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INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

MISSION

TO

INDIA

Mumbai, India

16-27 March 2015

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY

Integrated Regulatory Review Service
IRRS

Integrated
Regulatory
Review Service

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INTEGRATED REGULATORY REVIEW SERVICE (IRRS)
REPORT TO
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Mission dates:	*16 to 27 March 2015*
Regulatory body visited:	*Atomic Energy Regulatory Board (AERB)*
Location:	*Mumbai, India*
Regulated facilities and activities in the mission scope:	*Nuclear Power Plants*
Organized by:	*IAEA*

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The number of recommendations, suggestions and good practices is in no way a measure of the status of the regulatory body. Comparisons of such numbers between IRRS reports from different countries should not be attempted.

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EXECUTIVE SUMMARY

At the request of the Government of India, an international team of senior safety experts visited the Atomic Energy Regulatory Board (AERB) of India from 16 to 27 March 2015 to conduct an Integrated Regulatory Review Service (IRRS) Mission.

The IRRS mission was limited in scope and only covered nuclear power plants (NPPs). The mission compared the AERB regulatory framework for safety against IAEA safety standards as the international benchmark for safety. The mission was also used to exchange information and experience between the IRRS review team members and the Indian counterparts in the areas covered by the IRRS.

The IRRS review team consisted of eleven senior regulatory experts from nine IAEA Member States, five IAEA staff members and one IAEA administrative assistant. The IRRS review team conducted a review of the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including authorization, review and assessment, inspection, enforcement and development and content of regulations and guides; emergency preparedness and response as well as lessons learned from the TEPCO-Fukushima Dai-ichi accident. The IRRS mission also included discussions on policy issues regarding the licensing of imported reactors by the AERB and the safety culture evaluation and its application in regulatory decision-making.

In preparation for the IRRS mission, India conducted a self-assessment and prepared a preliminary action plan to address weaknesses that were identified. The results of the self-assessment and supporting documentation were provided to the team as advance reference material for the mission. During the mission, the IRRS team performed a systematic review of all topics presented in the advance reference material. The mission included a series of interviews and discussions with the AERB Chairman, management and staff from the AERB, the Chairman of the Atomic Energy Commission (AEC), the Director of the Bhabha Atomic Research Center (BARC), and the Chairman and Managing Director of the Nuclear Power Corporation of India Limited (NPCIL) to help assess the effectiveness of the regulatory system. It also included a visit to Kakrapar (KAPS) Nuclear Power Plant, including units under construction, to gather direct observations of the implemenation of the regulatory programme during safety inspections carried out by the AERB and activities related to emergency preparedness and response. This visit included discussions with the NPCIL management and staff including the Project Director, Construction manager, and Quality Assurance Manager.

Throughout the mission, the IRRS team received full cooperation in regulatory, technical, and policy issues by all parties; in particular the staff of the AERB.

The Republic of India has engaged in an ambitious energy policy, of which nuclear energy is a major element. It is forecasted that the nuclear power generation in India will increase significantly over the next decades. The IRRS team acknowledges that the AERB will face many upcoming challenges in regulating nuclear safety such as continuing to reinforce the safety of existing nuclear facilities, monitoring ageing, decommissioning, as well as construction, commissioning and operation of new NPPs.

The AERB was established by law in 1983 to oversee the safety of facilities and activities, as well as for the enforcement of safety related rules. Over the years, the AERB has developed codes and standards to conform with the IAEA safety standards and international best practices. The IRRS team recognized that the AERB continues to update its regulatory requirements and encouraged the AERB to further enhance its regulatory framework. In this regard, the IRRS team identified a number of good practices that should be considered for implementation by other Member States and identified recommendations and suggestions for improvements to better align the AERB’s regulatory functions with the IAEA Safety Standards.

The IRRS team found that India has an experienced, knowledgable and dedicated regulatory body for the protection of the public and the environment. As a result, the IRRS team identified the following good practices:

- India has a comprehensive and well established national educational and training system that supports competence building for its nuclear programme
- The AERB takes full benefit from operational experience with the aim of continuously enhancing its regulatory framework and processes
- The AERB's research and development infrastructure provides strong regulatory review and assessment activities
- The scope and depth of the AERB recruitment and training programme is effective in maintaining a knowledgable technical staff

The IRRS review team also identified certain issues warranting attention or in need of improvement and believes that consideration of these would enhance the overall performance of the regulatory system. Most important are:

- The Government should promulgate a national policy and strategy for safety, as well as a radioactive waste management strategy as a statement of the Government's intent
- The Government should embed in law, the AERB as an independent regulatory body separated from other entities having responsibilities or interests that could unduly influence its decision making
- The AERB should review the implementation of its policy and existing arrangements to ensure it maintains independence in the performance of its regulatory functions.
- The AERB should consider increasing the frequency of routine on-site inspections at NPPs. The increased frequency of inspections would allow for additional independent verification and more effective regulatory oversight of NPPs.
- The AERB should develop and implement its own internal emergency arrangements including detailed procedures, for fulfilling its emergency response role.

The IRRS review team findings are summarized in Appendices VI and VII.

An IAEA press release was issued at the end of the IRRS mission.

I. INTRODUCTION

At the request of the Government of India, an international team of senior safety experts met representatives of the Atomic Energy Regulatory Board (AERB) of India from 16 to 27 March 2015 to conduct an Integrated Regulatory Review Service (IRRS) mission. The purpose of the peer review was to review India's regulatory framework for nuclear safety applicable to nuclear power plants. The review mission was formally requested by the Government of India in January 2014. A preparatory meeting was conducted from 7 to 8 October 2014 at the AERB Headquarters in Mumbai to discuss the purpose, objectives, scope and detailed preparations of the review in connection with the facilities regulated by the AERB and selected safety aspects.

The IRRS review team consisted of eleven senior regulatory experts from nine IAEA Member States, five IAEA staff members and one IAEA administrative assistant. The IRRS review team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides, and emergency preparedness and response. As recommended by the IAEA Nuclear Safety Action Plan, special attention was given to regulatory implications in the Indian framework for safety of the TEPCO-Fukushima Dai-ichi accident. In addition, regulatory policy issues were discussed, including: licensing of imported reactors by the AERB and safety culture evaluation and its application in regulatory decision making.

The AERB conducted a self-assessment in preparation for the mission and prepared a preliminary action plan. The results of the AERB self-assessment and supporting documentation were provided to the IRRS team as advance reference material for the mission. During the mission the IRRS review team performed a systematic review of all topics by reviewing the advance reference material, conducting interviews with management and staff from the AERB, the BARC, the DAE and the NPCIL, and performed direct observation of the AERB working practices during inspections.

All through the mission the IRRS team received excellent support and cooperation from the AERB.

II. OBJECTIVE AND SCOPE

The purpose of this IRRS mission was to conduct a review of India's nuclear safety regulatory framework and activities to review its effectiveness and to exchange information and experience in the areas covered by the IRRS. The IRRS review scope was limited to nuclear power plants (NPPs), and the good practices, suggestions and recommendations identified during the mission are applicable to NPPs only. The review was carried out by comparison of existing arrangements against the IAEA safety standards.

It is expected that the IRRS mission will facilitate regulatory improvements in India and other Member States from the knowledge gained and experiences shared between the AERB and IRRS reviewers and through the evaluation of the effectiveness of the Indian regulatory framework for nuclear safety.

The key objectives of this mission were to enhance nuclear safety and emergency preparedness and response:

- Providing India and the AERB, through completion of the IRRS questionnaire, with an opportunity for self-assessment of its activities against IAEA safety standards;
- Providing India and the AERB with a review of its regulatory programme and policy issues relating to nuclear safety and emergency preparedness;
- Providing India and the AERB with an objective evaluation of its nuclear safety and emergency preparedness and response regulatory activities with respect to IAEA safety standards;
- Contributing to the harmonization of regulatory approaches among IAEA Member States;
- Promoting the sharing of experience and exchange of lessons learned;
- Providing reviewers from IAEA Member States and the IAEA staff with opportunities to broaden their experience and knowledge of their own fields;
- Providing key AERB staff with an opportunity to discuss their practices with reviewers who have experience with different practices in the same field;
- Providing India and the AERB with recommendations and suggestions for improvement; and
- Providing other States with information regarding good practices identified in the course of the review.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Government of India, a preparatory meeting for the Integrated Regulatory Review Service was conducted on October 7-8, 2014 at the AERB headquarters in Mumbai. The preparatory meeting was carried out by the appointed Team Leader Mr. Ramzi Jammal, Deputy Team Leader Mr. David Senior, and the IRRS IAEA Team representatives Mr. Tim Kobetz and Mr Jean-Francois Lafortune.

The IRRS mission preparatory team had discussions regarding regulatory programmes and policy issues with the senior management of the AERB represented by Mr S.S. Bajaj, Chairman, AERB and other senior management and staff. The discussions resulted in agreement that the regulatory functions covering the following facilities and activities were to be reviewed by the IRRS mission:

- Nuclear power plants;
- Regulatory implications of the TEPCO Fukushima Dai-ichi accident; and
- Selected policy issues.

Management and staff from the AERB made presentations on the national context, the current status of the AERB and the self-assessment results to date.

The IAEA staff presented the IRRS principles, process and methodology. This was followed by a discussion on the tentative work plan for the implementation of the IRRS in India in March 2015.

The proposed IRRS review team composition (senior regulators from Member States to be involved in the review) was discussed and the size of the IRRS review team was tentatively confirmed. Logistics including meeting and work space, counterparts and Liaison Officer identification, proposed site visits, lodging and transportation arrangements were also addressed.

The AERB Liaison Officer for the preparatory meeting was Mr. R.Bhattacharya, and the Liaison Officer during the mission were Mr. R. Bhattacharya and Mr. S. Harikumar acting as alternate Liaison Officer.

The AERB provided IAEA (and the review team) with the advance reference material for the review in January 2015, including the self-assessment results. In preparation for the mission, the IAEA review team members conducted a review of the advance reference material and provided their initial review comments to the IAEA Team Leader prior to the commencement of the IRRS mission.

B) REFERENCE FOR THE REVIEW

The most relevant IAEA safety standards were used as review criteria. A more complete list of IAEA publications used as the reference for this mission is given in Appendix IX.

C) CONDUCT OF THE REVIEW

An opening IRRS review team meeting was conducted on Sunday March 15, 2015 in Mumbai by the IRRS IAEA Team Coordinator and IRRS Team Leader to discuss the general overview, the focus areas and specific issues of the mission, to clarify the basis for the review and the background, context and objectives of the IRRS and to agree on the methodology for the review and the evaluation among all reviewers. They also presented the agenda for the mission.

In addition, the IAEA Team Coordinator, Deputy Team Coordinator and Review Area Facilitator presented refresher training on the conduct of IRRS missions and the expectations regarding the review of module on the “Regulatory implications from TEPCO-Fukushima Dai-ichi Accident”.

The Liaison Officer and alternate were present at the opening IRRS review team meeting, in accordance with the IRRS guidelines, and presented logistical arrangements planned for the mission.

The reviewers also reported their first impressions of the advance reference material.

The IRRS entrance meeting was held on Monday March 16, 2015, with the participation of the AERB and DAE senior management and staff. Opening remarks were made by Mr. S.S. Bajaj, Chairman AERB and Mr. Ramzi Jammal, IRRS Team Leader. Mr. R.Bhattacharya, Vice Chairman AERB, gave an overview of India's context, the AERB's regulatory structure and an overview of major areas discussed in the self-assessment.

During the mission, a review was conducted for all the review areas with the objective of providing India and the AERB with recommendations and suggestions for improvement as well as identifying good practices. The review was conducted through meetings, interviews and discussions, a visit to an NPP and direct observations regarding the national practices and activities.

The IRRS review team performed its activities based on the mission programme given in Appendix II.

The IRRS exit meeting was held on Friday, 27 March 2015. The opening remarks at the exit meeting were presented by Mr. S.S. Bajaj, Chairman AERB, and were followed by the presentation of the results of the mission by the IRRS Team Leader Mr. Ramzi Jammal. Mr. Denis Flory, IAEA Deputy Director General and Head of the Department of Safety and Security made an address and IRRS Team Leader Mr Ramzi Jammal handed over the IRRS report to Mr. S.S. Bajaj, Chairman AERB. Closing remarks were made by Mr. R. Bhattacharya, Vice-Chairman AERB and Liaison Officer.

A press release was issued at the end of the mission.

1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

1.1. NATIONAL POLICY AND STRATEGY FOR SAFETY

The IRRS team was informed that long term commitment to nuclear safety is affirmed by the Atomic Energy Act, 1962 as well as by the Government of India being a party to relevant international conventions, including the Convention on Nuclear Safety. The Government considers the national policy and strategy for safety as being established through legislation within the Atomic Energy Act (AEA) 1962, associated Atomic Energy Rules and the AERB Safety Codes and Standards. Exercising its power of authority given by the Act, the Government has issued the Atomic Energy (Radiation Protection) Rules, 2004; the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987; the Atomic Energy (Factories) Rules, 1996; the Atomic Energy (Working of the Mines Minerals and Handling of the Prescribed Substances) Rules, 1984, and the Atomic Energy (Radiation Processing of Food and Allied Products) Rules, 2012; which represent the basis of the regulatory framework for the safety of the activities relating to use of nuclear energy and regulatory control.

The AEA along with rules issued thereunder and the safety codes issued by the AERB address the fundamental safety principles from which the regulatory requirements are drawn.

The IRRS team was provided with the decision of the Supreme Court of India under Civil appeal 4440 of 2013. The Court decided that India's national policy has been clearly and unequivocally expressed through legislation within the AEA and that the term "welfare" covers both public safety and the welfare of citizens and considers both the living generation and generations to come.

IRRS team concluded that the elements of a national policy and strategy for safety are specified in various Codes and Standards issued by the AERB. These requirements have been developed with due account of the IAEA Standards and in particular with the fundamental safety principles established by SF-1 Safety Fundamentals. The AERB has made an effort to gather all elements of the national policy in a separate policy document called "Policies Governing Regulation of Nuclear and Radiation Safety".

The IRRS team acknowledged the AERB’s efforts to demonstrate country commitments, but has concluded that while the policy elements are established through the legislation and regulatory framework, the adoption of a comprehensive national policy and strategy for safety would be beneficial for the country, especially for a country with a growing nuclear power programme. Such a policy and strategy should be issued by the Government and due attention should be paid to the application of a graded approach to safety by the Government and the unequivocal declaration of a national long term commitment to safety.

The IRRS team noted that the graded approach to nuclear safety is not explicitly stated in the AEA. Nevertheless, the rules and the respective requirements provide a basis for the application of the graded approach in respect to licensing, regulatory requirements, etc. For example the Atomic Energy (Radiation Protection) Rules, 2004 establish a sound basis for the application of graded approach in the licensing process. The rules specify different categories of facilities and activities, depending on the associated radiological hazard and risk, and establish different types of supervision to the various categories of facilities and activities. The rules also introduce the principle of ‘exemption’ of sources or practices with lower risk from regulatory control.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *A National Policy and Strategy for Safety has been established throughout the legal framework, however it has not been promulgated as a statement of the Government's intent.*	
(1)	**BASIS: GSR Part 1 Requirement 1 states that** *"The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals."*
(2)	**BASIS: GSR Part 1 para. 2.3. states that** *"National policy and strategy for safety shall express a long term commitment to safety. The national policy shall be promulgated as a statement of the government's intent. The strategy shall set out the mechanisms for implementing the national policy."*
R1	**Recommendation: The Government should adopt and publish national policy and strategy for safety as a statement of the Government's intent.**

1.2. ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

The fundamental law in the nuclear and radiation field is the Atomic Energy Act of 1962. The Act specifies the authorities and responsibilities in respect to (i) production, development, use and disposal of atomic energy and (ii) control over radioactive substances or radiation generating plants in order to prevent radiation hazards and securing safety of public and occupational personnel and ensuring safe disposal of radioactive wastes. The Act covers both the promotion and regulation of nuclear energy. Among others bodies, it empowers the Government to issue Rules for implementation of the Act with the objective of securing the safety of the public, environment and workers and gives the competent authority the powers to enter and inspect any facility, as well as to take appropriate enforcement actions. These rules have the statute of laws and together with the Act itself establish the basis of the governmental and regulatory framework.

In respect to nuclear facilities, the Government has issued the:

- Atomic Energy (Radiation Protection) Rules, 2004
- Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
- Atomic Energy (Factories) Rules, 1996

The Atomic Energy (Radiation Protection) Rules, 2004 explicitly lists all of the regulated facilities and activities and specifies the licensing basis for different types of facilities. It also specifies the principle that "The licence shall not be transferable without the prior approval of the competent authority", as well as the principles of "Exemption" and "Exclusion". The Atomic Energy (Radiation Protection) Rules, 2004 defines the responsibilities of the "employer" and the "licensee".

The AERB constitution order empowers the Competent Authority (AERB) to enforce the safety related rules and requirements under the Atomic Energy Act. The AERB constitution together with the Atomic Energy (Radiation Protection) Rules, 2004 vests the AERB with the authority to develop and issue safety codes and standards and to develop safety policies in the areas of radiation and industrial safety. These Safety Codes and Standards are mandatory and secure the legally binding framework for safety. To date the AERB has issued about 150 safety documents including Codes and Standards covering both the licensing and safety assessment review processes, as well as defining specific nuclear safety related technical requirements. A list is attached. Specific Codes and Standards issued by the AERB are covered in more detail within the different sections of this report.

The IRRS team did not identify any other authority having regulatory functions in respect to NPPs except the AERB. The AERB was vested with, amongst other functions, the responsibility for regulating industrial and fire safety at the nuclear facilities. It should be noted that for some regulatory functions the requirements of additional legislation is also applicable which is applicable to other industrial safety applications and being enforced by other Government authorities. Examples are land use, environment, etc. However, the IRRS team did not find any evidence for overlapping or conflicting requirements. There is a practice of inducting the representatives of these authorities as required, in the regulatory process for nuclear facilities through membership of the various AERB safety committees.

The provisions with respect to appeal against regulatory decisions are given in the end of Para 2 of the constitution of the AERB, which states that the appeals against decisions of the AERB shall be with the Atomic Energy Commission (AEC) whose decision shall be final. However, the AERB decisions could be appealed against in the court. An example of that is the appeal against the AERB decision on commissioning of Kudankulam NPP. The respective AERB decision was appealed before the High Court and later on before the Supreme Court of India. Both courts confirmed the AERB's decision.

1.3. ESTABLISHMENT OF A REGULATORY BODY AND ITS INDEPENDENCE

The Atomic Energy Regulatory Board (AERB) was established by the Government of India with reporting to the Atomic Energy Commission. The Atomic Energy Commission (AEC) is the high level governing body with overall responsibility for policy matters relating to the use of nuclear energy in India. The AERB is administratively responsible and accountable to the AEC which also exercises overall governance of the nuclear industry through the DAE organisational framework to the operating organisations including the Nuclear Power Corporation of India (NPCIL) and Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI).

During discussions with the IRRS team the AEC, AERB and NPCIL emphasised that the regulation of the nuclear industry is conducted on an independent basis. The AEC was described as a facilitating function into Government for the AERB with governance matters limited to the approval of the financial budget and presentation of annual reports. The IRRS team met separately with both the Chair of the AEC and Chairman & Managing Director (CMD) of the NPCIL. The Chair of the AEC emphasised that the Commission did not in any way influence, interfere with or supervise regulatory decision making that was entrusted to the AERB Chair and Committees. This was reiterated by the CMD of the NPCIL who cited direct evidence of giving nuclear safety absolute priority over commercial considerations. The IRRS team noted the professionalism and integrity of the AEC, NPCIL and AERB senior staff towards ensuring the regulatory decision making processes/arrangements were completed independently and did not notice instances, in which de-facto AERB independence was compromised.

It was noted that the AERB has been established using the legal provisions of the AEA.With the statutory and legal provisions of the Atomic Energy Act and various rules framed thereunder and the powers conferred by its constitution, the AERB has the necessary legal authority for its regulatory activites. The mandate of the AERB doesn't include any functions other than regulation of nuclear and radiation safety. These provide functional independence for the AERB as a regulator.

The IRRS team noted that as the governance framework of atomic energy has both the nuclear industry and regulatory body reporting to the AEC, there isn't clear separation of regulation with the potential to compromise the independence of the AERB. The IRRS team considers that the regulatory body should be constituted through a legislative process thus demonstrating clear legal (de-jure) independence from the industry. Towards this, the IRRS team was informed that in 2011, the Nuclear Safety Regulatory Authority (NSRA) Bill was drafted by the DAE and submitted to the Union Cabinet for approval. The objective of the NSRA Bill was to establish a separate statutory framework for nuclear safety regulation in India. With the formation of the 16th Lok Sabha (Lower house of the Parliament) the Bill needs reintroduction following the governmental and parliamentary procedures. This process is currently under

way. The IRRS team noted that the Public Accounts Committee (PAC) and Comptroller and Auditor General (CAG) had undertaken both audit and review activities of the AERB during the period the NSRA Bill was being progressed with these bodies commenting on the need for the regulatory body to be established through legislation on a legally independent basis.

The IRRS team has concluded that in order to ensure the independence of the regulatory body is clear and transparent the Government should strengthen the legislative framework by creating in law, the AERB as a regulatory body separated from entities having responsibilities or interests that could unduly influence its decision making.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team noted that while the AERB has necessary functional independence, the governmental framework for atomic energy has both the nuclear industry through the DAE and the regulatory body reporting to the Atomic Energy Commission (AEC) and there isn't clear separation of nuclear regulation with the potential to compromise the independence of Atomic Energy Regulatory Board (AERB).*	
(1)	**BASIS: GSR Part 1 Requirement 4 states that** *"The government shall ensure that the regulatory body is effectively independent in its safety related decision making and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making."*
R2	**Recommendation: The Government should embed in law, the AERB as an independent regulatory body separated from other entities having responsibilities or interests that could unduly influence its decision making.**

1.4. COMPLIANCE WITH REGULATIONS AND RESPONSIBILITY FOR SAFETY

The Atomic Energy Act (1962) sets out the legal responsibility for safety. The AERB is established as the regulatory authority as set out under sections 16, 17 and 23 of the Act.

As the Competent Authority for regulation, the AERB grants licences in accordance with sections 16 and 17 of the Act. The Atomic Energy (Radiation Protection) Rules (2004) clearly state the requirement for a licence for all facilities and activities governed by the Act which are stated to be 'radiation installations and installations for the handling of radioactive sources'.

Using the powers of the Act and the Atomic Energy Rules, the AERB has issued a number of Safety Codes and Standards. The AERB safety code on 'Regulation of Nuclear and Radiation facilities' (AERB/SC/G) states the requirements to be met by the licenced facility.

The Rules state that the Licensee has prime responsibility for safety, the licence is not transferable without prior approval of the competent authority (AERB) and it covers all stages of the lifetime of a facility. The IRRS team noted that in accordance with the Legal system in India the Licensee is an appointed 'Individual'.

The IRRS team is satisfied from its assessment of the Advanced Reference Material and through the IRRS team's examination of relevant parts of the legislation, that the Government has demonstrated compliance with the relevant IAEA Requirements in this area.

1.5. COORDINATION OF AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

The licensing of nuclear facilities is covered by the Atomic Energy (Radiation Protection) Rules (2004) which clearly identifies the AERB as the single competent authority with responsibility for regulation of radiation safety on civil nuclear installations. In addition to radiation safety the AERB has been empowered to administer the provisions of the Factories Act, 1948 (industrial safety in the NPPs) and

perform certain functions of the Environment (Protection) Act, 1986. The IRRS team was appraised of the arrangements in place covering the allocation of responsibilities for the regulation of nuclear installations including new build and was satisfied that the respective responsibilities and interfaces were clearly defined.

The IRRS team is satisfied from its assessment of the Advanced Reference Material and through the IRRS team's examination of relevant parts of the legislation and arrangements, that the Government has provided for the effective coordination of authorities with responsibilities for safety and environmental protection within the regulatory framework in compliance with the relevant IAEA Requirements.

1.6 SYSTEM FOR PROTECTIVE ACTIONS TO REDUCE UNREGULATED RADIATION RISKS

The Atomic Energy (Radiation Protection) Rules (2004) provide for specifying the criteria for exemption of radioactive materials from regulatory control and exclusion. This applies mostly to naturally occurring radio-nuclides present in the human body, cosmic radiation at the earth surface, concentrations of radio-nuclides in raw materials, etc. An AERB Safety Directive No.1/2010 covers the criteria for exclusion, exemption and clearance of radio-nuclides in solid materials.

It should be noted that the AERB Code on Radiation Protection specifies the requirements and criteria for remediation of contaminated sites.Further activities to improve regulatory processes are being implemented in this area. The IRRS team noted the application of these regulatory arrangements as applied on the NPP sites but cannot extrapolate or comment on the adequacy of the position for other facilities as well as for other practices.

As the scope of the mission is restricted to regulated civil Nuclear Power Plant (NPP) facilities the IRRS team has not made any substantive conclusion as to the Government's compliance with the relevant IAEA Requirements in this area.

1.7. PROVISIONS FOR DECOMMISSIONING AND MANAGEMENT OF RADIOACTIVE WASTE AND SPENT FUEL

According to the legal and regulatory requirements in place, decommissioning is the responsibility of the owner of the facility. To commence decommissioning the owner is required to obtain a decommissioning license. A preliminary decommissioning plan (decommissioning concept) should be developed at the design stage of the facility. The plan is required to include the feasibility analyses of facility decommissioning options and to verify that the facility could be safely decommissioned after its shutdown. The preliminary decommissioning plan is required to be reviewed on periodic basis and should cover characterisation of the radioactive inventory, decontamination and dismantling activities, waste management requirements, safety assessments, human resource requirements etc.

Basic decommissioning requirements are set out within the Code on Waste Management (AERB/SC/RW). They are further developed in the AERB Safety Guide on Decommissioning of Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/RW-8). In addition, in December 1988 the Government established a decommissioning fund to ensure that sufficient financial resources will be available for the safe decommissioning of the NPPs. In this respect the utility NPCIL charges a decommissioning fee, which currently amounts to 0.02 rupee per KWh of the generated electricity. The IRRS team was advised that decommissioning contributions to the fund are reviewed periodically and the fund is managed by the NPCIL.

The AEA1962 sets out the principle that atomic energy shall be used for the welfare of the people of India. It gives the Government of India, the authority and responsibility to issue Rules (laws) and among others to "ensure safe disposal of radioactive wastes (RAW)". In India, only the Government (or a Government company or a corporation established by the Government) is allowed to construct and

operate a NPP. So, the overall responsibility of RAW management and disposal of RAW lies with the Government of India.

The IRRS team was advised that the Government has ensured the availability of appropriate policies and strategies for RAW management, as well as the necessary infrastructure for the safe disposal of radioactive wastes. Following detailed discussions on the subject, the IRRS team was not able to find clear evidences of the existence of high level policies and strategies. The only evidence that was provided were the answers from the Government in reply to the Parliamentary questions, which provide the Government position on the management of RAW. It was stated that: "The safe management of nuclear waste has been accorded high priority right from the inception of our nuclear energy program. A comprehensive radioactive waste management approach has been established based on safe operational experience for more than four decades, taking into account the operational capability for the management of radioactive waste and an independent regulatory overview. Management of nuclear waste in Indian context includes all types of radioactive wastes generated from entire nuclear fuel cycle and also from installations using radionuclides in medicine, industry and research. Utmost emphasis is given to waste minimisation, and volume reduction, in the choice of processes and technologies adopted in radioactive waste management plants....".

However, these statements of the Government do not provide sufficient information on Government plans and programmes for RAW, including interim targets and end states. Based on this evidence, the IRRS team concluded that it would be beneficial for India to develop a RAW Management Strategy, which should cover short and long term plans and measures and include the Governmental policy and respective strategy for the lifetime of the facilities.

The IRRS team was informed that India follows a closed nuclear fuel cycle and it treats the spent fuel as a resource to meet the future energy needs. India approach is related to reduction in volume of high level waste (HLW). This HLW generated will be vitrified and stored for about sixty years in the storage facilities. After generation of adequate quantities of HLW, India would consider creating deep geological repositories for storing this HLW.

In respect of R&D arrangements for RAW, the Government has established programmes for the development of the necessary technologies, infrastructure and competence. Programmes focus on the long term utilisation of nuclear energy and ionising radiation for the welfare of the people of India. The IRRS team did not find any issues related to the transfer of responsibilities and the interdependences in the management of radioactive waste.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team noted the significant commitment and progress in India to developing solutions for managing radioactive waste. However, there was no evidence of the existence of a formal national radioactive waste management strategy.*	
(1)	**BASIS: GSR Part 1 para. 2.28. states that** *"Decommissioning of facilities and the safe management and disposal of radioactive waste shall constitute essential elements of the governmental policy and the corresponding strategy over the lifetime of facilities and the duration of activities [3, 7]. The strategy shall include appropriate interim targets and end states...."*
(2)	**BASIS: GSR Part 1 para. 2.29. states that** *"In strategies for radioactive waste management, account shall be taken of the diversity between types of radioactive waste and the radiological characteristics of radioactive waste."*
R3	**Recommendation: The Government should promulgate a national radioactive waste management strategy in support of the Government declaration on the management of**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	radioactive waste.

1.8. COMPETENCE FOR SAFETY

The AEA sets the fundamental requirement for providing sufficient human resources with appropriate qualification and skills. The Government well understands the importance of the availability of sufficient number of competent and qualified experts (engineers and scientists) for the success of its nuclear programme. In this respect the Government has allocated enormous efforts on the establishment of a sustainable programme on education and training of nuclear human resources.

The educational policy is implemented by the Ministry of Human resources Development, which is responsible for the general system of higher education. The country has about 700 universities where students study engineering and science specialities. The graduates from these universities represent the pool from which companies and governmental organisations may select employees

In the implementation of this policy, the Government through the DAE had established the Bhabha Atomic Research Centre. The training and educational programme, which was initiated in 1957 with the foundation of a "Training School" to provide for the broad-based training in the field of nuclear science and engineering. Later on, when the country started the expansion of its nuclear power programme, Nuclear Training Centres (NTC) were also created by the utility. Recently, such training centres operate at the Raja Ramanna Centre for Advanced Technology, Indore (RRCAT), Nuclear Fuel Complex, Hyderabad (NFC) and Indira Gandhi Centre for Atomic Research, Kalpakkam (IGCAR). Up to now, about 10,000 engineers and scientists have been educated and trained by these institutions.

