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Kingdom of Saudi Arabia
King ʻAbd al-ʻAziz City for Science and Technology (KACST)
Atomic Energy Research Institute

General Instructions on

Protection against Ionizing Radiations

In

The Kingdom of Saudi Arabia

First edition

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Introduction:

In implementation of the duties assigned to KACST as set forth in High Order No.7/M/8897, dated 21 Rabi' II 1410 [25 February 1981], relative to the safe utilization of atomic energy technologies for peaceful purposes and out of KACST appreciation of the importance of regulating the handling of radioactive substances in the Kingdom, KACST developed the "*General Regulatory Instructions for Utilization of Ionizing Radiation and Isotopes in the Kingdom of Saudi Arabia"*, after soliciting feedback and the opinions of a number of concerned government agencies, such as the Ministry of Defense and Aviation, Ministry of Interior, National Guard, Ministry of Agriculture, Ministry of Water and Electricity, Ministry of Commerce and Industry, Ministry of Education, Ministry of Higher Education, Ministry of Petroleum and Mineral Resources, Presidency of Girls Education and King Faisal Specialist Hospital and Research Center.

Over the past ten years, the use of radiation and isotopes in the Kingdom has expanded to cover several human activities. The number of facilities using radiations and radioactive substances in the year 1427 stands now at 250 installations, the number of applications 2578 and the number of radioactive substances used 65 substances, compared with 1406 figures of 5 facilities, 5 applications and 3 radioactive substances. Today, radiation sources and ionizing radiations are used in several modern medical applications, basically in pharmaceutical and medical supplies sterilization. The role of nuclear technologies has grown in many of the industrial, agricultural and medical fields, besides research areas. Radiology has become one of the effective tools for testing several industrial operations, including detection of defects and cracks and in quality control tests. Irradiation, too, has become one of the more important vehicles for modification of the characteristics of a number of industrial and petrochemical products. Foodstuffs are now preserved using irradiation to reduce the percentage of rot. Nuclear sterilization techniques are likewise used to eliminate bacteria and harmful pests. Radiations and radioactive substances play a key and vital role in medical diagnosis and treatment of malignant tumors.

However, radiations and radioactive substances are associated with great risks where the responsibility for protection therefrom primarily falls on the shoulder of the handlers. There ought to be a government agency responsible for licensing and monitoring safe and integral handling of radioactive substances, not only for the protection of the environment and the public but also to prevent abuse and exposure of the workers, the public, and the environment to the risks of radiation

exposure. Similarly, atomic radiation, which does not recognize international borders between the countries in the event of any nuclear mishap occurring in any country, may expose great numbers of people in neighboring countries which may not have any nuclear activities to the hazards of atomic pollution. For this reason, the international organizations concerned with the nuclear energy and protection against radiation underscore the importance of subjecting all activities and practices which involve exposure to ionizing radiation to the supervision of an independent and competent national Competent Agency and to specific standards that would ensure protection of the workers, the public and the environment and that would mitigate to a reasonable degree the radioactive risks associated with their beneficial applications.

Ever since the beginning of research in the field of X-ray and nuclear radiation, it has been determined in no uncertain terms that exposure to such radiations will result in damage to human tissues and organs. Exposure to ionizing radiation has definitive health impacts whose symptoms become manifest upon exposure to relatively high doses of exposure to radiation within a short period of time. Such impacts are then described as definitive because they will certainly develop when the exposure exceeds a certain limit of the radioactive dose. The ailments of these exposures include radiation illness, redness of the skin, opaque eye lens and others.

Also, studies extending over long years on human groups exposed to radiation have demonstrated that such radiations do induce malignant cancerous tumors which develop after a long period of exposure ranging between a few numbers of years for leukemia and several tens of years for certain other varieties of cancer. Such impacts are described as random because they may or may not occur. There is no evidence of the existence of a certain level of random impacts but they may be induced from the smallest of the doses. The probability of occurrence depends on the value of the dose and the greater the probability the greater the occurrence of the impact while the value of the dose has no bearing on the severity of the disease.

