05 EMERGENCY PREPAREDNESS

Nuclear Power Plants (NPP) in India are designed, constructed, commissioned and operated in conformity with relevant nuclear safety requirements. These requirements ensure an adequate margin of safety so that NPPs can be operated without undue radiological risks to the plant personnel, members of the public and the environment. State of the art safety measures are provided based on principles of defence-in-depth, redundancy and diversity. Measures also include fail-safe shutdown systems to safely shutdown the reactor, combination of active and passive cooling system to remove the heat from the core at all times and a robust containment systems for confining any release of radioactivity. Notwithstanding these, it is mandatory to develop Emergency Preparedness and Response (EPR) plans as a measure of abundant caution. These plans are prepared in accordance with the national laws & regulations and deal with the effective management of any eventuality with a potential to pose an undue radiological risk to the plant personnel and public.

Similarly, EPR plans are ensured for nuclear facilities (under the purview of AERB) and handling hazardous chemicals namely ammonia and hydrogen sulphide based Heavy Water Plants (HWP) and some of the heavy water plants catering to the production of solvents. These plans are prepared as per AERB Safety Guidelines on 'On-Site' and 'Off-Site' Emergency Preparedness for non-nuclear installations and deal with effective management of any eventuality with potential to pose an undue chemical risk to the plant personnel and public.

The establishment and submission of emergency preparedness plans and procedures is one of the pre-requisites for licensing of radiation facilities (RF) also.

5.1 ROLE OF AERB IN EMERGENCY PREPAREDNESS AND RESPONSE

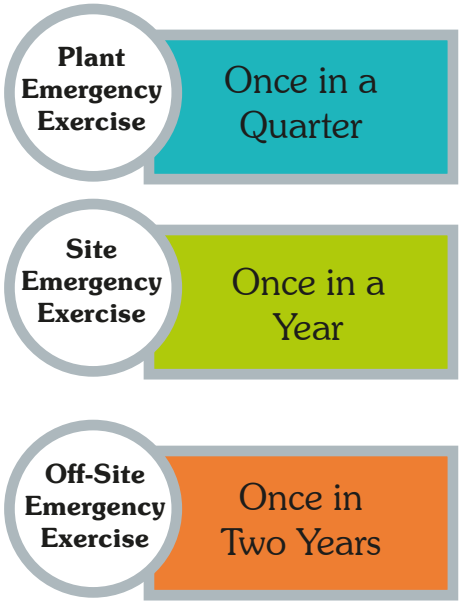
AERB establish the regulations and guidelines to specify the principles, requirements and associated guidance and criteria for EPR. It also ensures and verifies that arrangements for preparedness and response to a nuclear and radiological emergency for facilities and activities under purview of licensee are adequate. This is achieved by review and approving the EPR plan of the licensee. AERB oversees the arrangements and preparedness of the licensee through regulatory inspection and observation of emergency exercises. During an emergency, regulatory body is responsible for keeping itself apprised of situation, review of response actions and inform public as and when necessary.

The various type of Emergency conducted at nuclear facilities are elaborated below:

Plant Emergency	Declared emergency conditions in which the radiological/other consequences, confined to the plant or a section of the plant, requiring immediate operator action.
Site Emergency	Accidental condition/emergency situation in the plant involving radioactivity transgressing the plant boundary but confined to the site, or involving release of hazardous chemicals or explosion, whose effects are confined to the site, with off-site consequences being negligible.
Off-Site Emergency	Accident condition/emergency situation involving excessive release of radioactive materials/hazardous chemicals from the plant to the public domain calling for intervention.

5.2 REVIEW OF PREPAREDNESS FOR EMERGENCY AT NPP SITES

During the year, AERB officials carried out regulatory inspections on emergency preparedness aspects and the observations made during inspections were sent to stations for implementation of the corrective actions. AERB officials participated in emergency exercises as observers. Emergency exercise reports are discussed in AERB for appropriate corrective actions and guidance. The frequency for conduct of emergency exercises in NPP is as follows.



These exercises are used for twin purposes:

(a) Familiarization of personnel concerned with the management and implementation of emergency response and protective measures, and

(b) Assessment of the adequacy of these plans and improvement in them based on feedback from exercises.

It is also ensured that each shift crew of the plant takes part in these exercises at least once a year.

