Limiting Conditions for Operation

Chapter X

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Definition

Operational limits and conditions (OLCs) are at the junction between design, safety analysis and plant operations. The OLCs are the operating rules, derived from the design and safety analysis that assure that the plant is operated within its safety design basis

Objective

- Prevent operational situations that might lead to accident conditions and assure availability of mitigation if an accident should occur
- Restrict operation of plant such that all plant parameters are within the Safety Design Basis
- Thus if a postulated initiating event were to occur, the control and safety systems could function as designed to prevent excess radioactive release

Objective

Achieving Safety Objectives

Control operation in accordance with a set of Operational Limits and Conditions (OLCs)

- derived from the safety analysis
- identify safe boundaries of operation
- revised as necessary

- Minimum requirements for availability of staff and equipment
- Operations by trained and authorized personnel
- Validated and approved operating procedures

Plant Operation States and Conditions

- **Operational States**
  - **Normal Operation**
  - **Anticipated Operational Occurrences (AOOs)**
- **Accident Conditions**
  - **Design Basis Accidents**
  - **Beyond Design Basis Accidents**
    - **Accidents without severe core damage**
    - **Severe Accidents**

Plant Operation States and Conditions

- **Normal operation**
  - **Operation within specified operational limits and conditions.**
- **Anticipated Operational Occurrence**
  - **An operational process deviating from normal operation which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety or lead to accident conditions.**

Plant Operation States and Conditions

- **Accident conditions**
  - **Deviations from normal operation more severe than anticipated operational occurrences, including design basis accidents and severe accidents**
- **Severe accident**
  - **Accident conditions more severe than a design basis accident and involving significant core degradation**

Normal Operational States

- Starting up
- Power production
- Shutting down
- Maintenance, testing and refueling

