

Convention on Nuclear Safety Joint 8th and 9th Review Meeting – 2023



International Atomic Energy Agency IAEA, Vienna

Country Review Report for INDIA

Drafted by Country Group N° 7

Brazil, Chile, Congo, Germany, Ghana, India, Kuwait, Latvia,
Montenegro, Pakistan, Peru, Singapore, Vietnam

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Version: Final

DISCLAIMER: pursuant to INFCIRC/571/Rev.7, Para. 16-19 and Annex IV, Contracting Parties were invited to comment on the implementation of the CNS reporting guidance. Contracting Parties were also encouraged to submit proposed Good Practices, Challenges, and Suggestions prior to the Review Meeting. The draft Country Review Report documents the preliminary observations identified by the Contracting Parties. The Country Review Report is the result of the CNS Review Process and was agreed by consensus by the Country Group.

Glossary

The Glossary provides here the definitions of “Challenges”, “Suggestion” and “Good Practice” according to Annex IV of INFCIRC/571/Rev.7. The definition of “Area of Good Performance” was agreed upon by the Officers during the CNS Officers’ Meeting on 24-25 September 2019 and confirmed by the Officers at the CNS Officers’ Meeting on 18-19 July 2022.

A **Challenge** is “a difficult issue for the Contracting Party and may be a demanding undertaking (beyond the day-to-day activities); or a weakness that needs to be remediated.”

A **Suggestion** is “an area for improvement. It is an action needed to improve the implementation of the obligations of the CNS.”

A **Good Practice** is “a new or revised practice, policy or programme that makes a significant contribution to nuclear safety. A Good Practice is one that has been tried and proven by at least one Contracting Party but has not been widely implemented by other Contracting Parties; and is applicable to other Contracting Parties with similar programmes.”

An **Area of Good Performance** is “a practice, policy or programme that is worthwhile to commend and has been undertaken and implemented effectively. An Area of Good Performance is a significant accomplishment for the particular CP although it may have been implemented by other CPs.”

Executive Summary

India has 22 nuclear power reactor units. 22 are in operation; however, 1 unit has been shut down since 2004. There are 2 PWRs, 2 BWRs, and 18 pressurized heavy water reactors (PHWRs). India has 8 planned new builds (8 PHWRs) and 13 units under construction (8 PHWRs, 4 PWRs, and 1 sodium cooled fast reactor).

3 out of 3 Challenges and 1 out of 1 Suggestions from the 7th Review Meeting have been closed.

The Country Group highlights the following measures to improve safety in India's national nuclear programme:

- The Atomic Energy Regulatory Board (AERB) implemented several changes including enhancing its regulatory presence at the sites, optimising the number of committees, changing the organisational structure, developing and implementing an Integrated Management System (IMS), and forming the Emerging Regulatory Strategy Division (ERSD for developing new and emerging regulatory requirements).
- AERB is in the process of further consolidating and revising its requirements and guidance for emergency preparedness and response (EPR).
- AERB is revising its Safety Guide on 'Computer Based Systems of PHWRs' (AERB/NPP-PHWR/SG/D-25, 2010)
- Several long-term safety enhancements have been completed or are in progress, including implementation of Accident Management Guidelines at all operating NPPs, installation of Passive Catalytic Recombiner Devices (PCRDs) and implementation of automatic provision for maintenance of the inert steam atmosphere inside primary containment in all operating PHWRs, installation of equipment and instrument for Post-Accident Hydrogen Management System (PAHMS), refurbishment of containment inerting system in two BWRs, installation of the Containment Filtered Venting System (CFVS) at six sites.
- Construction of the On-Site Emergency Support Center (OESC) at five sites is in progress.

The Country Group highlights the following results of international peer review missions of India:

- In response to a 2015 IRRS Mission and June 2022 follow-up IRRS Mission, the AERB has taken various actions to address the recommendations and suggestions made by the IRRS Mission, including: strengthening of AERB management system by implementation of an Integrated Management System; changes in organisational structure of AERB for efficient and effective utilisation of resources; enhancement of regulatory inspection activities; improvements in regulatory functions related to emergency preparedness and response. Eleven (11) recommendations of 13 and 20 suggestions of 21 were considered closed during the IRRS follow-up mission.

The Country Group did not identify any Challenges for India.

