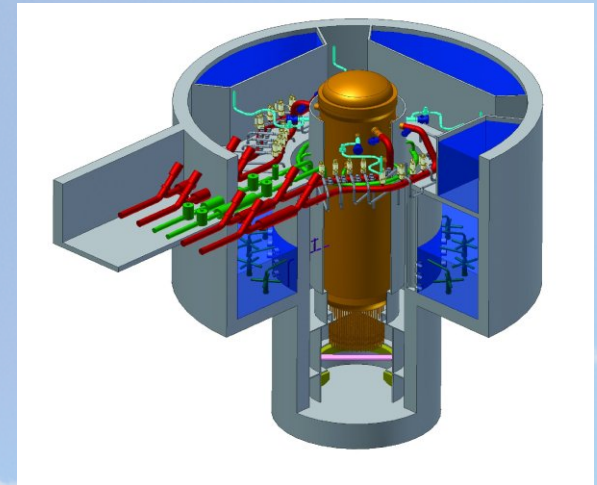


Power Upgrades

- NRC regulates the maximum power level plant operate
 - Measurement uncertainty recapture power upgrades $\leq 2\%$
 - Stretch power upgrades $\leq 7\%$
 - Extended power upgrades $\leq 20\%$
- Status: 112 total approved power upgrades; 4845 MWe

New Reactors

- NRC regulates
 - construction
 - operation
- Responsible for
 - standard design certifications
 - early site permits
 - construction permits
 - operating licenses
 - combined licenses

