National Association for Applications of Radioisotopes and Radiation in Industry (NAARRI) has published a thematic book entitled, “Safety, Security and Regulations in Handling Radiation Sources.” Thirty-two articles have been contributed by different authors. The book starts with “Forewords” by Dr. Sekhar Basu, Chairman, Atomic Energy Commission and Secretary, Department of Atomic Energy, Government of India and Shri S. A. Bhardwaj, Chairman, Atomic Energy Regulatory Board (AERB), India. It is commented that the book will be useful for the understanding of various aspects for radiation source handling and will be an asset for the readers in terms of providing information on the safety and security aspects of radiation sources being used in various applications. Preface, by the President, NAARRI, ends with a note that this thematic book can be widely acclaimed as one of the best reference materials by the scientific community in the field. The articles in the book deal mostly with experiences in safety, security and regulatory aspects in handling radiation sources in different radiation practices in India.

First article gives an overview of safety, security and regulatory aspects of radiation sources in India, while discussing medical, industrial, and research applications of ionizing radiations. The legal, administrative and regulatory framework in India has the necessary provisions such that the safety and security of radioactive sources receive required supervision and regulatory coverage and ensure control over the radioactive sources throughout their life cycle. Total safety is achieved by built-in safety combined with operational safety. To meet the challenge of the steady growth in the applications of ionizing radiation technology, AERB implemented a state-of-the-art e-governance system, electronic licensing of radiation applications (e-LORA), through automation of regulatory processes associated with the use of ionizing radiation in India.

Second article deals with biological effects of radiation and their implications in radiation protection and medical management. Health effects of radiation exposure may be grouped in two general categories: (i) Deterministic effects and (ii) Stochastic effects. It is stated that deterministic effects do not occur at low doses or following chronic exposures as encountered by occupational workers who are exposed within prescribed dose limits. The article describes how radiation induces damage in human cells and how the irradiated cells undergoing division result in alterations in the structure of chromosomes, namely, chromosome aberrations. Increase in the frequency of dicentric chromosomes in human lymphocytes (white blood cell) is used as a biological dosimeter. A table depicting “significance of different levels of radiation exposures” is given at the end of the article.

Third article specifies necessity for safety standards for working with radiation. The international safety standards (e.g., IAEA Basic Safety Standards, BSS-2014) are based on considerable research work done in international research institutes and universities on effects of ionizing radiation on man and his environment and critical review and analysis of these research reports by international organizations, including UNSCEAR, ICRP, ICRU, IAEA, etc. The international safety standards are endorsed by other international organizations such as the WHO, ISO, FAO, and ILO. Thus, the safety standards have a scientific basis as well as international acceptance. It is stated that radiation protection standards are required for different situations and applications. All these standards must be consistent with one another. This is achievable only if all these standards are derived from a common set of basic safety standards, leading to harmonization of standards. In conclusion of this article, it is stated that the national standards for radiological safety developed and being implemented in India are consistent with the international safety standards.

Six articles in the book deal with regulatory control of medical applications of radiation. Article 4 deals with regulatory control of radiotherapy sources and associated safety and security aspects. In radiotherapy, potential hazard is relatively high due to involvement of high activity/intensity sources, as well as due to introduction of high-tech treatment modalities, therefore, utmost care is needed while handling such radioactive sources. In order to obtain desired level of safety and security while handling these sources, all stakeholders, including licensee, RSO, radiation oncologist, medical physicist, radiation technologist and service engineer must execute their role effectively. Article 5 describes radiation protection procedures in radiotherapy facilities using radiotherapy equipment, as well as procedures for ensuring compliance with all the regulatory requirements, including the safety and security of radiotherapy sources. Article 6 discusses experience in handling/management of therapeutic sources for cancer treatment at Tata Memorial Hospital, with particular emphasis to brachytherapy equipment. It is opined that despite advancement of intensity modulated, image guided treatments
in external beam therapy, brachytherapy remains an important modality of treatment due to its ability to deliver very high dose to the core of the tumor and rapid dose fall-off, sparing normal tissues. Article 7 describes procedures used for safety in handling of radioisotopes for therapeutics and nuclear imaging in nuclear medicine, as well as advances in the field due to the development of new radiopharmaceuticals, including cyclotron and positron emission tomography products. It is projected that the future of nuclear medicine will be dominated mostly by new radioisotopes and procedures. Article 8 summarizes steps taken by AERB toward improving regulatory control and radiation safety in the field of diagnostic radiology through the provisions of recently published safety code (AERB/SC/Med-3, 2015). Article 32 discusses radiation safety in some of the commonly used cyclotron-produced radioisotopes, including $^{18}$F, and their transportation aspects to the utility. It is concluded that with appropriate design, workflow, safety interlocks, administrative controls, technical controls and radiation surveillance, radiation dose to the staff and members of the public can be maintained well below the regulatory limits.