In addition, the country group identified 1 Suggestion, 7 Areas of Good Performance and 0 Good Practices.

The Country Group concluded that India:

- Submitted National Reports for the 8th CNS Review Meeting and for the Joint 8th and 9th CNS Review Meeting, and therefore complies with Article 5, and in time, following Rule 39 of INFCIRC/573/Rev.6.
- Attended the Joint 8th and 9th CNS Review Meeting, and therefore complies with Article 24.1.
- Held a national presentation and answered questions during the Joint 8th and 9th CNS Review Meeting, and therefore complies with Article 20.3.

1. Basic Information on India's Nuclear Programme

India has 22 nuclear power reactor units – 22 units are in operation; however, 1 unit (RAPS-1) has been shut down since 2004. These are the types of nuclear power reactors: 2 PWRs, 2 BWRs, and 18 pressurized heavy water reactors (PHWRs). India has 13 units under construction (8 PHWRs, 4 PWRs, and 1 sodium-cooled fast reactor) and 8 planned new builds (8 PHWRs).

The Atomic Energy Regulatory Board (AERB) is the national regulatory body. AERB is responsible to Atomic Energy Commission (AEC), which is the apex policy making body, reporting to the Prime Minister. Within the limits of approved budget by Parliament, the AEC has the powers of Government of India, both administrative and financial. Department of Atomic Energy (DAE) provides administrative support to AERB for interfacing with the Government. This arrangement provides effective separation between the functions of the regulatory body and organisation concerned with the production of nuclear energy. For strengthening the statutory status of regulatory body, a proposal for setting up a Nuclear Safety Regulatory Authority (NSRA) was under consideration by Government of India, and the matter is currently under review.

2. Follow-Up from Previous CNS Review Meeting

2.1 Challenges

India provided the following updates on Challenges identified during the 7th CNS Review Meeting:

Challenge 1: Prepare for the planned rapid expansion of nuclear power in the coming years, including the buildup of the needed competence for many different types of new reactors

India addressed this Challenge by establishing state-of-the-art requirements, strengthening the human resources & competence of regulatory body and reinforcing its knowledge management processes. Further, the management systems of the regulatory body have also been reinforced with an Integrated Management System (IMS).

The utility, Nuclear Power Corporation of India Limited (NPCIL), is regularly recruiting technical personnel to meet the manpower requirements for planned rapid expansion of nuclear power programme. Key competences for the projects under construction and projects being pursued are developed and maintained through elaborate training programme. The manpower is optimised taking account of the requirements for projects under construction, operating NPPs, design & engineering also considering the requirements of multi-unit sites. For the 700 MWe PHWRs, NPCIL is striving for expeditious completion of pre-project activities (including land acquisition, design, procurement, obtaining regulatory and statutory clearances, setting up site infrastructure and so on) with due emphasis on quality assurance aspects. The procurement of long delivery equipment for reactors has already commenced as the industrial infrastructure is in place.

The challenges on the regulatory front for the planned expansion have been addressed by enhancement of regulatory processes, human resources, and competence and knowledge management. The Atomic Energy Regulatory Board (AERB) has implemented the Integrated Management System (IMS) for its regulatory processes. The regulatory body takes account of the aspects related to the planned rapid expansion of nuclear power programme, in particular the enhancement of its human resources, competence development as well as knowledge management with respect to safety aspects of different reactor technologies which are being regulated or expected to be regulated by it. The regulatory requirements for site evaluation and design of NPPs take into account the lessons learned from the nuclear accident at the Fukushima Daiichi NPP and are in line with the current IAEA safety standards. Thus, the requirements are in place for all the reactor technologies which India intends to deploy.

