Presentation On

Measures Taken at NAPP after Fukushima Reactor Accident to improve Safety for Off-site Emergency

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ABOUT NAPS

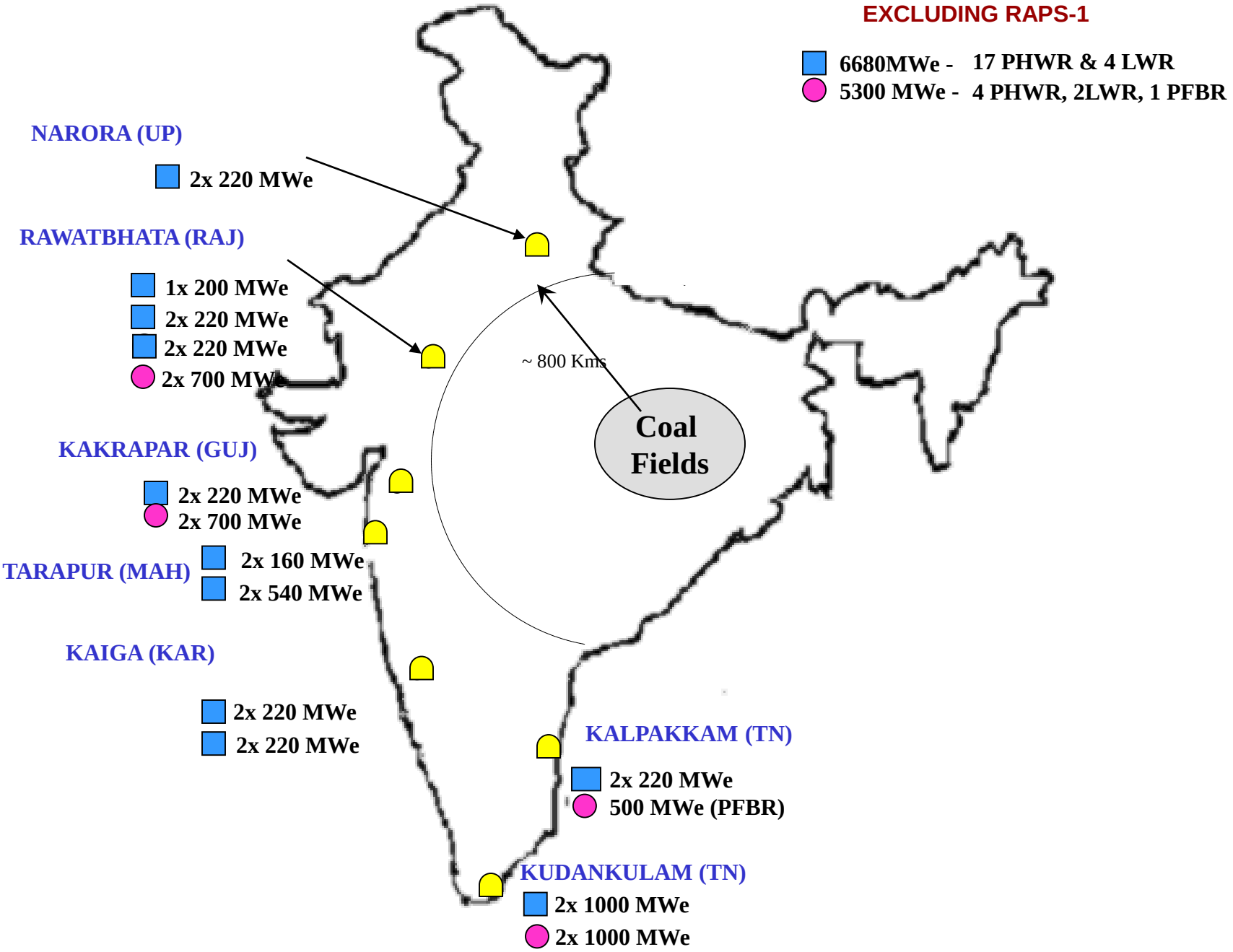
- Narora Atomic Power Station is situated in the gangetic heartland on the right bank of river Ganga.

- State - Uttar Pradesh.
- 140 Km East of Delhi, the National capital of India.
- District Bulandshahr

- The nearest Airport: Indira Gandhi International Airport, New Delhi.

- Geographical location of NAPS site is (28^{o} 10' 00" N, 78^{o} 24' 00" E).