Normal Operational States

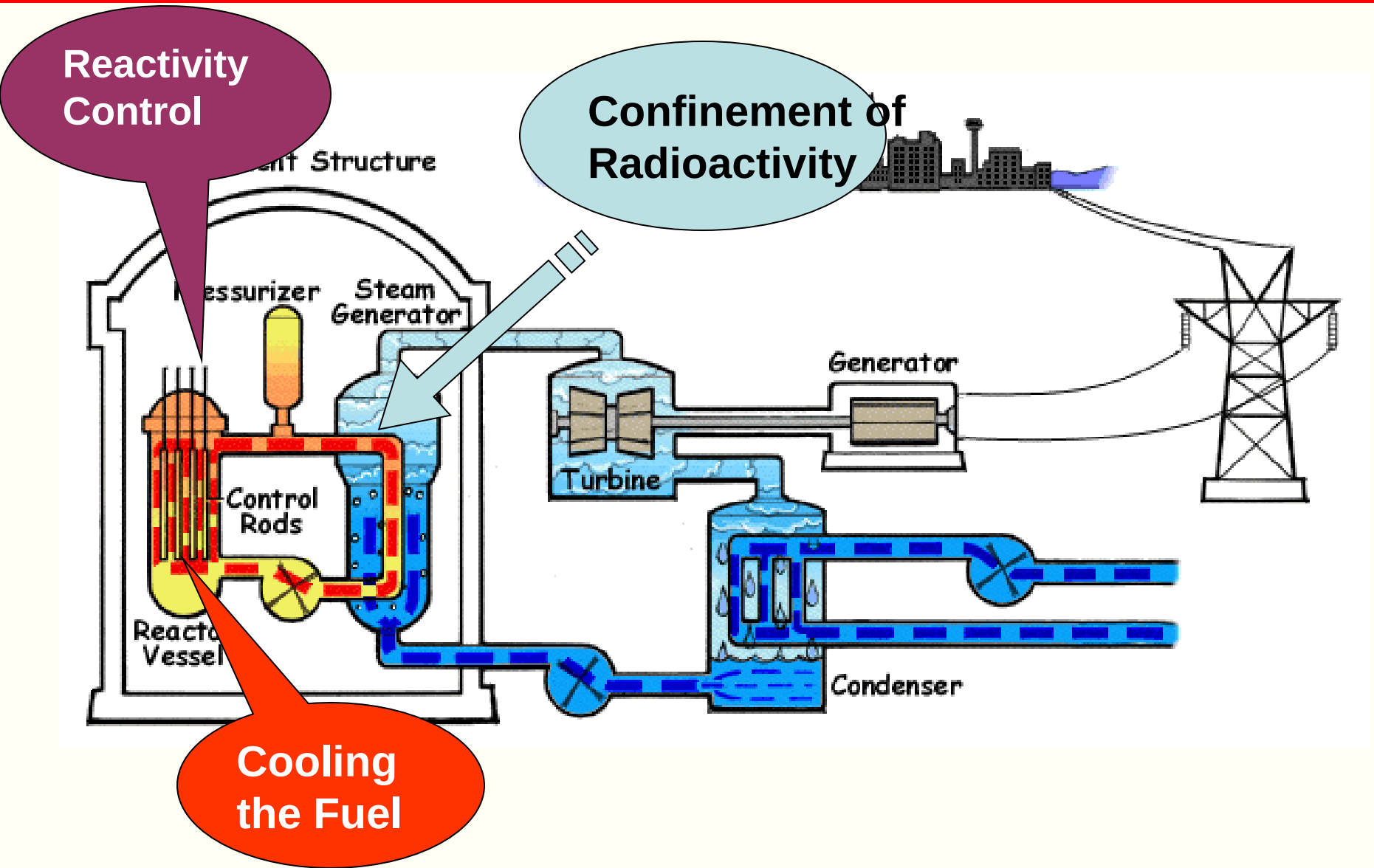
Chashma PWR NPP - Pakistan

Modes	Reactivity condition, keff	% Rated* Thermal Power	Average Coolant Temp.	RCS Pres.
1. Power operation	~1.0	(2-100)%	280-302°C	15.2MPa
2. Hot zero power	~1.0	(0-2)%	280± 2°C	15.2MPa
3. Hot shutdown	≤ 0.98	0	280± 2°C	15.2MPa
4A. Intermediate shutdown, stage A	≤ 0.98	0	280-180°C	15.2MPa~2.94MPa
4B. Intermediate shutdown, stage B	≤ 0.98	0	180-93°C	≤}2.94MPa
5. Cold shutdown	≤ 0.98	0	≤93°C ***	0.098MPa
6. Refueling**	<0.95	0	≤ 60°C	0.098MPa

Purpose of OLCs

- Controlling the power
- Cooling the fuel
- Confining the radioactive material

Purpose of OLCs



Technical Specifications

Technical Requirements

Bases for the technical requirements

Administrative Requirements

Classification of Technical Requirements

- Safety limits
- Limiting safety system settings
- Limits and conditions for normal operation
- Surveillance requirements

Definitions

Safety limits: imposed on process variables within which the plant operation is safe.

Safety system: limits on safety system settings that will assure activation of safety systems in time to prevent a safety limit from being exceeded, should a postulated initiating event (PIE) occur.

Limits and conditions for normal operation includes limits on normal process variables, as well as requirements for minimum staffing, minimum operable equipment, and allowable outage times for systems and equipment.

Definitions

Surveillance requirements: requirements for periodic checks, tests, calibrations, and inspections of equipment, components, and processes to establish operability performance, correct set points, and to assure reliability; and

Action statements: statements of actions to be taken by operating staff in the event of various abnormal conditions, which may take the form of emergency operating instructions or similar procedures

Safety Limits

- Application of limits imposed on
  - temperatures of fuel and fuel cladding,
  - coolant pressure,
  - pressure boundary integrity and
  - other operational characteristics influencing the release of radioactive material from the fuel
- Aim is to protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactive material
- If safety limit is exceeded, the reactor should be shut down and normal power operation restored only after appropriate evaluation has been performed

Limiting Safety System Settings

- **Parameters included in safety limits as well as other parameters**
- **Such settings cause**
  - **reactor trip if the limits are exceeded**
  - **initiate operation of engineered safety systems**

Safety System Settings (examples)