Follow Up Status: Closed

Challenge 2: Completion of the identified long-term measures after accident at Fukushima Daiichi

The safety enhancements identified for Indian NPPs subsequent to the accident at Fukushima Daiichi NPPs were classified as short term, medium term and long term. Implementation of the short-term and

medium-term safety enhancements have been completed as reported during the 7th review meeting of CNS. The long-term enhancements identified were:

- (a) enhancing severe accident management programme: Accident Management Guidelines have been implemented at all the operating NPPs, including implementation of the necessary hardware enhancements, training of the operating personnel, mock up tests and periodic surveillance.
- (b) strengthening hydrogen management provisions: Passive Catalytic Recombiner Devices (PCRD) have been installed in MAPS-2, KGS-1&2, NAPS-1, KAPS-1 and RAPS-5. For the PWR units of KKNPP-1&2, the Passive Autocatalytic Recombiners (PARs) for hydrogen management are already incorporated as part of the design. In TAPS-1&2, the containment inerting system has been indigenously refurbished and is in operation.
- (c) provision of containment filtered venting (CFVS): CFVS has been installed in TAPS-1&2 (BWR). Necessary Commissioning tests have been conducted and surveillance requirements have been finalized. Installation of CFVS is in progress in PHWR-based NPPs, where the requirement has been envisaged. For the PWR units at KKNPP-1&2, the requirement of containment venting is not envisaged.
- (d) creation of on-site emergency support centre: Construction of the On-Site Emergency Support Centres at two sites is in progress.

These required research & development efforts, analysis, detailed engineering and testing/qualification. The severe accident management guidelines for different NPP designs (PHWR, BWR & PWR) were developed based on technical bases reviewed & accepted by AERB and are now in place at all NPPs. The activities related to research and development (R&D), engineering, testing & qualification related to the rest of the long-term enhancements have been completed and their on-site implementation is now in progress. These safety enhancements have been made part of the regulatory requirements for new NPPs.

Follow Up Status: Closed

Challenge 3: Identification of root cause of the events of pressure tube leak at KAPS-1&2

India addressed this Challenge by completing root cause investigations of the pressure tube leak events in KAPS-1&2 on 11 March 2016, and 01 July 2015, respectively. Based on the investigation, it was concluded that the event occurred due to a small amount of unlisted impurity of hydrocarbons in carbon dioxide gas used for ‘Annulus Gas Monitoring System’ (AGMS) for detection of leak from pressure tubes. The underlying causal factors were latent deficiency in the specifications of carbon dioxide gas used for AGMS. Limit on hydrocarbon impurities in carbon dioxide gas was not specified.

AGMS gas mixture in combination with these hydrocarbons under reactor conditions resulted in formation of reactive chemical species causing localized corrosion on the outer surface of pressure tubes, which in turn led to enhanced hydrogen pickup. High hydrogen content in the affected pressure tubes eventually led to crack initiation and its propagation through Delayed Hydride Cracking (DHC). In the case of KAPS-1, the degradation in material properties was higher due to longer period of operation with contaminated carbon dioxide gas as compared to KAPS-2 and therefore the crack grew to critical size in the affected pressure tube and resulted in a small LOCA event. However, in KAPS-2, the material properties of the affected pressure tube remained adequate enough to allow for the crack to grow in a stable manner following leak before break (LBB).

Based on the lessons from these events, corrective measures were implemented at all PHWRs which included strengthening of AGMS specifications and quality checks, enhancing the surveillance and monitoring of AGMS, and enhancing the scope of the in-service inspection programme of pressure tubes. The capability of AGMS was also analysed and confirmed to meet the design requirements in all PHWRs.

Details of the investigations for establishing the root cause of the pressure tube leaks and the corrective actions taken are given in Articles 6 and 14 of the Indian National Report to the 8th Review Meeting of CNS.

Both KAPS reactors have undergone en-masse coolant channel replacement (EMCCR). After completion of EMCCR activities and necessary regulatory review and clearance, KAPS-1&2 have been operating safely.

Follow Up Status: Closed

In the National Report to 8th Review Meeting of CNS, India had identified a challenge. This pertains to 'Revision of the regulatory guidance to address the issues related to the increased use of digital technologies in the design of Instrumentation and Control systems'. This challenge was mentioned in the draft CRR, Revision 2 of the 8th Review Meeting. As encouraged by the Presidency, India addressed this challenge in the 9th national report. To address the proposed challenge, the AERB has taken up a comprehensive review of the current regulatory guidance documents on I&C for application in nuclear power plants. Based on this review, the revision of existing Safety Guide was taken up. The draft of revised Safety Guide has been prepared. The draft includes guidance with respect to Common Cause Failure (CCF) due to use of software, guidance for commercially available digital I&C systems, interface between safety and security aspects, etc. Latest requirements of IAEA safety standards and International Electrotechnical Commission (IEC) standards have been considered. This document is under review by the AERB.