NUCLEAR POWER PLANTS IN INDIA



Fukushima Accident – in brief

- On March 2011, a severe earthquake measuring 9.0 on Richter scale occurred off the coast of Fukushima Daichi, Japan.
- The earthquake damaged power distribution network causing loss of off-site power.
- 41 minutes after earthquake, tsunami hit the Fukushima site. Maximum Tsunami height was 14-15 Meters while design bases Tsunami height for the plant was 6.1 Meters only.
- Tsunami caused flooding of site at lower elevation where emergency diesel generators and switchgear room were situated.

Cont….

Fukushima Accident – in brief

- This resulted in non-availability of emergency power supply to plant safety systems.
- Power supply is required to inject water for Reactor Core cooling.
- In absence of core cooling radioactivity released from fuel to reactor containment and finally to environment.

Fukushima Accident – effects

- No casualty due to radiation exposure.
- All the casualties were due to trauma of evacuation.
- Many evacuated people remain unable to fully return home due to government-mandated restrictions based on conservative radiation exposure criteria. However, over 1000 premature deaths have been caused by maintaining the evacuation beyond a prudent week or so.
- Above observations shows that not much harm was caused by the accident itself, but preventive actions caused more harm.

FUKUSHMIMA Daai-ichi - Before

FUKUSHMIMA Daai-ichi - After

Assurance of Safety at Indian NPPS

NPPs Safety Under Different Phases

- Siting
- Design
- Construction
- Commissioning &
- Operation

In addition to General Siting Criteria:

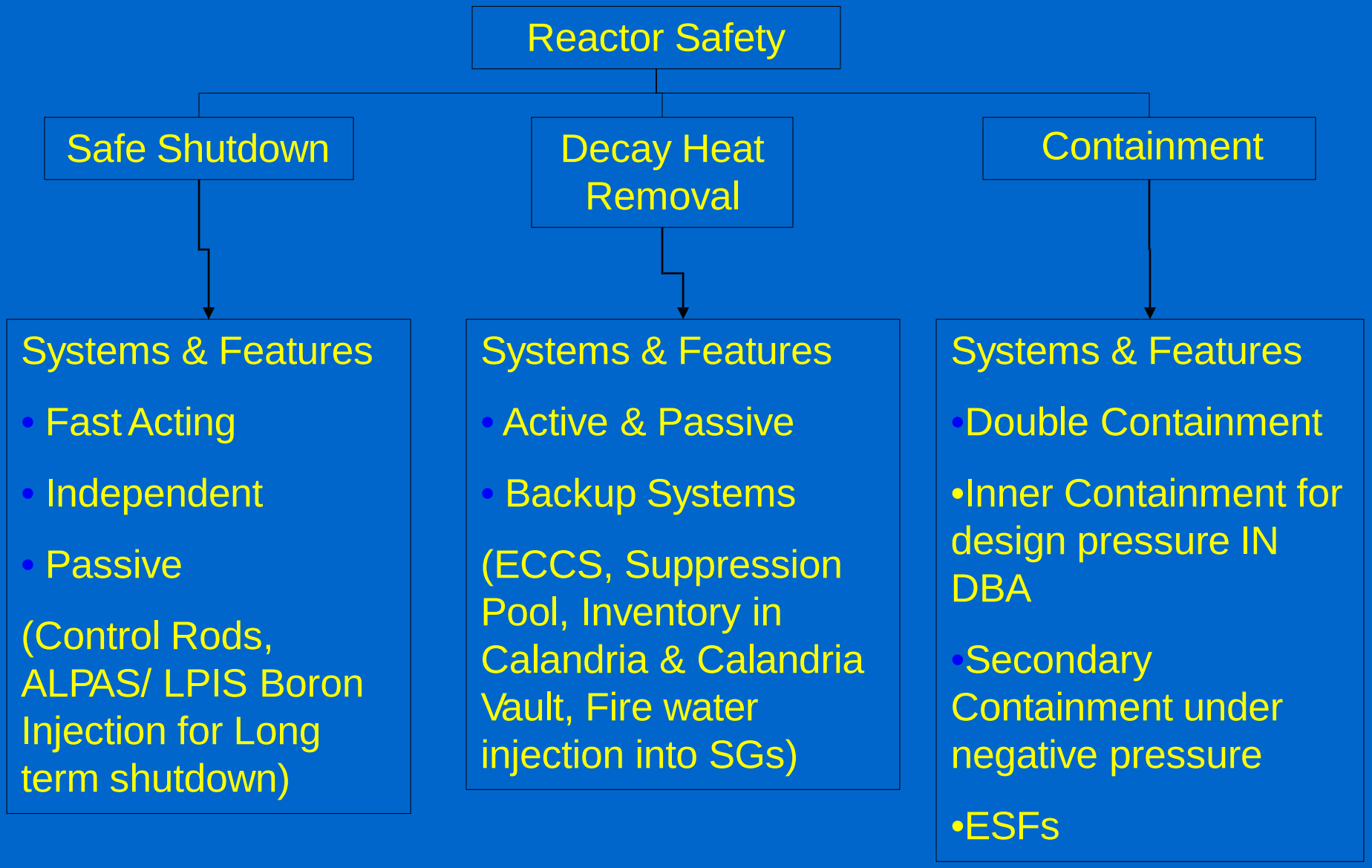
- Population distribution around proposed site
- Natural Events –Earthquake, Flood
- Man Made Events
- Ultimate Heat Sink
- Routine Releases to Environment
- Emergency Preparedness