Organisations have also established strong relationship with the higher education institutes in the country, e.g. the Indian Institutes of Technology (IIT) for the conduct of masters programmes in nuclear engineering. The DAE has established a 'DAE Graduate Fellowship Scheme' and the AERB has established 'AERB Graduate Fellowship Scheme'where it sponsors the masters students. The DAE Board of Research in Nuclear Sciences (BRNS) sponsors research projects in the field of Nuclear Science and Engineering at various educational institutes. The DAE 'Homi Bhabha National Institute' conducts masters and PhD programs in the areas of nuclear science and technology. Close cooperation with the academic institutions facilitates the use of DAE R&D facilities by the best candidates who take part in R&D projects.

All DAE organisations have created the Dedicated Knowledge Management Groups which to disseminate and further enhance the available knowledge. Country has ensured mechanisms by which AERB, BARC and NPCIL engineers and scientists take part in the international training programmes.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The Indian training and educational nuclear programme is commendable.*	
(1)	**BASIS: GSR Part 1 Requirement 11 states that** *"The government shall make provision for building and maintaining the competence of all parties having responsibilities in relation to the safety of facilities and activities."*
GP1	**Good Practice: India has established a unique educational and training system at national level that supports competence building for its nuclear programme, including the regulatory body.**

1.9. PROVISION OF TECHNICAL SERVICES

Various technical services relating to occupational radiation protection and safety are available in India, including external dosimetry services, laboratories for calibrating gamma and X-Ray dose rate survey equipment, environmental monitoring stations and radiation monitoring equipment, etc.

On a national level, the Bhabha Atomic Research Centre (BARC) has been involved in research in the areas related to radiological and environmental safety and has providing support for the development and deployment of the related technical services. This included the facilities for radiation monitoring instrumentation, dosimetry, environmental surveillance, etc. The BARC is supporting the establishment of Health Physics Units (HPUs) at the NPPs, including the related analytical facilities and laboratories. The BARC is operating the Environmental Survey Laboratories for environmental monitoring around the nuclear facilities.

The Government of India has established a system for technology transfer, where the know-how is transferred to all other governmental organisations, including NPPs as well as qualified private agencies. This includes assistance in establishing the required facilities and further accreditation of the facilities or labs. When needed, the BARC offers the required technical services on the basis of a MOU.

The IRRS team is satisfied from its assessment of the Advanced Reference Material and through the IRRS team's examination of relevant parts of the legislation and arrangements, that the Government has ensured the effective provision of technical services and has demonstrated compliance with the relevant IAEA Requirements.

1.10. SUMMARY

India has a structured and mature legislative and regulatory framework for the use of nuclear energy and providing protection against ionising radiation. The Government's commitment to nuclear safety is demonstrated through the Atomic Energy Act (1962) and associated series of Atomic Energy Rules.

However the IRRS team has identified areas for improvement and recommends that the Government should:

- promulgate the national policy and strategy for nuclear and radiation safety, as Government's intent, to underpin the safe operation of the existing nuclear power plants and nuclear new build programme in India.
- embed through legislation the AERB as an independent regulatory body that is in law separate from other entities having responsibilities or interests that could unduly influence its decision making.
- establish strategy for the management of radioactive waste.

The commitment in India to the future resilience of the nuclear industry is considered to be world leading and is identified as a good practice.

The IRRS team has concluded that the Government has:

- established a commendable educational and training system that robustly supports the provision of technical skills and capabilities to its nuclear programme including the regulatory body.

2. GLOBAL NUCLEAR SAFETY REGIME

2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR INTERNATIONAL COOPERATION

India is a contracting party to most of the international arrangements that are intended to enhance nuclear safety worldwide, namely:

- Convention on Physical Protection of Nuclear Material;
- Convention on Early Notification of a Nuclear Accident;
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
- Vienna Convention on Civil Liability for Nuclear Damage; (Signatory)
- Convention on Nuclear Safety.

The Government of India is committed to meeting its respective international obligations and developing its legal framework in a manner commensurate with the internationally accepted principles and standards. It follows the guidance of the Code of Conduct on the Safety and Security of Radioactive Sources; the Code of Conduct on the Safety of Research Reactors, as well as the Supplementary Guidance on the Import and Export of Radioactive Sources. In this respect, to foster exchanges of experience and good practices, India is taking active part in the related multilateral meetings and information exchanges on a regular basis.

India is not yet a contracting party to the Join Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (Joint Convention). The IRRS team was informed that India operates a closed fuel cycle and nuclear fuel is considered as resource material. Furthermore, India is a contracting party to the Convention on Nuclear Safety (CNS), which includes article 19 (viii) covering the matters for on-site management of spent fuel and radioactive waste.

The IRRS team was advised by the IAEA Office for Legal Affairs that there is an overlap between Article 19 (viii) of the CNS and Article 3.1 of the Joint Convention regarding on-site spent fuel and radioactive waste management. However, the scope of the Joint Convention is much broader than NPPs on-site arrangements (see preamble and articles 3.2 and 3.4).

The IRRS team encourages India to build on its participation in international arrangements and become a party to the Joint Convention and thus obtain full benefit from the information exchange and the peer-review processes.

India uses the IAEA safety requirements and guides as the basis for developing its national safety requirements. Furthermore, it is an active contributor to the process of establishing those standards by participation to the IAEA Nuclear Safety Standards Committee (NUSSC), Radiation Safety Standards Committee (RASSC), Transport Safety Standards Committee (TRANSSC) and Waste Safety Standards Committee (WASSC), as well as allocating significant resources for the working groups on development and revision of IAEA standards. For example, 64 Indian experts took part in the above mentioned process for the period 2013-2014.

The IRRS team was informed that all Indian NPPs have been peer-reviewed by WANO missions, including respective follow-up missions. The IRRS team was also advised that India has committed to the IAEA post-Fukushima action plan. Accordingly, the Government of India has requested international peer reviews related to the use of nuclear energy, namely the present IRRS mission, an OSART at the Rajasthan NPP held in Nov 2012 and OSART follow-up mission in February 2014. The IRRS team believes that to make better use of the various IAEA peer review services, the Government should be

encouraged to be more proactive and invite more international peer review services, according to its needs and to a predefined programme. This will support the country self-assessment initiatives and significantly contribute to the exchange of operating and regulatory experience.

With regard to international cooperation, the AERB has several bilateral agreements and cooperation programmes with the US NRC, ASN France, Rostechnadzor, Russian Federation and other regulatory bodies and organisations. The AERB is proactive in looking for bilateral agreements that will serve it in the future, justified by the latest agreements signed with the CNCAN (Romanian regulator;regulating CANDU reactors); Ukrainian Regulatory body in respect to safety of VVER plants; and the Finish regulatory body STUK in respect of the India EPR units.

India is also involved in various international forums for the co-operation and exchange of safety information, i.e. CSS, CRP, IRS, CANDU Senior Regulators Forum, VVER Regulators Forum, Multinational Design Evaluation Programme, etc. It should be noted that without being a Nuclear Energy Agency (NEA) member, India is an active player in the OECD/NEA activities (CNRA, CSNI, their working groups and NEA research projects like HYMERES, ATLAS).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *To date, India has invited only two IAEA services, namely OSART in 2012 and the recent IRRS mission.*	
(1)	**BASIS: GSR Part 1 para. 3.2. states that** *"The features of the global safety regime include: (a) International conventions that establish common obligations and mechanisms for ensuring protection and safety;"*
S1	**Suggestion: The Government should consider taking more benefit from the various IAEA peer review services by inviting more international reviews.**

2.2. SHARING OF OPERATING EXPERIENCE AND REGULATORY EXPERIENCE

Regulatory requirements specify that NPPs licensees shall report all safety related events to the AERB, and shall appropriately investigate and analyse them. Annually, the AERB receives from operating NPPs 400 to 500 event reports of which 30 to 40 significant event reports. Licensees are expected, when applicable, to disseminate the information internationally, i.e. to WANO, similar nuclear power plants, designers and manufacturers. The AERB publishes about 3 IRS reports per year, which is an indication of its commitment to share operating experience with international nuclear community. Foreign events are screened for applicability and when selected independently analysed. Corrective actions or measures, if any, arising out of analysis are timely implemented. However, the IRRS team identified that the loop is still open as there is no practice of reporting back the corrective actions and their effectiveness to the international community.

To fully benefit from the available information, the AERB has established a separate Operating Experience program which collects and utilizes the national and international operating as well as regulatory experience. The programme serves as "Continuous safety performance improvement tool" which collects and stores experience and records from domestic nuclear power plants, nuclear power projects, regulatory processes and various international co-operation arrangements (e.g. IAEA-IRS, INES, Convention reports, OECD-NEA committees and working groups, Regulators Forums, Peer Reviews, bilateral agreements, etc.). All the data is screened on a monthly basis to identify possible improvements. Improvements are categorised in the following categories:

- Enhance and maintain nuclear and radiation safety.
- Improve regulatory processes and requirements.
- Provide information to national & international stake holders.
- Enhance knowledge base and technical competence of regulatory staff.

The screening is carried out by a group of six to seven members, who are experts in different areas. The group screens all input records and assigns the possible improvements into the abovementioned categories. Group also prepares reports which are disseminated to the AERB staff.

Selected improvement records are reviewed by an Operating Experience Review Group (OERG), which consists of 10 AERB senior officials with vast experience in nuclear regulation and safety. The OERG evaluation comes out with an estimation of the importance of the selected issues. The group defines the actions to be taken for the continuous improvement of regulatory processes and documentation or plant safety. Actions are stored in an online database and are also disseminated to respective Directors of concerned AERB divisions. Established actions are inputs for the different regulatory processes as the respective procedures pay attention to the use of the database.

The IRRS team concludes this is a comprehensive and effective programme, which has a closed loop and significantly contributes to AERB strive for excellence.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *Established AERB system of use of feedback information and international contribution is a mature process. However, the element missing is the closure of the feedback loop by sharing the results of the use of external experience.*	
(1)	**BASIS: GSR Part 1 para. 3.5. states that** *"To enhance the safety of facilities and activities globally, feedback shall be provided on measures that have been taken in response to information received via national and international knowledge and reporting networks..."*
S2	**Suggestion: The AERB should consider including in its process on managing regulatory and operating experience the feedback on measures taken in response to internationally reported events.**
Observation: *The AERB has established a sound Operating Experience program which serves as "Continuous safety performance improvement tool", which provides for the effective use of feedback from all safety related, intelligence and other regulatory and safety records.*	
(1)	**BASIS: GSR Part 1 para. 3.4. states that** *"The regulatory body shall establish and maintain a means for receiving information from other States and from authorized parties, as well as a means for making available to others lessons learned from operating experience and regulatory experience....."*
GP2	**Good Practice: As part of its system for managing regulatory and operating experience, the AERB is taking full benefit from the incoming and generated records with the aim of continuously enhancing its regulatory framework and processes.**

2.3. SUMMARY

The IRRS team has concluded that India and the AERB generally fulfil their international obligations and actively participate in relevant international exchanges with other regulatory bodies and in the development of IAEA safety standards.

However, the IRRS team has identified areas for improvement and has concluded that the:

- The Government and the AERB should consider the benefits available from the various IAEA peer review services by inviting more international missions.
- The Government is encouraged to build on its participation in international arrangements and become a party to the Joint Convention and thus obtain full benefit from the information exchange and the peer-review processes

In respect of the use of international operating and regulatory experience, the AERB has successfully put in place a system to disseminate and process the lessons learnt and accumulated experience. This demonstrates the direct application of continuous improvement. This approach includes the use of intelligence from other member states and is considered to be a good practice through enhancing the safety of nuclear facilities in India and activities globally.

3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

The AERB is headed by the Board which is comprised of the AERB Chairman, five members and a secretary. The Board formulates the regulatory policies and decides on all important matters. The Chairman of the Safety Review Committee for Operating Plants (SARCOP) is an ex-officio member of the Board of the AERB. The other four members are external members who are distinguished academicians/ professionals in their respective field of expertise and have experience in areas interfacing with nuclear and radiological safety.

The current AERB organizational framework is comprised of eight technical divisions supported by a number of internal safety committees at varying levels of hierarchy. There are different divisions assigned to each of the NPP life stages (siting, construction and commissioning and operation). The AERB has the authority to make decisions related to its organizational structure. The IRRS team was informed that one of the divisions was recently split into two divisions in order to create a dedicated division for the production and revision of codes and guides. The IRRS team was also informed that the AERB has consolidated the area of reactor physics into one distinct group and noted that this technical group had been integrated as part of the communications and reactor physics division (C&RPD) which includes the assignments related to Board affairs, communications and international relations. The AERB is encouraged to consider if the combination of technical and management support functions in one division is appropriate.

A group assigned to the management of Human Resources (HR) exists in the AERB. That group is responsible for Human Resources planning and monitoring and its responsibilities are outlined in an IMS-procedure. The IRRS team has reviewed evidence that the AERB has a systematic approach for the allocation of resources. The organizational resource allocation process is based on a Government approved five-year HR and financial budget based on the AERB's estimated resource needs. These needs are also used to predetermine the type of specialists (technical, administrative, etc.) that will be needed in the future and that process feeds into the AERB's recruitment activities. Based on the five-year plan, an annual detailed HR plan is established for each AERB division based on previous estimates. The progress made in recruitment is evaluated a few times per year against the plan. In the five-year plan, a resource contingency is included, which has proven to be sufficient to cope with short-term reactive needs (e.g. after the Fukushima Daiichi accident).

The main division responsible for the regulation of operating NPPs is the Operating Plants Safety Division (OPSD). The IRRS team was provided with information about OPSD's HR-planning with detailed tasks and distribution of estimated effort within the division. The IRRS team's review revealed that OPSD is comprised of about 50 full-time staff and is responsible for the regulation of 20 NPPs.

The IRRS team noted that AERB staff were assigned a wide range of tasks that can be considered outside the scope of their prime areas of expertise (e.g. a technical specialist can be assigned tasks related to public communications). In the area of emergency preparedness response (EPR), the IRRS team expressed concerns regarding the absence of dedicated full-time specialists. A total of 8 to 12 staff assigning 20-30% of their time are dedicated to the area of EPR. The organizational chart shows an emergency preparedness unit and an emergency preparedness coordinator, but the IRRS team was informed that these are functions that do not require full-time positions. The IRRS team observed that there are no staff dedicated on a full-time basis to EPR. Although during the mission no other such areas were found, but taking into account the above mentioned assignement of tasks beyond the prime areas of expertise, the IRRS team considers it important that the AERB evaluates across its organisation if there are other important areas where there should be dedicated full-time experts.

The decision-making within the AERB consists of a 3-tier approach. For operating NPPs, the highest level committee in the decision-making process is the Safety Review Committee of Operating Plants (SARCOP). SARCOP monitors and enforces safety regulations in NPPs. The Chairman of this committee, who is an ex-officio member of the board, has the power to make most of the decisions, but depending on the safety significance, the Board may have the final say. Before a decision comes before the SARCOP, it has been considered by lower level committees (Unit Safety Committees, Working Groups, Expert Groups, etc.), which have specific mandate in terms of regulatory/safety review of the facilities/activities, in tandem with technical divisions, depending on the safety significance of the issue. Before the NPP sends in a document for review, it has gone through the Nuclear Power Corporation of India Limited's (NPCIL) own system of safety committees (NPP+HQ). The committees are also used for the familiarisation training of new employees after undergoing the initial AERB training processes.

To enhance knowledge transfer for staff responsible for the different phases of NPP (siting through operation), combined safety committee meetings are held.

To address technical innovation, the AERB established its own Safety Research Institute (SRI) located at Kalpakkam.

Bhabha Atomic Research Centre (BARC) provides technical support to the AERB in the area of safety review and assessments. The technical support arrangements have been formalized by the signing of a Memorandum of Understanding (MoU)between the AERB and the BARC.

Additionally, the AERB is empowered to nominate/invite officials who have retired from various units of the DAE and have expertise in areas of regulatory interests. This provides a pool of experts who participate in the activities of safety review and regulatory document development.

The AERB's core regulatory processes are assessed in details within modules 5 (authorization), 6 (review and assessment) and 7 (inspection). The IRRS team has found that the principle of graded approach is promulgated in the management system and policies, but at the implementation level there is an absence of guidance for individual staff members on how to apply the graded approach.

The AERB is currently developing Safety Performance Indicators (SPIs) that measure the performance of the licensees. The indicators are one of the inputs that are part of a broader integrated assessment process of the licensee's performance. During the mission, the IRRS team briefly reviewed the draft results of the integrated assessment from the last three years. As the system is still in a trial phase, the results are not yet published or used to inform licensees and not yet applied in all the AERB's regulatory functions, except in inspection planning processes.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB applies the graded approach to its regulatory functions, however there is an absence of documented guidance on how to apply it.*	
(1)	**BASIS: GSR Part 1 Requirement 26 and para 4.40 states that** *"Review and assessment of a facility or an activity shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach.* *4.40. The regulatory body shall review and assess the particular facility or activity in accordance with the stage in the regulatory process (initial review, subsequent reviews, reviews of changes to safety related aspects of the facility or activity, reviews of operating experience, or reviews of long term operation, life extension, decommissioning or release from regulatory control). The depth and scope of the review and assessment of the facility or activity by the regulatory body shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach."*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(2)	**BASIS: GSR Part 1 Requirement 19 and para 4.16. state that** *"The regulatory body shall establish, implement, and assess and improve a management system that is aligned with its safety goals and contributes to their achievement.* *4.16. The management system shall maintain the efficiency and effectiveness of the regulatory body in discharging its responsibilities and performing its functions. This includes the promotion of enhancements in safety, and the fulfilment of its obligations in an appropriate, timely and cost effective manner so as to build confidence."*
(3)	**GSR Part 1 para. 4.3. (a, b) states that** *"The objective of regulatory functions is the verification and assessment of safety in compliance with regulatory requirements. The performance of regulatory functions shall be commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach. The regulatory process shall provide a high degree of confidence, until the release of facilities and activities from regulatory control, that: (a) Safety is optimized, the balance between operational benefits and potential consequences for people and the environment being taken into account. (b) Safety assessments carried out for facilities and activities demonstrate that an adequate level of safety has been achieved, and that the objectives and criteria for safety established by the designer, the authorized party and the regulatory body have been met."*
(4)	**GSR Part 1 para. 4.46. states that** *"For an integrated safety assessment, the regulatory body shall first organize the results obtained in a systematic manner. It shall then identify trends and conclusions drawn from inspections, from reviews and assessments for operating facilities, and from the conduct of activities where relevant. Feedback information shall be provided to the authorized party. This integrated safety assessment shall be repeated periodically, with account taken of the radiation risks associated with the facility or activity, in accordance with a graded approach."*
(5)	**GSR Part 1 para. 4.67. states that** *"The regulatory body, in its public informational activities and consultation, shall set up appropriate means of informing interested parties, the public and the news media about the radiation risks associated with facilities and activities."*
R4	**Recommendation: The AERB should establish guidance for individual staff members for the implementation of the graded approach in all its regulatory processes.**
S3	**Suggestion: The AERB should consider formalizing the process for integrated assessment of licensees' performance using the system of SPIs. The results of the SPI process should be transparent to the interested parties and the public.**
Observation: *AERB staff are required to complete a wide range of tasks or activities in addition to the assigned activities outlined within their primary area of technical expertise In the important area of EPR there is no dedicated full-time expert.*	
(1)	**GSR Part 1 Requirement16 and para. 4.5. state that** *"The regulatory body shall structure its organization and manage its resources so as to discharge its responsibilities and perform its functions effectively; this shall be accomplished in a manner commensurate with the radiation risks associated with facilities and activities.* *4.5. The regulatory body has the responsibility for structuring its organization and managing its available resources so as to fulfil its statutory obligations effectively. The regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach."*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
S4	**Suggestion: The AERB should consider evaluating its resource allocation across the organization to ensure sufficient full-time specialists are available and dedicated to those areas which are not currently covered.**

3.2. EFFECTIVE INDEPENDENCE IN THE PERFORMANCE OF REGULATORY ACTIVITIES

Under the policy framework established by the Atomic Energy Commission (AEC), the responsibility for carrying out safety regulation in the nuclear and radiation facilities/ activities within India has been assigned to the AERB by constitutional order in 1983. The AERB reports to the AEC, which is the Apex body of the Central Government for policy-making in the area of nuclear energy. The main reporting mechanism of the AERB to the AEC is through the AERB annual report which is sent to the AEC for informational purposes. The other role of the AEC is to support the AERB administratively and financially. This is done in conjunction with the Department of Atomic Energy (DAE).The five-year HR- and budget plan of the AERB is approved by Government of India. Once approved, the chairman of the AERB can independently make decision regarding the AERB's internal resources allocation. This matter was discussed by the IRRS team in module 1 regarding the issue of independence of the AERB vis-à-vis the AEC and the DAE.

The IRRS team has noted that the independence of the AERB decision making vis-à-vis the interface with the licensee organizations needs reinforcement. This observation is based on the following:

- The regulatory supervision of operating NPPs is carried out in two parts: on-site inspections and a continuous supervision programme. The extent of the planned baseline on-site inspection programme is limited (Reference to the suggestion in module 7). Relative to the limited on-site inspection programme, continous supervision programme is conducted through the monthly plant safety committees and the SARCOP.
- The membership of the decisionmaking committees, including SARCOP, includes representatives of non-AERB organizations (including the NPCIL/NPP) as a full member of the committees. According to the Terms of Reference of these committees all members take part in the decisionmaking. Decisions are taken mainly in consensus (no voting). The IRRS team has concluded that the Terms of Reference of the safety committees are not clear regarding the role of non-AERB members in those committees. The AERB should update their terms of reference in order to clarify the role of non-AERB committee members to only provide input of information with respect to the regulatory decision making.
- Based on the IRRS team interviews and reviews, fire drills are not sufficiently evaluated by AERB staff. The role of the AERB as a regulator during an emergency is rather limited and it does not include direct verification of the situation. The assessment is done based on information received from the ground through the CMG. The AERB does not directly assess the situation on the ground during the course of an emergency. Independent presence on site in the course of an emergency could assist the regulatory authority in assessing the situation.
- The AERB does not carry out independent verification inspections of pressure boundary equipment during the execution of QA-plan activities by the NPP. The AERB's verifications are limited to the assessment of the documentation following the completion of the QA-plan.
- There are several potential conflicts of interest:
    - TSO is working for both the regulator and the operator. The advice of experts from the TSO is taken as input to the regulatory assessment process and AERB staff use the input,

along with other inputs, as necessary to make their regulatory decisions. The AERB noted that the current system has certain benefits, for example the dissociation of the BARC from the AERB's regulatory decisions allows it to freely challenge the regulator's positions when new elements of scientific information come to its attention. An MoU exists between the BARC and the AERB which includes a conflict of interest clause indicating that an expert reviewer supporting the licensee or utility cannot support the AERB at the same time. This arrangement heavily relies on the integrity of the individuals at the managerial level within both organizations.

- The AERB recruits experts from NPP organizations and obtains support from retired NPP employees in some of the committees. Previous NPP employees recruited by the AERB are subject to induction and training processes, which take a minimum of two years, considered as a cooling off period. However, the AERB does not have a formal policy to control the potential conflict of interest resulting from this approach (e.g. a cooling off period).
- Retired NPP employees, used as experts in the committee structure must abide to an obligation stipulating that they have to come forward and notify the AERB in the situation where they would have entered in a contractual agreement with an NPP.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The independence of the AERB's decision making vis-a-vis the interfaces with licensees needs reinforcement.*	
(1)	**BASIS: GSR Part 1 Requirement 17, paras. 4.6. and 4.9. state that** *"The regulatory body shall perform its functions in a manner that does not compromise its effective independence.* *4.6. Requirements 3 and 4 in Section 2 stipulate that the government establish and maintain a regulatory body that is effectively independent in its decision making and that has functional separation from entities having responsibilities or interests that could unduly influence its decision making. This imposes an obligation on the regulatory body to discharge its responsibilities in such a way as to preserve its effective independence. The staff of the regulatory body shall remain focused on performing their functions in relation to safety, irrespective of any personal views. The competence of staff is a necessary element in achieving effective independence in decision making by the regulatory body.* *4.9. To maintain its effective independence, the regulatory body shall ensure that, in its liaison with interested parties, it has a clear separation from organizations or bodies that have been assigned responsibilities for facilities or activities or for their promotion.*
R5	**Recommendation: The AERB should review the implementation of its policy and existing arrangements to ensure it maintains independence in the performance of its regulatory functions.**

3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

The AERB had planned for the future taking into account India's growing nuclear energy programme. Based on the divisional examinations of current and foreseen resource needs, the AERB established a five-year plan covering the period 2012-2017. In the plan, the AERB identified the need to increase manpower by 134 full-time employees and requested funding to the Government via the AEC in order to meet this organizational human resources need. The IRRS team was informed that the AEC has asked the AERB to provide further details and the decision is still pending. It was explained to the IRRS team that it is a normal practice of the governmental budgeting process that such funding decisions are taken during the cycle covering the five-year plan. Evidence was provided to the IRRS team that this situation also

occurred during the 2007-2011 five-year plan. During that budgeting cycle, funding was provided for the AERB to hire an additional 130 full-time employees. The gradual recruitment of staff in line with the 2007-2011 budget allocation is still ongoing and will be completed this year, four years after the end of the 2007-2011 cycle. The IRRS team was informed by the AERB that a decision on the funding request for the 2012-2017 cycle is expected by the AEC this year. Based on the evidence provided during the review, the IRRS team, is confident that the combination of the expected increase of 134 full-time employees with the availability of staff from the BARC will ensure the AERB has sufficient human resources available to fulfil its mandate.

In the five-year plan, the AERB's future resource needs are evaluated division by division through a an analysis exercise identifying the human resources needs and related competences required for the AERB to conduct its regulatory activities. In 2013, the AERB created a Task Force to develop a structured competence mapping on the basis a IAEA TECDOC 1254 and using the IAEA Systematic Assessment of Regulatory Competence Needs (SARCON) approach. In 2014, the AERB carried out a gap-analysis of its competence needs and intends to finalize to close the gaps through training and recruitment. The IRRS team was informed that this process is not yet part of the IMS or the five-year planning process.

The IRRS team concluded that the AERB doesn't have dedicated competences in the areas of human and organizational factors (HOF) and public communications, even though these areas are essential in assessing the safe construction and operation of NPPs and the subsequent communications of the regulatory decisions to interested parties. The AERB should consider securing these competences since human and organizational factors are an integral part of the root causes associated with incidents as demonstrated during the Fukushima Daiichi accident. This accident demonstrated the importance of communications and transparency as integral functions within a regulatory body.

The AERB's recruitment process for new employees is done through several channels. The most important channel is through Training Schools run by the DAE which induct the new science post-graduates/engineers who have passed a one-year course in nuclear sciences and engineering. Other channels are through Indian academic institutes and direct recruitment from other organizations. In addition, retired staff are used as a pool of experienced and knowledgeable resources and their technical input are valuable in complementing the work of the AERB's technical specialists. After their recruitment, the staff undergo an orientation course on regulatory processes. Following this course, the staff are deployed for 'NPP Operational Training' in various facilities/activities and for further training as per AERB requirement. The 'NPP Operational Training' may range in duration from a few months to 2-3 years. During the training, some staff also become qualified as control engineers for operating NPPs and they are granted. The license to operate an NPP. This training gives them a comprehensive knowledge and exposure to the operational safety requirements of nuclear power plants. Those who perform inspections are subsequently certified by the AERB after training and on-job learning programme. The IRRS team concluded that the recruitment approaches, training and qualification of the AERB's staff is comprehensive and can be considered as a good practice (reference to good practice related to training is made in module 1).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB has identified competence gaps but does not yet have a fully developed competence needs analysis process This will ensure a resilient regulatory organization with the essential knowledge, skills and abilities needed to regulate NPPs.*	
(1)	**BASIS: GSR Part 1 Requirement 18, paras. 4.11. and 4.13. state that** *"The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities.*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	4.11. The regulatory body has to have appropriately qualified and competent staff. A human resources plan shall be developed that states the number of staff necessary and the essential knowledge, skills and abilities for them to perform all the necessary regulatory functions. *4.13. A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management."*
R6	**Recommendation: The AERB should fully develop its recently initiated process to analyse its competence needs to secure the essential knowledge, skills and abilities needed to regulate NPPs.**
Observation: *The AERB does not have competences in the area of human and organizational factors and in the area of public communications (ref. par. 3.1.).*	
(1)	**BASIS: GSR Part 1 Requirement 18 and para. 4.11. state that** *"The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities.* *4.11. The regulatory body has to have appropriately qualified and competent staff. A human resources plan shall be developed that states the number of staff necessary and the essential knowledge, skills and abilities for them to perform all the necessary regulatory functions."*
S5	**Suggestion: The AERB should consider ensuring that a sufficient number of staff with specialised competence, knowledge, skills and abilities in the area of human and organizational factors (HOF) and communications are avaible.**

3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

The AERB's advisory committees include the committees for preparation of regulatory documents, project safety review, nuclear and radiation safety review and other specific activities. The advisory committees, as appropriate, are supported by various project design safety review committees, working groups, specialist groups and other committees in their activities. The committees are an essential component in the AERB's key regulatory processes and decision-making as explained in module 3.1. They have an essential role in the Indian nuclear regulatory framework. The AERB has made a strong commitment to the approach through its membership on various advisory bodies and committees which are reflected within the AERB's integrated management system. The AERB staff has to apply its 'Code of Ethics' during their activities in these committees.

Certain safety relevant recommendations made by the advisory committees have to be considered by the AERB Board for a final decision, but in most cases, when plant modifications are proposed to existing plants, SARCOP is empowered to make a final decision. The Chairman of SARCOP informs the Chairman of the Board about pending decisions, so his opinion is also considered. However, the IRRS team noted that the operator of the facility (NPCIL) is also a member of SARCOP and that decisions are usually made as a result of consensus of the committee.

Bhabha Atomic Research Centre (BARC) is the most important TSO of the regulator. Some other domestic organizations are used to provide technical support. The AERB has not yet requested the assistance of foreign technical organizations for technical support. The AERB doesn't have commercial arrangements for the use of technical support organizations and therefore processes for purchasing or supply management are not defined in the management system. However, the AERB has a memorandum of understanding with the BARC and regular meetings take place between both organizations to ensure effective and efficient operations. The BARC is considered as having the status of 'named member' within the various AERB safety committees.

The requirements for recruitment, education and training programme AERB employees guarantee that the AERB can fulfil an "intelligent customer" role.

3.5. LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

Within the AERB's processes, the interfaces with authorized parties (NPPs) are defined as both formal and informal. The IRRS team was informed that the formal interaction takes place within the various safety committees e.g. plant safety review committee, which meet almost every month, and SARCOP. Based on the decisions and advice the AERB receives from the committees, a regulatory decision is prepared and communicated to the NPP, which is part of the documented process within the management system.