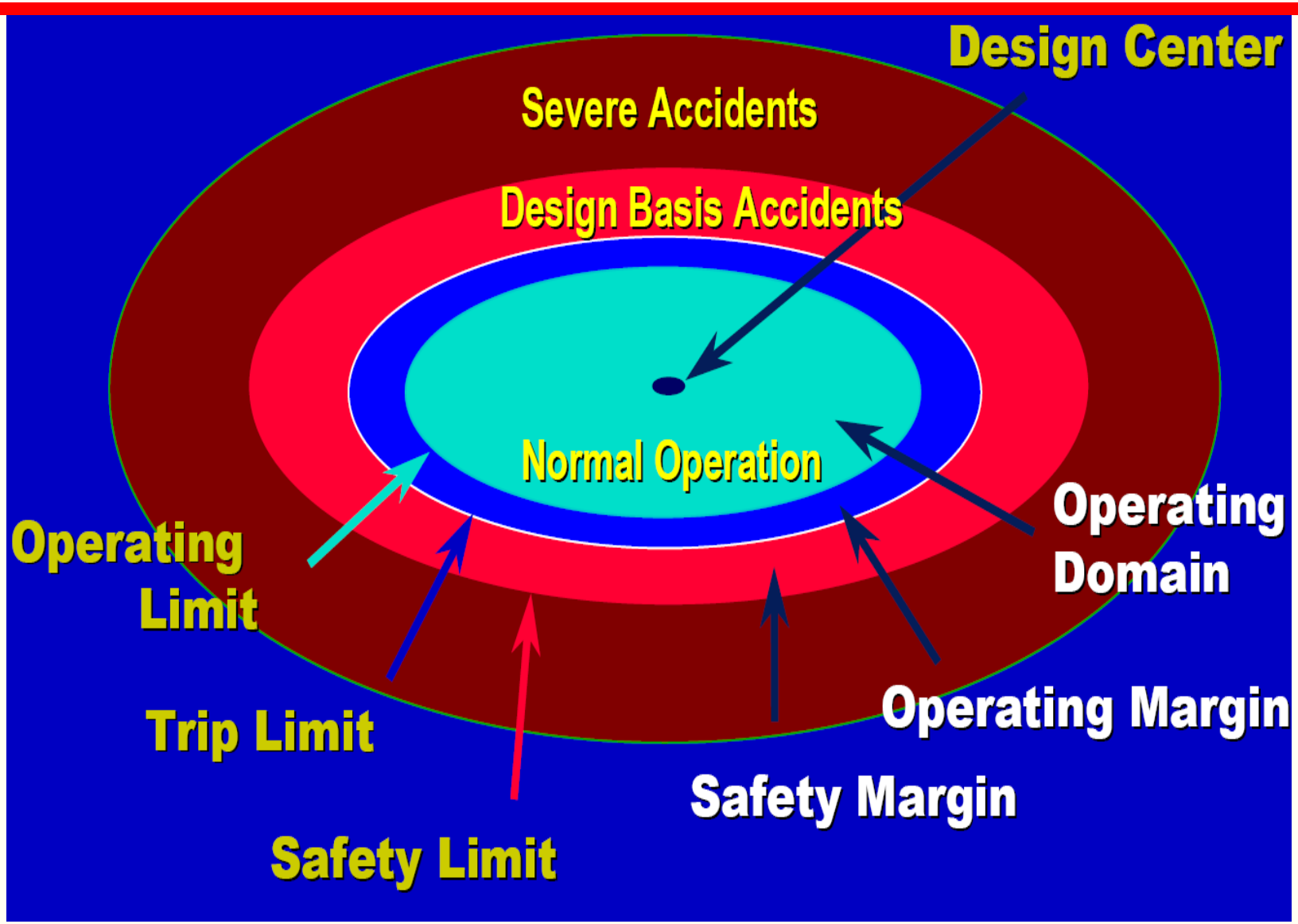
- Neutron flux and distribution
- Rate of change of neutron flux
- Reactivity protection devices
- Temperatures of fuel cladding or fuel channel coolant
- Temperature of reactor coolant
- Pressure of the reactor coolant system
- Water level in reactor vessel or pressurizer
- Reactor coolant flow
- Tripping of primary coolant circulation pump
- Steam flow
- Steam pressure