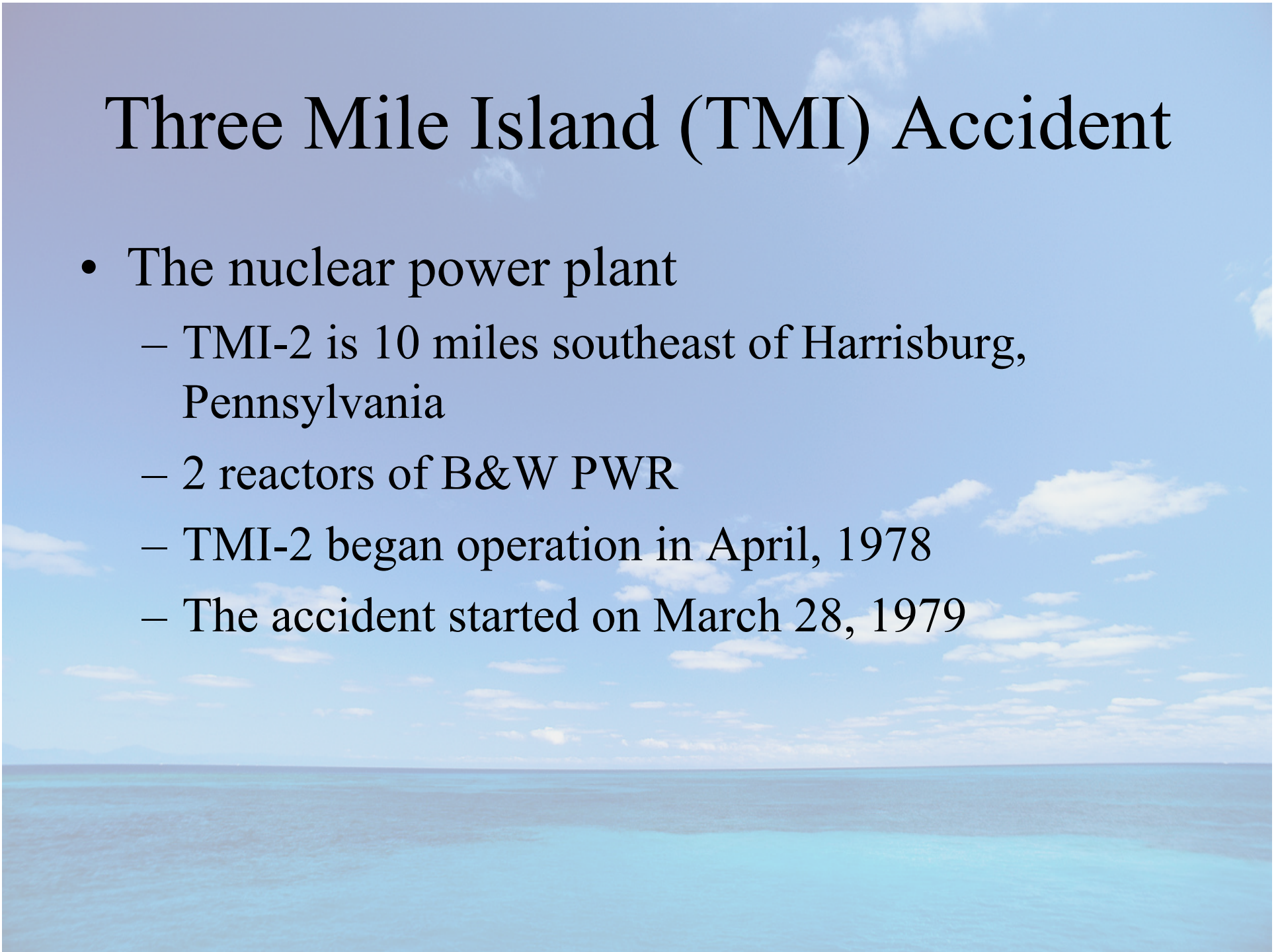


License Renewal

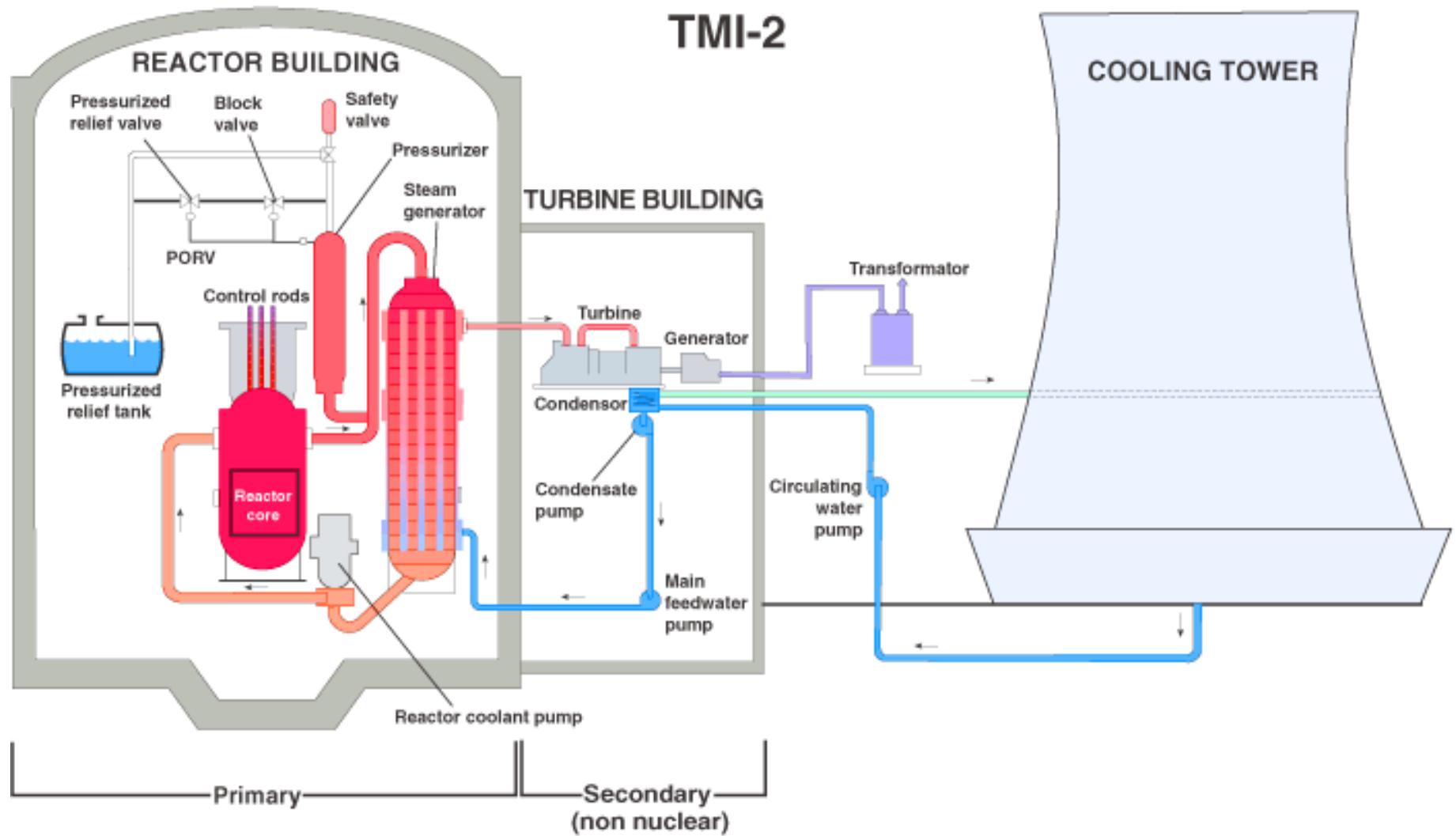
- AEA grants power reactor to operate up to 40 years
- 10 CFR Part 54 allow renewals for up to additional 20 years
- Two parallel reviews: safety and environmental
- Length of Review: 30 months with hearing
22 months without hearing
- Status: Completed – 48 units
Under review – 8 units
Future – 4-6 applications/year