In the light of the experience acquired through organization and streamlining of the handling and utilization of ionizing radiations and radioactive substances in the Kingdom, the scientific breakthrough, the massive advances made in the human knowledge in the area of the impacts and risks of these radiations, and in keeping with the recent recommendations and publications of the international organizations concerned with the issues of protection against ionizing radiations, including the UN Scientific Committee on the Effects of Atomic Radiation, the International Commission on Radiological Protection, and the International

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Atomic Energy Agency, KACST has developed technical regulatory standards designed to protect man and the environment against uncalled for exposure to ionizing radiation but without blocking the beneficial and justifiable applications of such radiations and nuclear technologies in general.

These instructions exclusively address ionizing radiations, specifically X-rays, Gama rays, alpha beta, neutrons and any other ionizing particles, to the exclusion non ionizing radiations.

The development of these instructions has taken into consideration Recommendation No.60, for the year 1991 of the International Commission on Radiological Protection (ICRP) as well as the 1994 international basic safety standards on protection against ionizing radiations and the safety of radioactive sources of the International Atomic Energy Agency (IAEA), in collaboration with five other international organizations, namely FAO, the International Labor Organization (ILO), NEA/OECD, PAHO and WHO.

The instructions define the requirements that all concerned agencies and persons licensed to carry out any of the works or practices which involve exposure to radiation must comply with and such persons will be held fully responsible for enforcement of these instructions.

The first edition of subject instructions was issue in the year 1408, the second in 1417, the third in the year 1422 and in the year 1427 we present to you the fourth edition where the remarks received from users have been incorporated.

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Chapter I

General Provisions

Article 1: objective

The objective of these instructions is to identify the basic requirements and controls that govern the practices related to radioactive sources as well as the controls which regulate handling of these sources by man for the purpose of protecting man and the environment against the detriments of ionizing radiations without handicapping their beneficial and safe utilization.

Article 2: scope of application

The provisions of these instructions apply in the Kingdom of Saudi Arabia to all of the following facilities, practices, persons and sources:

a- All government and non- government facilities which deal in any way or form with radioactive sources, including nuclear installations and radioactive waste management facilities.
b- Any practice or involvement which is associated directly or indirectly with radioactive sources and which may lead to man's exposure to ionizing radiation.
c- Any person who works on a permanent or temporary basis in a field which involves ionizing radiation or performs a work which calls on him to be in a location where radioactive sources are in use.
d- All radioactive sources, as well as the consumer products that the Competent Agency for Protection against Radiation subjects to the provisions of these instructions.
e- Any facility or practice identified by the Competent Agency for Protection against Radiation.

Article 3: Duties of the Competent Agency

The Competent Agency is the agency tasked with all issues related to protection against ionizing radiation and monitoring of compliance with its regulations in the

Kingdom of Saudi Arabia. The Competent Agency will be in charge of the following:

a- Ensure compliance by all parties with the provisions of the general regulation for protection against ionizing radiations in the Kingdom of Saudi Arabia and the related rules and instructions.
b- Propose amendment, additions to and deletion of any article of these general instructions for protection against ionizing radiation.
c- Propose the rules related to protection against ionizing radiation and the safety of radioactive sources.
d- Establish the rules, instructions, standards and guidelines related to protection against ionizing radiation and the safety of radioactive sources.
e- Evaluate and approve the practice manuals to be applied by those who are covered by the general regulation for protection against radiation and ensure that all human, regulatory, technical and administrative requirements related to safety and safety are fulfilled by the facilities that are licensed to handle radioactive sources and practices.
f- Evaluate the licensing applications as provided for in the articles of the general regulation for protection against radiation and the related instructions and rules in addition to issuing, revoking or suspending such licenses.
g- Perform periodic announced and surprise inspections of the facilities, practices, individuals and radioactive sources related to these practices as well as of the locations which may have an effect on or otherwise be affected by such sources and follow up on all types of records related to the radioactive sources and protection of the workers, the public and the environment.
h- Establish various national limits of exposures to radioactive substances, limits of pollution by radioactive substances and limits of concentration of saturated radionuclides in circulating products.
i- Review and approve the protection programs filed by the license applicants.
j- Review the annual protection and safety reports which are filed by the licensed facilities, direct those agencies to the required remedial actions in the light of these reports and the inspections, and approve the operating limits established by the licensee for its radioactive practices and sources.
k- Review and approve the contingency plans established by the licensee to counteract the radioactive or nuclear incidents and accidents, including cases of emergency involving transfer of radioactive sources.
l- Review and approve the quality assurance programs established by the licensee.