Currently, off-site emergency exercises are carried out with a frequency of once in two years. The number of Site Emergency Exercise (SEE) and Off-Site Emergency Exercises (OSEE) conducted at various NPP sites in 2019 are listed in Table 5.1.

Table 5.1: Site and Off-site Emergency Exercises at NPP (2019)

NPP Site	SEE	OSEE
Tarapur	1	---
Rawatbhata	1	---
Kalpakkam	1	1
Narora	1	---
Kakrapar	1	---
Kaiga	1	---
Kudankulam	1	---
Total	**7**	**1**

In order to further strengthen the level of preparedness, new system for conducting off-site emergency exercises is being developed by AERB. Different type of exercises were conceptualized and conducted, focusing on different aspects of emergency management.

- Table top exercise emphasizing on decision making process and use of EALs.
- Integrated Command Control and Response (ICCR) exercise to test the command control functions, response timeline, initial response and communication & co-ordination among various response agencies, and
- Field exercise to test the resources and field actions.

During this year, trial table-top exercise was conducted at three sites (Narora, Tarapur and Kaiga).

Integrated Command Control and Response (ICCR) Exercise

The first ICCR exercise was conducted at Rawatbhata Rajasthan (RR) site in the year 2018. The Second ICCR offsite emergency exercise was conducted at Kalpakkam site on September 27, 2019. The revised off-site response framework as approved in the template (Ref. Sec. 5.3 below) was implemented.

The various DAE and other Government organisations actively participated in the exercise viz. Kalpakkam site (MAPS and IGCAR), DAE-CMG, DAE-RERD, NPCIL HQ, the District Administration & State Authority, AERB and National Disaster Management Authority (NDMA). The exercise was designed to challenge all organisations

having a role in responding to a nuclear emergency. Exercise spanned a wide spectrum of the response functions that would normally take place during such an emergency. The exercise evolved from the initial indications of a problem at the plant to subsequent notification of response organisations. The accident scenario was not pre-informed to the responders and it was unfolded in the form of injects as the accident progressed.

Emergency Operation Centres (EOCs) were then activated as the scenario demanded. Response organisations were asked to analyse the impact with actual environment and meteorological conditions. Decision Support System (DSS) worked in real time situation and determined the affected area according to prevailing meteorological conditions and actions to protect the public were recommended to district authorities. The local administration and environmental survey team of DAE responded with physical movement of various response teams to the most affected areas. Response time of administration and medical team to reach the most affected area were assessed. The exercise progressed from Early to Intermediate phase with proper handover of responsibility after analysing need for public protection from plant management to Radiation Emergency Response Director (RERD) at BARC under the supervision of DAE-CMG. Field survey and sample analysis data was also given in the form of injects and process for taking decision in the early phase, intermediate phase and for termination was verified.

Strengths and gap areas were identified, which would be used to finalize revised AERB policy on conduct of off-site emergency exercises.

Demonstration of Decision Making Process by District Authorities at the District Emergency Operation Centre (EOC)

5.3 HARMONIZATION OF EMERGENCY PREPAREDNESS PLANS OF NPP

Successful demonstration of EPR plans is a mandatory requirement for issuing licence for operation of NPP. AERB ensures that necessary EPR plans are in place and they are successfully demonstrated before issuing regulatory consent for First Approach to Criticality (FAC) of NPP. AERB evaluates all the elements of the EPR plans such as identification of emergency, classification, decision making, notification, communication and projected dose assessment, and ensures the periodic revision of these plans.

During review and revision of plant EPR of few of NPPs, AERB felt the need for harmonization of plant, site and offsite EPR plans of NPPs. Keeping this in view, standard templates on plant and site EPR plans were prepared by NPCIL and all NPPs were asked to revise their plant and site EPR plans accordingly.

The off-site EPR plans are being revised in line with the identified roles and responsibilities of the respective response organisations (utility & local authorities). Subsequent to the Disaster Management Act, 2005 and as per National Disaster Management Plan (NDMP, 2019), the response plan in public domain for a nuclear emergency shall be part of the integrated District Disaster Management Plan (DDMP) for emergency response under an all hazard approach. In compliance with the same, the off-site EPR plan covering response actions in the public domain is prepared by local authorities in coordination with the NPP. Hence the plan of the utility shall be focused towards addressing the responsibility and arrangement necessary for effective technical support and recommendation of protective action to public authorities.