2.2 Suggestions

India provided the following updates on Suggestions identified during the 7th CNS Review Meeting:

Suggestion 1: Consider continuing participation to NEA activities, specifically with respect to WGHOE and the related R&D activities.

India continued to participate in the activities of committees of Nuclear Energy Agency (NEA) and their various working groups such as the Committee on Safety of Nuclear Installations (CSNI) and the Committee on Nuclear Regulatory Activities (CNRA). India is attending and considering joining formally the Working Group on Human and Organizational Factor (WGHOE).

Follow Up Status: Closed

3. Measures to Improve Safety

3.1 Changes to the Regulatory Framework and the National Nuclear Programme

Since the last Review Meeting, the Country Group took note of the following changes to the regulatory framework and the national nuclear programme

➤ AERB implemented the following changes:

- Enhanced regulatory presence at sites by increasing the frequency of regulatory inspections. Also deployed the Site Observer Teams (SOTs) to provide continuous on-site regulatory presence. SOTs have been deployed at sites where NPPs under construction/commissioning and operation are co-located (four sites), to observe the activities at these sites.
- Optimised the number of committees, thereby, increasing the efficiency of regulatory processes
- Changed organisational structure to effectively utilise its resources
- Developed and implemented an Integrated Management System (IMS), which is in line with IAEA Safety Standards: Leadership and Management for Safety (No. GSR Part -2,

2016) and IAEA Safety Guide: Application of the Management System for the Facilities and Activities (No. GS-G-3.1).

- Formed the Emerging Regulatory Strategy Division (ERSD for developing new and emerging regulatory requirements.
- Revised AERB Safety Guide “Periodic Safety Review for Nuclear Power Plants (AERB/SG/O-12 Rev. 1),” which takes into account the requirements of IAEA SSG-25.

AERB has consolidated and revised its requirements and guidance for emergency preparedness and response (EPR). A bottom-up approach was followed for consolidation and revision of regulatory requirements and guidance related to EPR with engagement of all stakeholders within National framework and Utility feedback at all steps. As a step towards holistic revision, the existing requirements have been consolidated/updated through a dedicated Safety Code and Safety Guides. The Safety Code on “Management of Nuclear and Radiological Emergencies” (AERB/NRF/SC/NRE) has been published and made available on AERB website. The drafting of Safety Guide on “Management of Nuclear and Radiological Emergencies in Nuclear Facilities” is in advanced stage. These documents take into account the existing EPR requirements, developments including the change in approach to public protection during emergency conditions as elaborated in ICRP publications, IAEA General Safety Requirements (IAEA GSR Part-7), lessons learned from the accident at Fukushima Daiichi NPP, and subsequent safety reviews of Indian NPPs and guidance available nationally & internationally.
- In 2017, AERB started conducting the annual National Conference on Regulatory Interface (NCRI), with an objective to foster an environment wherein, the stakeholders and professional associations could interact, discuss safety and regulatory issues and provide valuable feedback to AERB on various issues related to regulatory requirements and practices world-wide, emerging trends in design and manufacturing, challenges in supply chain and other issues of regulatory interest.
- The increasing use of digital/software I&C systems for safety critical applications pose certain issues from the regulatory perspective such as consideration of Common Cause Failure (CCF) of software-based systems, regulatory acceptance of commercially available digital I&C systems, and interface between safety & security aspects of digital I&C systems. The AERB Safety Guide on ‘Computer Based Systems of PHWRs’ (AERB/NPP-PHWR/SG/D-25, 2010) is being revised to address the above aspects as well as to consider the latest IAEA safety standards and IEC standards. Draft of the revised Safety Guide is prepared, which is under review in AERB.
- The following international cooperation agreements were signed:
 - AERB signed a bilateral arrangement with Bangladesh Atomic Energy Regulatory Authority (BAERA) on 8 April 2017 for exchange of technical information and co-operation in the regulation of nuclear safety and radiation protection. The arrangement provides for sharing of knowledge and expertise on various issues related to nuclear and radiation safety, education and training of the regulatory personnel and relevant assistance related to development of regulatory requirements of Bangladesh.
 - On 1 March 2018, India, Russia and Bangladesh signed Memorandum of Understanding on trilateral cooperation in implementation of the Rooppur Nuclear Power Project in Bangladesh. The MoU envisages rendering of consultancy to Bangladesh in performance of work related to Rooppur Nuclear Power Plant construction and transfer and exchange of knowledge, expertise, consultancy advice, technical support and knowhow, sharing of resources and experience on regulatory aspects, rendering assistance in respect of Indian personnel and qualified Indian institutions experienced in construction, commissioning and operation of technically demanding industrial facilities to the Rooppur Nuclear Power Plant.