Three Mile Island (TMI) Accident

- The nuclear power plant
 - TMI-2 is 10 miles southeast of Harrisburg, Pennsylvania
 - 2 reactors of B&W PWR
 - TMI-2 began operation in April, 1978
 - The accident started on March 28, 1979



TMI-2



TMI-2 Accident

- Summary of events
 - 4 a.m. of 3/28/79, a failure in the secondary, non-nuclear section of the plant occurred
 - Main feedwater pumps stopped running
 - Turbine tripped, then reactor shutdown
 - NSSS pressure increased
 - Piloted-operated pressurizer relief valve opened
 - The relief valve failed to close
 - Signals did not show the operator that the valve was still open
 - Cooling water poured out of the stuck-open valve, the reactor core overheated
 - No deaths or injuries to plant workers or public

TMI-2 Accident

- Causes
 - Personnel error
 - Design deficiencies
 - Component failures

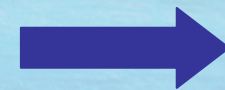


TMI-2 Accident

- Impact of the accident
 - Emergency response planning
 - Reactor operator training
 - Human factors engineering
 - Radiation protection system
 - Other areas of NPP operations
 - Tighten and heighten USNRC regulatory oversight
 - Enhanced safety

TMI-2 Accident

- Major changes:
 - Upgrading and strengthening plant design and equipment (valves) requirements
 - Enabling plants to shutdown automatically
 - Emphasizing the importance of human performance
 - Enhancement of emergency preparedness
 - Establishment of INPO