Informal interactions are namely the ad-hoc meetings and consultations that take place between AERB management and staff and the authorized parties for information exchange and procedural matters. Nonetheless, protocols are maintained for these meetings and informal communications with NPPs are minimized.

3.6. STABILITY AND CONSISTENCY OF REGULATORY CONTROL

All the core processes of the AERB's regulatory regime, i.e. establishment of the regulatory requirements, carrying out safety review in accordance with the established requirements and ensuring adherence to these are carried out following the established methodologies as documented in the QMS which is now part of the IMS. The IRRS team is satisfied with the practice of founding regulatory decisions on well-established and communicated regulatory requirements coupled with the multi-tier review. This ensures that the AERB's regulatory control maintains the necessary reliability and consistency in its approach and implementation. The multi-tier safety committee approach, management controls and adherence to procedure within the regulatory bodies operating sections ensure the quality of the decision- making process and helps avoid inconsistencies. For example, the team leader of the regulatory inspection team has been granted the authority to make impromptu decisions in cases of extreme non-compliance (in consultation with senior AERB management). For all other cases, the segregation of findings into different categories and enforcement measures are discussed within the respective technical division of the AERB. The Fukushima Daiichi accident challenged the execution of the annual plan, by moving manpower to augment inspection teams of planned inspections and to complete additional special inspections. To complete this work, a special expert group was created to review the potential implications for the NPPs, and existing regulatory approaches to confirm the primary NPP safety functions were met.

The AERB has produced a comprehensive set of around 150 regulatory safety codes and guides and other guidance that have been published on its website. The approach that is used by the AERB in this area is considered comprehensive and complies with the international practice.

3.7. SAFETY RELATED RECORDS

The AERB maintains all the records necessary to support its regulatory decisions through an established documentation and record keeping system, which is integrated within the AERB's Quality Management System. For its core regulatory processes, namely the development of regulatory documents, the performance of safety review for the granting of consents and the conduct of regulatory inspections, the AERB also has certification under ISO 9001:2008.

The record keeping process pertaining to documents specific to a facility/ activity is co-ordinated by the member-secretaries of the associated safety committee. Most of the records are available in hard copies as well as in electronic formats with adequate back up storage arrangements.

The records associated to occupational doses of individual workers, including those from the regulatory body, are maintained through National Occupational Dose Registry System in the BARC. These records are accessible to the AERB and the provisions to this effect have also been outlined in the MoU between the AERB and the BARC. NPPs provide their data directly to the BARC.

The AERB also maintains other records relating to the safety of facilities and activities such as records of accidents and/or significant events including non-routine releases of radioactive material to the environment, etc.

The important documents/ records relating to safety of NPPs as well as plant staff / workers, are also required to be maintained by the NPP and compliance is verified during regulatory inspections.

The modes/ systems of maintenance of the documents, physical as well as in electronic format, have evolved in terms of efficiency by taking advantage of technological advancements. In this respect, the AERB has recently established a centralized document maintenance / management system, which has inter alia features of sharing of documents, defining access, interweaving structure wherein the same document can be accessed by committees, divisions, facilities for a specific period of time.

The new electronic database was presented to the IRRS team as an easy to use system where not only all the necessary data per NPP (inspection reports, documents related to consents, event reports, etc.) can be found, but also international visit reports, national reports for the discharging of international obligations etc. The database is accessible to those that need to make use of the data for different purposes (e.g. to improve the regulatory primary processes). The database also has the potential to become a tool for education and knowledge management and preservation of lifetime records.

3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

The AERB Constitution Order requires taking all necessary steps to keep the public informed on major issues of radiological significance. Since its inception, the AERB has continuously developed and adopted various mechanisms / tools for strengthening its processes for public communications.

The AERB currently employs modern communications, including the maintenance of the AERB's website (www.aerb.gov.in), the issuance of press releases, the conduct of media briefings, writing / responding to news items published/aired in print/ visual media, the conduct of interviews with senior management representatives and the conduct of various seminars/ theme meetings/ symposia for sensitizing professional bodies and the public.

The AERB's website contains, among other information, annual reports, periodical status on the licensing of nuclear facilities, significant events, press releases, Rules promulgated under the Atomic Energy Act, 1962 pertaining to radiological safety, Government Notifications in this regard, India's reports as submitted during Convention on Nuclear Safety (CNS) meetings, the structure of the AERB's Board, committee structures and regulatory documents (Safety Codes, Safety Guides, etc). The website also allows interested parties to send questions to the AERB.

The AERB annual report is a comprehensive document which is prepared based on the safety status of facilities/ activities, including observance of safety regulations and standards, and implementation of safety requirements and recommendations in all NPPs. It is a consolidated document that includes information on all major regulatory activities and decisions made during the financial year.

Considering the developments which took place over the past few years, the AERB has also been publishing 'AERB Bulletins' which are illustrated, simplified and condensed versions of the Annual Reports and are published in several regional languages and disseminated in a manner that enables wider public outreach.

The AERB's responses submitted with respect to the Queries made by the Parliament are available on the Parliament website. These responses provide the information on regulatory aspects under consideration and also contain elaborate description in form of 'Supplementary Notes'.

Under the Environmental Protection Act, prior to granting environmental clearance, the plant management is required to inform the nearby public of the possible hazards associated with the proposed facility/activity and the mitigation measures planned in this respect. In these cases, the public's concerns are addressed during public hearings. No additional public hearings are held by the AERB for subsequent consents or license renewals.

Section 41B of The Factories Act, 1948 makes it mandatory for the authorized parties to inform the public about possible risks associated with its facilities and activities. The IRRS team noted that there is no AERB regulatory requirement that specifies what specific elements should be communicated by the authorized parties. However, the AERB has informed the IRRS team that it is satisfied with the public communications procedures undertaken by the NPPs. Furthermore, it can be concluded that there is no independent public information process put in place by the AERB to inform local communities around NPPs.

The decisions and their rationales are not published on the website, only a press release stating that a decision has been made is issued. Moreover, this information is not entirely conveyed in the annual report.

Draft codes and standards are not published for consultation with the public (reference is made to module 9).

During the interviews with representatives of the AERB, it was discovered that press releases and media briefings are issued in reaction to a certain situation or incident. In addition press releases are issued providing general information. The IRRS team noted that the AERB is increasing the use of press releases as an instrument.

Based on the information gathered above, the IRRS team has concluded that the AERB should improve its outreach to the media, the general public and the public in the vicinity of NPP sites. An enhanced communications outreach would also support the image of the AERB as an independent regulator.

As a result, the IRRS team concludes that the AERB should develop a written Communication Strategy based on the AERB's general policy to inform the public. The communication procedure, which was shown to the IRRS team, does not fulfil the role of a strategy. The implementation of the already mentioned advice (ref. 3.3) to include public communications experts in the AERB's organizational structure could help the development of the strategy in this respect.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *Engagement with the media, outreach to and consultation with the general public and the population in the vicinity of the NPP needs improvement in accordance with the IAEA safety standards.*	
(1)	**BASIS: GSR Part 1 Requirement 36, paras. 4.66. (a,d,e) and 4.67. state that** *"The regulatory body shall promote the establishment of appropriate means of informing and consulting interested parties and the public about the possible radiation risks associated with facilities and activities, and about the processes and decisions of the regulatory body.* *4.66. The regulatory body shall establish, either directly or through authorized parties, provision for effective mechanisms of communication, and it shall hold meetings to inform interested parties and the public and for informing the decision making process. This communication shall include constructive liaison such as:* *(a) Communication with interested parties and the public on regulatory judgements and decisions;* *(d) Communication on the requirements, judgements and decisions of the regulatory body, and on the bases for them, to the public;* *(e) Making information on incidents in facilities and activities, including accidents and abnormal occurrences, and other information, as appropriate, available to authorized parties, governmental bodies, national and international organizations, and the public.* *4.67. The regulatory body, in its public informational activities and consultation, shall set up appropriate means of informing interested parties, the public and the news media about the radiation risks associated with facilities and activities, the requirements for protection of people and the environment, and the processes of the regulatory body. In particular, there shall be consultation by means of an open and inclusive process with interested parties residing in the vicinity of authorized facilities and activities.*
(2)	**BASIS: GS-R-3 para. 3.6. states that** *"The expectations of interested parties shall be considered by senior management in the activities and interactions in the processes of the management system, with the aim of enhancing the satisfaction of interested parties while at the same time ensuring that safety is not compromised."*
(3)	**BASIS: GSR Part 1 para. 4.8. states that** *"The authorized party has an obligation to inform the public about the possible radiation risks associated with the operation of a facility or the conduct of an activity, and this obligation shall be specified in the regulations promulgated by the regulatory body …"*
R7	**Recommendation: The AERB should establish a communications strategy to effectively engage with the media, and communicate and consult with the general public and the population in the vicinity of NPPs. This includes consultation with the general public on draft safety codes and standards.**

3.9. SUMMARY

The IRRS team has reviewed AERB responsibilities. Overall, it was noted that the organization meets the requirements. The AERB has a systematic approach for the allocation of resources. Most of AERB expert staff are responsible for taking care of primary functions and other tasks. The IRRS team has concerns regarding the AERB's allocation of resources to dedicated experts in safety critical areas. Graded approach is promulgated in the management system, but there is often no internal application guidance. The AERB developed Safety Performance Indicators (SPI's) and is encouraged to formalize them. The independence of decision making vis-à-vis the interface with the licensees needs reinforcement. In

relation to the AERB employing former NPCIL staff, there is no written policy/process for a ‘cooling off period’.

The AERB should fully develop its recently initiated process to analyse its competence needs to secure the essential knowledge, skills and abilities needed to regulate NPPs. The AERB should ensure the availability of a sufficient number of staff with specialised competence, knowledge, skills and abilities in the area of human and organizational factors (HOF) Basic education, training and qualification of the AERB’s employees are comprehensive. The AERB’s regulatory decisions are made on well-established requirements coupled with the multi-tier review, thus ensuring that the AERB’s regulatory control meets the stability and consistency requirements. The multi-tier approach to decision making, teamwork and the detailed internal guidance minimize individual perceptions and varying interpretations in regulatory decision making. Record keeping at the AERB is well established through a modern electronic system (eBase).

The AERB has adopted various mechanisms/tools for public communications. There are no AERB regulatory requirements that specify what the authorized parties should communicate. There is no AERB public information to the local communities around NPPs. The decisions and their bases are not published individually. The AERB should improve its engagement with the media, communication and consultation with the general public and the public in the vicinity of the NPP sites, including consultation of draft AERB safety standards.

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY

4.1. IMPLEMENTATION AND DOCUMENTATION OF THE MANAGEMENT SYSTEM

The AERB has established a Quality Management System (QMS) compliant with ISO 9001:2008, which is certified by an accreditation body. About 75 management system documents are currently available. The AERB has recently initiated a project for developing and implementing an Integrated Management System (IMS) and developed a project plan, which indicates that a GS-R-3 compliant IMS will be implemented mostly in 2015. Some aspects will be further developed as a part of continuous development.

The AERB's main processes (consenting, regulatory inspection and development of regulatory documents) were already defined in QMS since 2006. As part of the IMS development project the AERB has identified the other processes (management and supporting processes) which were not included in the scope of QMS. In the area of the AERB's mandate related to NPPs (in the OPSD, NPSD and IPSD), about 50 documents were identified and prepared. The need for enhancing the existing QMS to bring it into compliance with GS-R-3 was also identified by the self-assessment conducted by the AERB in preparation for the IRRS mission.

Because of the transition phase, some overlapping functions currently exist. The QMS Monitoring Committee follows the functioning of QMS, as IMS has its own IMS Monitoring Committee. This solution selected was to keep the certificated QMS in force and at the same time continue developing the new IMS and its ways of actions. This may have an implication of additional workload.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IMS is currently under development, but only parts have been applied. Currently, there are redundancies between QMS and IMS. The AERB IMS and QMS are separately managed by two committees of the same composition.*	
(1)	**BASIS: GSR Part 1 paras. 4.14. and 4.16. state that** *"4.14 The regulatory body shall establish and implement a management system whose processes are open and transparent. The management system of the regulatory body shall be continuously assessed and improved. 4.16. The management system shall maintain the efficiency and effectiveness of the regulatory body in discharging its responsibilities and performing its functions. This includes the promotion of enhancements in safety, and the fulfillment of its obligations in an appropriate, timely and cost effective manner so as to build confidence."*
R8	**Recommendation: The AERB should finalize and fully implement its integrated management system (IMS), based on GS-R-3.**

The AERB's management system identifies safety as a priority and provides guidance for its promotion and continuous improvement. The process for promoting the safety culture includes self- and independent assessments. In February 2015, the AERB developed, as part of its management system, a process and internal procedure for assessing its safety culture, using specific questionnaires/ survey. This process has been applied first on a pilot basis, in the Operating Plants Safety Division (OPSD), and later on in the Nuclear Projects Safety Division (NPSD), resulting in the participation of approximately 100 staff members. The results of the pilot self-assessment were recorded in an action plan. An annual plan for implementation of the safety culture surveys will be implemented by all AERB divisions by the end of 2015.

Summaries of self-assessment surveys are reviewed by an AERB level committee, which identifies areas for improvement and actions. The AERB's Executive Committee (EC) will review and give orders for

improvements. However, final conclusions of the multi-stage handling of survey results are not presented to employees prior to decision-making on corrective actions.

The IAEA has developed the Safety Culture Continuous Improvement Process (SCCIP) to assist member states in strengthening and improving their organizational safety culture. The SCCIP service would support the AERB in its further development of safety culture assessment.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB has piloted safety culture review in OPSD and later on performed a review in NPSD. The process used for safety culture assessment does not include consulting with all contributing staff prior to deciding the action plan.*	
(1)	**BASIS: GS-R-3 para. 3.4. states that** *"Management at all levels shall foster the involvement of all individuals in the implementation and continual improvement of the management system."*
(2)	**BASIS: GS-G-3.1 para. 2.5. states that** *"The management system shall be used to promote and support a strong safety culture by… providing the means by which the organization continually seeks to develop and improve its safety culture."*
S6	**Suggestion: The AERB should consider implementing its safety culture review process throughout the organization, including the consultation of staff on the safety culture action plan before its implementation.**

Changes in the licensee's organization are not seen as a modification in the spirit of the AERB's procedures.

The Technical Specifications for NPP operation includes an overall structure and definition of the roles and responsibilities of key management positions who have a role in the safety organisation of the licensee's organisation. Any changes to this structure require review and approval of the AERB, as a modification to the NPP's technical specification in accordance to technical specification review procedure. The AERB has a requirement specified in its Code on Quality Assurance to review the Organization Changes of the licensee. However, no specific procedure/ criteria used by the AERB for conducting this review/approval were presented.

The IRRS team was informed that there were no changes impacting the organizational structure in any NPP in India for the last 30 years, therefore leading the AERB to conclude that there was no need to conduct such reviews.In a construction phase of the plant, the AERB has requirements and approves licensees' Quality Assurance (QA) System for construction and commissioning. Information on the licensees' organizational structure are presented in the description of the QA Manual. However, there is no specific procedure/guide describing how the AERB is assessing licensees' organizational changes during construction and commissioning. The IRRS team was informed that there were no organizational changes impacting the organizational structure of NPP during construction and commissioning phases, and that the AERB did not need to approve such changes.

In subsection 3.3 it is suggested that the AERB should consider recruiting people who have education and experiences in human factors engineering. The above-mentioned finding supports the view of the IRRS team that human factor related aspects are not widely recognized in the AERB's oversight functions.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB does not have an internal process for assessing licensees' organizational changes during all life cycle phases of a NPP.*	
(1)	**BASIS: GSR Part 1 paras. 4.15. (1) and 4.62. state that** *"4.15 The management system of the regulatory body has three purposes: (1) The first purpose is to ensure that the responsibilities assigned to the regulatory body are properly discharged.* *4.62. The regulations and guides shall provide the framework for the regulatory requirements and conditions to be incorporated into individual authorizations or applications for authorization. They shall also establish the criteria to be used for assessing compliance. The regulations and guides shall be kept consistent and comprehensive, and shall provide adequate coverage commensurate with the radiation risks associated with the facilities and activities, in accordance with a graded approach."*
(2)	**BASIS: GS-R-3 paras. 5.28. and 5.29. state that** *"5.28. Organizational changes shall be evaluated and classified according to their importance to safety and each change shall be justified. 5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised."*
R9	**Recommendation: The AERB should review organizational changes of NPPs and develop internal procedures to assess whether the licensees' organizational changes are planned, categorized, implemented and monitored in a manner that does not compromise safety.**

A policy issue was discussed regarding the promotion and oversight of safety culture at both the AERB and the NPCIL. The AERB recognizes that promotion of safety culture within the NPCIL as well as in the regulatory body is important for securing nuclear safety. The requirements for establishing safety culture within a utility are contained in AERB regulatory requirements. The AERB recognizes that the promotion of safety culture within its staff members is the integral part of the AERB integrated management system. To provide a structured approach for evaluation of safety culture of its own staff and the utility, the AERB has established formal procedures, working level documents and pilot studies at the divisional level.

Most of the IRRS team members participated in the discussion and provided insights on the promotion and oversight of safety culture in their countries. The main points of discussion were:

- It can be helpful to hire third party organizations to evaluate safety culture at both the regulatory body and the utility
- Consideration should be given to collecting safety culture information through inspection programmes
- Regulatory bodies should consider hiring staff with expertise in human factors, social behavior, industrial psychology etc.
- Regulatory bodies should designate a senior management to champion its safety culture programme and senior management should lead by example
- Regulatory bodies and utilities must promote a questioning attitude among its staff
- Regulatory bodies and utilities should consider conducting structured interviews at all levels with a predefined list of questions linked to safety culture characteristics
- A process should be developed to resolve differences of opinions in the resolution of safety issues including a process to protect "whistleblowers".

- Establishing and evaluating an organizations' safety culture is a significant effort and takes time to implement
- IAEA is currently developing guidelines for assessing safety culture for regulatory bodies and encourages member states to participate in establishing the guidelines

4.2. MANAGEMENT RESPONSIBILITY

The AERB's management is committed at all levels to the establishment, implementation, assessment and continual improvement of the Management System. In order to ensure that all regulatory processes are carried out in a systematic approach to achieve its goal, targets consistent with the annual targets of the AERB are set in each division. An external committee performs an evaluation at the organizational level for the fiscal year.

Performance of the AERB is periodically reviewed by senior management to assess the extent of compliance with established objectives and targets. Based on review and assessment, areas of improvement are identified, and policies and procedures are reviewed/ revised to confirm their continued appropriateness for the regulatory activities.

For coordinating the development and implementation of the management system, its assessment and continual improvement, a management representative has been appointed. This representative has sufficient organizational freedom to implement the Management System programme and reports to the management.

The AERB's communication with interested parties is processed in subchapter 3.8.

4.3. RESOURCE MANAGEMENT

The AERB's management system contains procedures for the resource management on annual and long-term basis. The subject is processed in details in subsection 3.3.

The AERB does not have a written policy for rotation of employees inside the organization. In practice, divisions offer their expertise to the committees and regulatory functions and task. Although tasks are variable, the AERB should consider rotation of employees in a more systematic manner.

4.4. PROCESS IMPLEMENTATION

The AERB has documented its processes in the Management System Manual. Each of the major regulatory processes (consenting, Regulatory Inspection and development of Regulatory documents) are supported by detailed guidance that are either part of QMS or already updated to IMS. Other defined processes support the three main functions. The processes are owned by the management representative, who is appointed for coordinating the development and implementation of the management system, its assessment and continual improvement. The management representative has sufficient organizational freedom to implement the Management System programme.

For daily use, a web-based system is currently in place that outlines the processes, related guidance, assessments, results and development actions in a very comprehensive and sophisticated way. The system links the systems and management system guidance, and compensates for the lack of a visual project map (which does not exist currently and would be one of the development areas), together with clear definition of supporting processes. The system offers employees a direct link to the procedures that they use in their daily work. The web-based system also provides outputs and records of the processes (like regulatory consents in the form of license, authorization, registration and approval, regulatory inspection report and AERB regulatory documents).

The AERB has established mechanism for the management of its own organizational changes. It is assessed that there is no negative impact on regulatory effectiveness and that safety is not compromised.

Currently, the AERB is in the transition phase where QMS is moving to IMS. The transition is being conducted in a planned and organised manner by approval and support of AERB management. Challenges being faced in this transition are discussed in subchapter 4.1 where related suggestions are provided.

The AERB's processes are communicated to interested parties via published regulatory codes, guides and other documents. However, its internal processes or procedures are not communicated to any of the stakeholders. The AERB's communication policy and openness for discussion with interested parties is discussed in details in subsection 3.8.

4.5. MEASUREMENT, ASSESSMENT AND IMPROVEMENT

The AERB has established a mechanism for carrying out self-assessment, independent assessment and monitoring of effectiveness of its Management System. Self-assessments are performed annually at all levels of the organization by performing an analysis of each of the main processes. Assessments are organized inside the divisions by nomination of a group which performs the assessment of related processes. To support the assessment, a checklist is prepared with a corresponding procedure for each of the processes. As a part of an assessment, indicators, which are defined for each of the main processes, are also overseen. Results, including corrective actions, are summarized and enforced within the divisions. Self-assessment reports are later reviewed by the Executive Committee to identify possible generic issues.

Independent assessments of the AERB's Management System include both internal and external audits. Internal audits are carried out twice a year by independent, certified auditors from other divisions. To support auditing and to ensure its quality and comprehensiveness, checklists are prepared. Results of the audits are given to the head of auditee, and corrective actions for non-conformances and observations are followed-up in a post audit meeting. Audit findings are also reviewed by the Monitoring Committee and Executive Committee. External independent audits are usually performed by the certification body. External audits were also conducted by Comptroller and Auditor General (CAG) of India, the report of which was reviewed by the Public Accounts Committee of Parliament.

A new feature in management system assessment is management reviews to be performed every six years. At the beginning of the review, findings from previous internal audits are summarized by the Management Representative, and the summary report is then discussed by the Executive Committee who evaluates if additional corrective actions are deemed necessary.

The IRRS team observed that the internal and external assessments/audits and management reviews provide a good basis for the development of the Management System. The IRRS team identified potential areas for optimization includingin depth audits of specified regulatory functionson a more frequent basis.. This would provide a more focussed approach and a more effective programme of audit and improvement.

Additional external audits and international reviews should be considered as a component of futurereview programme of the Management System.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB is developing its internal and external audit and review programme. It performs independent internal management system audits twice a year. A single audit covers all functions of the audited division. The full scope audits might not be the most effective way to identify deficiencies.*	
(1)	**BASIS: GS-R-3 para. 6.1. states that** *"The effectiveness of the management system shall be monitored and measured to confirm the ability of the processes to achieve the intended results and to identify opportunities for improvement."*
S7	**Suggestion: The AERB should consider a wider implementation and optimization of its**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	audit and review programme of the integrated management system (IMS), e.g. deep dive audits of specific functions.

Non-conformances identified during audits or reviews are recorded and reported to the management representative, and issues are resolved by the concerned division. Causes of the identified non-conformance are analyzed during discussions in each division and Management System Monitoring Committee. The corrective/preventive actions are documented and followed-up to correct the deficiency and prevent their recurrence as per the procedures for corrective and preventive actions.

The AERB is currently developing Safety Performance Indicators (SPIs) that measure the performance of NPP licensees. Use of SPIs is processed in details in subchapter 3.1. Stakeholder surveys are processed in details in subchapter 3.8.

4.6. SUMMARY

The AERB has established a Quality Management System (QMS) compliant with ISO 9001:2008. The AERB has recently initiated a project for developing and implementing an Integrated Management System (IMS). A GS-R-3 compliant IMS will be implemented mostly in 2015. The need for enhancing the existing QMS to bring it into compliance with GS-R-3 was also identified by the self-assessment conducted by the AERB in preparation for the IRRS. Because of the transition phase, there are some overlapping functions that currently exist. This may result in unnecessary confusion and workload.

The AERB's management system identifies safety as a priority and provides guidance for its promotion and continuous improvement. The AERB has developed a process and internal procedure for assessing its safety culture, using specific questionnaires/ survey. Safety culture surveys will be implemented by all AERB divisions by the end of 2015. The IRRS team saw the process very positively, but at the same time, questioned how staff would be involved when finalising the action plans. This would support staff's commitment to a positive safety culture and help in targeting the right areas for development.

The AERB's Management System (QMS and IMS) covers most of the necessary regulatory functions. The IRRS team observed that there is no dedicated procedure to review changes in the licensee's organization. In subsection 3.3, it is suggested that the AERB should consider recruiting people who have education and experiences in human factors engineering. Combined, these findings provide the IRRS team with a comprehensive understanding that human factors related aspects are not widely noticed in the AERB's oversight functions.

Performance of the AERB is periodically reviewed by senior management to assess the extent of compliance with an established set of objectives and targets. Based on review and assessment, areas of improvements are identified, policies and procedures are reviewed/revised to confirm their continued appropriateness for the regulatory activities. This well-defined basis gives a good opportunity to further develop and optimize the system of internal and external audits and reviews. The IRRS team proposes to include international peer- review in the programme at least every 10 years.

5. AUTHORIZATION

5.1. GENERIC ISSUES

Though the IRRS review is restricted to nuclear power plants, the general legal framework for licensing installations and activities in relation to radiation sources or radiation generating equipment are unified by the Atomic Energy Act, 1962 (referred as the Act) and by the Atomic Energy (Radiation Protection) Rules 2004 (referred as RPR). According to Section 3 of the former Act "to produce, develop, use and dispose of atomic energy" is restricted to the Government or to a Corporation established by the Government. Sections 14, 16 and 17 of the Act prohibit any such activity except under a written consent. The Constitution Order (S.O. 4772) stipulates that this consenting authority is delegated to the Atomic Energy Regulatory Board (AERB).

On the basis of its empowerment and in concert with the Act and the RPR, the AERB developed and issued safety codes and guides to specify the process, conditions, requirements and criteria of the different consenting cases. The safety guides that are referred to in the specific clauses of the legally binding safety codes renders the safety guide legally binding.

Apart from the initial site license, where the Ministry of Environment and Forests of India is also involved, the licensing/consenting activities of the AERB require no interface with other authorities.

5.2. AUTHORIZATION OF NUCLEAR POWER PLANTS

The IRRS team noted that a general restriction for all radiation related facilities/activities, stipulated in the RPR, limits the validity of any authorisation licence to a maximum period of 5 years. An NPP operating licence must be renewed at the 5 year term through the licence renewal process. The licensee is also required to conduct a full scale Periodic Safety Review (PSR) and submit it as part of the renewal process, which takes place at least every 10 years. For first-of-a-kind NPPs the first PSR is required after five years following the issuance of the first operating license.

The IRRS team was informed that according to the general practice in India, two (identical) NPP units form a 'plant' and the director of that plant formally becomes the licensee. However, the 'responsible organisation' bearing prime responsibility for safety is the whole organisation to which the Plant belongs.

The AERB is bound by the following RPR rule: "licence shall be issued within a period of one hundred and eighty days from the date of receipt of the application subject to the condition that all the requirements for issuance of the licence have been duly fulfilled". The IRRS team was informed that the current practice as it applies to a complex licence application, the applicant is to submit the supporting documentation prior to the submission of the licence application which allows for additional review time which may be required for the AERB to meet the statutory limit of 180 days. The lead time for submission of these documents is prescribed in detail for the different types of consenting cases in a legally binding safety guide. In cases where the AERB cannot issue the licence within the 180 day statutory period, the AERB will grant a restricted short term licence or grant an extension to the already existing license in order to allow for the continuation of the authorized activities.

Within the AERB terminology the general term 'consent' is used to cover the written permissions issued by the regulatory body, including license, approval, authorization and registration. The main stages of the NPP life cycle requiring regulatory consent correspond to the phases considered in the IAEA safety standards, such as siting, construction, commissioning, operation, and decommissioning. The general requirements are outlined in the AERB safety codes and supporting guides. The IRRS team noted that the legal aspects specifically stipulated in the safety guide are not fully included in the standard format and template applied for issuing individual authorizations/licenses. The modification process in order to correct the situation is under way, but not completed yet (Action items in SARIS 5-R5 and 9-R12).

The IRRS team was informed that the process for issuing a license is controlled by established internal procedures of the AERB. According to those, the incoming material is first judged for completeness by a dedicated working team, and any further request for information is communicated to the applicant. When the material is judged sufficient for review, then a review plan is set up and the review team starts the review process. The detailed review may or may not contain independent analysis calculations or modelling. If the volume, topic or resource conditions justify then the AERB seeks for external support from its technical support organisations for the independent analyses. The results of the review team are submitted to ACPSR/SARCOP, which reviews the submitted results and elaborates a recommendation for consideration by the Board of the AERB (in case of majour regulatory decisions such as siting clearance, initial license, etc) or Chairman of the AERB (for decisions like periodic renewal of the operating licenses, clearances for sub-stages, etc). The final decision about issuing the license or consent rests with the Board or Chairman of the AERB (as brought out above). The license/consent documents are signed by Chairman AERB. All of the action steps of this process (i.e.: submittals, letters, minutes, plans, review materials, decisions etc.) are duly recorded in a well-structured electronic documentation system which ensures proper traceability.

Any regulatory consent can be amended either on the basis of review of a request from the consentee or on the need felt by the regulatory body itself.

The AERB has the authority and duty to curtail an ongoing activity or to modify/suspend/revoke a licence whenever an immediate endangering of the population or the environment is identified. Such an action would be carried out in accordance with the established regulatory enforcement framework. The recently issued procedure for enforcement satisfactorily covers this issue, thus the IRRS team considers the action item 5-R6 in the ARM as closed.

The IRRS team was informed that two main documents shall be submitted for the siting stage: the Site Evaluation Report and the Design Basis Information of the given type of reactor. The content of this document, which basically corresponds to the content of Chapter 1 of the safety assessment report (SAR), is appropriately described in the applicable safety code issued by the AERB. The AERB does not consent to the siting stage until the Ministry of Environment and Forests of India has accepted the Environmental Impact Assessment (EIA) as submitted by the applicant. The regulatory requirements for the site evaluation report are detailed in an AERB safety code that is applicable to all nuclear installations.

The basic goal of the site approval is to determine whether the nature of the site and the design basis of the plant are compatible and satisfy all requirements.

The IRRS team was informed that the AERB is currently not issuing any generic ‘Design Certificate’. In the current practice the licensing and review process of each plant unit goes separately, however, in the case of repeat design, the information obtained from the previous review is used and the review focuses mainly on the design differences.