Siting •Design •Construction •Commissioning & Operation

General Design Principles and Requirements

- Plant Layout
- Systems Classification
- Defence-in-Depth
- Redundancy
- Diversity
- Independence
- Fail Safe
- Reliability

Siting •Design •Construction •Commissioning & Operation



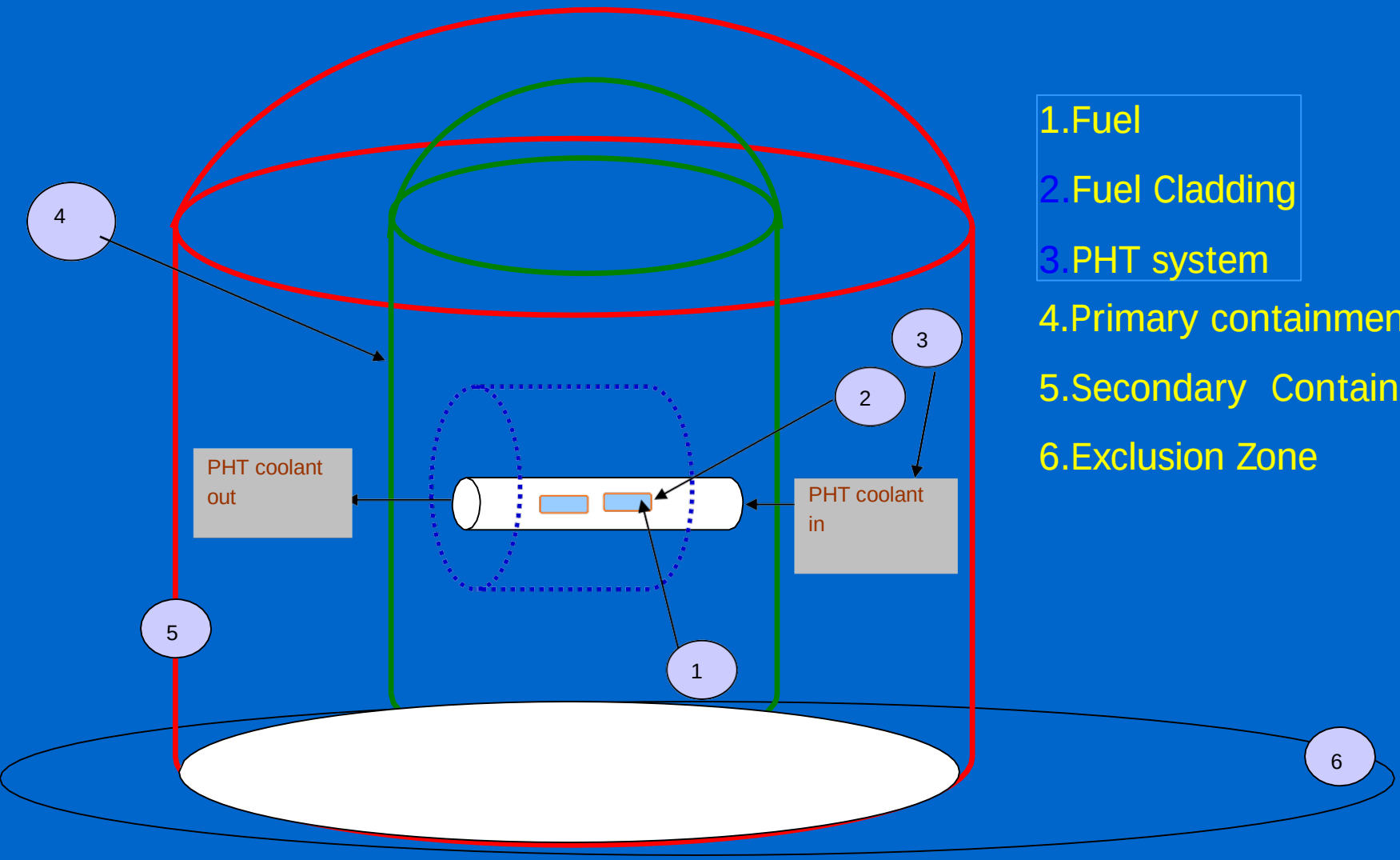
Levels of Defence-in-Depth

Level 1	Objective	Prevention of abnormal operation and failures
	Means	**Conservative design and high quality in construction and operation**
Level 2	**Objective**	Control of abnormal operation and detection of failures
	Means	**Control, limiting and protection system and other surveillance features**
Level 3	Objective	Control of accidents within the design basis
	Means	**Engineered safety features and accident procedures**
Level 4	**Objective**	Control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of severe accidents
	Means	**Complementary measures and accident management**
Level 5	**Objective**	Mitigation of radiological consequences of significant releases of radioactive materials
	Means	**Off-site emergency response**

Prevention of accident

Prevention of severe core damage

Barriers to release of activity



1.Fuel

2.Fuel Cladding

3.PHT system

4.Primary containment

5.Secondary Containment

6.Exclusion Zone

Siting •Design •Construction •Commissioning & Operation

- Regulatory approvals
- QA during construction
- NPP organization during construction
- Use of national & International standards
- Industrial and fire safety
- Stage wise quality assurance verification
- Hold points for critical activities
- Use of best nuclear industry standards
- Regulatory clearances for identified construction activity

Siting •Design •Construction •Commissioning & Operation

Highly qualified and trained man-power.

- Induction training
- Written check-out, walkthrough, interviews
- Simulator training
- Licensing of key officials by AERB.
- Deployment of graduate engineers for control room operations.

Operating Limits & Conditions

- Technical Specifications
  - Safety Limits
  - Limiting Safety System Settings
  - Limiting conditions for operation
  - Testing and Surveillance Requirements