TMI-2 Accident

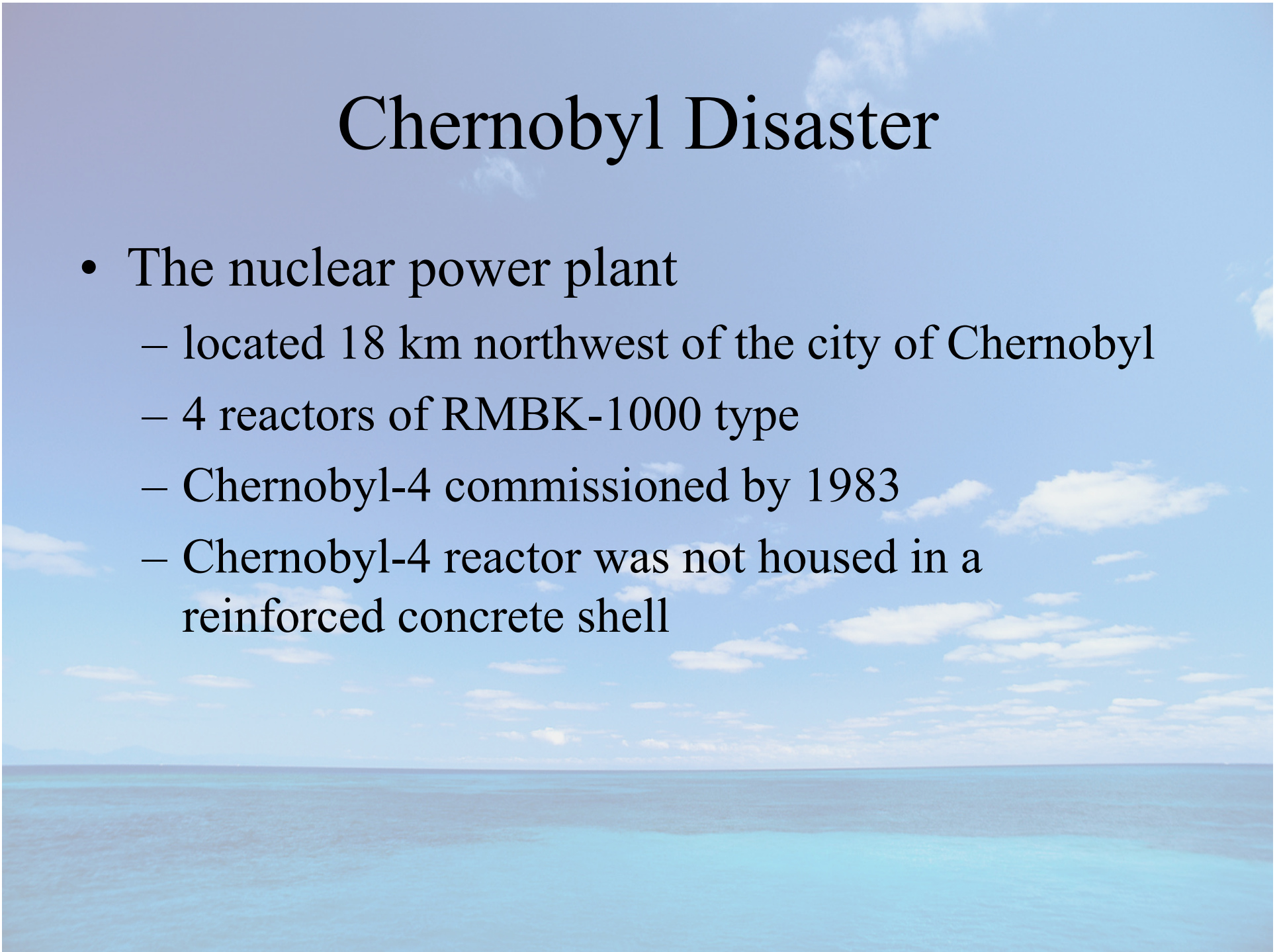
- The installation of additional equipment to mitigate accident and monitor both radiation levels and plant status
 - Reactor vessel head vent system
 - Reactor vessel level instrumentation system
 - Expansion of NRC's international activities