The construction license could be issued through a single application for review and consent, however in practice the construction approvals are requested and granted in several steps, e.g. clearance for excavation, clearance for first concrete pour, clearance for start of erection of major equipment, etc. In addition to these particular clearances, a generic approval of quality assurance programmes is required which has to be issued before the construction is started. The related documents constitute the preliminary safety analysis report (PSAR), which is the basic technical document during the construction stage.

The prerequisite for starting the commissioning stage is the consent for commissioning. The condition for issuing that consent is the approved technical specifications and procedures which have to be obeyed to maintain the design parameters. The approved commissioning programme and the availability of appropriately licensed personnel are conditions as prescribed in the applicable safety codes and guides. The consentee is required to have approved emergency plans. The specific sub-stages of commissioning may be authorized separately. The IRRS team was informed that, similar to the approach used during the

construction approval stage, the use of sub-stages is applied during the commissioning stage because it facilitates the imposition of specific AERB hold points within the stage.

The IRRS team was informed that the prerequisites for licensing for operation are as follows:

- the completed and approved commissioning report,
- the final SAR,
- the organizational details of the operating organization; including:
    - the qualification of operating staff,
    - policies and procedures that are to be used in the operating facility;
    - as well as several other prescribed documentation.

The requirements for the operating consent are prescribed in the applicable Code of Practice for Operation. Once the AERB is satisfied with the content of the submitted material, the operational licence/consent is issued for a maximum period of 5 years (prior to 2004 the licence/consent term was restricted to a 3 year period).

In the course of the operation of the plant the regime of periodic re-licensing is carried out in such a way that a thorough periodic safety review (PSR) is required at least every 10 years, while the in-between renewal of the licence, carried out at the 5 year mark, is done according to the licence renewal requirements. The IRRS team was presented with an example of the specific application of the graded approach that for first-of-a-kind constructions a thorough PSR is required no later than 5 years following the issuance of the initial licence. After approval of the first PSR, the authorisation process typically follows an alternating pattern of licence renewal and PSR type relicensing on a 5 year period.

The IRRS team observed that the detailed requirements for PSR are well codified. These include the requirement for ageing management, event evaluation and operational experience feedback (internal and external), any change in the environment of the plant (natural or human related), and any modification of SSCs, etc.

According to the practice in India, the operating licences of twin units are managed together, e.g. for Units 1 & 2 at a site. As the completion of the construction is not simultaneous, the second unit receives the first operating license for a shorter period of time, in order to carry out the next licence renewal or PSR together for the two units. This approach is practical, when the two units are quite identical.

The IRRS team was informed that the preliminary decommissioning plan shall be included in the first issue of the FSAR and then updated at every PSR process. Plant decommissioning is not allowed without a consent from the AERB. This consent is obtained through an application to the AERB where the applicant shall submit a detailed decommissioning plan outlining all the phases of decommissioning and the activities to be completed within the phases, with the goal of ultimate release of site as ‘green field’ (unrestricted use) or as ‘brown field’ (restricted use). The regulatory requirements for decommissioning are outlined in AERB safety guides. The plant unit after the final shut down remains under a modified operating licence with technical specifications to reflect the risks and hazards with the shut-down state of the unit, as long as the decommissioning consent is issued.

The IRRS team was informed that any plant modification or modification to SSCs important to safety is subject to approval by the AERB before being implemented by the licensee. The notification and request for approval of these modifications shall be submitted to the AERB and the AERB decision on approval is carried out according to a graded approach. The required documentation and the depth related safety review corresponds to the safety classification of the related equipment. Typically, the requests for safety related modifications are not considered as license amendments, therefore the statutory timeframe of 180

days is not applicable. The IRRS team was informed that in practice the actual license amendment cases (e.g. power up-rating) are normally processed in combination with a license renewal following a PSR.

Certification of the operators is required by the safety codes of the AERB. The licensing of the operating personnel is carried out according to a certification procedure authorised by the AERB. The licenses of the operational personnel are officially issued by the AERB, thus they can be revoked by the AERB in case of any serious offense or negligence, as integral part of an enforcement action. The responsible organisation (RO), as consentee of the plant licence is responsible to define the necessary qualifications, training and experience required for personnel performing duties that may affect safety. The document containing these requirements shall be issued by the RO after obtaining necessary approval from the AERB. Suitably qualified personnel shall be selected and given the necessary training to enable them to perform their duties correctly. It is a requirement prior to commissioning that the appropriate certified operating personnel shall be available. These requirements are prescribed in the AERB safety code controlling the operating conditions of the NPPs.

It was demonstrated for the IRRS team that the detailed licensing requirements for PHWR type reactors are specified by the AERB in a safety code which is complemented by safety guides; one of which specifies the required list of postulated initiating events. Thus the IRRS team considers the regulations with respect to the PHWR reactors to be very comprehensive. The AERB has recently issued a safety code on the general design requirements for light water reactors, however the related safety guides with the detailed requirements are not yet developed. Since 3 light water reactors (LWRs) are already operating in India, one additional LWR is under construction, and several others are planned. The IRRS team noted that the existing requirements also contain appropriate requirements in relation to severe accidents.

Since there are three operating LWRs and several others are being planned, the IRRS team considers the development of the specific and detailed requirements and guidelines for those reactors to be necessary. The issue is similar in case of the fast breeder type reactors, as the prototype is actually approaching the commissioning phase. The IRRS team was informed, that the applicable safety requirements on the basis of international requirements and guidelines as well as by domestic experiences (e.g. on the Fast Breeder Test Reactor) are specified and communicated through formal channels to the licensee.

The requirement for carrying out level-1 PSA for full power operation and for internal initiating events is set forth in the AERB safety codes and these analyses are also required to be updated at every PSR case. In the same documents the PSA analyses for external events and for low power and shut down states, as well as the level-2 PSA are recommended but not required. However, the recently issued safety codes for site evaluation and also for the design of LWRs contain such requirements which can only be precisely evaluated by full scope PSA and also by level-2 PSA. The initiating events from the different low power and shut-down states, as well as those related to external hazards may contribute significantly to the CDF and other probabilistic parameters, therefore they should also be required to be carried out and submitted to the AERB in the license applications for review. The IRRS team noted that in the recently published LWR design code there are requirements for shutdown PSA, and also implicit requirements for external events and level-2 PSAs. It was also noted, that one PHWR plant has already completed such studies and also submitted them for review, as a pilot for the process of submission and review. The IRRS team considers the requirements for level-1 and level-2 PSA which address the contributors for internal and external events, including the initiating events at low power and shut-down states should be required in general for all existing and planned reactor types. The IRRS team noted that the required expertise and well trained technical staff is available at both the licensee and regulatory organisations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES
Observation: *The current template for licences/consents issued by the AERB does not cover all the related*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
legal issues applicable for the case.	
(1)	**BASIS: SSG-12 para. 2.12. states that** *"The objective of granting authorizations in the licensing process is for the regulatory body to establish regulatory control over all activities and facilities where safety is concerned. … Licences, authorizations, permits and other regulatory instruments are the principal documents issued by the regulatory body that, at each step of the licensing process, relate the legal and regulatory framework to the duties of the person or organization responsible for the nuclear installation and its activities. …"*
(2)	**BASIS: SSG-12 para. 2.14. states that** *"Licence conditions are additional specific obligations with the force of law. … Licences should state explicitly, or should include by reference or attachment, all conditions imposed by the regulatory body."*
(3)	**BASIS: SSG-12 para. 2.40.(q) states that** *"Procedures for, information about and identification of the legal framework for challenging the licence or part of the licence."*
S8	**Suggestion: The AERB should consider developing or amending the safety code or guide specifying the template for the specific licenses.**
Observation: *While detailed and comprehensive requirements are prescribed for PHWR type reactors (including the list of required PIEs), non PHWR reactors which are operating or are under construction require similar comprehensive requirements.*	
(1)	**BASIS: GSR Part 1 Requirement 23 states that** *"Authorization by the regulatory body, including specification of the conditions necessary for safety, shall be a prerequisite for all those facilities and activities that are not either explicitly exempted or approved by means of a notification process."*
(2)	**BASIS: GSR Part 1 Requirement 32 states that** *"The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based."*
S9	**Suggestion: The AERB should consider specifying the detailed and specific licensing requirements for all NPP types which are operating, under construction, or planned in the country.**
Observation: *According to the actual AERB requirements, only Level-1 PSA for full power operation is required, as part for the supporting material for applicable licensing cases, while the latest general design requirements extend to all states and rely on several probabilistic criteria.*	
(1)	**BASIS: SSR 2/1 para. 5.76. states that** *"The design shall take due account of the probabilistic safety analysis of the plant for all modes of operation and for all plant states, including shutdown, with particular reference to:* *a) Establishing that a balanced design has been achieved such that no particular feature or postulated initiating event makes a disproportionately large or significantly uncertain contribution to the overall risks, and that, to the extent practicable, the levels of defence in depth are independent;* *b) Providing assurance that small deviations in plant parameters that could give rise to large variations in plant conditions (cliff edge effects) will be prevented (see footnote 5);* *c) Comparing the results of the analysis with the acceptance criteria for risk where these have been specified."*
S10	**Suggestion: The AERB should consider requiring full scope Level-1 and Level-2 PSA analyses within the scope of required safety analyses for demonstrating the satisfaction**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	of the applicable licensing criteria for all reactor types.

A policy issue was discussed regarding the licensing of reactor technologies imported from foreign countries for use in India. It was noted that the basic regulatory process of the AERB is essentially same for all type of reactors.

For an application for a new NPP the utility is required to incorporate the Indian Regulatory Requirements in the Technical Assignment and be able to submit the required information as required during the regulatory review process. In addition, key elements essential for the review of an imported design include: 1) The NPP design to be imported should be licensable in the Country of Origin; and 2) the utility should obtain sufficient technical details from vendor during the regulatory review process to demonstrate and establish safety. It was also noted that the AERB does not interact with vendors for the NPP design review but works solely with the utility.

Most of the IRRS team members participated in the discussion and provided insights on the on the licensing strategies for new technologies in their countries. The main points discussed were:

- A common method for regulatory bodies to approve a new reactor technology is to perform a detailed generic design assessment
- Regulatory bodies should dedicate sufficient resources to performing the design reviews.
- Regulatory bodies should consider issuing specific regulations for approving and using a new design
- When selecting a new technology, consideration should be given to ensuring that it has a proven design that is already licensed by the vendor's home country and that there is sufficient operating experience for the design
- The vendor must supply sufficient information, for the regulatory body to assess the design and make a licensing or certification decision
- In some countries, the codes and standards of the vendor country are also referred to during the review.
- The application should contain a table matching the codes and standards used by the regulatory body with those of the vendor country and the most conservative standards should be selected.
- Regulatory bodies should perform an independent review of the new technology and not rely on the approval of the regulatory body of the host country of the vendor
- The IAEA can provide a generic design review of various designs as per the request and funding of the member state.

5.3. SUMMARY

Well-developed codification of licensing requirements is available in India, especially for the majority of operating NPPs, i.e., the PHWR type reactors. For the other type of reactors operating, under construction or planned, the specification of requirements is not yet fully developed. The codification of requirements is continuously being developed and updated. The latest international practices and experiences are taken into account, covering the severe accident related issues, including the Fukushima related issues. Some of the formalized and detailed requirements for LWRs and for PFBR have not been prescribed in safety codes and guides. However, the IRRS team was informed that the AERB provided additional specific requirements through the established means of communication. The IRRS team was informed that the

AERB considers these apparent inconsistencies and gaps in the codified requirements do not hinder with the ongoing AERB licensing and oversight processes.

The current strict requirements in India for PSA analyses are limited to level-1 PSA for full power and of internal events. To demonstrate the applicability of several state-of-the-art safety requirements which are already incorporated in AERB safety requirements cannot be carried out without performing the full scope and up to level-2 PSA studies.

The IRRS team proposed three suggestions in relation to the above issues.

6. REVIEW AND ASSESSMENT

6.1. GENERIC ISSUES

6.1.1. MANAGEMENT OF REVIEW AND ASSESSMENT

The IRRS team's observations confirmed that the AERB has established the programmes and processes necessary for the conduct of regulatory reviews and assessments for the authorized facilities and activities.

The AERB has established requirements for the evaluation of potential interactions of systems important to safety and relevant safety information resulting from research findings or reviews of both national and international operating experience is considered and applied in the conduct of safety reviews and assessments.

The conduct of the AERB reviews and assessments covers all phases of the facility lifecycle, from siting to decommissioning, and includes a systematic evaluation of all safety relevant features of the facility.

Although site clearance from the Government of India, Ministry of the Environment and Forests (MoEF) is required for any new or proposed NPP there is no direct interface between MoEF and the AERB for site authorization. The proponent, the NPCIL, applies for the site clearance from the Ministry of the Environment and Forests. For issuance of the site consent the AERB conducts its own independent review to confirm the acceptability of the site after verification of the specified requirements in its regulatory documents. These two review processes are completely independent, however they may be conducted in parallel.

A graded approach is applied based on the design of the facility for initial licensing, and on the phase of the licence renewal cycle, and on the complexity of any proposed plant modification. The scope and depth of the reviews and assessments is greater for licensing of new or more complex designs and less for designs similar to those previously reviewed and accepted. The authorisation period for NPPs operation is 5 years with detailed periodic safety reviews conducted every 10 years. The scope and depth of the reviews are greater when the licence renewal coincides with the conduct of a periodic safety review.

The AERB has made provisions for the review and assessment of changes to the safety related aspects of the facility or activity.

Records of AERB decisions derived from the review and assessment are kept in an electronic documentation system which facilitates the subsequent location, retrieval, and use of the information by AERB staff. The IRRS team noted the high quality and capacity of this electronic documentation system during the mission.

6.1.2. ORGANIZATION AND TECHNICAL RESOURCES FOR REVIEW AND ASSESSMENT

Nuclear Projects Safety Division (NPSD) and Operating Plants Safety Division (OPSD) of the AERB are responsible for management of safety reviews and assesments for authorization of NPPs during project stages and operation stages respectively.These technical divisions carry out preliminary reviews of the technical submissions made in support of license applications and provide input to the safety committees during multi-tier reviews at different stages of the NPPs. NPSD and OPSD have established interfaces with related technical divisions of the AERB such as Siting and Structural Engineering Division (SSED), Nuclear Safety Analysis Division (NSAD), Industrial Plants Safety Division (IPSD) and Safety Reseach Institute (SRI) for Technical and analytical support for review and assessment.

The AERB has established the Safety Research Institute (SRI) dedicated to Research and Development (R&D) in important safety-related areas to support the AERB regulatory functions.

The SRI is located on the campus of the Indira Gandhi Centre for Atomic Research (IGCAR) which facilitates the SRI research staff with access to various state of the art laboratories and facilities. The areas of research studies include nuclear and reactor safety, radiation safety, engineering safety, environmental safety, waste management, and transportation safety.

The AERB has established a Nuclear Safety Analysis Division (NSAD) which comprises approximately 25 staff members and a Siting and Structural Engineering Division (SSED) which currently comprises 11 staff members. The NSAD and SSED activities support the AERB review and assessment processes through the conduct of independent verification and research activities in several subject areas.

The subject areas supported by NSAD activities include safety analysis, thermal hydraulics, containment hydrogen distribution and mitigation, severe accident studies and assessments, and computer code development. The NSAD uses internationally validated and accepted system codes, lumped parameter codes, structural analysis codes along with AERB in-house developed computer codes to carry out these independent activities.

The SSED is responsible for the safety review and assessment for NPP siting which focus on the civil and structural engineering aspects of NPPs as it applies to the granting of regulatory approvals. To accomplish this mandate, the SSED undertakes research and development activities relating to structural integrity, seismic safety, and flood hazard assessments. These activities are intended to support AERB decision making, regulatory document development, and the development of state-of-the-art approaches and expertise capability.

The IRRS team was informed that both the NSAD and SSED capabilities have been applied to AERB activities relating to all current NPP designs.

The AERB has access to Technical Support Services (TSS) which support the conduct of the AERB functional activities. The technical support for the AERB comes mainly from the Bhabha Atomic Research Centre (BARC) and includes support in the areas of development of safety documents, radiological and environment safety, review and assessment inspection and verification, reactor physics and chemistry, post-irradiation examination, control and instrumentation, and shielding. Arrangements are in place to support the management of the interface between the AERB and the TSS and ensure the services provided by TSS are aligned with those requested by the AERB.

The AERB is also structured to ensure it has access to the support of external consultants which may be required from time to time to address specific issues.

Notwithstanding the positive IRRS team observations regarding the establishment of a sustainable national education and training programme for nuclear human resources described in Section 1.8 of this report and already categorised as a good practice; the AERB has implemented screening and selection processes for job applicants with well documented position entry level qualification requirements and orientation training programme for the new recruits. The training programme is adjusted with the support of the HR group in accordance with the technical function that the new employee will be performing. These programmes include training on the AERB regulatory processes (with a duration of 6 to12 months), on-the-job training conducted at a site facility (with a duration of 1 to 3 months), a mentoring period with more experienced staff (with a duration of 3 to 5 years), and site experience for inspectors (with a duration of 2 to 3 years). AERB employees are delegated with the powers of inspector and lead inspectors by the AERB Chairman. For an operating NPP or RR, a lead inspector/team leader with a few years of operating experience as shift-charge-engineer or equivalent is desirable. The IRRS team was informed that this requirement is not mandatory since inspection teams may also be lead by experienced technical staff from specialised disciplines who undergo a different training program that is aligned with the position occupied by the employee.

The AERB has also made provisions for delivery of refresher training to its staff.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB has implemented the measures to obtain the technical expertise and capability which may be required to support delivery of the AERB mandate.*	
(1)	**BASIS: GSR Part 1 Requirement 20 paras. 4.20. to 4.22. state that** *"The regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions, but this shall not relieve the regulatory body of its assigned responsibilities."*
GP3	**Good Practice: The research and development infrastructure established to support the regulatory review and assessment activities is worthy of the attention of other regulatory bodies.**
Observation: *The arrangements established between the AERB and its support organizations, the clearly defined position entry level academic requirements, and the technical and practical training programme of the AERB should provide suitably qualified and experienced technical assessment and inspection staff.*	
(1)	**BASIS: GSR Part 1 Requirement 11 states that** *"The government shall make provision for building and maintain the competence of all parties having responsibilities in relations to the safety of facilities andactivities."*
(2)	**BASIS: GSR Part 1 Requirement 18 states that** *"The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions, and discharge its responsibilities."*
GP4	**Good Practice: The scope and depth of the AERB recruitment and training programme is worthy of the attention of other regulatory bodies.**

6.1.3. BASES FOR REVIEW AND ASSESSMENT

The IRRS team's observations confirmed that the AERB has developed and is maintaining an extensive system of comprehensive regulatory documents for the conduct of safety reviews and assessments. These documents include procedures, safety codes, and safety guides which are aligned with the IAEA safety standards and cover all safety related areas in sufficient scope and depth to support the conduct of consistent assessments and reviews.

The AERB has conducted technical reviews to evaluate the adequacy of the existing regulatory codes and requirements based on the lessons learned from the Fukushima accident. Areas where improvements are required have been identified and improvement actions have been initiated and are being tracked for all identified areas.

The AERB review and assessment process allows for access to additional technical information which may not have been included in any specific submission.

6.1.4. PERFORMANCE OF REVIEW AND ASSESSMENT

The AERB has established the programmes and processes required to maintain an independent regulatory oversight of the authorized facilities and activities while fostering mutual understanding and respect on the part of authorized parties to achieve the common safety objectives.

The AERB follows a multi-tier review and assessment system that is supported by several committees to carry out its regulatory functions. The goal of this system is to ensure reviews are based on unbiased expert opinions. Review and assessment is one of the main functions of the AERB which often results in the formation of teams and committees depending on the complexity and scale of the issue. Committees,

whether standing or ad-hoc are formed and categorised according to documented criteria. The mandates and functions of the already formed standing committees are also documented.

The AERB programmes and processes include opportunities for the licensee representatives to provide input or feedback to the AERB decision making bodies. Examples include discussions between inspectors and licensee staff during inspections and mandated attendance to safety review committees such as the SARCOP where one committee member is a senior representative from the licensee organization who can provide input and seek clarification concerning the decisions made by the AERB decision making authority. The IRRS team was informed that, in the AERB's opinion, the licensee representative cannot influence the decision or proposition of the SARCOP (reference is made to subchapter 3.2).

In all cases discussed, the IRRS team confirmed that the applicant is required to submit an adequate demonstration of safety in support of the application for authorization of a facility or an activity. This demonstration, in addition to the relevant safety analyses, includes the provision of acceptable operation, maintenance, engineering, radiological protection, training, management programmes as well as radioactive waste and spent fuel management programmes.

The results of regulatory activities such as inspections, reviews and assessments, reviews of operating experience, research findings are evaluated to determine whether the safety assessment needs to be reviewed and reaffirmed by the AERB.

The AERB has made provisions for the review and assessment of changes to the safety related aspects of the facility or activity. The licensee is required to submit a formal written notice which describes the nature of the change and or modification required or being considered, the supporting rationale for the proposed modification, and the technical basis which demonstrates the modification will not have an adverse impact on nuclear safety. Criteria is established to delineate the station systems which are covered by these requirements and these criteria apply to both permanent and temporary modifications.

6.2. REVIEW AND ASSESSMENT FOR NUCLEAR POWER PLANTS

For the most critical cases, the AERB carries out independent safety analyses in order to verify the results of the submitted safety analyses. These independent verifications can be done by AERB staff or through arrangements with an external technical support organisation. The internal and external human and other resources for carrying out these analyses are well established for different types of safety related analyses, including the deterministic and probabilistic methods. These analyses may also cover the structural analyses of structures systems and components related to safety, the reactor physics calculations, the thermal-hydraulic analyses, and modelling of containment processes and radiation dispersion.

The IRRS team noted that one of the PHWR plants has already completed an extended PSA analysis, including shut down PSA and level-2 PSA, as well as analysis of external events. This analysis was submitted to the AERB for review. The AERB is considering requiring such analyses for all NPPs.

A recently issued design requirement code for LWR already includes requirements in respect of the design extension conditions, covering the cases of severe accidents without and with core melt. With respect to these cases the general requirement is the 'Limited Environmental Impact', which has to be demonstrated in the safety report. These requirements will have to be satisfied to support the upcoming LWR licensing cases, however similar requirements have not yet been developed for the other reactor types.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The requirements for design extension condition handling have been recently elaborated for LWRs, however the corresponding requirements for other reactor types are not yet in place.*	
(1)	**BASIS: SSR2/1 Requirement 20 states that** *"A set of design extension conditions shall be derived on the basis of engineering judgment, deterministic assessments and probabilistic assessments for the purpose of further improving the safety of the nuclear power plant by enhancing the plant's capabilities to withstand, without unacceptable radiological consequences, accidents that are either more severe than design basis accidents or that involve additional failures. These design extension conditions shall be used to identify the additional accident scenarios to be addressed in the design and to plan practicable provisions for the prevention of such accidents or mitigation of thei consequences if they do occur."*
S11	**Suggestion: The AERB should consider addressing the design extension conditions (DEC) without core melt (multiple failure situations and rare external events) and DEC with core melt (severe accident) in other regulatory documents in addition to the newly published safety codes.**

6.3. SUMMARY

The AERB has implemented a well-documented screening and selection process and a comprehensive training programme for new recruits.

The IRRS team's observations confirmed that the AERB has developed and is maintaining an extensive system of comprehensive regulatory documents for the conduct of safety reviews and assessements which cover all phases of the facility lifecycle from siting to decommissioning, and include a systematic evaluation of all safety relevant features of the facility.

The AERB follows a multi-tier process which includes a graded approach based on defined criteria.

The IRRS team's observations confirmed that the AERB has established the programmes and supporting processes necessary for the conduct of regulatory reviews and assessments for the authorized facilities and activities. These programmes are being delivered using internationally accepted methodologies and tools.

The AERB benefits from the support of safety research establishments dedicated to research and development in important safety-related areas.

On the above basis, the IRRS team proposed two good practices.

The AERB has elaborated the LWR requirements for DEC, however these have not yet been developed for other reactor types. On this basis the IRRS proposed a suggestion.

7. INSPECTION

7.1. GENERIC ISSUES

7.1.1. INSPECTION APPROACHES, METHODS AND PLANS

The AERB's inspection program was established to verify compliance with the rules, provisions, and regulatory requirements. The inspection program includes guidance to conduct inspections during various phases of a NPP life cycle, verification of licensee's compliance with regulatory requirements, carrying out planned and reactive inspections, and documenting inspection activities and findings in reports. Regulatory inspections are carried out as per the guidelines given in the Safety Guides and Safety Manuals.

Inspection Schedules are developed annually for all NPPs and are commensurate with the radiation risks associated with the facility or activity, in accordance with the graded approach. These inspection schedules outline the dates and duration of inspection activities that will be conducted at each NPP, and also list the type of inspection (regular or special). The inspection schedules are shared with the NPCIL for each NPP. The AERB Safety Manual outlines the regular inspections to be performed at each NPP and the required periodicity of each inspection. Provisions are included to perform additional inspections, called special inspections, in addition to the regular inspections.

Inspection activities are outlined in the Safety Manual and include provisions for routine and reactive inspections that may be announced or unannounced. The IRRS team identified that while the guidance does allow for the use of unannounced inspections, the AERB has not performed planned unannounced inspections until recently, starting in 2013. Prior to 2013, the only unannounced inspections performed were reactive inspections. In both 2013 and 2014, the AERB performed five unannounced inspections at either NPPs or RTRs. The IRRS team identified that the AERB guidance documents contain provisions for performing unannounced inspections, however there was no specific guidance for the purpose, frequency, number, or location of unannounced inspections.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team noted that the AERB guidance documents, while allowing provisions for conducting unannounced inspections, did not contain specific guidance for implementing unannounced inspections.*	
(1)	**BASIS: GSR Part 1 Requirement 28 states that** *"Inspections of facilities and activities shall include programmed inspections and reactive inspections; both announced and unannounced."*
(2)	**BASIS: GS-G-1.3 para. 4.1. states that** *"To ensure that all nuclear Facilities in a State are inspected to a common standard and tht their level of safety is consistent, the regulatory body should provide its inspetors with written guidelines in sufficient detail. The guidlelines should be followed to ensure a systematic and consistent approach to inspection while allowing sufficient flexibility for inspectors to take the initiative in dealing with the new concerns that arises."*
R10	**Recommendation: The AERB should add specific guidance to their inspection planning documents to perform unannounced inspections with defined purpose and periodicity at all NPPs.**

7.1.2. INSPECTION PROCESSES AND PRACTICES

The AERB conducts inspections at NPPs per the approved annual inspection schedule. Prior to the onsite inspection, the Inspection Team Leader will develop an inspection plan that details what inspections are

to be performed by the various team members. As part of the inspection preparation each inspector is responsible for reviewing previous inspection reports and any associated enforcement actions so that corrective actions can be reviewed for closure. Inspections are conducted using inspection checklists as outlined in the Safety Manual. The AERB inspectors utilize many of the common inspection methods mentioned in IAEA GS-G-1.3, including monitoring, direct observation, discussion, reviews, and examinations of procedures, records and documentation.

Inspection activities are documented in inspection reports. Draft Inspection reports, which contain any findings identified during the inspection, are prepared and shared with the NPP at the end of an onsite inspection. The final inspection report is approved by the appropriate Division Director and sent to the NPP within 15 days of the inspection exit meeting. Enforcement actions from all NPP inspection activities are shared with all inspectors and are used by inspectors to prepare for upcoming inspections. Additionally, the AERB publishes an annual report that is publically available that documents the activities conducted by the AERB as well as information regarding enforcement actions taken at each NPP.

The IRRS team noted that as the result of an internal self-assessment, the AERB recognized that the assessment of safety culture was carried out indirectly during regulatory inspections. An action item was created (SARIS Action Item 7&8-R9) to develop and implement a more systematic method for assessment of the licensees' safety culture. Prior to the IRRS review, the AERB implemented a procedure to provide a systematic method to assess the safety culture of an operating NPP.

The results of inspections are also used as feedback information for the regulatory process. During the development of annual inspection schedules, each NPPs enforcement actions are reviewed to identify any potential trends or areas that may warrant additional inspection. If warranted, additional inspections may be added to the annual inspection schedule as special inspections. The IRRS team noted that as the result of an internal self-assessment, the AERB recognized that they should develop a mechanism to analyse findings and trends and use the analysis for improving the regulatory process (SARIS Action Item 7&8-R10). The AERB completed this action item in November 2014 when they implemented a procedure for the evaluation of the regulatory inspection process for operating NPPs. Inspection results are incorporated in this self-assessment to determine whether various elements of the inspection program are adequate, including the annual Reactor Inspection Plans, whether special/unannounced inspections are justified, and whether human resources were allocated in proportion to the number of areas to be inspected.

The AERB Safety Guide identifies the inspection areas for nuclear and radiation facilities, including the siting stage, the construction stage, the commissioning stage, the operating stage, and the decommissioning stage. The IRRS team noted that the AERB Safety Manual for Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities does not include inspection checklists to carry out the required inspections for the decommissioning inspection stage.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team noted that there are no inspection guides for performing the required decommissioning inspections.*	
(1)	**BASIS: GS-G-1.3 para. 4.1. states that** *"To ensure that all nuclear facilities in a State are inspected to a common standard and that their level of safety is consistent, the regulatory body should provide its inspectors with written guidelines in sufficient detail."*
S12	**Suggestion: The AERB should consider developing inspection guides for implementing inspections during the decommissioning of a NPP.**

7.1.3. INSPECTORS

In the AERB, there are approximately 322 staff, including 94 inspectors directly responsible for implementing the inspection program for NPPs. All of the AERB inspectors for NPPs are located in Mumbai and the AERB does not have resident inspectors. Prior to 2013 all planned inspections were announced and the only unannounced inspections were reactive inspections. In 2013 the AERB began performing planned unannounced inspections. The AERB guidance does allow for the use of external experts as inspection team member, however a external expert cannot act as the inspection team leader. The use of external experts is not common and is typically only employed when expertise is needed in a specific area of inspection. No external experts were used as inspectors in 2014, and only one externalexpert was used as an inspector in 2013.

The AERB inspectors are trained using a robust, systematic training program that involves approximately six months of classroom training in nuclear technology and the Regulatory Process, a minimum of two years of Core Competency Training at an operating NPP to gain knowledge of NPP systems and operation, and then at least two years as an inspector under instruction or participate in a minimum of 7 inspections at a NPP/Research Reactor. AERB employees are appointed to the position of inspectors by the AERB Chairman. Section 6.1.2 marks the AERB's robust training program as a Good Practice.