- Station Policies
  - Good operating Practices

Use of Procedures

- Normal operation
  - Start-up / Power Raising / Shutdown
  - Transients
  - System upsets
  - Testing & Surveillance
- Emergencies
  - Emergency Operating Procedures
  - Emergency preparedness Plans

Conclusions

- Safety is accorded highest priority in all activities relating to NPPs in India
- No accident in any of Indian NPP
- Radiation exposure at exclusion boundary about 1/100th of the limit specified by AERB
- Periodic safety enhancements based on operating experience / new findings
- Handled Tsunami at MAPS and SBO at NAPS without affecting safety

Safety of Indian NPPs is assured

Design modifications at NAPP & other Nuclear Power Stations in India post Fukushima event

MODIFICATIONS

- Provision for Emergency water injection to various system is existing in design.

- In addition to above provision of direct injection of water to core through fire tender is made.

EQUIPMENT & LOGISTICS

- Portable DG set of 200 KVA has been procured and being tested on weekly basis. Station Loads to which power supply may be required to be extended from DG set in case of extended SBO, have been identified.

- Additional Emergency water tank of capacity 3500 M^3 is constructed at site.

ACTION TAKEN BASED ON FUKUSHIMA EVENT

- Two petrol engine driven portable fire pump of 10 Kg/cm^2 discharge pressure & 2250 lpm flow are available at site.

- A trolley mounted diesel engine driven pump of the similar capacity is available at site.

- Severe Accident Management Guideline (SAMG) to handle such events is prepared based on equipment/ services available at site. SAMG includes list of parameters to be monitored with the help of calibrators available with Control Room.

ACTION TAKEN BASED ON FUKUSHIMA EVENT

- Ability to transfer the water from Parallel Lower Ganga Canal & Lower Ganga Canal to fire injection points has been established and being tested at regular interval.
- Ability to make up the diesel fire pump Day Tanks manually from under ground HSD tanks is established and system modification done for easy addition .
- On-line Decision Support System is commissioned.