- AERB signed a bilateral arrangement with the Office for Nuclear Regulation (ONR) of Great Britain on April 17, 2018. The scope of the arrangement provides for the information exchange concerning the regulation in various mutually interest areas such as siting, construction, commissioning, operation, radioactive waste management and decommissioning of civil nuclear installations; preparedness and management of nuclear and radiological emergencies and co-operation in safety research, training and assignments.
- The bilateral arrangement between AERB and USNRC was renewed on September 20, 2018. The arrangement envisages, among other things, the exchange of technical information, co-operation in safety research and training of regulatory staff.
- A MoU was signed between AERB and the Vietnam Agency for Radiation and Nuclear Safety (VARANS), the nuclear regulatory body of Vietnam, on December 18, 2020. The MoU inter-alia provides for sharing of experiences related to licensing, safety assessments, regulatory inspections, cooperation in the fields of research and development in radiation protection and nuclear safety; co-operation in the review of legislation, regulation relating to radiation protection and nuclear safety.
- The arrangement between AERB and Nuclear Safety Authority (ASN) of France for the exchange of technical information and co-operation in the regulation of nuclear safety and radiation protection was renewed in September 2021. The arrangement provides for mutual assistance related to training of scientific personnel, setting of joint working group to carry out specific studies and projects, exchange of information and documentation and exchange of personnel among other things.

3.2 Safety Improvements for Existing Nuclear Power Plants

The Country Group took note of the following implemented and planned safety measures for existing nuclear power plants in India:

- The following long-term safety enhancements have been completed or are in progress:
 - Accident Management Guidelines based on severe accident management guidelines have been implemented at all operating NPPs, including implementation of necessary hardware enhancements, training of operating personnel, mock-up tests, and periodic surveillance. Exercises were conducted at all stations simulating multi-unit accidents.
 - Installation of Passive Catalytic Recombiner Devices (PCRDs) and implementation of automatic provision for maintenance of the inert steam atmosphere inside primary containment have been completed in all operating PHWRs.
 - Installation of equipment and instrument of Post-Accident Hydrogen Management System (PAHMS) is in progress. For the PWR units of KKNPP-1&2, the Passive Autocatalytic Recombiners (PARs) for hydrogen management are already incorporated as part of the design. At TAPS-1&2, the containment inerting system has been indigenously refurbished and is in operation.
 - Containment Filtered Venting System (CFVS) has been installed in TAPS-1&2 (BWR). Installation of CFVS is in progress in PHWR NPPs, i.e., RAPS-2, MAPS-1&2, NAPS-1&2, KAPS-1&2 and TAPS-3&4, where the requirement has been envisaged.
 - Construction of the On-Site Emergency Support Center (OESC) at five sites (i.e., Kaiga, Kakrapar, Kalpakkam, Rawatbhata, Tarapur) is in progress.

3.3 Response to International Peer Review Missions

The Country Group took note of the following implemented or planned measures in response to the results of international peer review missions:

- An IRRS Mission was hosted by AERB during 16 – 27 March 2015, and an IRRS follow-up mission with extended scope (including radiation sources, facilities, and activities) during 9 – 20 June 2022. The AERB has taken various actions to address the recommendations and suggestions made by the IRRS Mission. These include: strengthening of AERB management system by implementation of an Integrated Management System; changes in AERB organisational structure for efficient and effective utilisation of resources; enhancement of regulatory inspection activities (presence of regulatory site observer teams (SOT) at nuclear sites that are expanding); and improvements in regulatory functions related to emergency preparedness and response. India reported that of the original 13 recommendations and 21 suggestions from the IRRS mission in year 2015, 11 recommendations and 20 suggestions were considered closed during the IRRS follow-up mission. There were no new findings related to the topics covered during the initial IRRS mission.

The Country Group took note of the following international peer review missions that were conducted during the reporting period. India provided information on implemented or planned measures in response to the results of these peer reviews during its national presentation.