In line with above, templates for preparation of respective off-site EPR plan were prepared and issued to the district authorities and NPPs by respective agencies (NDMA to District authorities and NPCIL-HQ to NPPs). The template for offsite plan of NPPs was reviewed and approved by AERB. The template includes a revised overall response framework for off-site emergency to ensure an effective and co-ordinated response. This has been evolved through consultation among utility, CMG-DAE, NDMA and AERB. The template also covers various aspects of EPR plans including, classification, declaration and notification of emergency, protection strategy with focus on doing more good than harm, public communication, infrastructure for decision making during emergency exercises, comprehensive list of procedures for implementation of the emergency

response plans, operational control and responsibility for protection of personnel providing external services when they are at the facility, among others.

Based on the directive from AERB, NPPs are revising the off-site ERP plans including development of plant specific EALs and protection strategy based on the approved template.

5.4 CREATION OF ON-SITE EMERGENCY SUPPORT CENTRE AT NPP

In light of the accident at Fukushima NPPs, AERB mandated the requirement for establishing the On-Site Emergency Support Centre (OESC) at all NPP sites in the country. This facility will have capability to withstand earthquake and flood of magnitudes larger than their respective design basis for the NPP. The building will be designed with requisite shielding for protected stay of response personnel for extended duration. AERB, after a detailed review, accepted the generic guidelines prepared by the Advisory Committee for establishing OESC and had asked NPCIL to submit design basis report for the site specific OESC for all NPP sites in accordance with these guidelines. The design of OESCs has been finalized by the utility and the implementation is in progress.

Decision Support System (DSS) for nuclear emergencies is intended to provide comprehensive and timely information to emergency managers in an emergency situation arising from a nuclear accident. Based on the radiological monitoring readings of installed radiation monitors and meteorological conditions, the DSS estimates the projected public dose. These estimates are used to decide appropriate protective action in the public domain. A decision has been taken to implement DSS progressively at all the NPP sites.

5.5 NUCLEAR AND RADIOLOGICAL EMERGENCY MONITORING CENTRE

During nuclear emergency, AERB monitors and keeps itself informed about the emergency situation. It reviews & assesses the emergency situation, and if required, provides appropriate regulatory support and advice to the relevant response agencies. AERB also informs the public and government on the safety significance of events and actions being taken. To facilitate this, AERB has instituted an Emergency Response Monitoring Organisation (AERB-ERMO) which gets activated during an emergency. The activities of AERB-ERMO are carried out and coordinated by the Nuclear and Radiological Emergency Monitoring Centre (NREMC) established at AERB. The centre is equipped with various cells (Communication, Assessment, Analysis & Legal) along with necessary software and hardware infrastructure.

The capabilities of NREMC include, emergency analysis, assessment of emergency response actions & protective actions and communication with all stakeholders. The software systems with on-line DSS, source term and radioactivity release assessment, environmental monitoring data inputs, video conferencing with other emergency response agencies and trained & experienced personnel for NREMC has been established. NREMC is also activated during the site and off-site emergency exercises conducted at various plants to test its mechanism for obtaining information for assessing the situation.

5.6 DEVELOPMENT OF DOCUMENTS RELATED TO EMERGENCY MANAGEMENT

AERB is in the process of consolidating & revising its requirements and guidance for EPR, which presently are addressed in a number of documents and were developed in different timeline over many years. As a step towards holistic revision, the existing requirements are being consolidated/updated through safety code and safety guides for management of nuclear and radiological emergency. Safety Code specifies the requirements that are to be fulfilled by the licensees and various other authorities / agencies responsible for management of nuclear and radiological emergencies, in line with the role entrusted to AERB by NDMA through its National Disaster Management Plan (NDMP, 2019).

Safety code and guides for EPR are being developed taking into account existing EPR requirements, developments including change in approach to public protection during emergency conditions as elaborated in ICRP publications, IAEA General Safety Requirements (IAEA GSR Part-7), lessons learnt from the Fukushima Daiichi accident & subsequent safety reviews of Indian NPPs and guidance available nationally and internationally.

These new regulatory documents (Code and Guides) are being prepared following a bottom to top-approach. Necessary supporting documents on areas including development of Emergency Actions Levels (EAL), development of protection strategy, conduct of emergency exercise and the template for EPR plans of NPPs have been developed. These documents are being developed in AERB by expert groups consisting of members from AERB, NPCIL, BARC and CMG-DAE. The understanding established in these basis/supporting documents are used in a graded manner in the Code and the Safety Guides.