The legal basis for carrying out inspections is derived from India's Atomic Energy Act, 1962, Factories Act 1948, Atomic Energy (Radiation Protection) Rules, 2004, Atomic Energy (Safe Disposal of Radioactive Wastes) Rules 1987 and Atomic Energy (Factories) Rules 1996. Provisions require that licensees provide prompt access to all areas for inspection. The competent authority (Chairman AERB) has also delegated the power to lead inspectors to implement on the spot enforcement action in consultation with the Chairman or Vice-Chairman AERB in accordance with the Atomic Energy Act, 1962.

7.2. INSPECTION OF NUCLEAR POWER PLANTS

The AERB uses the methods and processes described above to perform periodic regulatory inspections of NPPs. The regulatory inspections are carried out during the siting, construction, commissioning, and operating stages of a NPP. No NPPs in India have initiated decommissioning. The annual inspection schedule for each NPP is written at the start of each fiscal year and inspection activities are documented in written reports that are provided to the NPP.

The IRRS team members visited the Kakrapar Atomic Power Station (KAPS) on March 17 and 18, 2015. During the visit, IRRS team members met with plant management and observed inspection performed by AERB inspectors at both the operating units (KAPS-1 and KAPS-2) and units under construction (KAPP-3 and KAPP-4). While at KAPS-1 and KAPS-2, the IRRS team observed inspectors performing inspections in the areas of operations, maintenance, and plant events. The IRRS team members also toured the control room and areas of the turbine building including the turbine deck and one of the emergency diesel generator rooms. While at KAPP-3 and KAPP-4, the IRRS team members toured the construction site with AERB electrical, civil, and industrial safety inspectors and plant personnel. The IRRS team members observed the control room, the installed KAPP-3 Endshield, and the KAPP-4 End shieldthat has not yet been installed in the plant.

The IRRS team discussed the relationship between the AERB and the NPCIL with the KAPP-3 and KAPP-4 Project Director, Construction Manager, and Quality Assurance Manager. Plant Management confirmed that AERB inspectors are considered to be knowledgeable, competent, professional, and well prepared for inspections. Plant Management also discussed the importance of industrial safety and stated that the AERB also places a high importance on industrial safety.

During the construction and commissioning stages, the AERB conducts regulatory inspections of NPPs at a frequency of four inspections in a year, with the inspections being conducted approximately each

quarter. During the operating stage the AERB conducts regulatory inspections of NPPs at a frequency of two times per year, with inspections being conducted approximately 6 months apart. Inspection teams consist of six to eight members and inspections are carried out for a period of about one week (typically Monday through Friday). The composition of inspection teams and the areas of inspection are pre-decided. The AERB has also identified a list of important activities during construction and commissioning as hold points for which the licensee is required to inform the AERB in advance so that inspectors may observe the activities.

All NPPs are required to submit specific technical reports regarding the operation of the NPP to the AERB on a monthly/quarterly/annual basis. The list of technical reports required to be submitted include, but is not limited to: Monthly Performance Reports, Significant Event Reports, Station Operating Review Committee meeting minutes, and unit long outage reports. The AERB places a high level of reliance upon the information submitted by the licensee in these periodic document submissions. The documents submitted are reviewed, and the information is used as part of the planning process for onsite inspections. The IRRS team recognized that the level of actual on-site inspection at NPPs is often limited to just two weeks per year. For an operating NPP special inspections have been carried out during biennial shutdowns of NPPs radiation protection activities. These special inspections are not required by AERB manuals or guidance. The IRRS team, through observation of inspectors at KAPS and interviews with inspectors, determined that only about 50% of the on-site inspection time is spent in the field observing operators, testing and maintenance, and equipment. The remainder of the on-site inspection is conducted in an office environment reviewing documents or conducting interviews with plant personnel.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team recognized that the level of inspection effort at an NPP consists of two week-long inspections per year, performed by an inspection team consisting of 6 to 8 members. The AERB places a large burden of their inspection activities upon the information received from the NPP because continuous supervision of NPPs is ensured by the AERB by carrying out review of performance reports, reports on radiological safety aspects, event reports, etc. The IRRS team also identified, through interviews with inspectors, that the AERB does not require nor do they routinely inspect the reactor shutdown and start-up that occurs during a shutdown for maintenance activities.*	
(1)	**BASIS: GSR Part 1 Requirement 27 states that** *"The regulatory body shall carry out inspections of facilities and activities to verify that the authorized party is in compliance with the regulatory requirements and with the conditions specified in the authorization."*
(2)	**BASIS: GSR Part 1 Requirement 29 states that** *"Inspections of facilities and activities shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach."*
(3)	**BASIS: GSR Part 1 para. 4.50. states that** *"The regulatory body shall develop and implement a programme of inspection of facilities and activities, to confirm compliance with regulatory requirements and with any conditions specified in the authorization. In this programme, it shall specify the types of regulatory inspection (including scheduled inspections and unannounced inspections), and shall stipulate the frequency of inspections and the areas and programmes to be inspected, in accordance with a graded approach."*
(4)	**BASIS: GS-G-1.3 para. 2.3.(d) states that** *"Sufficient numbers of personnel, who have the necessary competences for the efficient and safe performance of their duties, are available at all times and throughout all stages of the facility's lifetime."*
S13	**Suggestion: The AERB should consider increasing the frequency of routine on-site inspections at NPPs commensurate with the size of India's nuclear programme. The increased frequency of inspections would allow for additional independent verification**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	and more effective regulatory oversight of NPPs.

7.3. SUMMARY

The IRRS team concluded that there are sufficient legal basis and AERB documents to carry out regulatory inspections at NPPs in accordance with IAEA standards.

- AERB inspectors are well trained using a rigorous training program, are respected by the NPP personnel, and are motivated to discharge their duties;
- The AERB performs continuous monitoring of NPPs through the review of various documents submitted by each NPP, and also performs inspections that are planned and performed in accordance with written guidance.
- Results of AERB inspections are recorded and communicated to the inspected NPP and AERB personnel through the inspection reports, and members of the public through the AERB Annual Report.

The IRRS team identified one recommendation and one suggestion for improvement of the AERB inspection programme and practices, including specific guidance related to the performance of unannounced inspections and specific guidance for performing decommissioning inspections. Additionally, the IRRS team identified a suggestion to consider increasing the frequency of on-site inspections to allow for enhanced regulatory oversight at NPPs. The IRRS team also identified a good practice regarding the AERB inspector training programme which is further discussed in chapter 6.

8. ENFORCEMENT

8.1. ENFORCEMENT POLICY AND PROCESSES

The AERB is empowered to impose corrective measures and enforce their adoption, including sanctions in case of failure as described in Sub-section (5) of Section 17 of the Atomic Energy Act, 1962. Section 23 (Administration of Factories Act, 1948) of the Atomic Energy Act, 1962 empowers the AERB for enforcement of industrial safety in units under control of the DAE.

The AERB can take the following enforcement actions depending on significance of the non-compliance identified:

a) Sending an enforcement letter.

b) Sending a written warning/directive.

c) If there is a safety risk due to delay, or in the case of an occurence of undesirable facts important from the point of view of nuclear safety, radiation protection, physical protection, and emergency preparedness, the AERB can order the NPP to curtail the authorized activities in case of situations deemed to be serious and considered to pose an imminent radiological hazards to workers, the public or the environment.

d) Revoke, suspend or modify the Operating Consent of a licence employee who has substantially infringed their duties to satisfy professional, physical or mental requirements.

e) Initiation of penal action.

The AERB imposes corrective measures in accordance with the Atomic Energy Act, 1962. Inspectors are empowered to demand a submission of information in writing on corrective actions taken to eliminate deficiencies found during an inspection based on the Act.

The AERB has established an enforcement policy within the legal framework for responding to non-compliance by the licensee. The enforcement policy is prescribed in AERB internal documents for practical application of enforcement.

The AERB guidance contains provisions for the possibility of a license appeal. In the case of disagreement on the decisions of the Regulatory Body, the Licensee may appeal against such decisions to the AEC whose decision shall be final. Even if the Licensee intends to appeal the decision, the NPP is required to implement the measures intended to protect the NPP personnel, the public and the environment against any radiological hazards.

The AERB is granted the authority to take enforcement action with respect to the areas of industrial safety, fire protection, the use of radioactive materials, and the production of radioactive waste. The national legal framework does not grant the AERB the authority to take enforcement action for those activities that do not fall under its jurisdiction, such as criminal offences or violations of environmental laws. When asked if the AERB had any formal arrangements in place with relevant Government agencies where enforcement action requires the involvement of the police, justice ministry, or other authorities, the AERB stated that no such agreements exist.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The IRRS team noted that the AERB does not have any formal arrangements with relevant Government agencies where enforcement action requires the involvement of the police, justice ministry, or other authorities.*	
(1)	**BASIS: GS-G-1.3 para. 5.16. states that** *"procedures should stipulate which other governmental organizations, if any, should be informed in the event of enforcement notifications."*
S14	**Suggestion: The AERB should consider establishing formal arrangements with other Government agencies and procedures for implementing the formal arrangements in the event enforcement actions require the involvement of those agencies.**

During the IRRS team's review of the various areas of enforcement, it was noted that the legal framework and internal AERB documents do not appear to identify methods that would provide commensurability between enforcement actions and the gravity of the non-compliance. Those documents do not have the guidance to implement the legislation that empowers the AERB to impose civil penalties.

The IRRS team noted that as the result of an internal self-assessment, the AERB recognized that an enforcement procedure should be prepared that describes the process to be followed during various types of enforcement actions, including enforcing the cessation of activities or the shutting down of the facility where necessary (SARIS Action Item 7&8-R11).

8.2. ENFORCEMENT IMPLEMENTATION

Regarding the implementation of enforcement, the AERB and their inspectors' rights are given by the Atomic Energy Act, 1962. In general, inspectors are empowered to demand the elimination of findings.

The AERB procedures imposing corrective measures are described in internal documents, e.g. in the AERB Safety Code on Regulation of Nuclear and Radiation Facilities, the AERB Safety Guide on Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities and the AERB Safety Manual on Regulatory Inspection and Enforcement in Nuclear Power plant and Research Reactors.

In practice, the AERB can take appropriate enforcement actions for the elimination of non-compliances through the following actions:

- sending an enforcement letter
- sending awritten warning/directive
- order to curtail activities
- modification, suspension or revocation of consent/authorization
- initiation of penal action

For NPPs the AERB issues an enforcement letter and/or written warnings / directives based on the gravity of the non-conformance. In each case, the letter and/or written warning identifies the nature and importance of each violation. The letter and/or written warning specifies a period of time to implement remedial actions. The information regarding implementation of remedial measures is provided by the licensee to the AERB. The AERB evaluates the response and, if the nature of the finding demands, the effect of the implementation of the measures is verified at the nuclear power plant. The compliance with requirements stipulated in the letter and /or written warning is tracked by the AERB Safety Committee. In determining a reasonable period of time for completion of corrective action, the AERB considers the following:

- the significance of the deficiency and its influence on nuclear / radiation safety
- the possibility to temporarily compensate for the deficiency by substitute measures
- the complexity of the action that is necessary to implement, in particular if there are large equipment modifications (unless there is a danger in delay, quality is preferred over timeliness)

The fulfilment of prescribed requirements and the date of completion are verified upon the expiration of the specified period. Findings from previous inspections are usually corrected prior to subsequent inspections, and the inspector will verify and document corrective actions are complete in the subsequent inspection report. If the inspected NPP fails to fulfil a requirement within the required verification period, the inspector makes a record in the inspection report, which is assessed for further enforcement, and continues to monitor the progress of the required corrective actions.

The AERB can issue orders to a licensee to curtail the authorized activities especially for situations deemed to be serious and considered to pose an imminent radiological hazard to workers, the public or the environment.

In the event of recurring or extremely serious non-conformance, or significant contamination of the environment due to serious malfunction or damage to the nuclear power plant, the AERB may modify, suspend or revoke the Consent, depending upon the nature and severity of the situations.

Regarding to the power delegated to a lead inspector, the lead inspector is empowered to implement on the spot enforcement action with permission from Chairman / Vice-Chairman, AERB. Only in cases of serious non-compliances affecting safety of the plant, workers, public or environment, is the lead inspector empowered to implement on-the-spot enforcement action. The lead inspector can stop work if minimum safety precautions and requirement set for working, portable electric equipment, fire safety, personal protective equipment and working in confined areas are not followed.

For serious violations, willful or repeated or for deliberate non-conformance of the applicable provisions of the Atomic Energy Act, 1962, and of the requirements or remedial actions stipulated by the AERB, penal action may be initiated as prescribed in the Atomic Energy Act, 1962. The IRRS team noted that the AERB does not have any guidance on how to implement a decision making process to refer any enforcement action to another Government authority for prosecution.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The AERB does not have the guidance to implement the legislation that empowers the AERB to impose penalties.*	
(1)	**BASIS: GSR Part 1 para. 4.54. states that** *"the response of the regulatory body to non-compliances with regulatory requirements or with any conditions specified in the authorization shall be commensurate with the significance for safety of the non-compliance, in accordance with a graded approach."*
(2)	**BASIS: GS-G-1.3 para 5.13. states that** *"The regulatory body should have the authority to impose or recommend penalties, such as fines on the operator as a corporate body or on individuals, or to institute prosecution through the legal process, depending upon the legal systems and authorization practices in the State concerned. The use of penalties is usually reserved for serious violations, for repeated violations of a less serious nature or for deliberate and wilful non compliance."*
S15	**Suggestion: The AERB should consider developing and implementing enforcement procedures that describe the process to impose penalties.**

8.3. SUMMARY

The AERB is empowered by the Atomic Energy Act, 1962 and related legislative documents to impose corrective measures and enforce their adoption, including revocation of the Consents and sanctions. The AERB enforcement process includes diverse and graded tools incorporated into their enforcement policy and systematically performs the evaluation of effectiveness of enforcement actions.

The IRRS team noted that there are no formal provisions with other Government agencies in the event enforcement actions require the involvement of other Government agencies. Additionally, the IRRS team identified that there is no guidance to implement the legislation that empowers the AERB to impose civil penalties.

9. REGULATIONS AND GUIDES

9.1. GENERIC ISSUES

The AERB Constitutional Order (S.O. 4772) Clause 2(i) requires the regulatory body to develop Safety Codes, Guides and Standards for siting, design, construction, commissioning, operation and decommissioning of the different types of facilities, recognising international and national requirements.

The AERB has established a dedicated division, Resources and Documentation Division (RDD), which is mandated with the responsibility of coordinating the process of development of regulatory documents in the AERB. The AERB has an established process for the development and publication of safety codes, standards and guides. These documents are prepared in accordance with the AERB Safety Guide on 'Development of Regulatory Safety Documents for Nuclear and Radiation Facilities (AERB/NRF/SG/G-6 (Rev.-1)].

A multi-tier system is followed for the development and updating of regulatory safety documents. Members of the multi-tier review committees are nominated so as to ensure that expertly written, unbiased and transparent documents are prepared, consistent with current international practices. In addition to specialists from the AERB, experts from the DAE, academic institutes, Central/State Government departments, industries etc., are nominated in the AERB committees for development/revision of regulatory safety documents. The IRRS-team has concluded that draft codes and standards are not published for consultation with the public. A reference to this matter is discussed in module 3 and a recommendation based on this issue was provided.

The preparation and updating of AERB safety documentation is normally carried out in two stages:

i. Identification and initiation of safety document development through a formal safety document development proposal (SDDP) which is subsequently reviewed and approved by a multi-tier mechanism.

ii. Development of the document which includes preparation of the draft document, subsequent review and comments disposition in a multi-tier mechanism and final approval by the competent authority.

The need for development/revision of a safety document is identified by the various divisions of the AERB. Having identified the document to be prepared/revised, a Safety Document Development Proposal (SDDP) is prepared and circulated within the AERB for comments. The revised SDDP based on AERB comments is further reviewed by the relevant advisory committees for development of safety documents and revised based on the comments from this committee. The revised SDDP is further reviewed by the Advisory Committee on Nuclear Safety (ACNS) and the Chairman, AERB, grants the final approval. The SDDP for safety codes is approved by the Board of the AERB.

Based on the SDDP, the initial draft of the document is prepared by a working group constituted for the purpose. The initial draft is reviewed by an advisory committee, comprising of senior specialists in the relevant field(s) which includes experts from the academic institutions,and their comments are incorporated to revise the document. Draft document thus prepared is circulated among the interested parties and experts in relevant field seeking for further comments. Disposition of the received comments is done by the advisory committee and document is again revised accordingly. The revised document is further reviewed by the ACNS and their comments are incorporated before final approval of the document by the competent authority. Approved documents are available for purchase and important documents are also displayed on the AERB website.

The AERB has issued about 150 regulatory documents in various areas of safety regulation with 70 that are specific to NPP's. With regard to revision of documents, for each of the AERB regulatory document,

a divisional coordinator is identified and made responsible for keeping track of development in the subject with respect to changes in relevant international safety standards, technological advances, research and development, relevant operational lessons learned, institutional knowledge, feedback on the published documents etc. The documents are revised based on the above inputs as and when required.

Recently, the AERB has undertaken and completed a comprehensive review of the prevailing safety requirements in the light of lessons learnt from the Fukushima accident.

The AERB follows a graded approach within its document development process which is specified in the revised AERB Safety Guide 'Development of Regulatory Safety Documents for Nuclear and Radiation Facilities [AERB/NRF/SG/G-6 (Rev. 1)]'. The multi-tier review system is adapted to the classification of the document.

Regulatory safety documents issued by the AERB are classified in the following decreasing order of hierarchy:

a) Safety codes

b) Safety standards

c) Safety guides

d) Safety manuals

e) Technical documents.

The safety codes and safety standards state legal requirements and as such are mandatory in nature. The safety guide is a document containing detailed guidance and methodologies that if complied with represent good practice and would be acceptable to the AERB in demonstrating compliance with the specific requirements of a safety code/safety standard. Safety codes, which are higher level documents are approved by the Board of the AERB while other regulatory documents are approved by Chairman, AERB.

The AERB Safety Code on 'Regulation of Nuclear and Radiation Facilities (AERB/SC/G)' is issued to provide the requirements that are to be met by the licensee (utility) during the regulatory consenting and licensing process. The AERB carries out consenting and licensing process as per requirements specified in this safety code. It gives the mandatory requirements/obligations to be met by a nuclear or radiation facility, and is intended to qualify for the regulatory consent/ licence. It also provides the requirements for the conduct of regulatory inspection and enforcement of safety provisions at nuclear and radiation facilities.

Different guides (G-Series) developed under this code provide further guidance which are used in the review process to check compliance against the requirements. For example, the AERB Safety Guide on 'Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)' specifies the consenting process necessary for nuclear power plant/research reactor. It covers in details the required information to be included in the submissions to the AERB, mode of document submissions and their classification, and areas of review and assessment for granting the regulatory consent. The major stages of consenting process for NPPs/Research Reactors are Siting, Construction, Commissioning, Operation and Decommissioning. The AERB Safety Guide on 'Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)' specifies the regulatory inspection and enforcement process. It provides guidance for regulatory inspection to verify the compliance of the prescribed safety requirements by the Consentee and the enforcement action that may be entailed as a result of the inspection. This safety guide also contains guidance on inspection resources of the regulatory body, organisation of inspection programmes, methods of inspection, obligations of the Consentee in regard to the regulatory inspection, content of inspection reports, and enforcement actions.

The AERB Safety Code on 'Site Evaluation of Nuclear Facilities [AERB/NF/SC/S (Rev. 1)]' establishes the requirements for evaluation of a site from the perspective of safety considerations. It includes requirements w.r.t. site related hazards, site characteristics and related phenomena, assessment of the impact of facility, assessment of the capability for implementing emergency plans in public domain over the projected lifetime of the facility, etc. Several safety guides issued under the code provide guidance for meeting these requirements.

The AERB Safety Code on "Design of Pressurised Heavy Water Reactor based Nuclear Power Plants [AERB/NPP-PHWR/SC/D(Rev. 1)]' and Safety Code on Design of Light Water Reactor Based Nuclear Power Plants (AERB/NPP-LWR/SC/D), lay down mandatory nuclear safety requirements that define the necessary elements to ensure safety. The safety code AERB/NPP-PHWR/SC/D (Rev. 1) covers the safety philosophy which should be applied in design of the plant and principal requirements to be followed by design organisation in the management of design process. It also covers requirements for safety assessment, quality assurance and the use of proven engineering practices and operational experience. It provides the principal and general technical requirements for implementation of defence in depth (DID), radiation protection, general plant design requirements and system design requirements that are applicable to specific plant systems. Various guides (D-Series) developed under this code provide further guidance on how to meet the above requirements.

The AERB Safety Code on 'Nuclear Power Plant Operation [AERB/NPP/SC/O(Rev. 1)]' deals with various aspects necessary for the safe operation of a NPP, such as responsibility of licensee, requirements w.r.t. plant management, commissioning programme, operating personnel, plant operations, operational experience feedback, plant modifications, radiation protection, emergency preparedness, plant life management, probabilistic safety assessment, decommissioning requirements, etc. Several safety guides (O- Series) issued under this safety code describe and make available methods to implement specific requirements presented in the Code.

The AERB Safety Code on 'Quality Assurance for safety in Nuclear Power Plants [AERB/SC/QA (Rev. 1)]' provides the basic requirements for the establishment, implementation and continual improvement of QA programme for all stages of the nuclear power plant viz. siting, design, construction, commissioning, operation and decommissioning. Several safety guides (QA-Series) issued under the safety code provide guidance to achieve the objectives envisaged in the safety code.

The AERB Safety Code on 'Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)' stipulates the requirements for providing adequate assurance for radiation safety of the occupational workers, members of the public and the environment against the undue exposure to ionising radiation. This document takes into account the recommendations of ICRP and specifies the requirements for establishing emergency preparedness program and the roles and responsibilities of the various agencies.

The AERB Safety Code on 'Management of Radioactive Waste (AERB/NRF/SC/RW)' establishes the requirements, which need to be fulfilled for safe management of solid, liquid and gaseous radioactive waste disposal. This safety code deals with the requirements for radiation protection aspects in design, construction and operation of waste management facilities and the responsibilities of different agencies involved.

Further reference to the application of the regulations (e.g. PSR, SAM, OEF, PSA), are outlined in modules 5 and 6.

Apart from the requirements from IAEA, other international regulations are used for the improvements of the AERB regulations. In its process for the improvement inspectors also are involved.

The AERB's regulatory safety document development approach is based on the IAEA approach. The set of regulations are also based on the IAEA standards. Regulatory standards are published on the website.

The only IAEA requirement that is not followed is the consultation of the general public (reference is made to module 3).

9.2. REGULATIONS AND GUIDES FOR NUCLEAR POWER PLANTS

For the listed requirements, refer to subsection 9.1. The AERB follows closely and participates in the developments of the IAEA standards. Recently, the siting code (2014) was updated, based on lessons learned from the Fukushima accident. Moreover, a design code for LWRs is published, which contains the most recent design requirements from the IAEA. The AERB published a revised document dealing with 'Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency' even earlier than the IAEA.

Following the Fukushima accident, the AERB has undertaken an upgrade of its regulatory documents. Post Fukushima, the AERB created a working group to review the regulatory/safety documents of the organization in order to identify areas of revision of the requirements for addressing the lessons learned from the Fukushima accident. The report of the working group was submitted to the AERB in March 2014.

In order to ensure the incorporation of the recommendations identified by the working group in the regulatory documents, the AERB issued an order on January 12, 2015. The intent of the AERB is to incorporate the recommendations in their regulations in a phased manner. Most of the additional requirements arising out of lessons learnt from Fukushima accident are already implemented, or being implemented in the NPPs.

9.3. SUMMARY

The AERB follows a robust development and revision process of its regulatory documents, that is based on IAEA approach. In principle, the AERB adopts, with country specific modifications, all relevant IAEA standards. It also benchmarks regulations against those of other countries.

The Fukushima-related modifications in the documents are being carried out in a structured way.

The IRRS team notes the action 9-R12 from the AERB action plan.

10. EMERGENCY PREPAREDNESS AND RESPONSE

10.1. GENERAL EPR REGULATORY REQUIREMENTS

Basic responsibilities

The AERB is responsible for the regulatory oversight with respect to all aspects related to emergency preparedness in NPPs. The AERB derives this mandate from Rule 33 of the Atomic Energy (Radiation Protection) Rule of 2004 and its constitution order. The AERB's role with respect to emergency preparedness is to establish the requirements and guidance; review and approve onsite EPR plans, prepared by NPP operator; ensure implementation of onsite EPR plan; and participate as observers in periodic exercises to verify various EPR elements. The facility operator, in coordination with State and District authorities, develops the offsite EPR plans. The AERB reviews offsite EPR plans for subsequent approval by District Authorities.

AERB/SC/G stipulates the minimum safety related requirements including that for emergency preparedness to be met by a nuclear facility to qualify for the issue of regulatory consent at every stage. Prior to issuance of licence for operation of a NPP, the AERB ensures that the approved emergency preparedness plans are in place and tested.

The implementation of offsite EPR plans is the responsibility of the National, State and District Disaster Management Authorities. The AERB is a member of the Crisis Management Group of the DAE, which coordinates with the National Crisis Management Committee (apex body for coordination at the national level), to provide technical advice to the Government in preparedness and in response to emergencies.

Hazard assessment

The development of emergency plans is based on a comprehensive hazards assessment, which is a regulatory requirement. Requirements specifically include the need to consider conventional hazards and external events. Regulatory guidance on hazard assessment exists consistently with IAEA safety standards.

10.2. FUNCTIONAL REGULATORY REQUIREMENTS

Establishing emergency management and operations

Regulatory requirements and guidance on the facility operator's emergency management structure exist.

The effectiveness of the licensee's emergency management function is verified by the AERB by review of EPR plans, periodic regulatory inspections, observation of emergency exercises, review of reports on emergency exercises, etc.

Identifying, notifying and activating

The regulatory requirements and criteria for classification of various emergencies, based on the severity of the potential consequences, exist. The classification levels are Emergency Alert, Plant Emergency, Site Emergency and Off-site Emergency.

The classification system (excluding "personnel emergency"), is comparable to, but not fully consistent with, the levels contained in the IAEA safety standards. For example, Offsite Emergency (the equivalent of General Emergency) is defined in terms of the release of radioactivity, whereas General Emergency is defined in terms of the imminence of core damage. There is a conceptual difference between "Offsite Emergency" and "General Emergency"; Offsite Emergency applies to offsite authorities and is declared by the Offsite Emergency Director (the District Magistrate), on the basis of a technical recommendation from the Site Emergency Director. This is not consistent with IAEA Safety Standards, which call for the prompt declaration of the appropriate emergency class by the facility operator and thus may cause a delay

in initiating public protective actions when core failure is imminent. The AERB safety guide provides details for classification of emergencies (Plant/site/offsite).

AERB/SG/O-6 specifies that key personnel shall be promptly notified of any emergency situation. However no specific time frame to perform the declaration of emergency class and notification to local authorities is provided in the AERB documents, consistent with the guidance provided in Table 12 to GS-G-2.1.

Taking mitigatory actions (by facility operator)

The regulatory requirements and guidance regarding the arrangements to mitigate the consequences of an emergency and the use of external emergency services (e.g. police, medical and fire fighting services) for mitigatory actions onsite exist.

The fire protection standard, AERB/NF/SS/FPS 2010, contains a clear requirement on the number and composition of 24/7 fire fighting crew that must be present at the facility. It also contains a requirement for the operating organization to provide training to services that may be called to the facility to provide assistance. There is no requirement for formal agreements with external services that may be asked to provide additional assistance. The IRRS team was informed that as per requirement of Disaster Management Act 2005, each district has District Disaster Management Plan (DDMP) specifying the roles and responsibilities during disaster/emergencies in the district and as such under this DDMP, all the required external assistance is provided to the facility during an Off Site Emergency. However, the IRSS team noted that there is no clear regulatory requirement for the emergency plans and agreements with external emergency services to contain a clear statement regarding command and control, and the responsibility for the protection of those external people when at the plant.

Generic SAMGs have been completed and reviewed by the AERB. Site-specific SAMGs are now in the process of being reviewed. Seven-day inventories of cooling water are in place in seismically qualified storage tanks except at Kakrapar Atomic Power Station (KAPS), where it is in the process of being built. Mobile emergency diesel generators have been deployed to the sites and emergency hook-ups for cooling have been installed. The development of SAMGs continues.

Taking urgent protective action

The AERB is responsible for the establishment of a system of protective and other response actions, including the definition of reference levels, generic and operational criteria. IRRS members noted that although these actions and criteria are consistent with IAEA Safety Standards, they require further improvements. For example, AERB/SG/EP-5, though promulgated, is not yet reflected in the current EPR plans of NPPs.

Emergency planning zones are defined consistently with IAEA safety standards for the Precautionary Action Zone (PAZ) and the Urgent Protective Action Zone (UPZ). However, at the time of this mission, GSR Part 7, the updated version of GS-R-2, had just been approved for publication by the IAEA Board of Governors. It contains a slightly modified definition of emergency planning zones and distances. The AERB could examine the definition of emergency planning zones in light of this new general safety requirement.

With regards to the protection of personnel at the NPPs, regulatory requirements are clearly stated and reflected in the emergency plans of the facilities.

Providing information and issuing instructions

District authorities, rather than the NPPs, are responsible for issuing instructions to the public.

The facility operator has a support role in public communication. Regulatory requirements clearly address this aspect. Facility operator and offsite arrangements on public communication are verified by observing

exercises, but the IRRS team noted that this is not done systematically or rigorously. This aspect is addressed in the findings under the section on training and exercises.

Protecting emergency workers

Guidance values for both on-site and off-site emergency workers and the latest guidance on protective actions and other response actions, take into account IAEA safety standards (primarily GSR Part 3 and GSG-2). While the IRRS members noted consistency with IAEA safety standards, further improvements are needed (e.g., dose units are not the same).

Assessing the initial phase

AERB/SG/EP-1 and AERB/SG/EP-2 specify that the evaluation of emergencies shall be based on plant conditions and parameters, including for example detection of loss of safety barriers, release of radioactivity by effluent monitors, concentration at site boundary, projected doses, plant conditions which indicates a release of large amounts of radioactivity during a very short time period, etc.