Nine articles in the book deal with regulatory control of industrial applications of radiation. Article 9 describes general principle as well as uses of radiotracer techniques for troubleshooting and process optimization in full scale industrial reactor due to their many advantages over conventional tracers. Article also gives criteria for selection of a radiotracer, their applications in industry, as well as radiological safety, security and regulatory aspects. It is stated that specialized services are provided to Indian Industry by Bhabha Atomic Research Centre (BARC) and Board of Radiation and Isotope Technology (BRIT) leading to significant benefits to the Industry. Articles 10–12 describe the objective of radiation processing of foods. Different classes of food products and their corresponding dose limits for radiation processing are given. At present, there are 19 gamma radiation processing facilities (GRAPFs) in India. All the radiation safety and regulatory requirements for GRAPFs are discussed in the articles. As per the security requirements, GRAPF containing Category 1 radioactive source requires “Security Level A.” It is stated that the volume of food irradiated in India has been steadily increasing. Article 13 discusses safety aspects in electron beam (EB) processing in the energy range up to 10 MeV, including depth dose characteristic for various energies. It is concluded that industrial EB accelerators incorporating proper safety features ensure reliable operation. Article 14 discusses radiation safety and regulatory aspects of particle accelerators-electron, proton and heavy ion accelerators. Accelerators in terms of energy, intensity, and technology are growing at a rapid pace, which is driven by the need of industry, scientific research, medicine, agriculture, etc. Due to the uncertainties in dose estimation prevailing in these peculiar radiation environments, one has to give importance to engineered, redundant radiation safety such as various interlocks, shielding, zoning, access control, training of personnel, and operational procedures. Article 15 describes nondestructive evaluation of welding, castings, and assemblies using industrial radiography sources. All the radiation safety, security and regulatory requirements for industrial radiography practice are nicely covered. Article 16 shares experience in handling/management of industrial radiography sources in Heavy Engineering manufacturing. Article also discusses regarding use of thermoluminescent dosimeter badge based on CaSO$_4$;Dy Teflon discs for personnel monitoring. Article 17 describes safety, security and regulatory aspects in nucleonic control system and oil well logging.

Articles 19–21 in the book deal with production and handling of radioisotopes (sealed and unsealed), as well as provide guidelines for establishing radioisotope laboratories using sealed/unsealed radioisotopes. Sealed radioactive sources (SRSs) are designed and manufactured in BRIT, DAE in accordance with national and international standards while complying with safety and security requirements for production of sealed sources. Sealed radioactive sources manufactured by BRIT are widely used in medicine, industry, and agriculture. The radioisotope production program at BARC involves several interrelated activities such as target fabrication, irradiation in a reactor or accelerator, transportation of irradiated target to the radioactive laboratory, radiochemical processing or encapsulation in the sealed source, quality control, and transportation to end users while complying with all the requirements for safety, security, and applicable regulations. Radioisotopes with activity ranging from $10^4$ to $10^7$ TBq are supplied to end users through BRIT, DAE. Because of potentially hazardous properties of radioisotopes (sealed as well as unsealed), their use must be closely regulated so that protection of workers, public and the environment could be ensured through adherence to rules and regulations and good procedures.

Article 27 describes the interaction of ultra-high intensity ($\geq$ tera-watt) laser beam with foil target, which produces electron bunches with the energy of several MeV and relatively high charge. Further these electrons, through secondary processes, produce MeV energy photons, protons, heavy ions and neutrons, which pose ionizing radiation hazard similar to a radioactive source and therefore require radiological safety. Thus, ultra-high intensity laser facility should comply with all the applicable safety and regulatory requirements similar to that for an ionizing radiation facility.