Safety System Settings

Safety limit	**: RCS press. ≤ 2750 psia**
Design	**: RCS design press. = 2500 psia**
PSV	**: Open Pressure = 2500 psia**
LSSS*	**: PZR high press. = 2415 psia**
LCO	**: 2100 psia ≤ PZR op. press. ≤ 2300 psia**
SR**	**: Every 12 hour for PZR press.**

**** LSSS : Limiting Safety System Setting***
*****SR : Surveillance Requirement***

Safety Margins and Limits



Limits and Conditions for Normal Operation

- **Ensure safe operation**
  - **assumptions of the safety analysis report are valid**
  - **established safety limits are not exceeded**
- **Ensure acceptable margins between the normal operating values and the established safety system settings to avoid undesirably frequent actuation of safety systems**

Limits and Conditions for Normal Operation [Cont.]

- **Limits and conditions for normal operation includes**
  - **Limits on operating parameters**
  - **Minimum amount of operable equipment**
  - **Applicable mode(s) of operation**
  - **Actions to be taken by the operating staff in the event of deviations from the established OLCs and**
  - **Time allowed to complete these actions**

Limits and Conditions for Normal Operation [Cont.]

- **Items for which limits and conditions for normal operation are generally necessary**
  - **Reactivity control (negative reactivity requirements, rate of insertion for positive reactivity, neutron flux, etc.)**
  - **Instrumentation (RPS and ESFAS, remote shutdown, seismic monitors, radiation monitors)**
  - **Core cooling (RCS temperature and pressure, power distribution, primary water chemistry, RCS safety and relief valves, RCS leakage, RCS radioactivity, etc.)**

Limits and Conditions for Normal Operation [Cont.]

- Containment systems (leakage rates, isolation valves, vacuum breaker valves, actuation devices; systems for filtration, cooling, dousing and spraying, control and analysis systems for combustible gases, venting and purging systems, etc.)
- Other systems (HVAC, MCR habitability system, electrical power systems, fuel storage and handling, fire protection system, etc.)

Surveillance requirements

- Demonstration of operability of equipment and systems
- Monitoring, inspection, checking, calibration and testing
- Surveillance frequency
- Acceptance criteria

An Example of OLCs (Pressurizer)

- **LIMITING CONDITION FOR OPERATION**

  The pressurizer shall be OPERABLE with a water volume of ≤28.12m3 (Water Level ≤8.12m) and at least two groups of pressurizer heaters each having a capacity of at least [225]kW.
- **APPLICABILITY: MODES: 1,2, 3 and 4A**
- **ACTION:**
  - **With only one group of pressurizer heater operable, restore at least two groups to operable status within 72 hours or 6 hours to 4A and following 6 hours to 4B.**
  - **With the pressurizer otherwise inoperable, be in at least 4A within 6 hours and following 6 hours to 4B.**

An Example of SR (Pressurizer)

- **SURVEILLANCE REQUIREMENTS**
  - **The pressurizer water volume shall be determined to be within its limit at least once per 12 hours.**
  - **The capacity of each of the above required groups of pressurizer heaters shall be verified by energizing the heaters and measuring circuit currents at least once per 92 days.**
  - **The emergency power supply for the pressurizer heaters shall be demonstrated operable at least once per 18 months by manually transferring power from the normal to the emergency power supply and energizing the heaters.**

OLCs Bases

- **Bases for the Technical Requirements**
  - **Design (main)**
    - **Deterministic**
    - **Probabilistic**
  - **Manufacturing (additional)**
    - **Surveillance**
    - **Preventive maintenance**

Administrative Requirements

- Responsibility
- Organization (overall and operating personnel including shift requirements)
- Qualification and Training
- Review, Control and Audit
- Reporting Requirements including events
- Plant Procedures and Programmes
- Record Retention
- Approval Requirements

Plant Procedures and Programs

- Normal and Abnormal Operating Procedures
- Emergency Operating Procedures
- Severe Accident Management Guidelines
- Quality Assurance Program
- Physical Security Plan
- Radiological Emergency Response Plan
- Off-site Dose Calculation Manual
- Process Control Program
- Effluent and Environmental Monitoring Program
- Radiation Monitoring Program

Thanks