AERB/NRF/SG/EP-5 further specifies the need for the development of Emergency Action Levels for emergency classification and specifies Operational Intervention levels (OILs) to determine the appropriate protective actions to be taken by each facility and included in their EPR Plans. SG/O-6 provides guidance on indicating, recording and annunciating instruments provided in the main control room, radiation surveys, environmental surveys, meteorological data and status of plant shall be utilized to assess the situation and for predicting projected doses. The examples of EALs presented are fairly generic and high-level. The IAEA is currently working on the development of specific EALs for heavy water reactors. The AERB is encouraged to collaborate with the IAEA on this effort.

The skill and knowledge of plant personnel is assessed by the AERB during the licensing and qualification program. During periodic emergency exercises, AERB observers verify the ability of the licensee to assess the initial phase of an emergency.

Managing the medical response

AERB/NPP/SC/O specifies the requirements for medical response management by the licensees. The regulatory guidance on medical response management by the facility operator exists. Requirements include the need for first aid at the site, transport arrangements and treatment at a local hospital for contaminated and exposed personnel. These arrangements are verified through periodic inspections. The effectiveness of these arrangements is also observed during some drills and exercises, though the IRRS team was not convienced that this is done systematically or rigorously. A suggestion to this effect is made in the section on training and exercises.

Other activities in emergency preparedness

AERB/SG/EP-2 clearly specifies that the system of radiological protection must be based on the requirement for the proposed intervention to do more good than harm, and for the form, scale and duration of intervention to be optimized to take into account public concern, effect on economic condition and need for social welfare. This is reflected in the NPP EPR plans. AERB/SG/EP-5 does mention the need for counselling when individuals may have received high doses, but it does not address the need for facility operator to consider the non-radiological impacts (e.g. post-traumatic stress) among onsite emergency workers following an emergency.

On the aspect of recovery, the AERB has promulgated regulatory requirements. Regulatory guidance on recovery and post-accident phase addresses the role of the Regulatory Body in authorizing follow up actions, criteria for re-entry into plant areas and affected places, review and authorization of actions necessary for the plant recovery, resumption of operations or decommissioning of the nuclear facility as appropriate, and conduct of an overall assessment of the events that led to the emergency.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The emergency classification system promulgated by the AERB is not fully consistent with the IAEA safety standards and could potentially delay the initiation of urgent protective actions under some emergency conditions. Regulatory requirements for notification procedures and declaration of offsite emergency by the offsite authorities are also not fully consistent with IAEA safety standards. Regulatory requirements do not specify a time frame for completion of the declaration and notification of emergency class to off-site officials.*	
(1)	**BASIS: GS-R-2 para. 4.19. states that** *"The operator of a facility…shall make arrangements for the prompt identification of an actual or potential nuclear or radiological emergency, and determination of the appropriate level of response."*
(2)	**BASIS: GS-R-2 para. 4.19. states that** *"The operator of a facility or practice in threat category I, II, III or IV shall make arrangements [that] include a system for classifying all potential nuclear and radiological emergencies [...] such as below: general emergencies [...]. Upon declaration of this class of emergency, actions shall be promptly taken to mitigate the consequences and to protect people on the site and within the precautionary action zone and urgent protective action planning zone; site area emergency [...]."*
R11	**Recommendation: The AERB should review and revise the regulatory requirement on declaration of an offsite emergency to ensure that it is consistent with IAEA safety requirements.**
S16	**Suggestion: The AERB should consider setting response time objectives for declaration and notification of emergencies.**
Observation: *SG/EP-5 has been promulgated and it is being implemented in the emergency plans, though at present it is not reflected in the NPP plan examined.*	
(1)	**BASIS: GS-R-2 para. 3.8. states that** *"The regulatory body shall require that arrangements for preparedness and response be in place for the on-site area for any practice or source that could necessitate an emergency intervention."*
S17	**Suggestion: The AERB is encouraged to continue the implementation of the recently published regulatory requirements, for example those contained in SG/EP-5.**
Observation: *There is no regulatory requirement for MOU with external services that may be called upon to assist the facility during an emergency, even though it is reportedly be implemented by some NPP. The need for a clear assignment of operational control and authority, and for a clear statement on who is responsible for external services safety when they are at the facility is not addressed in the regulations.*	
(1)	**BASIS: GS-R-2 para. 4.40. states that** *"For facilities in threat category I, II or III arrangements shall be made to provide technical assistance to the operational staff. Teams for mitigating the consequences of an emergency (damage control, fire fighting) shall be available and shall be prepared to perform actions in the facility. [...] Arrangements shall be made to obtain support promptly from police, medical and fire fighting services off the site. Off-site support personnel shall be afforded prompt access to the facility and shall be informed of on-site conditions and the necessary protective actions."*
S18	**Suggestion: The AERB should consider establishing a regulatory requirement for emergency plans to include clear statements on operation control and on responsibility for personal protection of external services when they are at the facility, and for this to be reflected in documented agreements with external services.**

10.3. REGULATORY REQUIREMENTS FOR INFRASTRUCTURE

Authority

This aspect has been covered under 10.1 above. The authority of the operating organization with respect to offsite authorities is clearly defined in the existing regulations.

Organization

Regulatory requirements and guidance clearly address this aspect. This is reflected in the site-specific EPR plans, which cover the organizational structure, hierarchy, designations and alternate officials with roles and responsibilities. In addition, AERB/SC/O and technical specifications establish the minimum number of licensed staff, positions and field personnel that must be present at all times. This requirement is tested for all emergency operating procedures, including events involving fires and casualties, but it has not been formally tested in exercises.

AERB/NPP-SC-O states that the plant management structure shall: provide for performance of all functions having an immediate bearing on the safe operation of the plant; that at any time a sufficient number of qualified persons shall be available for the performance of these functions; and ensure that the plant and site emergency organization are in a state of readiness to handle the emergency situations. AERB/SG-O-6 states that initial plant personnel/plant emergency response in key functional areas shall be adequate and take into account not only the personnel available on each shift but also the offsite personnel mobilized for this purpose.

Coordination of emergency response

The requirement for the operating organization to coordinate with offsite officials during an emergency is well documented in the existing codes and guidelines, including the organizational and communication protocols to ensure an effective degree of coordination between the onsite and offsite response. However, there is a need for clarification of the respective roles of the Site Emergency Director and his alternate during an offsite emergency. Namely, the Site Emergency Director relocates to the Offsite Emergency Control Centre and becomes an advisor to the Offsite Emergency Director and is replaced in his function as Site Emergency Director by either a Station Director or Chief Superintendent, who are expected to direct operations at the site but are not designated as Site Emergency Director in the Regulatory Body documents or in the NPP EPR plans. AERB/NPP/SC-O states that in an Offsite Emergency the Offsite Emergency Director directs both site and offsite actions, and that the Site Emergency Director assists the Offsite Emergency Director. This appears to be inconsistent with the responsibilities for response, as documented for example in AERB/SG/O-6, which clearly states that the Offsite Emergency Director is responsible for directing offsite emergency response operations, and the Site Emergency Director is responsible for directing emergency handling operations and coordination with the site.

AERB observers verify the effectiveness of the coordination arrangements during periodic emergency exercises.

Plans and procedures

Rule 33 of the Atomic Energy (Radiation Protection) Rules-2004 provides clear requirements for EPR plans for the operating organization. Requirements and guidance on the contents of the onsite and offsite EPR plans are clearly stated. The requirements for the offsite EPR plan, at the district level, are established by the AERB. The operating organization is responsible for developing the offsite plan, in cooperation with the District authorities. The onsite EPR plan is approved by the AERB after a thorough review against the requirements by an AERB working group and a unit safety committee. The offsite EPR plan is approved by the State/District authorities after a similar review by the AERB.

During the site visit, the reviewers requested to view emergency procedures used to implement the emergency plan, but were informed that the procedures are included in the plan. Subseqently, AERB

provided the IRRS team with a list of procedures and some actual procedures. The IRRS team noted that these procedures relate not only to emergency response functions to be performed but also to some preparedness elements such as testing sirens. The IRRS team noted that these procedures, covering emergency response functions, are not as comprehensive and complete as it may be necessary to support the implementation of EPR plans.

Logistical support and facilities

AERB/NPP/SC/O specifies requirements for logistic and facilities for emergency preparedness and response plan, their availability, condition monitoring and storage. AERB/SG/EP-1 further elaborates on those requirements and includes specifications for periodic testing and maintenance, replacement of equipment and the responsibility for its implementation for on-site EPR plan. AERB/SG/EP-2 specifies requirements of resources and facilities, the system for periodic testing & maintenance and replacement of equipment and the responsibility for its implementation for off-site EPR plan. Guidance on the same is provided in AERB/SG/O-6.

IRRS team members toured the KAPS emergency facilities and noted that the Site Emergency Control Centre (used by the Site Emergency Director and his Advisory Group) is located in an office that is not protected against potential hazards and would not be suitable for protracted operation during a severe emergency. The IRRS members where informed that this is consistent at all NPPs and will be corrected once On-Site Emergency Support Centre, planned as a result of the Fukushima accident, is completed for all NPPs (see Fukushima module).

Verification of facilities and equipment is part of the periodic inspection checklist and records confirm that this is carried out as planned.

Training, drills and exercises

Regulatory requirements and guidance for EPR training and exercises exist. Periodicity of exercises is stipulated in the document, "Crisis Management System for Radiological/Nuclear Emergencies," and technical specifications for operating plants. Plant emergency exercises are required once per quarter; site emergency exercises are required once per year; and offsite emergency exercises are required once every two years. During routine regulatory inspections, AERB inspectors verify training and exercise records. The IRRS team noted that there is no regulatory requirement for the facility operator to satisfactorily test all emergency functional objectives over a certain period (e.g., five years).

Emergency exercises are evaluated by AERB observers using a checklist developed on the basis of safety guide AERB/SG/G-5, NDMA guidelines and AERB/SG/EP-5. This checklist includes potential functional objectives to be evaluated during emergency exercises carried out by NPPs as per the EPR plan. A formal report is issued by the AERB, containing recommendations for improvement. All recommendations by the AERB and other participating organizations are tracked in the AERB database, which contains data from 2006.

The IRRS team reviewed past exercise reports and identified that the number of AERB observers in facility operator exercises varied based on the scope of exercise, but exceeded the minimum number of two observers. Previous exercise reports indicated that the exercise evaluation checklist is not comprehensively used (i.e., some areas that are exercised are not evaluated). The IRRS team was informed that some evaluations are still informal (i.e., AERB staff is present but no record of evaluation is produced). This may result in a non-comprehensive evaluation of the overall EPR plan.

Quality assurance programme

AERB/NPP/SC/QA specifies the requirements for quality management programmes, which cover emergency preparedness and response. AERB/SG/EP-1 and AERB/SG/EP-2 specify requirements and guidance on quality assurance in EPR including periodic revision of the plans and procedures, testing of equipment, periodic replacement, conduct of exercise and periodicity, review of exercises as well as continuous improvement of the licensee's EPR arrangements for onsite and off-site emergency response.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *AERB/NPP/SC/O and AERB/SG/O-6 provide inconsistent requirements on responsibility for directing site response actions following the declaration of an Offsite Emergency. The role of the Site Emergency Director and of his alternate during an offsite emergency is not clear.*	
(1)	**BASIS: GS-R-2 para. 5.7. states that** *"The positions responsible within each operating and response organization for the performance of the response functions identified in Section 4 shall be assigned in the emergency plan."*
R12	**Recommendation: The AERB should revise applicable safety codes and safety guides to clarify the designation and responsibilities of the Site Emergency Director, Advisor to the Offsite Emergency Director, and the Offsite Emergency Director for managing the onsite and offsite response organizations.**
Observation: *The habitability of the site emergency control centre is not suitable for protracted severe emergencies. However, the IRRS team was informed that post Fukushima Daiichi NPP accident, the AERB has taken action to establish technical requirements for construction of onsite emergency support centre (OESC) at all NPP site. (See Fukushima module).*	
(1)	**BASIS: GS-R-2 para. 5.27. states that** *"For facilities in threat category I, an on-site emergency control centre, separated from the [facility] control room, shall be provided to serve as [a] meeting place for the emergency staff who will operate from there in the event of an emergency. Information about important [facility] parameters and radiological conditions in the [facility] and its immediate surroundings should be available there. The room should provide means of communication with the control room, the supplementary control room and other important points in the [facility], and with the on-site and off-site emergency response organizations. Appropriate measures shall be taken to protect the occupants for a protracted time against hazards resulting from a severe accident."*
S19	**Suggestion: The AERB should consider ensuring that the NPPs continue the implementation of seismically and environmentally qualified site emergency support centres at all sites and that this be implemented as a regulatory requirement.**
Observation: *The AERB tracks all exercise recommendations, including those from other organizations, in its database.*	
(1)	**BASIS: GS-R-2 para. 5.39. states that** *"The operator of a facility [...] shall make arrangements to review and evaluate responses in emergencies and in drills and exercises, to record the areas in which improvements are necessary and to ensure that the necessary improvements are made."*
GP5	**Good Practice: The database and process used to systematically track all recommendations from emergency exercises, including those of other organizations, is considered a good practice.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *Emergency exercises are evaluated by AERB observers. A formal report is issued by the AERB, containing recommendations for improvement. However, the IRRS team noted that there is no regulatory requirement for the facility operator to satisfactorily test all emergency functional objectives over a certain period.*	
(1)	**BASIS: GS-R-2 para. 5.33. states that** *"The exercises shall be systematically evaluated and some exercises shall be evaluated by the regulatory body."*
(2)	**BASIS: GS-R-2 para. 5.36. states that** *"The performance of exercises at facilities in threat categories I, II or III shall be evaluated against established response objectives that demonstrate that identification, notification, activation and other initial response actions can be performed in time to achieve the practical goals of emergency response."*
S20	**Suggestion: The AERB should consider establishing regulatory requirements for licensees to test all emergency functional objectives over a determined period of time.**
Observation: *The IRRS team noted that there is not a comprehensive list of procedures necessary to support the consistent implementations of key response functions in EPR plans for all NPPs.*	
(1)	**BASIS: GS-R-2 para. 5.21. states that** *"The operating and response organizations shall develop the necessary procedures, analytical tools and computer programs in order to be able to perform the functions specified to meet the requirements for emergency response established in Section 4."*
S21	**Suggestion: The AERB should consider identifying a comprehensive list of procedures for NPPs to develop in support of implementation of the emergency response plans.**

10.4. ROLE OF REGULATORY BODY DURING RESPONSE

The role of the AERB during an emergency is defined in a safety guide. During an emergency, the AERB has to keep itself informed of the actions taken by the operating organization, review and assess the emergency situation as necessary and inform the public concerning the emergency situations as and when required. Coordination with other parts of the national emergency management organization is through the DAE Crisis Management Group. In 2013, recognizing the need for enhanced capabilities of the regulatory body in performing these important functions, and based in part on the lessons learned from the Fukushima Daiichi accident, the AERB established the Nuclear and Radiological Emergency Monitoring Cell (NREMC). Standard Operating Procedures (SOP) for this group have been developed and are in the process of being implemented.

However, at present, the only source of information for the NREMC on the situation at the affected plant is a proformat fax that contains only very basic information on the plant status, which is insufficient for any type of advanced technical assessment, as well as some environmental readings. Therefore, at present, the AERB is challenged in the performance of its emergency response functions by the lack of information on the plant status and actions by the operator. In addition, the AERB does not at present have a documented internal emergency plan beyond the NREMC SOPs. Formal internal organizational structure for managing the AERB's emergency functions exists, however, individuals involved in Emergency funtions are also assigned other regulatory functions.

The AERB in-house training program, which is imparted to its officials, include modules related to emergency management. AERB officials participate in the periodic emergency exercise of NPPs. AERB officials also participate in the IAEA ConvEx exercises and various other workshops and training programmes.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The lack of an adequate internal emergency plan and framework, and the absence of reliable mechanisms to get prompt and accurate information on the situation at the affected plant poses a challenge to AERB ability to perform its emergency response functions effectively.*	
(1)	**BASIS: GS-R-2 para. 3.5. states that** *"[...] In the event of a nuclear or radiological emergency, the regulatory body shall act as an adviser to the government and [response organizations]in respect of nuclear safety and radiation protection."*
R13	**Recommendation: The AERB should develop and implement its own internal emergency arrangements including detailed procedures, for fulfilling its emergency response role.**

10.5. SUMMARY

Generally the regulations for NPPs are consistent with IAEA safety standards in the area of EPR, and regulatory processes for verification of their adequate implementation are well defined. However, some aspects in the following areas need to be clarified, such as declarationand notification procedures, mutual aid arrangements for mitigatory actions, habitability of the site emergency control centre, organizational roles and responsibilities, the need for comprehensive emergency procedures and exercise evaluation. Recent improvements to the regulatory requirements will greatly enhance the regulatory framework in EPR and their continued implementation is encouraged. With respect to the role of the AERB during an actual emergency, there is a need to formalize the AERB's emergency response framework and procedures to be able to effectively carry out its role. One good practice was observed in the AERB's system for tracking the status of and decisions related to recommendations and actions on EPR arising from drills and exercises.

11. REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAI-ICHI ACCIDENT

11.1. IMMEDIATE ACTIONS TAKEN BY THE REGULATORY BODY

Emergency response by the regulatory body

The AERB bears no direct responsibility in the Indian off-site nuclear emergency situation. As India was not affected, no activation of an AERB Emergency Response Team was necessary at the time of the accident. In case of emergencies in India, a Crisis Management Group is activated, which includes an AERB member.

On March 25, 2011, the AERB established a Monitoring Cell, consisting of five members of the AERB, with the task of continuously monitoring the events at Fukushima NPPs, collecting and storing the related information. Daily reports were submitted to the Chairman, Vice-Chairman and Secretary of the AERB in order to provide information to the media, to the general public and via Internet. The Monitoring Cell continued its operation on a daily basis until May 13, 2011. Following that the Monitoring Cell operated periodically. Monitoring reports on the actual status of the TEPCO Fukushima Daiichi NPP are being prepared regularly every three months ever since.

Following the accident the National Disaster Management Authority (NDMA), the NPCIL and the AERB initiated the review of existing Emergency Preparedness and Response plans at all NPP sites in order to take into account the immediate lessons learned. Furthermore, NDMA organised emergency exercises at all NPPs and identified areas for improvements.

AERB Committee to review the safety of operating NPPs

In order to assess the implications of the TEPCO Fukushima Daiichi accident on the safety of the nuclear power plants in India, the Safety Review Committee for Operating Plants (SARCOP) of the AERB was called together on March 15, 2011. SARCOP decided that the events leading to the accident in Fukushima necessitated the reassessment of the safety of nuclear power plants in India in cases of severe external events and multiple failures. On March 19, 2011, the AERB established a high level Committee to review the safety of nuclear power plants in India against external events of natural origin and to recommend measures to protect the plants against such events, both within and beyond the design basis. The high level Committee included experts from the AERB, its TSO (BARC), from the operating utility (NPCIL) and from other national agencies, organizations and institutions having expertise in the natural phenomena to be taken into account.

The Committee focused its work on the potential consequences of beyond the design basis (BDB) events of natural origin and of a prolonged station blackout (SBO). Nine thematic working groups were set up. One dealt with developing guidelines on evaluating BDB external events; another with reviewing the BDB accident aspects relevant for the boiling water reactors; and five working groups examined the external events and SBO aspects relevant for pressurized heavy water reactors, related to SBO & Loss of Ultimate Heat Sink (LUHS), Electrical system, I&C, SFSF, heavy water upgrading plants, respectively. Further working groups examined the safety issues related to waste disposal facilities under extreme natural circumstances and examined severe accident guidelines for NPPs, respectively.

The Committee submitted its report on August 2011. The report contained 27 recommendations on various subjects: eight recommendations for external events, three for BWRs, four for PHWRs, one for the VVER reactor, two for spent fuel storage facilities, three for severe accident management and six for miscellaneous topics. These latter included recommendations related to power supply, operability of I&C devices, and the storage, management and disposal of radioactive waste, etc. (Note that further recommendations were formulated for the VVER reactors in an annexure to the report as discussed in the next section on the technical issues considered.)

The Chairman of the AERB in a letter informed Chairman and Managing Director of the NPCIL, as early as April 28, 2011, that the utility needs to take into account and comply with the recommendations established by the high level Committee. Work by the high level Committee and its working group was followed and also discussed by SARCOP. The report of the Committee was forwarded to the utility on September 26, 2011, and the NPPs and the NPCIL were requested to study the observations and recommendations therein. They were also requested to submit the action plan of the utility for meeting the recommendations by November 2011.

Safety evaluations promptly required from the licensees

During its 616th meeting held on 15.03.2011, SARCOP requested the utility NPCIL to carry out a comprehensive reassessment of safety and emergency mitigation measures at all operating NPPs and submit a report on the reassessment. During a subsequent meeting, SARCOP set a deadline of June 2011 for the completion of the report. The NPCIL submitted its Interim Report on April 20, 2011. The report contains recommendations common to all NPPs and recommendations specific to the various reactor types. General recommendations were established on provision of automatic reactor trip on seismic events; on establishing additional options for powers sources for cooling (diesel operated water transfer systems, diesel driven electric generators, passive pressurization of water tanks by nitrogen gas); on additional water sources (use of water suppression pool, qualifying existing water storages, etc.); on hydrogen management in containment; and on miscellaneous topics like battery operated devices, shore protection, review of EOPs, solar power lighting, boreholes for water supply, flood proof doors, etc.

The reactor-specific recommendations were formulated for BWRs and PHWRs of three types. They cover a number of actions increasing the resistance against external events, SBO and LUHS that are closely related to the specificity of the reactor type in question.

Most of the recommendations were due to be implemented within six months, except a few (see the long term actions below) to be implemented within one year. Taking into account feasibility, need for assessment/analysis, procurement and planned outages, the actions were categorized into short term, medium term and long term. Short term safety enhancement measures (due to be implemented within about six months) included implementation of external hookup points for PHWRs; solar cell assisted emergency lighting; revision of EOPs and personnel training and exercises. Long term measures (that are expected to be completed in or after 2015) included enhancement of SAM program; strengthening hydrogen management in PHWRs; filtered venting of containment; establishing protected emergency response facilities. All other safety enhancement measures following from the utility investigations are of medium term to be completed before 2015. (The status of the implementation is reviewed in Section 11.3 below.)

The utility NPCIL was also requested to conduct safety assessment of the NPPs under design or construction. These assessments pertained to the four 700 MW PHWR units and the two VVER 1000 units under construction (see in next section).

In a letter of June 14, 2011 the Chairman of the AERB asked the Chairman of utility BHAVINI to carry out safety assessment of the on-going PFBR power projects similar in line with that carried out for the operating NPPs. The utility formed teams to address the issues related to BDBA. The teams submitted their reports on August 09, 2012. The foreseen activities were ordered to be completed on October 5, 2012, by the Project Design Safety Committee for PFBR of the AERB. Details on the assessment are given in the next section.

Inspections by the regulatory body

The AERB held regulatory inspections of all NPPs in a phased manner to examine the plant capability and the preparedness to deal with the consequences of natural disasters such as flood, tsunami, earthquake, etc., as well as of extended SBO and multiple failures.

A special inspection was held on March 26, 2011, at the Indian boiling water reactors (units No. 1 and 2 of the Tarapur NPP). The objective of the inspection was to assess the capability of the plant to withstand severe natural events and multiple failures. The inspection has established that a flood still within the revised design basis would render the emergency as well as the station blackout power supply systems unavailable. Also other systems and components of safety significance may be affected by a flood within revised design basis. It was also observed that EOPs do not envision multiple failures, and that there is no severe accident management program. The AERB high level committee report dated 31 August 2011 concluded that the essential safety functions including core cooling function would still have been met adequately due to the availability of the emergency condenser.

During its 617th meeting on May 25, 2011, SARCOP took note of the inspection results and the high level AERB Committee was also informed. Recommendations by the Committee took into account these inspection results. The utility has submitted its revised flood level evaluation on November 8, 2011 and initiated the respective modifications to elevate the devices below design basis flood level. SARCOP acknowledged the implemented modifications during its 661st meeting on December 19, 2014.

The six PHWR units of the Rajasthan NPP were inspected from August 23-26, 2011. The inspection concluded that for units 1 to 4 additional hookup points in case of extended SBO should be implemented, and the case of an SBO beyond 24 hours should be analyzed. Further conclusions were drawn for units 3 and 4, while no additional concerns were identified on units 5 and 6. The plant management promptly reacted on the inspection conclusions and gave an implementation program for the elimination of the deficiencies.

Further inspections related to the implications of the TEPCO Fukushima Daiichi accident were held in the other units of the Indian nuclear sites between October 2011 and February 2012.

Public communication

The AERB has an indirect role in public communication related to nuclear emergency situations. To illustrate this it is mentioned that in case of emergencies the NDMA is in charge of public communication, yet after the accident this authority sought advice from the AERB Chairman if monitoring of persons arriving from Japan was necessary. The answer to this question was negative. Another example: based on the advice of a committee in which AERB experts participated, the Food Safety and Standards Authority of India suspended the import of food stuff from Japan for 3 months on April 5, 2011, and requested monthly review of the situation in Japan.

The following data characterize the participation of the AERB in public communication: since March 2011, the AERB issued 26 press releases (ten in 2011, four dedicated to the Fukushima accident), answered 450 information queries raised by the public (86 in 2011), 71 queries raised by Members of Parliament in relation with the accident in Fukushima (46 in the upper chamber, 25 in the lower chamber), and held one press conference. The website of the AERB is visited about 10,000 times each month.

Lessons learned from the immediate actions

Inspired by the success of functioning of the Monitoring Cell, the AERB decided to formalize its role and functioning. A facility is being established with the necessary documentation and equipment that make it possible for the AERB to obtain up to date information about the emergency situation in the NPP affected, radiological safety of the emergency plant workers, public and the environment in a more formal and continuous basis.

As a further consequence of the accident, new guidelines on intervention levels in the public domain were elaborated and issued. As a consequence of this the emergency plans of the NPPs need revision.

Thirdly the decision support system was made operational at two sites, and it is intended to be installed at each NPP.

11.2 TECHNICAL AND OTHER ISSUES CONSIDERED IN THE LIGHT OF THE ACCIDENT

Technical recommendations by the high level Committee

The report prepared and published in August 2011 by the high level Committee. The working groups established by it continued working and the last group report was submitted in August 2013. The report published in 2011 established that the AERB regulations with respect to design basis for external events are sufficiently conservative. It offers general recommendations related to external events as summarized below:

Earthquakes: the AERB guide on seismicity should be revised taking into account uncertainties in site tectonics; beyond design basis earthquake level should be defined based on study of ground motion parameters derived with a methodology suggested by the report.

Floods: the method of estimating design basis flood level should be refined based on the results of on-going work; for inland sites combination of earthquake and flood due to a dam break should be accounted for; a great number of aspects are listed to be taken into account for reasonable quantification of beyond design base flood levels (e.g. use of conservative estimates for dam breaks, quantification of pressure drop and wind speed for storms, need for validated numerical tsunami model, accounting for specificities of multi-unit sites, etc.).

Other meteorological hazards: for determination of beyond design basis wind speed and temperature values algorithms and limiting values are proposed.

The report contains specific recommendations for TAPS 1&2 related to: seismic events (some systems and components, including those related to filtered venting need further study concerning their seismic capabilities); tsunami followed by SBO (which call forth appropriate actions to rectify the deficiencies revealed); fire protection (some elements need seismic qualification); spent fuel pool (where in unfavourable cases the water inventory will decrease faster than the design basis); severe accident management (there is no SAMG available).

A separate section of the report deals with recommendations for PHWRs: with respect to SBO it is recommended that further study be performed on the consequences of an extended SBO coupled with LUHS and/or with flooding; in case of flooding in some of the PHWR plants the availability of electrical system, diesel generators or I&C systems need further considerations and actions; for spent fuel storage facilities the report states that an external water hookup provision is to be implemented at all plants to maintain the water level for a sufficiently long period of time, and suitable passive level and temperature monitoring/indicating devices should be installed.

The report also gives recommendations for heavy water processing plants and radioactive waste management facilities at the NPP sites and further recommendations are formulated on extreme natural events like floods due to cyclones, dam break or heavy rainfall; high temperature or strong wind.

An extensive list of recommendations for the units of the than constructed VVER 1000 type Kudankulam NPP was given by the report that includes implementation of alternative water sources; seismic qualification of emergency water storage facility; mobile emergency pumps; EOPs for BDBA situations; confirmation or reassessment of certain safety related components in BDBA conditions; etc.

In the 2013 August report, the respective AERB Expert Group presented the methodology of BDB earthquake level evaluation and applied it as case studies for the various sites. Further, a detailed methodology for capacity assessment under BDB earthquakes was developed in a report of December 2014 by the Civil Engineering Safety Committee Task Force. The utility is going to apply this methodology for evaluating the earthquake level margins in design.

Maximum estimated possible tsunami wave run-up values were determined for two costal sites. It is concluded that the site elevations are safely above the maximum tsunami heights. For the third costal site (Kalpakkam) study on BDB tsunami was initiated in December 2011 with the participation of the NPCIL and AERB experts. The study is still ongoing. For BDB cyclones the plant-wise assessment is also in progress.

Technical issues considered for power plant projects

As indicated in the previous section the AERB requested the utilities active in design and/or construction of new NPPs to carry out post-Fukushima safety assessment of their projects. The major assessment directions are listed in brief below.

For the 700 MWe PHWR development project completion of beyond design basis safe shutdown seismic margin assessment and BDB flood level assessment was recommended. Additional electric power sources are also requested. The requirements set for all NPPs are valid here too, thus automatic reactor trip on seismic events and various enhancements in severe accident management (such as BDBA core cooling, water hookup points, filtered containment venting, hydrogen management, enhanced emergency operating centre) are also requested in case of this reactor type.

For the 1000 MWe VVER project the recommendations are listed in the previous subsection.

For the 500 MWe prototype fast breeder reactor (PFBR) the capability of withstanding BDBA events was reassessed. Additional measures were recommended on installation of additional DGs and of diesel operated fire tenders, pumps, and bore wells; installation of diverse instrumentation; solar power lighting; water tight doors. Here also the seismically qualified emergency operating centre is required and emergency preparedness system is to be extended to cope with the events foreseen.

Revision of AERB safety documents

The report of March 2014 prepared by a working group of the AERB to review regulatory documents for need for revision based on Fukushima experience lists those AERB safety documents that need to be revised. (Note that this particular document also presents the consolidated list of 91 action items determined by the various studies and reports.)