- WANO Peer Reviews were conducted at the following plants:
 - 2017: TAPS-1&2, RAPS-1&2, RAPS-5&6, NPCIL (Corporate Peer Review)
 - 2018: NAPS, RAPS-3&4, RAPS-5&6
 - 2019: RAPS-2, RAPS-3&4
 - 2022: Peer Review at KAPS-1&2; enhanced Performance Monitoring (ePM) at NAPS-1&2, RAPS-2
- NPCIL hosted a “Restart Review” by WANO in the year 2019 at KAPS-1 after its long outage for carrying out en-masse coolant channel replacement (EMCCR).

4. Implementation of the Vienna Declaration on Nuclear Safety (VDNS)

On 9 February 2015, the Contracting Parties adopted “Vienna Declaration on Nuclear Safety” (INFCIRC/872), which is a commitment to certain principles to guide them in the implementation of the CNS’ objective to prevent accidents and mitigate their radiological consequences, should they occur. The Contracting Parties agreed to discuss the principles of the Vienna Declaration on Nuclear Safety in their National Reports to the 7th and the subsequent Review Meetings.

In response to VDNS Principle 1 regarding the design, siting, and construction of new nuclear power plants, India reports that the generic requirements and design principles specified in the AERB Safety Code on “Design of Light Water Reactor based Nuclear Power Plants (AERB/NPP-LWR/SC/D) issued in 2015 are considered during design and safety review of the PHWR-based NPPs also. As per this Code, provision shall be made in the design for automatic safety actions for the necessary actuation of safety systems or additional safety systems/features, to prevent progression of accident to more severe plant conditions. The Safety Code also requires provision of complementary safety features for mitigating the consequences of severe accidents, should they occur. Further, the design of NPPs shall be such that design extension conditions that could lead to large or early releases of radioactivity are practically eliminated. For design extension conditions that cannot be practically eliminated, only protective measures that are limited in terms of area and time shall be necessary for protection of the public, and sufficient time shall be made available to implement these measures. The design and

regulatory assessment of new NPPs is done to meet these requirements. The Safety Code on ‘Design of Pressurised Heavy Water Reactor based Nuclear Power Plants’ is being revised to include these requirements.

In response to VDNS Principle 2 regarding systematic safety assessments to identify safety improvements at existing NPPs, India reports that the regulatory system in India has adopted the Periodic Safety Review (PSR), which incorporates addressing the cumulative effects of ageing and comparison with the current safety requirements / practices, to identify the need for safety enhancements in the existing NPPs. In the regulatory system in India, licence for operation of NPP has a maximum validity period of five years. Renewal of the licences is based on a limited scope safety review once in 5 years and conduct of PSR, once in 10 years. Linking of the PSRs and renewal of operating licences helps in ensuring that the identified safety enhancements are implemented timely.

India reported the following regarding PSRs:

- Since 2019, PSRs were completed for RAPS-1&2, RAPS-5&6, KKNPP-1&2, TAPS-3&4, and KGS-1&2, and their licenses were renewed. The identified safety improvements are being implemented in a planned manner. The PSR of RAPS-3&4 is in progress.
- Limited Scope Safety Reviews (LSSRs) were conducted at TAPS-1&2 and MAPS-1&2.

In response to VDNS Principle 3 regarding national requirements and regulations for addressing the stated objective of CNS, India reports that the AERB Safety Code on ‘Design of Light Water Reactor based Nuclear Power Plants’ (AERB/NPP-LWR/SC/D) issued in 2015 specifies the safety requirements for design of LWR-based NPPs in India. The requirements given in this Safety Code are in line with the current IAEA Safety Standard ‘Safety of Nuclear Power Plants: Design (SSR 2/1 (Rev.1))’. The Safety Code on ‘Design of Pressurised Heavy Water Reactor based Nuclear Power Plants’ (AERB/NPP-PHWR/SC/D, 2009) is being revised to include these requirements. The AERB has also taken up the development of a Safety Code on Design of Sodium Cooled Fast Reactors (AERB/NPP-SFR/SC/D). These Safety Codes are being based on latest international standards including that of IAEA as well as national and international experience. The Safety Codes contain both general requirements which are technology neutral like implementation of defence in depth, safety analysis, concept of single failure, management of safety, etc. as well as requirements which are technology specific. These Safety Code requirement documents are in an advanced stage.