Questions



Chernobyl Disaster

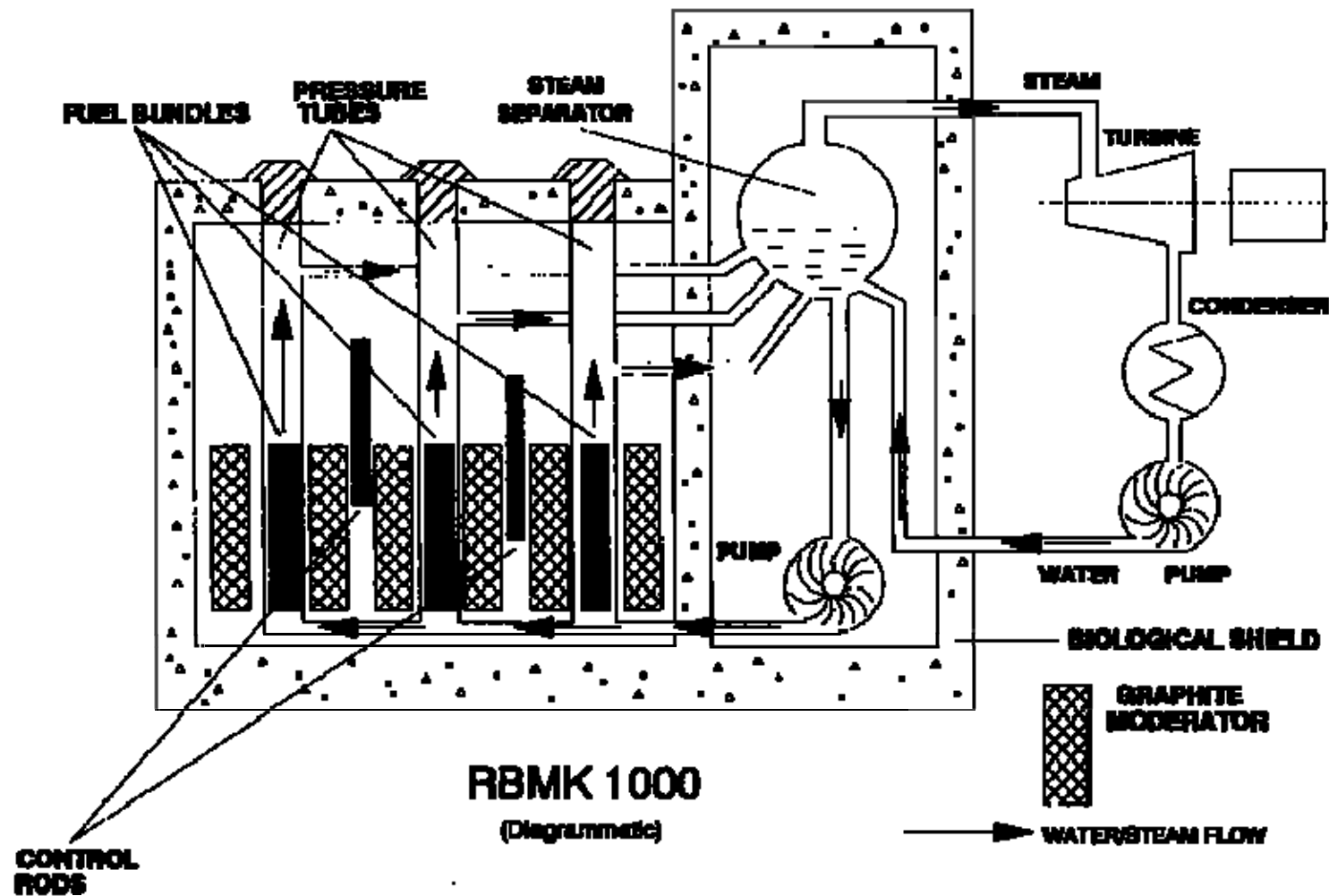
- The nuclear power plant
 - located 18 km northwest of the city of Chernobyl
 - 4 reactors of RMBK-1000 type
 - Chernobyl-4 commissioned by 1983
 - Chernobyl-4 reactor was not housed in a reinforced concrete shell



The site of the Chernobyl nuclear power complex



Chernobyl reactor design



The Accident

- Evening of 4/25/86, too many rods lowered during RCP testing
- Safety systems disabled
- Reactor overheated and cooling water turned to steam
- About 01:24 a.m., Chernobyl-4 exploded, resulted in fire, reactor's roof blown off, and series of additional explosions
- Building severely damaged and large amount of radioactive debris escaped into the atmosphere
- Nuclear meltdown

Chernobyl Disaster

- Causes:
 - The operators were not informed about the problems with the reactor
 - Plants management was largely composed of non-RBMK-qualified personnel
 - The RBMK reactor design had a large positive void coefficient
 - Solid graphite as neutron moderator was used which meant water flowed through core vertically; created a temperature gradient in the core (CANDU reactors horizontally)
 - Operator were careless and violated plant procedures
 - The reactor had only partial containment

After the accident