When initiating the revision of the AERB regulatory documents the working group determined those lessons learned from the accident which are not adequately covered by the existing documents that need to be considered during revision. The regulatory documents are grouped according to their subjects. In the regulatory process group three documents (one code and two guides) need revision (regulation of facilities, consenting process, role of the AERB in EPR). Equally three documents need revision on siting (site evaluation, design basis flood, seismic design basis) and 15 on design of PHWRs (one code, 13 guides and one manual on safety classification and seismic categorization; various systems, components and protection aspects; waste management; fuel handling and accident management). In the civil engineering series two standards (on structures important for safety and on containment design), in the operation series the code and six guides are to be revised (recruitment, training, qualification; OLCs; EPR; maintenance; surveillance; license renewal). Finally, the code on quality assurance and the guide on preparing emergency plans are on the list of the documents to revised.

Follow-up of progress in technical recommendations

The progress in implementation of the recommendations made by the AERB high level Committee and by the utility in their various assessment documents is followed up during regulatory inspections and review meetings of unit safety committees of SARCOP. The identified actions are also assessed in the permissions related to plant start-up after bi-annual shutdown of PHWRs or at the time of license renewal. SARCOP also reviews periodically the status of implementation of the recommendation.

The review of implementation of the recommendations related to the various nuclear power plantsand nuclear power projects is performed by the Safety Committees for the corresponding stages, such as Construction, Commissioning, etc. The implementation at the various sites is also verified during regulatory inspections. Furthermore, any subsequent consent is given only if the compliance with or implementation of the recommendations related to the consent are observed by the respective safety committee.

Activities related to the IAEA Nuclear Safety Action Plan

The AERB is committed to implement the recommendations by the IAEA Action Plan. Details on India's activity related to the Action Plan are given in the National Report submitted to the 2014 review meeting of the Convention on Nuclear Safety.

India has performed extensive safety assessment in the light of the accident as detailed in this and the previous sections. India invited an IRRS mission thus contributing to the strengthening of IAEA peer reviews. The emergency preparedness system of India got specific attention after the accident; a number of steps are discussed in the present report. In the other items of the Action Plan India in general and the AERB in specific demonstrated commitment and progress.

CONCLUSION [1]

The IRRS team concludes that in response to the TEPCO Fukushima Daiichi accident the AERB acted responsibly and expeditiously. It initiated a thorough reassessement of the safety of the Indian nuclear power plants both operating and under construction, and requested in a timely manner the implementation of the measures deemed necessary to avoid the possibility of consequences similar to those in the Fukushima event.

11.3 PLANS FOR UPCOMING ACTIONS TO FURTHER ADDRESS THE REGULATORY IMPLICATIONS OF THE ACCIDENT

Upcoming actions follow from the recommendations by the AERB Committee and by the utilities and the action plans resulting from them. A short overview of the status of implementation is given below.

All short term measures determined by the utility have been completed, the completion rate of medium term measures is about 70%. In specific, according to a report of early 2014 by the utility automatic reactor trip on seismic events is implemented in 16 units and is to be implemented during the next shut-down period at three units. Installation of additional air cooled DGs is due in early 2015 in most plants. Water storage capacity has been or is being increased at those units where it is necessary. Implementation of battery operated parameter display is implemented everywhere, so are the hookup points for additional water inlet, revision of EOPs on SBO have also been completed. Solar powered lighting has been or is soon to be implemented. Long term measures are in various statuses, implementation of hydrogen management is expected by end of 2016, containment filtered venting, completion of SAMGs and establishment of protected on-site emergency support centres are expected to be completed at later stages. The data above shows a slight delay as compared to the original plans submitted by the utility.

The AERB maintains a thorough, detailed and highly user-friendly database that, among others provides a full overview of the status of ongoing regulatory actions. Derived from this database the following completion rates are determined for the actions related to various recommended safety enhancement subjects:

Subject	Total number of actions	Ratio of completion [%]
NPP specific recommendations by the AERB	27	60
External events affecting NPP safety	21	50
I&C systems of PHWRs	150	80
Electrical systems of PHWRs	51	95
SBO and SBO+LUHS in PHWRs	40	77
Spent fuel storage facilities	43	84

The AERB has no plans to modify its working methods due to the implications of the TEPCO Fukushima Daiichi accident, neither is deemed necessary to introduce changes into the legal background of the Indian nuclear safety regulatory regime.

Progress in the Fukushima-related action was also reported at the Extraordinary Review Meeting of CNS in 2012 and at the sixth Review Meeting in 2014.

CONCLUSION [2]

The IRRS team observes that the recommendations by the various assessment teams and organizations on safety upgrading measures have been duly summarized, implementation of the measures have been initiated, proceed mostly in a timely manner, and are under control of the regulatory body.

11.4 CONCLUSIONS BY REVIEWED AREAS

Note: ***The significance of Fukushima implications was considered as part of the review of each IRRS module. The review conclusions below and the plans presented by India to further address issues associated with the TEPCO Fukushima Dai-ichiaccident in the coming years should be included in the scope of the follow-up IRRS mission to be invited by India.***

Module 1: Responsibilities and Functions of the Government

The TEPCO Fukushima Dai-ichi accident highlighted the importance of having a strong, competent and independent nuclear safety regulatory body. The IRRS team noted that as the governance framework of the DAE has both the nuclear industry and regulatory body reporting to the AEC there isn't clear separation of regulation with the potential to compromise the independence of the AERB. The IRRS team concluded that the AERB did demonstrate 'functional (de-facto) independence' against the IAEA safety requirements. However, the IRRS team recommended that in order to ensure the independence of the regulatory body is clear and transparent the Government should strengthen the legislative framework by creating in law, the AERB as a regulatory body separated from entities having responsibilities or interests that could unduly influence its decision making.

In exercising its power of authority given by the Atomic Energy Act, the Government of India has issued a series of Atomic Energy Rules which represent the basis of the regulatory framework for the control of activities and for ensuring safety in the activities relating to use of nuclear energy. However, these laws

have not been promulgated as statement of the Government to establish a national safety policy and strategy which the IRRS team has noted is a shortfall in relation to lessons learned from Fukushima.

A more generic lesson from Fukushima was the importance of sufficient nuclear safety competence. The IRRS team has noted that in accordance with this expectation, the Government maintains a strong programme for research and development related to atomic energy through R & D institutions and national laboratories. Currently, there are various centres of excellence to carry out the research in fields associated with nuclear energy and radiation e.g. Bhabha Atomic Research Centre (BARC) and India Gandhi Centre for Atomic Research (IGCAR). These institutions represent a considerable pool of highly qualified nuclear safety experts for both the industry and the regulatory body.

CONCLUSION [3]
The TEPCO Fukushima Dai-ichi accident highlighted the importance of having a strong, competent and independent nuclear safety regulatory body. This reinforces the recommendation in Section 1 of this report to strengthen and embed in law the AERB as an independent regulatory body separated from other entities having responsibilities or interests that could unduly influence its decision making. **The lessons learned from Fukushima call for strong commitment and leadership for nuclear safety from the Government. Although the Government of India has exercised its authority through the legislation of the Atomic Energy Act (1962), the Government should also adopt and publish its Policy and Strategy for Safety.** **India has established a unique educational and training system that heavily supports the provision of competence, technical skills and capabilities to its nuclear programme, including the regulatory body.**

Module 2: Global Nuclear Safety Regime

India is a contracting party to the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident and has made arrangements to fulfil its respective international obligations. The IRRS team did not find any other mechanisms in place to effectively communicate at the international level in case of crisis situations. For example no bilateral agreements with neighbouring countries were signed.

India is actively participating in the meetings to the Convention on Nuclear Safety and the related peer review mechanisms.

The Government of India has requested only two international peer reviews of IAEA related to the use of nuclear energy and radiation sources, namely the present IRRS mission and an OSART at RAPS, held in Nov 2012 (with a follow-up mission in February 2014). A suggestion is offered in the main text on Module 2 in this respect.

CONCLUSION [4]
The IRRS team considers that the existing status is appropriate; the regulatory body is committed to act as necessary.

Module 3: Responsibilites and Functions of the Regulatory Body

During an emergency, the AERB has to keep itself informed of the actions taken by the operating organization, review and assess the emergency situation as necessary and inform the public concerning the emergency situations as and when required. Coordination with other parts of the national emergency

management organization is through the DAE Crisis Management Group. In 2013, recognizing the need for enhanced capabilities of the regulatory body in performing these important functions, and based in part on the lessons learned from the Fukushima Daiichi accident, the AERB established the Nuclear and Radiological Emergency Monitoring Cell (NREMC). Standard Operating Procedures (SOP) for this group have been developed and are in the process of being implemented.

However, the AERB/NREMC have limited data from the plant (only a very basic notification per fax) nor do they deploy inspectors to the site as eyes and ears of the AERB. The AERB thus has limited capability to assess the situation during an emergency.

After an extreme natural disaster and off-site emergency situation the local district authorities in charge of the situation will be supported by a specially trained National Disaster Response Force (NDRF) which has 10 batallions, spread over India, of which, four are trained for dealing with radiation emergencies, to clear the roads and to inform the population if normal communications are not working (Reference is made to module 10).

CONCLUSION [5]
The role of the AERB as a regulator during emergency is rather limited and it does not include direct verification of the situation. The assessment is done based on information received from the ground through the CMG. The AERB does not directly assess the situation on the ground during the course of an emergency. Independent presence on site in the course of an emergency could assist the regulatory authority in assessing the situation.

Module 4: Management System of the Regulatory Body

The AERB has in place a mature QMS, ISO certified, for its primary functions (creation and updating of AERB safety standards, authorization, review and assessment and inspection and enforcement). Currently an IMS is being finalized and is in the first stages of implementation. This leads to more detailed internal guidelines for the already existing QMS processes and to description of further existing and new work practices based on the IAEA GS-R-3. The IRRS team has found strong commitment on all management levels to provide the manpower and competence to sustain the development and further improvement of the IMS. The lessons learned from the TEPCO Fukushima Daiichi accident for the MS are mainly related to improvement of safety culture (regulator and licensees), increased openness and transparency and further international activities, including relationship with the neighbouring countries on a bilateral basis (although no signed bilateral agreement is in existence yet) or through multilateral fora (e.g. VVER Regulators Forum, CANDU Senior Regulators Forum, etc.). The existing primary processes in combination with a dedicated taskforce post Fukushima have led to safety improvement plans in the NPPs that will be implemented in a timely manner, already before the related regulatory requirements are adopted. A pilot safety culture review programme that has been carried out recently in one department will be implemented in the rest of the organisation.

CONCLUSION [6]
The IRRS team considers that the actual processes in the IMS (QMS) and the way they are praticed and implemented represent a strong basis to garantee that lessons learned from the TEPCO Fukushima Daiichi accident are utilized by the Indian NPPs and by the AERB.

Module 5: Authorization

NPP siting requires approval of both the Indian Ministry of the Environment and Forests and of the AERB. The AERB retains the authority to establish conditions for the site or reject the site on the basis of safety concerns which may arise during the review of the type of facility design being considered. The methods applied to characterize external hazards during siting have been reviewed and revisions to make them more robust in light of the TEPCO Fukushima Daiichi accident are being considered.

The AERB safety codes and supporting safety guides reflect all areas associated with the design and operation of NPPs.

The reviews to reassess the design provisions relating to heat removal from the reactor and fuel stored in the pool, to ensure the confinement of radioactive material in accident states, and to limit accidental radioactive releases have been completed. Implementation of the post-Fukushima measures is in-progress and being monitored by SARCOP.

The IRRS team noted that the guidance provided in AERB documents is incomplete. While detailed and comprehensive requirements are laid down for PHWR type reactors, for the other type of reactors which are operating or under construction these specific detailed requirements are not fully documented. Additionally, the AERB has requirements for carrying out a level-1 PSA for full power operation and for internal initiating event, and for providing updates at every at every periodic safety review case. The higher level PSA-s are recommended but not required. The AERB has completed a review of this subject in the light of the TEPCO Fukushima Daiichi accident and the required revisions of the impacted AERB documents will be implemented in a structured and progressive manner. The IRRS team has issued a recommendation to this effect in Module 6 of this report.

The IRRS team also noted that the new design code for light water reactors (LWRs), issued by the AERB in December 2014, does meet the latest generic design requirements.

CONCLUSION [7]
The IRRS team considers that the Governement of India is fully committed to act in light of the TEPCO Fukushima Daiichi accident. Appropriate technical reviews have been conducted to confirm the adequacy of the existing measures and to identify areas where improvements are required. The actions to improve safety have been or are being implemented for all identified safety issues. Implementation of these actions is being tracked.

Module 6: Review and Assessment

The IRRS team noted that a set of conditions equivalent to design extension conditions are specified and reviewed during the authorization process for NPPs.

The detailed expectations for means of cooling the reactor core, for systems aimed at transferring the residual heat from items important to safety to the ultimate heat sink, for emergency power supplies, and for fuel handling and storage are specified in the authorization process. They have been reviewed in light of the TEPCO Fukushima Daiichi accident and will be revised based on the results of this review as appropriate.

The AERB has requirements for the evaluation of potential interactions of systems important to safety. No need for the development of specific procedures on this subject has been identified.

The requirements for a supplementary control room are part of the authorization process.

CONCLUSION [8]

The IRRS team considers that the Governement of India is fully committed to act in light of the TEPCO Fukushima Daiichi accident. Appropriate technical reviews have been conducted to confirm the adequacy of the existing codes and requirements and to identify areas where improvements are required. The actions to improve safety have been or are being implemented for all identified areas. Implementation of these actions is being tracked.

Module 7: Inspection

The AERB has completed inspections at India's NPPs with regard to their capabilities and preparedness to respond to extreme natural weather events such as extended SBO and the unavailability of water through normal sources. The inspections concluded that India's NPP's are adequately equipped to handle extreme natural weather events.

AERB requirements call for a Periodic Safety Review (PSR) to be performed at each NPP. This PSR is a detailed design and operational safety review that is conducted every 10 years, with a less detailed review being done every 5 years. These PSRs take into account operational experience and would give a mechanism to detect precursor events on a routine basis.

Following the TEPCO Fukushima Daiichi accident, the NPCIL and the AERB carried out a safety re-assessment of all Indian NPPs. These assessments reviewed the NPP's abilities to withstand currently defined site specific design basis accidents as well as evaluating the margins available for beyond design basis accidents. Additionally, the NPCIL was asked to carry out safety assessments for extended SBO and extended loss of heat sink removal. The NPCIL was asked to augment the capabilities of NPPs to cope with extended SBO and augment the NPPs capabilities for continued heat removal for seven days. The review identified additional measures to be implemented at NPPs, including alternate provisions for core cooling and cooling of reactor components with additional sources of water, provisions for the use of portable DGs and/or power packs, the use of battery operated devices for plant status monitoring, and the additional hookup points for adding water to the spent fuel storage pools. The assessment also included a review and strengthening of the severe accident management provisions with emphasis on Hydrogen management and containment venting. Finally, the AERB directed the creation of an On-Site Emergency Management Support Centre at each NPP which would remain functional during an accident and would have provisions for communication and monitoring of plant status with the capability for housing essential personnel for a minimum period of one week.

CONCLUSION [9]

The IRRS team considers that the AERB has the capability to detect precursor events, an inspection programme has been performed to reassess the capability of NPPs to respond to extended SBO and loss of cooling, and inspetions activities do review the robustness of emergency power supplies, fuel handling and storage systems, and the NPP's emergency reponse capabilities.

Module 8: Enforcement

The AERB has established enforcement policy and programme in the form of respective acts, rules, codes and procedures enabling to evaluate violations or non-conformances with regulatory requirements or with conditions specified in the authorization.

The AERB is empowered by several methods of enforcement commensurate with the safety significance of the non-conformances, following a graded approach and ensuring adequate enforcement actions.

CONCLUSION [10]
The IRRS team noted that there was no need for actions related to enforcement in connection with the regulatory implications of the TEPCO Fukushima Daiichi accident.

Module 9: Regulations and Guides

The AERB is heavily involved in the activities related to the IAEA CSS and its committees and uses the IAEA standards as the main basis of their own regulations. In the development of its own regulations it also compares the regulatory documents of some other countries like USA and Finland, lessons learned from foreign events and R&D. A dedicated working group has reviewed the need for updated or new AERB safety standards post Fukushima. Through a structured approach the updates or new documents identified are being implemented. The new siting code and design code already addresse the aspect of extreme rare events and includes requirements in the areas of multi-unit effects, emergency preparedness, periodic assessment of external hazards, assessment of safety margins and cliff-edge effect. Also the design extension conditions are introduced. The IRRS team considers that more has to be done in the areas of combination of initiating events and to develop full scope Level 1 and Level 2 PSA.

CONCLUSION [11]
The IRRS team considers the development practice is of AERB standards robust. The AERB, closely and broadly following developments in IAEA standards and from other countries, is able to include the lessons learned from the TEPCO Fukushima Daiichi accident into its regulatory framework in a timely manner, allthough more effort is necessary in some areas, PSA is an example of this.

Module 10: Emergency Preparedness and Response – regulatory aspects

Following the TEPCO Fukushima Daiichi accident, the AERB took immediate actions to review EPR arrangements in place at NPPs as well as in the regulatory processes. As a result, short-, medium- and long-term actions were adopted, including the installation of a seven-day seimically qualified inventory of cooling water at KAPS NPP for extended blackout (other stations already had this), the deployment of emergency mobile diesel generators, the installation of hookups for cooling water injection and the review of SAMGs. In addition, an onsite emergency support centre is being built at all sites; this centre will be higher-grade seismically qualified than the plant, able to accommodate 60 people and able to deal with all units on one site. They are expected to be completed in 2016-17. Two apex committees were established: one for the AERB and one for the NPCIL, with submcommittees to carry out self-assessments of system performance under severe conditions, as well as examine specific issues associated with severe accidents. In 2011, in response to the accident, an offsite emergency exercise was conducted at each of the seven sites. The IRRS team was informed that multi-unit emergencies are now considered as regulatory requirement and brought out in revised AERB safety codes and guides for its implementation in a progressive manner. All the measures adopted are now being incorporated in the regulations.

CONCLUSION [12]
The IRRS team considers that the AERB has recognized the actions necessary in emergency preparedness and response and is committed to act as necessary.

APPENDIX I – LIST OF PARTICIPANTS

INTERNATIONAL EXPERTS:		
JAMMAL Ramzi	Canadian Nuclear Safety Commission (CNSC)	ramzi.jammal@cnsc-ccsn.gc.ca
SENIOR David	Office for Nuclear Regulation (ONR)	david.senior@onr.gsi.gov.uk
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JANSEN Rob	Authority for Nuclear Safety and Radiation Protection (ANVS)	rob.jansen@ilent.nl
ORLIKOWSKI Robert	U.S. Nuclear Regulatory Commission (NRC)	robert.orlikowski@nrc.gov
POULET Benoit	Canadian Nuclear Safety Commission (CNSC)	benoit.poulet@cnsc-ccsn.gc.ca
TSHUVA Avraham	Israel Atomic Energy Commission (IAEC)	avits@soreq.gov.il
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IAEA STAFF		
NICIC Adriana	Division of Nuclear Installation Safety	a.nicic@iaea.org
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LIAISON OFFICERS		
BHATTACHARYA Ramdas	Atomic Energy Regulatory Board (AERB)	rbhattacharya@aerb.gov.in
HARIKUMAR S.	Atomic Energy Regulatory Board (AERB)	harikumar@aerb.gov.in

TEAM PHOTO

APPENDIX II – MISSION PROGRAMME

First Week

Time	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN
9:30-10:00	Arrival of Team Members	Team building meeting: • 5 minutes/TM self-intro • Refresher training	Entrance Meeting	Interviews / Visits	Interviews / Visits	Interviews / Visits / DTC writes introductory parts	TM write Report TL and DTL review introductory part Draft text to TL	• Discussing and improving Draft Report • Cross-Reading • TL, DTL, TC and DTC read everything	Free day, Social Tour / Reading, Cross-reading of the Report
10:00-13:00									
14:00-16:00		Initial Team Meeting: • IRRS process • Main objectives • Report writing • Schedule • First observations • In-Group discussions	Interviews	Interviews / Visits	Interviews / Visits	Interviews / Visits / DTC writes introductory parts	Policy Discussions Secretariat edits the report Preliminary Draft Report Ready Cross-reading by TM	Finalisation of the Draft Report	
16:00-17:00					Written preliminary findings delivered				
17:00-18:00			Daily Team Meeting	Daily Team Meeting	Daily Team Meeting: Discussion of findings	Daily Team Meeting	Daily Team Meeting		
20:00-24:00			Writing of the report	Writing of the report	Secretariat edits Report TM write Report	Writing of the report	TM Read Draft	Secretariat edits the report	

Second Week

<table>
<tr><th></th><th>MON</th><th colspan="2">TUE</th><th colspan="3">WED</th><th>THU</th><th>FRI</th><th></th></tr>
<tr><td>9:30-10:00</td><td rowspan="2">Individual discussions of Rs, Ss and GPs with counterparts</td><td colspan="2" rowspan="2">Cross-Reading
TL, DTL, TC and DTC read everything
Finalisation</td><td colspan="3" rowspan="2">Common read through and finalisation by the Team
Submission of the Draft to the Host</td><td rowspan="2">Discussion with Host</td><td>Submission of the Final Draft</td><td>9:00-10:00</td></tr>
<tr><td>10:00-12:00</td><td>Exit Meeting
Press Release</td><td>10:00-12:00</td></tr>
<tr><td>13:00-15:00</td><td>Policy Discussions</td><td rowspan="3">Discussion of the report by the team</td><td rowspan="3">TC, DTC prepare Executive Summary and exit presentation</td><td rowspan="2">Host reads Draft</td><td rowspan="2">TL finalises Executive Summary and exit presentation</td><td rowspan="2">TC Drafts the Press Release</td><td>Written comments by the Host

Team meeting for finalisation of the Report</td><td rowspan="4">Departure Home</td><td>13:00-15:00</td></tr>
<tr><td>15:00-17:00</td><td>Individual discussions of Rs, Ss and GPs with counterparts</td><td>15:00-17:00</td></tr>
<tr><td>17:00-18:00</td><td>Daily Team Meeting</td><td colspan="3">Discussion of Executive Summary</td><td>Briefing of the DDG
Finalisation of the press release</td><td>17:00-18:00</td></tr>
<tr><td>20:00-21:00</td><td rowspan="2">Secretariat includes changes</td><td colspan="2" rowspan="2">Secretariat finalises text</td><td colspan="3" rowspan="2">Free</td><td rowspan="2">Free</td><td>20:00-21:00</td></tr>
<tr><td>21:00-24:00</td><td>21:00-24:00</td></tr>
</table>

APPENDIX III – SITE VISITS

1. Kakrapar (KAPS) Nuclear Power Plant, including units under construction.

APPENDIX IV – LIST OF COUNTERPARTS

	IRRS EXPERTS	Lead Counterpart	Support Staff
1.	**LEGISLATIVE AND GOVERNMENTAL RESPONSIBILITIES**		
	Nikolay Vlahov, David Senior	S. Harikumar	C.S. Viswanadham, Soumen Sinha, Susheel Kumar
2.	**GLOBAL NUCLEAR SAFETY REGIME**		
	Nikolay Vlahov, David Senior	J. Koley	S. Padmakumar, Vivek Piplani, Rajnish Kumar
3.	**RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY**		
	Rob Jansen, Tapani Virolainen	Reeta Rani Malhotra	Gour Mohan Behera, Rahul Porwal, Avinash Shrivastava
4.	**MANAGEMENT SYSTEM OF THE REGULATORY BODY**		
	Rob Jansen, Tapani Virolainen	Sekhar Bhattacharyya	Sonal Gandhi, Mayank Verma, Pinki Choudhary
5.	**AUTHORIZATION**		
	Ferenc Adorjan, Ben Poulet	D. Bhattacharya	Neeraj Kumar, Anjit Kumar, S. Chockalingam
6.	**REVIEW AND ASSESSMENT**		
	Ferenc Adorjan, Ben Poulet	R.P. Gupta	R.B. Solanki, Ajai Pisharady, Santosh K. Pradhan
7.	**INSPECTION**		
	Bob Orlikowski, Miroslav Jakes	S.K. Ghosh	Nishant K. Sangam, Sourav Acharya, Ashis Panda, Bharati Ingavale

	IRRS EXPERTS	Lead Counterpart	Support Staff
8.	**ENFORCEMENT**		
	Bob Orlikowski, Miroslav Jakes	A.P. Garg	K. Ramprasad, Suneet Kavimandan, Sunil Pagar
9.	**REGULATIONS AND GUIDES**		
	Rob Jansen, Tapani Virolainen	K. Srivasista	Animesh Biswas, Dhanesh B. Nagrale
10.	**EMERGENCY PREPAREDNESS AND RESPONSE**		
	Avraham Tshuva, Joseph Anderson	R.U. Parmar	R. K. Mishra, P. Vijayan, S. Pawar, Shyam Vyas, Swati Burewar
11.	**REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAI-ICI ACCIDENT**		
	Ivan Lux	A.D. Roshan	S.C. Utkarsh

APPENDIX V – RECOMMENDATIONS (R), SUGGESTIONS (S) AND GOOD PRACTICES (GP)

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
1. LEGISLATIVE AND GOVERNMENTAL RESPONSIBILITIES	R1	The Government should adopt and publish national policy and strategy for safety as a statement of the Government's intent.
	R2	The Government should embed in law, the AERB as an independent regulatory body separated from other entities having responsibilities or interests that could unduly influence its decision making.
	R3	The Government should promulgate a national radioactive waste management strategy in support of the Government declaration on the management of radioactive waste.
	GP1	India has established a unique educational and training system at national level that supports competence building for its nuclear programme, including the regulatory body.
2. GLOBAL NUCLEAR SAFETY REGIME	S1	The Government should consider taking more benefit from the various IAEA peer review services by inviting more international reviews.
	S2	The AERB should consider including in its process on managing regulatory and operating experience the feedback on measures taken in response to internationally reported events.
	GP2	As part of its system for managing regulatory and operating experience, the AERB is taking full benefit from the incoming and generated records with the aim of continuously enhancing its regulatory framework and processes.

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY	R4	The AERB should establish guidance for individual staff members for the implementation of the graded approach in all its regulatory processes.
	S3	The AERB should consider formalizing the process for integrated assessment of licensees' performance using the system of SPIs. The results of the SPI process should be transparent to the interested parties and the public.
	S4	The AERB should consider evaluating its resource allocation across the organization to ensure sufficient full-time specialists are available and dedicated to those areas which are not currently covered.
	R5	The AERB should review the implementation of its policy and existing arrangements to ensure it maintains independence in the performance of its regulatory functions.
	R6	The AERB should fully develop its recently initiated process to analyse its competence needs to secure the essential knowledge, skills and abilities needed to regulate NPPs.
	S5	The AERB should consider ensuring that a sufficient number of staff with specialised competence, knowledge, skills and abilities in the area of human and organizational factors (HOF) and communications are avaible.
	R7	The AERB should establish a communications strategy to effectively engage with the media, and communicate and consult with the general public and the population in the vicinity of NPPs. This includes consultation with the general public on draft safety codes and standards.

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
4. MANAGEMENT SYSTEM OF THE REGULATORY BODY	R8	The AERB should finalize and fully implement its integrated management system (IMS), based on GS-R-3.
	S6	The AERB should consider implementing its safety culture review process throughout the organization, including the consultation of staff on the safety culture action plan before its implementation.
	R9	The AERB should review organizational changes of NPPs and develop internal procedures to assess whether the licensees' organizational changes are planned, categorized, implemented and monitored in a manner that does not compromise safety.
	S7	The AERB should consider a wider implementation and optimization of its audit and review programme of the integrated management system (IMS), e.g. deep dive audits of specific functions.
5. AUTHORIZATION	S8	The AERB should consider developing or amending the safety code or guide specifying the template for the specific licenses.
	S9	The AERB should consider specifying the detailed and specific licensing requirements for all NPP types which are operating, under construction, or planned in the country.
	S10	The AERB should consider requiring full scope Level-1 and Level-2 PSA analyses within the scope of required safety analyses for demonstrating the satisfaction of the applicable licensing criteria for all reactor types.

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
6. REVIEW AND ASSESSMENT	GP3	The research and development infrastructure established to support the regulatory review and assessment activities is worthy of the attention of other regulatory bodies.
	GP4	The scope and depth of the AERB recruitment and training programme is worthy of the attention of other regulatory bodies.
	S11	The AERB should consider addressing the design extension conditions (DEC) without core melt (multiple failure situations and rare external events) and DEC with core melt (severe accident) in other regulatory documents in addition to the newly published safety codes.
7. INSPECTION	R10	The AERB should add specific guidance to their inspection planning documents to perform unannounced inspections with defined purpose and periodicity at all NPPs.
	S12	The AERB should consider developing inspection guides for implementing inspections during the decommissioning of a NPP.
	S13	The AERB should consider increasing the frequency of routine on-site inspections at NPPs commensurate with the size of India's nuclear programme. The increased frequency of inspections would allow for additional independent verification and more effective regulatory oversight of NPPs.
8. ENFORCEMENT	S14	The AERB should consider establishing formal arrangements with other Government agencies and procedures for implementing the formal arrangements in the event enforcement actions require the involvement of those agencies.
	S15	The AERB should consider developing and implementing enforcement procedures that describe the process to impose penalties.