India reports the following planned activities related to the principles of the VDNS:

- India plans to complete the remaining activities related to the long-term safety enhancements identified subsequent to the accident at Fukushima Daiichi NPP and the on-going action for issuance of the remaining regulatory documents.

The Country Group made the following observation:

- India complies with the VDNS principles.

5. Results of the Review

5.1 General Quality of the National Report

Contracting Parties and officers were invited to provide general comments on the India implementation of the obligations of the CNS (e.g., report submitted on time), addressed all articles, addressed the Vienna Declaration on Nuclear Safety, and addressed all Challenges, the general quality of its National Report, transparency issues, and the compliance with the CNS guidance documents and Major Common Issues identified in the previous CNS Review Meeting.

With regards to the general quality of the National Report and transparency issues, the members of the Country Group made the following observations:

- The Report is comprehensive, very well written, informative, and reader friendly.

- The Report addresses all obligations of the CNS.
- The Report follows the recommendations of the President's 23 June 2021 letter: it clearly highlights information that was updated since the last Report (Annexure), addresses new safety issues that have arisen since the previous report, reports on progress made on challenges from the 7th RM, and reports on experience with response to the COVID-19 pandemic.

With regards to the compliance with the requirements of the CNS and its Guidelines, the members of the Country Group made the following observations:

- The Report for the 8th CNS Review Meeting was submitted on the deadline of 15 August 2019.
- The Report for the Joint 8th and 9th CNS Review Meeting was submitted before the deadline of 5 August 2022.
- The content and structure of India's National Report for the Joint 8th and 9th CNS Review Meeting complies with the CNS guidance.
- The directions of the Summary Report of 7th CNS Review Meeting were taken into consideration in the Report for the Joint 8th and 9th CNS Review Meeting.

5.2 Participation in the Review Process

With regards to India's participation in the review process, the members of the Country Group made the following observations.

In the 8th CNS Review Cycle, India:

- posted questions to Contracting Parties.
- delivered answers to the questions of Contracting Parties on time.

In the 9th CNS Review Cycle, India:

- posted questions to Contracting Parties.
- delivered answers to the questions of Contracting Parties on time.
- delivered its national presentation during the Joint 8th and 9th Review Meeting.

5.3 Challenges

The Country Group did not identify any Challenges for India.

5.4 Suggestions

The Country Group identified the following Suggestion for India:

- **Suggestion 1:** Continue pursuit of converting the AERB's functional independence into de-jure independence

5.5 Good Practices and Area of Good Performance

During the peer review of India's National Report, the Contracting Parties were invited to recommend Good Practices and to highlight Areas of Good Performance.

The Country Group did not identify any Good Practices.

The following Areas of Good Performance of India were commended by the Country Group:

- **Area of Good Performance 1:** Establishment of a system for safety culture assessment of operating NPPs
- **Area of Good Performance 2:** Multi-tier system of safety review and assessment implemented at the Regulatory Body
- **Area of Good Performance 3:** Organization of annual National Conference on Regulatory Interface (NCRI) with a purpose to create a common platform for the Licensee,

vendors/suppliers and the regulators to share experience feedback on regulatory requirements, emerging trends and changes required in regulatory regime

- **Area of Good Performance 4:** NPCIL's innovative efforts in establishing the state-of-art "hall of nuclear power" gallery in Mumbai, New Delhi, and Chennai in seeking to create public awareness and educating interested parties in nuclear technologies
- **Area of Good Performance 5:** Basic competency development in Human and Organizational Factors (HOF) and addressing Human, Organizational & Technical (HOT) factors following systemic approach holistically in review and investigation of safety cases rather than separating HOF from technical factors
- **Area of Good Performance 6:** Knowledge Management Programme with proper alignment among people, process and technology as part of management system (utilities as well as regulatory body); regular induction of human resource at different levels of organizations from different sources with due orientation programme commensurate with their background; competence development during service; use of retired experts; effective record and information system
- **Area of Good Performance 7:** Integration of graded approach in all regulatory and associated processes through IMS with formal guidance document for implementation system

5.6 Response to COVID-19 Situation

The Country Group took note of the following information related to the COVID-19 pandemic:

India reported that the licensees took the following actions to address difficulties during the pandemic:

- NPPs periodically reported on the number of COVID-19 infections at the sites to AERB in accordance with directives of AERB. Since NPPs are located away from urban centres, there was no large scale spread of COVID-19 infection in these facilities. The required manpower was ensured at sites. Reserve manpower was also maintained at NPPs for unforeseen exigencies.
- The nuclear sector has been taking required measures to protect the staff from COVID-19 infection. These include general awareness on preventive measures for COVID-19, maintaining social distance, wearing masks, conduct of meetings in virtual/hybrid mode, sterilization of work area, temperature screening of employees, no-touch entry to the premises, arrangement of necessary medical facilities, vaccination drives for the staff, etc.
- Essential consumables/spares and fuel required for safe operation of NPPs was ensured by making special arrangements for their supply and transportation.
- Most of the planned activities including planned shutdown and maintenance activities were carried out with necessary precautions during the lockdown. Some of the planned outages were rescheduled after necessary reviews and approvals.
- NPPs conducted the plant emergency and site emergency exercises as per schedule. The off-site exercises were not conducted due to restrictions on activities in the public domain.

India reported that the regulator took the following actions during the pandemic:

- At the early phase of the lockdown, AERB had advised the NPPs to revisit their respective Emergency Preparedness and Response Plans to identify the need of augmentation of any additional resources/change in the preparedness and response plans considering COVID situation, as well as to apprise the respective local administrators/governments of the same. AERB advised NPPs to continue testing their preparedness for off-site emergency response through table-top off-site exercises.
- The Crisis Management Group of the Department of Atomic Energy (CMG-DAE) continued its function of overseeing the emergency preparedness for responding to any radiation emergency in the public domain and coordinating response actions with state or national level

public officials/agencies. During the pandemic, it was ensured that at least one of the Emergency Control Rooms (ECRs) of CMG-DAE remained functional. These control rooms, manned on round-the-clock basis and equipped with diverse means of communication; were in contact with various nuclear facilities in the country, with Ministry of Home Affairs (MHA) as well as with the IAEA in Vienna.

- The government offices, including AERB, remained functional in Work-From-Home (WFH) mode in the initial phases of the lockdown. With relaxation of restrictions in phases, the proportion of personnel working from the office was progressively increased. The Information Technology (IT) infrastructure was enhanced so that during the entire period of lockdown, AERB had access to email, telephone & videoconferencing facilities for regular communication with NPPs as well as for discharging its regulatory responsibilities. Meetings of safety review committees and for other regulatory activities were mostly conducted in the virtual/hybrid mode. AERB conducted many public awareness programs and webinars in virtual mode. International cooperation activities were continued through virtual means. Updates on important issues were posted on AERB website from time to time.
- AERB maintained its regulatory oversight of NPPs through review of periodic reports on safety status of the NPPs, event reports, etc. AERB stayed in regular communication with NPP authorities to obtain safety status of NPPs.
- Nuclear and Radiation Emergency Monitoring Centre (NREMC) of AERB continued to be available to receive information on any emergency situation round the clock.
- Onsite regulatory inspections of AERB were affected. To overcome this challenge, AERB devised alternate method for regulatory inspections, viz. Remote Regulatory Inspection process. It involves review of self-assessment checklist filled by the NPPs, on-line interaction with NPP personnel and verification by photographic/video-graphic evidence, as necessary. AERB Site Observer Teams (SOTs) deputed at NPP sites continued to report on the safety status of NPPs on daily basis. AERB has resumed the regular onsite inspections from the first quarter of year 2022.
- AERB shared the 'Action Plans adopted by NPPs worldwide to manage risks related to COVID-19' received from IAEA with NPPs. India also shared information on the measures adopted in the Indian nuclear industry in the wake of pandemic with the international community.

6. Fulfilment of CNS Review Requirements

The Country Group concluded that India:

- Submitted National Reports for the 8th CNS Review Meeting and for the Joint 8th and 9th CNS Review Meeting, and therefore complies with Article 5, and in time, following Rule 39 of INFCIRC/573/Rev.6.
- Attended the Joint 8th and 9th CNS Review Meeting, and therefore complies with Article 24.1.
- Held a national presentation and answered questions, and therefore complies with Article 20.3.