Since the consumer products, such as ICSD, GTLS/GTLD, fluorescent lamp starter, and incandescent gas mantle, involve very small amount of radioactive material in each of these devices, manufacturers/suppliers of these consumer products are only regulated by AERB; end users are not regulated (article 22). Various industrial scanning systems which are used for security and quality assurance purposes, end users are also regulated in addition to manufacturers/suppliers. Article 23 deals with the transport of radioactive material in India. The recently published (Rev. 1, 2016) code on “Safe Transport of Radioactive Material” prescribes the classification, design and test requirements for radioactive material and classification, design and test requirements for packagings, packages, and corresponding activity limits, etc. In the article the role of Emergency Control Room, DAE (ECR, DAE) in the event of any accident or emergency during transport of radioactive material is stated.
In India, Atomic Energy Act, 1962 is the primary legislation and Atomic Energy (Radiation Protection) Rules, 2004 are the regulatory rules promulgated under the Act (article 24). Chairman, AERB has been notified as competent authority to enforce these Rules. In the event of contravention of any of the provisions of these Rules by the licensee, the Rules have provisions for enforcement actions including suspension, modification, revocation or withdrawal of license issued under the Rules. For these enforcement actions calling for judiciary action and penalty, provisions of the Atomic Energy Act, 1962 are invoked. Article vividly describes all the aspects of enforcement actions as per the Act and the Rules. Article 25 describes the rules and regulations applicable for radioactive waste management, classification of waste, waste management practices in India and the role of regulatory bodies (BARC Safety Council (BSC) and AERB) for ensuring the safety of workers, the public and the environment. While BSC, constituted under the Atomic Energy Act, 1962, regulates the safety of BARC facilities, AERB regulates nuclear and radiological facilities in the public domain. Compliance with the relevant codes and guides of AERB is also followed in BARC facilities. Article 26 stresses the requirement to establish an overall nuclear security policy and a nuclear security system to prevent, detect and respond to theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear and other radioactive substances. The factors which affect/influence nuclear safety culture and other security issues are also discussed.

Training in radiation protection and safety is an important means of promoting safety culture and enhancing the level of competence of personnel involved in radiation protection activities. In this context, RP and AD, BARC is conducting a number of radiation safety related training and certification programs in the field of medicine, industry and research, some of these training programs are conducted by BARC/AERB approved institutions. Syllabi of all these training courses have been approved by AERB. Articles 28 and 29 give details of the radiation safety related training courses conducted by RP and AD, BARC. These articles also give details regarding various training courses and the number of personnel certified by RP and AD till October 2016.

Article 18 provides details of requirements related to the infrastructure, regulatory consents to be obtained from AERB for setting up calibration laboratory of radiation monitoring instruments and qualified personnel required from safety and security considerations. It is stated that till date six such laboratories have been recognized by AERB. Article 31 describes uses of different types of radiation monitoring instruments in different applications of ionizing radiation in industry, medicine and research, covering uses of both dose and dose rate meters. The article also describes the procedure for tests, maintenance and calibration of monitoring instruments. However, detectors/instruments used for measuring pulsed radiation fields (e.g., pulsed X-ray beams) are not covered. Article 30 describes salient features of the e-LORA system which is a web-based information and communication technology application establishing direct communication channel between AERB and its stakeholders for exchange of information and communication transaction for delivering its regulatory services, as well as for achieving higher efficiency, reliability and transparency in dealings, while ensuring compliance with all the applicable regulatory requirements. The system is designed to automate the comprehensive business processes of radiological application of regulations targeted to a large number of facilities involved in the use of ionizing radiation.

There are some conspicuous formatting errors, typos and some other errors of minor nature in the texts of some of the articles, these are mentioned below:

i. At many places in the text, words have wrongly joined together, which affect the readability of the text.
ii. Legends of some of the figures are not legible.
iii. For some of the references cited in the articles, year of publication is neither given in the text nor in the list of references.
iv. In the article 10, title in the article is different than that given in the “Table of contents.” In the article 32, there is something amiss in the title. In article 20, the order of the authors is different in the article than that given in the “Table of contents.”

In conclusion, the editors and the contributors of different articles in the book have done a commendable task in bringing out this very useful compilation. Inclusion of ionizing radiation hazard of ultra-high intensity laser beams, in the books on radiation protection and safety, is probably a recent development. The book will be an asset to the readers, practitioners of radiation technology in particular, in terms of providing information on safety, security and regulatory aspects of radiation sources being used in various applications, as well as in strengthening the provisions for the same in different practices using ionizing radiation.

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