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
10. EMERGENCY PREPAREDNESS AND RESPONSE	R11	The AERB should review and revise the regulatory requirement on declaration of an offsite emergency to ensure that it is consistent with IAEA safety requirements.
	S16	The AERB should consider setting response time objectives for declaration and notification of emergencies.
	S17	The AERB is encouraged to continue the implementation of the recently published regulatory requirements, for example those contained in SG/EP-5.
	S18	The AERB should consider establishing a regulatory requirement for emergency plans to include clear statements on operation control and on responsibility for personal protection of external services when they are at the facility, and for this to be reflected in documented agreements with external services.
	R12	The AERB should revise applicable safety codes and safety guides to clarify the designation and responsibilities of the Site Emergency Director, Advisor to the Offsite Emergency Director, and the Offsite Emergency Director for managing the onsite and offsite response organizations.
	S19	The AERB should consider ensuring that the NPPs continue the implementation of seismically and environmentally qualified site emergency support centres at all sites and that this be implemented as a regulatory requirement.
	GP5	The database and process used to systematically track all recommendations from emergency exercises, including those of other organizations, is considered a good practice.
	S20	The AERB should consider establishing regulatory requirements for licensees to test all emergency functional objectives over a determined

AREA	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		period of time.
	S21	**The AERB should consider identifying a comprehensive list of procedures for NPPs to develop in support of implementation of the emergency response plans.**
	R13	**The AERB should develop and implement its own internal emergency arrangements including detailed procedures, for fulfilling its emergency response role.**

APPENDIX VI – CONCLUSIONS ON THE REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAI-ICHI ACCIDENT

AREA	NO.	CONCLUSION
TECHNICAL AND OTHER ISSUES CONSIDERED IN THE LIGHT OF THE ACCIDENT	**1**	**The IRRS team concludes that in response to the TEPCO Fukushima Daiichi accident the AERB acted responsibly and expeditiously. It initiated a thorough reassessement of the safety of the Indian nuclear power plants both operating and under construction, and requested in a timely manner the implementation of the measures deemed necessary to avoid the possibility of consequences similar to those in the Fukushima event.**
PLANS FOR UPCOMING ACTIONS TO FURTHER ADDRESS THE REGULATORY IMPLICATIONS OF THE ACCIDENT	**2**	**The IRRS team observes that the recommendations by the various assessment teams and organizations on safety upgrading measures have been duly summarized, implementation of the measures have been initiated, proceed mostly in a timely manner, and are under control of the regulatory body.**
1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT	**3**	**The TEPCO Fukushima Dai-ichi accident highlighted the importance of having a strong, competent and independent nuclear safety regulatory body. This reinforces the recommendation in Section 1 of this report to strengthen and embed in law the AERB as an independent regulatory body separated from other entities having responsibilities or interests that could unduly influence its decision making.** **The lessons learned from Fukushima call for strong commitment and leadership for nuclear safety from the Government. Although the Government of India has exercised its authority through the legislation of the Atomic Energy Act (1962), the Government should also adopt and publish its Policy and Strategy for Safety.** **India has established a unique educational and training system that heavily supports the provision of competence, technical skills and capabilities to its nuclear programme, including the regulatory body.**

AREA	NO.	CONCLUSION
2. GLOBAL NUCLEAR SAFETY REGIME	4	The IRRS team considers that the existing status is appropriate; the regulatory body is committed to act as necessary.
3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY	5	The role of the AERB as a regulator during emergency is rather limited and it does not include direct verification of the situation. The assessment is done based on information received from the ground through the CMG. The AERB does not directly assess the situation on the ground during the course of an emergency. Independent presence on site in the course of an emergency could assist the regulatory authority in assessing the situation.
4. MANAGMENT SYSTEM OF THE REGULATRY BODY	6	The IRRS team considers that the actual processes in the IMS (QMS) and the way they are praticed and implemented represent a strong basis to garantee that lessons learned from the TEPCO Fukushima Daiichi accident are utilized by the Indian NPPs and by the AERB.
5. AUTHORIZATION	7	The IRRS team considers that the Governement of India is fully committed to act in light of the TEPCO Fukushima Daiichi accident. Appropriate technical reviews have been conducted to confirm the adequacy of the existing measures and to identify areas where improvements are required. The actions to improve safety have been or are being implemented for all identified safety issues. Implementation of these actions is being tracked.
6. REVIEW AND ASSESSMENT	8	The IRRS team considers that the Governement of India is fully committed to act in light of the TEPCO Fukushima Daiichi accident. Appropriate technical reviews have been conducted to confirm the adequacy of the existing codes and requirements and to identify areas where improvements are required. The actions to improve safety have been or are being implemented for all identified areas. Implementation of these actions is being tracked.

AREA	NO.	CONCLUSION
7. INSPECTION	**9**	**The IRRS team considers that the AERB has the capability to detect precursor events, an inspection programme has been performed to reassess the capability of NPPs to respond to extended SBO and loss of cooling, and inspetions activities do review the robustness of emergency power supplies, fuel handling and storage systems, and the NPP's emergency reponse capabilities.**
8. ENFORCEMENT	**10**	**The IRRS team noted that there was no need for actions related to enforcement in connection with the regulatory implications of the TEPCO Fukushima Daiichi accident.**
9. REGULATONS AND GUIDES	**11**	**The IRRS team considers the development practice is of AERB standards robust. The AERB, closely and broadly following developments in IAEA standards and from other countries, is able to include the lessons learned from the TEPCO Fukushima Daiichi accident into its regulatory framework in a timely manner, allthough more effort is necessary in some areas, PSA is an example of this.**
10. EMERGENCY PREPAREDNESS AND RESPONSE – REGULATORY ASPECTS	**12**	**The IRRS team considers that the AERB has recognized the actions necessary in emergency preparedness and response and is committed to act as necessary.**

APPENDIX VII – COUNTERPART'S REFERENCE MATERIAL USED FOR THE REVIEW

A) Module 1

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984
6. Policies Governing Regulation of Nuclear and Radiation Safety
7. The Environment (Protection) Act, 1986
8. The Disaster Management Act, 2005
9. The Environment (Protection) Rules,1986
10. The Manufacture, Storage and Import of Hazardous Chemical (MSIHC) Rules 1989 (http://www.envfor.nic.in/legis/hsm/hsm2.html)
11. The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000 (http://www.moef.nic.in/legis/hsm/msihcar.html)
12. Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996 (http://www.moef.nic.in/legis/hsm/gsr347.htm)
13. The Civil Liability for Nuclear Damage Act, 2010
14. Civil Liability for Nuclear Damage Rules, 2011

AERB Safety Codes

15. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
16. Nuclear Power Plant Operation [AERB/NPP/SC/O (Rev. 1)]
17. Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)
18. Quality Assurance in Nuclear Power Plants [AERB/NPP/SC/QA (Rev. 1)]
19. Management of Radioactive Waste (AERB/NRF/SC/RW)

AERB Safety Guidelines

20. Preparation of Site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-1)
21. Preparation of Off-site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-2)

AERB Safety Guides

22. Glossary of Terms for Nuclear and Radiation Safety (AERB/SG/GLO)
23. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
24. Consenting Process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors (AERB/NF/SG/G-2)
25. Consenting Process for Radiation Facilities (AERB/RF/SG/G-3 Volume 1 | Volume 2 | Volume 3 | Volume 4)
26. Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)
27. Role of the Regulatory Body with respect to Emergency Response & Preparedness at Nuclear & Radiation Facilities (AERB/SG/G-5)
28. Classification of Radioactive Waste (AERB/NRF/SG/RW-1)
29. Predisposal Management of Low and Intermediate Level Radioactive (AERB/NRF/SG/RW-2)
30. Predisposal Management of High Level Radioactive Waste (AERB/NF/SG/RW-3)
31. Near Surface Disposal of Radioactive Waste (AERB/NRF/SG/RW-4)
32. Management of Radioactive Waste from Mining and Milling of Uranium and Thorium (AERB/NF/SG/RW-5)
33. Management of Spent Radioactive Sources and Radioactive Waste arising from the Use of Radionuclides in Medicine, Industry and Research, including Decommissioning of such facilities (AERB/RF/SG/RW-6)
34. Decommissioning of Nuclear Fuel Cycle Facilities other than Nuclear Reactors (AERB/NF/SG/RW-7)
35. Decommissioning of Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/RW-8)
36. Safety Classification and Seismic Categorisation for Structures, Systems and Components of Pressurised Heavy Water Reactors (AERB/NPP-PHWR/ SG/D-1)
37. Liquid and Solid Radwaste Management in Pressurised Heavy Water Reactor Based Nuclear Power Plants (AERB/SG/D-13)
38. Design of Fuel Handling and Storage Systems for Pressurised Heavy Water Reactors (AERB/SG/D-24)
39. Staffing Recruitment, Training, Qualification & Certification of Operating Personnel of NPPs (AERB/SG/O-1)
40. Preparedness of the operating organisation for Handling Emergencies at Nuclear Power Plants (AERB/SG/O-6)
41. Management of Nuclear Power Plants for Safe Operation (AERB/SG/O-9)
42. Management of Radioactive Wastes arising during operation of PHWR Based NPPs (AERB/NPP/SG/O-11)

43. Intervention Levels and Derived Intervention levels for Off-Site Radiation Emergency (AERB/SG/HS-1)
44. Compliance Assurance Programme for the Safe Transport of Radioactive Material (AERB/SG/TR-1)
45. Standards of Safety in Transport of Radioactive Material (AERB/SG/TR-2)
46. Procedure for Forwarding, Transport, Handling and Storage of Radioactive Consignments (AERB/SG/TR-3)
47. Security of Radioactive Material During Transport (AERB/NRF-TS/SG-10)

AERB Safety Manuals

48. Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)
49. Regulatory Inspection and Enforcement in Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors (AERB/NF/SM/G-2)

B) Module 2

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)

AERB Safety Codes

4. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
5. Design of Pressurised Heavy Water Reactor based Nuclear Power Plants [AERB/NPP-PHWR/SC/D (Rev. 1)]
6. Nuclear Power Plant Operation [AERB/NPP/SC/O (Rev. 1)]
7. Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)
8. Transport of Radioactive Materials (AERB/SC/TR-1)

AERB Safety Guides

9. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
10. Development of Regulatory Safety Documents for Nuclear and Radiation Facilities [AERB/NRF/SG/G-6 (Rev.1)]
11. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)
12. Operational Safety Experience Feedback on Nuclear Power Plants (AERB/NPP/SG/O-13)
13. Security of Radioactive Material During Transport (AERB/NRF-TS/SG-10)

C) Module 3

Acts, Rules and Policies

1. Atomic Energy (Radiation Protection) Rules, 2004
2. Atomic Energy (Factories) Rules, 1996
3. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)

AERB Safety Codes

4. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)

AERB Safety Guides

5. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
6. Regulatory Consents for Nuclear and Radiation Facilities Contents and Formats (AERB/SG/G-7)

AERB Safety Manuals

7. Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)

AERB Management Documents

8. Quality Manual of AERB (AERB/QMS/L-1)
9. Human Resource Planning, Development and Maintenance Manual of Atomic Energy Regulatory Board (AERB/ITSD/HR/01)
10. AERB Code of Ethics

Additional Documents:

11. Latest annual report
12. Latest annual bulletin
13. Latest newsletter

D) Module 4

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984
6. The Factories Act, 1948
7. The Environment (Protection) Act, 1986

8. The Civil Liability for Nuclear Damage Act, 2010
9. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)
10. Policies Governing Regulation of Nuclear and Radiation Safety

AERB Safety Codes

11. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)

AERB Safety Guides

12. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
13. Consenting Process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors (AERB/NF/SG/G-2)
14. Consenting Process for Radiation Facilities (AERB/RF/SG/G-3 Volume 1 | Volume 2 | Volume 3 | Volume 4)
15. Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)
16. Development of Regulatory Safety Documents for Nuclear and Radiation Facilities [AERB/NRF/SG/G-6 (Rev.1)]
17. Criteria for Regulation of Health and safety of Nuclear Power Plant Personnel, the public and the environment (AERB/SG/G-8)
18. Security of Radioactive Material During Transport (AERB/NRF-TS/SG-10)

AERB Safety Manuals

19. Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)
20. Regulatory Inspection and Enforcement in Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors (AERB/NF/SM/G-2)

AERB Management Documents

21. Quality Policy of AERB
22. Management System Manual (AERB/MS/L-1)
23. Quality Manual of AERB (AERB/QMS/L-1)
24. Procedure for Consenting Process of New Projects (AERB/QMS/L-II/01A)
25. Procedure for Consenting Process of Operating Plants (AERB/QMS/L-II/01B)
26. Procedure for Regulatory Inspection Process (AERB/QMS/L-II/02)
27. Procedure for Development of Regulatory Documents (AERB/QMS/L-II/03)
28. Procedure for Control of Documents (AERB/QMS/L-II/04)
29. Procedure for Control of Records (AERB/QMS/L-II/05)
30. Procedure for Internal Audit (AERB/QMS/L-II/06)

31. Procedure for Control of Non Conformance (AERB/QMS/L-II/07)
32. Procedure for Corrective Action (AERB/QMS/L-II/08)
33. Procedure for Preventive Action (AERB/QMS/L-II/09)
34. Procedure for Handling of Customer's Feedback (AERB/QMS/L-II/10)
35. Procedure for Control of Revision, Updation and Amendments of Quality Management Systems Documents (AERB/QMS/L-II/11)
36. Procedure for Documents/Records Numbering and Distribution (AERB/QMS/L-II/12)
37. Human Resource Planning, Development and Maintenance Manual of Atomic Energy Regulatory Board (AERB/ITSD/HR/01)
38. Procedure for Assessment of Management System of AERB and its Processes (AERB/MS/L-II/01)
39. Procedure for Management of Safety Review Process (AERB/MS/L-II/02)
40. Procedure for Resource Management for Regulation of Nuclear and Radiation Facilities (AERB/MS/L-II/03)
41. Procedures for Promotion of Safety Culture in AERB (AERB/MS/L-II/04)
42. AERB Code of Ethics

Additional Documents

43. Safety Directive No.7-1999

E) Module 5

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. The Environment (Protection) Act, 1986
6. The Environment (Protection) Rules,1986
7. The Factories Act, 1948
8. The Water (Prevention & Control of Pollution) Act, 1974
9. The Air (Prevention & Control of Pollution) Act, 1981
10. The Water (Prevention & Control of Pollution) Cess Act, 1977
11. The Electricity Act, 2003
12. The Boilers Act, 1923
13. Explosives Act, 1884
14. Electricity Rules, 2005

15. The Hazardous Waste (Management, Handling and Transboundary Movement), Rules 2008.
16. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)

AERB Safety Codes

17. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
18. Nuclear Power Plant Operation [AERB/NPP/SC/O (Rev. 1)]
19. Quality Assurance in Nuclear Power Plants [AERB/NPP/SC/QA (Rev. 1)]

AERB Safety Guides

20. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
21. Regulatory Consents for Nuclear and Radiation Facilities Contents and Formats (AERB/SG/G-7)
22. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)

AERB Management Documents

23. Human Resource Planning, Development and Maintenance Manual of Atomic Energy Regulatory Board (AERB/ITSD/HR/01)
24. Procedure for Consenting Process of New Projects (AERB/QMS/L-II/01A)
25. Procedure for Consenting Process of Operating Plants (AERB/QMS/L-II/01B)

F) Module 6

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. The Factories Act, 1948
6. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)
7. Policies Governing Regulation of Nuclear and Radiation Safety

AERB Safety Codes

8. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
9. Site Evaluation of Nuclear Facilities [AERB/NF/SC/S (Rev.1)]
10. Design of Pressurised Heavy Water Reactor based Nuclear Power Plants [AERB/NPP-PHWR/SC/D (Rev. 1)]
11. Nuclear Power Plant Operation [AERB/NPP/SC/O(Rev.1)]

12. Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)
13. Quality Assurance in Nuclear Power Plants [AERB/NPP/SC/QA (Rev. 1)]
14. Management of Radioactive Waste (AERB/NRF/SC/RW)

AERB Safety Guidelines

15. Preparation of Site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-1)
16. Preparation of Off-site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-2)
17. Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency [AERB/NRF/SG/EP-5 (Rev.1)]

AERB Safety Guides

18. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
19. Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)
20. Role of the Regulatory Body with respect to Emergency Response & Preparedness at Nuclear & Radiation Facilities (AERB/SG/G-5)
21. Development of Regulatory Safety Documents for Nuclear and Radiation Facilities [AERB/NRF/SG/G-6 (Rev.1)]
22. Regulatory Consents for Nuclear and Radiation Facilities: Contents and Formats (AERB-SG-G-7)
23. Criteria for Regulation of Health and safety of Nuclear Power Plant Personnel, the public and the environment (AERB/SG/G-8)
24. Quality Assurance in Siting of Nuclear Power Plants (AERB/NPP/SG/S-10)
25. Safety Classification and Seismic Categorisation for Structures, Systems and Components of Pressurised Heavy Water Reactors (AERB/NPP-PHWR/ SG/D-1)
26. Design Basis Events for Pressurised Heavy Water Reactor (AERB/SG/D-5)
27. Loss of Coolant Accident Analysis for Pressurised Heavy Water Reactor (AERB/SG/D-18)
28. Staffing Recruitment, Training, Qualification & Certification of Operating Personnel of NPPs (AERB/SG/O-1)
29. Commissioning Procedures for Pressurised Heavy Water Based Nuclear Power Plants (AERB/SG/O-4)
30. Radiation Protection during Operation of Nuclear Power Plants (AERB/SG/O-5)
31. Preparedness of the operating organisation for Handling Emergencies at Nuclear Power Plants (AERB/SG/O-6)
32. Maintenance of Nuclear Power Plants (AERB/SG/O-7)
33. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)

34. Operational Safety Experience Feedback on Nuclear Power Plants (AERB/NPP/SG/O-13)
35. Decommissioning of Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/RW-8)
36. Intervention Levels and Derived Intervention levels for Off-Site Radiation Emergency (AERB/SG/HS-1)

AERB Safety Manuals

37. Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)
38. Probabilistic Safety Assessment for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/O-1)
39. Decommissioning of Nuclear Facilities (AERB/SM/DECOM-1)

AERB Management Documents

40. Management System Manual (AERB/MS/L-1)
41. Procedure for Consenting Process of New Projects (AERB/QMS/L-II/01A)
42. Procedure for Consenting Process of Operating Plants (AERB/QMS/L-II/01B)
43. Procedure for Management of Safety Review Process (AERB/MS/L-II/02)
44. Human Resource Planning, Development and Maintenance Manual of Atomic Energy Regulatory Board (AERB/ITSD/HR/01)

G) Modules 7 and 8

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. The Factories Act, 1948

AERB Safety Codes

6. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
7. Nuclear Power Plant Operation [AERB/NPP/SC/O(Rev.1)]
8. Quality Assurance in Nuclear Power Plants [AERB/NPP/SC/QA (Rev. 1)]

AERB Safety Guides

9. Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)
10. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)

AERB Safety Manuals

11. Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)

H) Module 9

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. Atomic Energy (Factories) Rules, 1996
4. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984
6. The Factories Act, 1948
7. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)
8. Policies Governing Regulation of Nuclear and Radiation Safety

AERB Safety Codes

9. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
10. Site Evaluation of Nuclear Facilities [AERB/NF/SC/S (Rev.1)]
11. Design of Pressurised Heavy Water Reactor based Nuclear Power Plants [AERB/NPP-PHWR/SC/D (Rev. 1)]
12. Nuclear Power Plant Operation [AERB/NPP/SC/O(Rev. 1)]
13. Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)
14. Quality Assurance in Nuclear Power Plants [AERB/NPP/SC/QA (Rev. 1)]
15. Management of Radioactive Waste (AERB/NRF/SC/RW)

AERB Safety Guidelines

16. Preparation of Site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-1)
17. Preparation of Off-site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-2)
18. Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency [AERB/NRF/SG/EP-5 (Rev.1)]

AERB Safety Guides

19. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
20. Development of Regulatory Safety Documents for Nuclear and Radiation Facilities [AERB/NRF/SG/G-6 (Rev.1)]

21. Regulatory Consents for Nuclear and Radiation Facilities Contents and Formats (AERB/SG/G/7)
22. Commissioning Procedures for Pressurised Heavy Water Reactor Based Nuclear Power Plants (AERB/SG/O-4)
23. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)

AERB Management Procedures

24. Procedure for Development of Regulatory Documents (AERB/QMS/L-II/03)

Additional Documents

25. Safety Directive No.7-1999

I) Module 10

Acts, Rules and Policies

1. The Atomic Energy Act, 1962
2. Atomic Energy (Radiation Protection) Rules, 2004
3. AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)

AERB Safety Codes

4. Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
5. Site Evaluation of Nuclear Facilities [AERB/NF/SC/S (Rev.1)]
6. Nuclear Power Plant Operation [AERB/NPP/SC/O (Rev.1)]
7. Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)
8. Quality Assurance in Nuclear Power Plants (AERB/NPP/SC/QA (Rev. 1))
9. Transport of Radioactive Materials (AERB/SC/TR-1)
10. Emergency Response Planning and Preparedness for Transport Accidents involving Radioactive Materials (AERB/SC/TR-3)

AERB Safety Guidelines

11. Preparation of Site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-1)
12. Preparation of Off-site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-2)
13. Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency (AERB/NRF/SG/EP-5 (Rev.1))

AERB Safety Guides

14. Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
15. Intervention Levels and Derived Intervention levels for Off-Site Radiation Emergency (AERB/SG/HS-1)
16. Role of the Regulatory Body with respect to Emergency Response & Preparedness at Nuclear & Radiation Facilities (AERB/SG/G-5)
17. Criteria for Regulation of Health and safety of Nuclear Power Plant Personnel, the public and the environment (AERB/SG/G-8)
18. Design Basis Events for Pressurised Heavy Water Reactor (AERB/SG/D-5)
19. Radiation Protection Aspects in Design for PHWR based NPPs (AERB/NPP-PHWR/SG/D-12)
20. Staffing Recruitment, Training, Qualification & Certification of Operating Personnel of NPPs (AERB/SG/O-1)
21. Preparedness of the operating organisation for Handling Emergencies at Nuclear Power Plants (AERB/SG/O-6)
22. Renewal of Authorisation for Operation of Nuclear Power Plants (AERB/SG/O-12)
23. Medical Management of persons exposed in radiation accident (AERB/SG/MED-1)
24. Site Consideration of NPPs for Off-Site Emergency Preparedness (AERB/NPP/SG/S-8)

AERB Safety Manuals

25. Hand Book for Medical Management of Person Exposed in Radiation accident (AERB/SM/MED-2)

Annex III

Advance Reference Material as per IRRS Guideline Appendix V

A) National legal framework:

1. Law(s) governing the siting, design, construction, commissioning, operation or decommissioning of nuclear installations, other facilities, activities and practices;
   (a) The Atomic Energy Act, 1962
   (b) Atomic Energy (Radiation Protection) Rules, 2004
   (c) Atomic Energy (Factories) Rules, 1996
   (d) Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
   (e) Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984
   (f) Policies Governing Regulation of Nuclear and Radiation Safety
   (g) The Environment (Protection) Act, 1986
   (h) The Disaster Management Act, 2005

(i) The Environment (Protection) Rules,1986

(j) The Manufacture, Storage and Import of Hazardous Chemical (MSIHC) Rules 1989 (http://www.envfor.nic.in/legis/hsm/hsm2.html)

(k) The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000 (http://www.moef.nic.in/legis/hsm/msihcar.html)

(l) Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996 (http://www.moef.nic.in/legis/hsm/gsr347.htm)

(m) The Civil Liability for Nuclear Damage Act, 2010

(n) Civil Liability for Nuclear Damage Rules, 2011

2. Synopsis of the constitutional legislative system of the country and the responsibilities of the various government departments that deal with nuclear installations;

   (a) National Report to the Convention of Nuclear Safety - 2014 (Chapter 7 & 8)

3. An outline of the administrative structure of government departments and other bodies dealing with nuclear installations and how they all interrelate;

   (a) National Report to the Convention of Nuclear Safety - 2014 (Chapter 7 & 8)

4. Legislation for the use of radiation sources and the management of the associated radioactive waste;

   (a) The Atomic Energy Act, 1962

   (b) Atomic Energy (Radiation Protection) Rules, 2004

   (c) Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987

5. Regulations on nuclear, radiation, waste management, transport safety and security of radioactive sources.

   (a) Regulation of Nuclear and Radiation Facilities (AERB/SC/G)

   (b) Site Evaluation of Nuclear Facilities (AERB/NF/SC/S (Rev.1)

   (c) Design of Pressurised Heavy Water Reactor based Nuclear Power Plants (AERB/NPP-PHWR/SC/D (Rev. 1))

   (d) Nuclear Power Plant Operation [AERB/NPP/SC/O (Rev.1)]

   (e) Radiation Protection for Nuclear Fuel Cycle Facilities (AERB/NF/SC/RP)

   (f) Quality Assurance in Nuclear Power Plants (AERB/NPP/SC/QA (Rev. 1))

   (g) Management of Radioactive Waste (AERB/NRF/SC/RW)

   (h) Transport of Radioactive Materials (AERB/SC/TR-1)

B) Regulatory body organization and procedures:

1. Legal status and responsibilities assigned by law to the regulatory body;

   (a) The Atomic Energy Act, 1962

   (b) AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)

(c) Atomic Energy (Radiation Protection) Rules, 2004

2. Objectives of the regulatory body and how it maintains its effective independence;
   (a) AERB Constitution Order - Presidential (gazette) notification issued by the Central Government (SO 4772)
   (b) Policies Governing Regulation of Nuclear and Radiation Safety
   (c) Quality Policy of AERB
   (d) Management System Manual (AERB/MS/L-1)
   (e) Quality Manual of AERB (AERB/QMS/L-1)
   (f) Human Resource Planning, Development and Maintenance Manual of Atomic Energy Regulatory Board (AERB/ITSD/HR/01)
   (g) AERB Code of Ethics
3. Regulatory body safety policy and quality management system;
   (a) Policies Governing Regulation of Nuclear and Radiation Safety
   (b) Quality Policy of AERB
   (c) Management System Manual (AERB/MS/L-1)
   (d) Quality Manual of AERB (AERB/QMS/L-1)
4. Structure, organization and staffing;
   (a) Management System Manual (AERB/MS/L-1)
   (b) Quality Manual of AERB (AERB/QMS/L-1)
   (c) AERB Website www.aerb.gov.in
5. Description of the authorization process;
   (a) Consenting Process for Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SG/G-1)
6. Procedures for assessment and review of technical submissions;
   (a) Procedure for Consenting Process of New Projects (AERB/QMS/L-II/01A)
   (b) Procedure for Consenting Process of Operating Plants (AERB/QMS/L-II/01B)
7. Inspection practices;
   (a) Regulation of Nuclear and Radiation Facilities (AERB/SC/G)
   (b) Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)
   (c) Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)
   (d) Procedure for Regulatory Inspection Process (AERB/QMS/L-II/02)
8. Enforcement practices;
   (a) Regulation of Nuclear and Radiation Facilities (AERB/SC/G)

(b) Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)

(c) Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors (AERB/NPP&RR/SM/G-1)

9. Roles and responsibilities in relation to nuclear emergencies;

(a) Role of the Regulatory Body with respect to Emergency Response & Preparedness at Nuclear & Radiation Facilities (AERB/SG/G-5)

(b) Intervention Levels and Derived Intervention levels for Off-Site Radiation Emergency (AERB/SG/HS-1)

(c) Preparation of Site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-1)

(d) Preparation of Off-site Emergency Preparedness Plans for Nuclear Installations (AERB/SG/EP-2)

(e) Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency (AERB/NRF/SG/EP-5 (Rev.1))

(f) Preparedness of the Operating Organisation for Handling Emergencies at Nuclear Power Plants (AERB/SG/O-6)

C) Regulatory body's written response to the IRRS Self-Assessment Questionnaire:

(a) Modules 1-10

(b) Tailored Module

D) Self-assessment analysis and results

APPENDIX VIII – IAEA REFERENCE MATERIAL USED FOR THE REVIEW

1.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Fundamental Safety Principles, No SF-1, IAEA, Vienna (2006)
2.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements Part 1, No. GSR Part 1, IAEA, Vienna (2010).
3.	**INTERNATIONAL ATOMIC ENERGY AGENCY** – The Management System for Facilities and Activities. Safety Requirement Series No. GS-R-3, IAEA, Vienna (2006).
4.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Preparedness and Response for Nuclear and Radiological Emergencies, Safety Requirement Series No. GS-R-2, IAEA, Vienna (2002).
5.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety assessment for facilities and activities, General Safety Requirements Part 4, No. GSR Part 4, IAEA, Vienna (2009)
6.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Predisposal Management of Radioactive Waste, General Safety Requirement Part 5, No. GSR Part 5, IAEA, Vienna (2009).
7.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Facilities, Safety Requirement Series No. GSR Part 6, IAEA, Vienna (2014).
8.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Nuclear Power Plants: Design, Specific Safety Requirements No. SSR-2/1, IAEA, Vienna (2012).
9.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Nuclear Power Plants: Commissioning and Operation, Specific Safety Requirements Series No. SSR-2/2, IAEA, Vienna (2011).
10.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Site Evaluation for Nuclear Installations, Safety Requirement Series No. NS-R-3, IAEA, Vienna (2003).
11.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Disposal of Radioactive Waste, Specific Safety Requirements No. SSR-5, IAEA, Vienna (2011)
12.	**INTERNATIONAL ATOMIC ENERGY AGENCY** – Regulations for the Safe Transport of Radioactive Material, Specific Safety Requirements No. SSR-6, IAEA, Vienna (2012)
13.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Organization and Staffing of the Regulatory Body for Nuclear Facilities, Safety Guide Series No. GS-G-1.1, IAEA, Vienna (2002).
14.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Review and Assessment of Nuclear Facilities by the Regulatory Body, Safety Guide Series No. GS-G-1.2, IAEA, Vienna (2002).
15.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body, Safety Guide Series No. GS-G-1.3, IAEA, Vienna (2002).

16.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Documentation Used in Regulating Nuclear Facilities, Safety Guide Series No. GS-G-1.4, IAEA, Vienna (2002).
17.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Guide Series No. GS-G-2.1, IAEA, Vienna (2007)
18.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Criteria for use in Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Guide Series No. GSG-2, IAEA, Vienna 2011)
19.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Commissioning for Nuclear Power Plants, Safety Guide Series No. SSG-28, IAEA, Vienna (2014)
20.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Periodic Safety Review of Nuclear Power Plants, Safety Guide Series No. SSG-25, IAEA, Vienna (2013)
21.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - A System for the Feedback of Experience from Events in Nuclear Installations, Safety Guide Series No. NS-G-2.11, IAEA, Vienna (2006)
22.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Deterministic Safety Analysis for Nuclear Power Plants, Specific Safety Guides Series No. SSG-2, IAEA, Vienna (2010)
23.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants, Specific Safety Guide Series No. SSG-3, IAEA, Vienna (2010)
24.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants, Specific Safety Guide Series No. SSG-4, IAEA, Vienna (2010)
25.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Licensing Process for Nuclear Installations, Specific Safety Guide Series No. SSG-12, IAEA, Vienna (2010)
26.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Geological Disposal Facilities for Radioactive Waste Specific Safety Guide Series No. SSG-14, IAEA, Vienna (2011)
27.	**INTERNATIONAL ATOMIC ENERGY AGENCY** - Storage of Spent Nuclear Fuel Specific Safety Guide Series No. SSG-15, IAEA, Vienna (2012)
28.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Classification of Radioactive Waste, General Safety Guide No. GSG-1, IAEA, Vienna (2009)
29.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Nuclear Power Plants and Research Reactors, Safety Guide Series No.WS-G-2.1, IAEA, Vienna (1999)
30.	**INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Medical, Industrial and Research Facilities (1999) Safety Guide Series No.WS-G-2.2, IAEA, Vienna (1999)

APPENDIX IX – ORGANIZATIONAL CHART