Modification made in Off-site Emergency Procedure for NAPS

- Revision of AERB / Safety Guide / EP-5.

1. RP approach: From process-based approach of practices and interventions to an approach based on the characteristics of radiation exposure situations i.e. planned, emergency and existing exposure situation.

2. For protection of people it specifies “Reference Levels” in terms of dose (Residual doses) during and post emergency.

3. Precautionary protective actions even before the start of release (EALs based on control room indications)

Modification made in Off-site Emergency Procedure for NAPS

- Revision of AERB / Safety Guide / EP-5.

4. RP approach: From process-based approach of practices and interventions to an approach based on the characteristics of radiation exposure situations i.e. planned, emergency and existing exposure situation.

5. Generic & Operational criteria in place of ILs & DILs.

Implementation of Decision Support System at NAPS

- It facilitate the decision making on GIS Platform in public domain of 80 km x 80 km around site considering stack as centre during Nuclear emergency.
- Predict the radioactive doses due to exposure pathways like plume dose, ground shine dose and inhalation dose in real time & forecast.
- Estimate around 48 hour radiological forecast for atmospheric release and calculates the concentrations of various radionuclides as well as doses received by individuals.
- Predict real-time protective counter-measures and emergency management to minimize the radiological consequences.

EMERGENCY PREPAREDNESS AT NAPS

EMERGENCY RESPONSE PLANS

Following emergency response plans exist at NAPS:

- PLANT & SITE EMERGENCY PREPAREDNESS & RESPONSE PLAN DULY APPROVED BY ATOMIC ENERGY REGULATORY BOARD.

- OFF-SITE EMERGENCY PREPAREDNESS & RESPONSE PLAN CONCURRED BY ATOMIC ENERGY REGULATORY BOARD & DULY APPROVED BY DISTRICT AUTHORITY.

EMERGENCY CLASSIFICATION

PERSONNEL EMERGENCY

EMERGENCY INVOLVING SERIOUS INJURY AND/OR EXCESSIVE CONTAMINATION OF PERSONNEL INVOLVING RADIOACTIVE / TOXIC CHEMICALS.

PLANT EMERGENCY

ACCIDENT SITUATIONS IN WHICH RADIOLOGICAL / OTHER CONSEQUENCES ARE CONFINED TO THE PLANT OR A SECTION OF THE PLANT.

EMERGENCY CLASSIFICATION

SITE EMERGENCY

ACCIDENT SITUATIONS IN THE PLANT INVOLVING RADIOACTIVITY TRANSGRESSING THE PLANT BOUNDARY, BUT CONFINED TO THE SITE BOUNDARY, OR INVOLVING RELEASE OF HAZARDOUS CHEMICALS / EXPLOSION / FIRE , WITH OFF-SITE CONSEQUENCES EXPECTED TO BE NEGLIGIBLE.

OFF-SITE EMERGENCY

ACCIDENT SITUATIONS WITH THE EXCESSIVE RELEASE OF RADIOACTIVITY OR RELEASE OF LARGE AMOUNTS OF HAZARDOUS CHEMICALS / EXPLOSION / FIRE, WITH CONSEQUENCES LIKELY TO EXTEND AND TRANSGRESS INTO PUBLIC DOMAIN , CALLING FOR INTERVENTION.

DECLARATION / TERMINATION OF EMERGENCY

- **PLANT EMERGENCY SHALL BE DECLARED / TERMINATED BY SITE EMERGENCY DIRECTOR (STATION DIRECTOR).**

- **SITE EMERGENCY SHALL BE DECLARED / TERMINATED BY SITE EMERGENCY DIRECTOR (STATION DIRECTOR).**

- **OFFSITE EMERGENCY SHALL BE DECLARED / TERMINATED BY OFFSITE EMERGENCY DIRECTOR (DM, BULANDSHAHR) ON ADVICE OF SED.**

FREQUENCY OF EMERGENCY EXERCISE

COMMUNICATION	**:**	**TWICE IN A MONTH**
PLANT EMERGENCY	**:**	**ONCE IN 3 MONTHS**
SITE EMERGENCY	**:**	**ONCE IN A YEAR**
OFF - SITE EMERGENCY	**:**	**ONCE IN TWO YEARS**


THANKYOU