m- Draw up the national radioactive contingency plan and ensure preparedness to confront and respond to all types of radioactive emergency cases, including cases of emergency involving transfer of radioactive sources.
n- Carry out ongoing radioactive monitoring, all components of environmental radioactive gauges and early warning of local radioactive hazards or hazards resulting from accidents outside the Kingdom's borders.
o- Monitor the Kingdom's radioactive wastes management and establish the national standards for safe disposal and management of such wastes.
p- Perform research and studies related to protection and safety and impacts of ionizing radiations on man and the environment.
q- Approve the contents of the qualifying training courses for the workers in the radiation field which are offered by other organization and participation in the training courses in the field of safety and protection.
r- Propagate the scientific culture and awareness in the field of radiation protection and nuclear safety.
s- Support and encourage the research and studies conducive to the promotion of the levels of protection against ionizing radiation on the local, regional, and global levels.
t- Identify the levels of exemptions from the requirements of the regulations on protection against ionizing radiation and related instructions and rules.
u- Carry out the procedures and enforce the penalties secondary to failure to comply with the regulation and related rules and instructions in accordance with article 15 of this regulation and the regulations of concerned countries.
v- Approve the centers, organizations and individuals which offer services in the field of protection from ionizing radiation.

Article 4: Definitions and terms

For implementation of the provisions of these instructions and related rules, the terms and expressions mentioned herein shall have the meaning assigned to them in appendix 1.

Article 5: Responsible parties:

a- in addition to the Competent Agency for Protection against Radiation, the parties which assume responsibility for the enforcement of these instructions and related rules shall be:
    1- The principal parties which have earned specific practice or source license, represented by the heads of these agencies.

2- The parties involved in or which supervise the activities of protection against radioactive practices or sources, including:
    a- the licensee
    b- the supplier
    c- the workers
    d- radiation protection officer
    e- the medical practitioner
    f- the qualified expert

b- Each of the parties listed under paragraph (a) above shall assume the general and special responsibilities set forth in chapter 4 of these instructions and related rules.

Article 6: Radioactive sources

A radioactive source is any radioactive substance or material form that may result in radioactive exposure through emission of ionizing radiations or release of radioactive materials. The sources to which these instructions apply include consumer products, nuclear measuring and gauging devices, radiology instruments, open sources, sealed sources, irradiation instruments, nuclear installations and radioactive waste management facilities. They shall also include any other radioactive sources identified by the Competent Agency.

Article 7: Exclusions

These instructions exclude exposures resulting from the presence of carbon 14 and potassium 40 in the human body, the exposure to galactic radiations on the surface of the earth and exposures resulting from unmodified concentrations of radioactive radionuclides in raw materials and exposure to natural radiation levels at ground level. The Competent Agency will identify the exposures which are excluded from the Protection Regulation and its Rules for Implementation.

Article 8: Exemptions:

The radioactive sources whose radioactive activity does not exceed the exemption levels identified by the Competent Agency shall be exempted from enforcing the requirements of these instructions.

Article 9: Violations and breaches

a- If any violation is committed in the operating rules or breach of the Regulation on Protection against Ionizing Radiation and related rules, the licensee shall be required to notify the Competent Agency forthwith, shall investigate the reasons of the violation or breach and shall rectify the status and the circumstances leading to either of them.

b- If the licensee fails to take the remedial action in due course, the Competent Agency shall have the right to suspend or otherwise revoke the license granted, whereupon work with all existing radioactive sources shall be suspended, the sources be safeguarded in a secure storage pending safe disposal thereof at the expense of the licensee and under the supervision of the Competent Agency in the event of cancellation of the license.

c- Upon revocation of the license, the licensee may file an application for a new license only after elimination of all causes of the violation or breach and only after persuading the Competent Agency that such causes have in effect been eliminated and on the proviso that the facility assume the re licensing expenses.

d- Violators of the provisions of the General Regulation for Protection against Ionizing Radiation, its rules and these instructions shall be subject to the penalties set forth in article 18 of the Regulation on Protection against Ionizing Radiation applicable in the Kingdom of Saudi Arabia.

Article 10: Interpretation

The Competent Agency shall solely have the exclusive right to interpret the articles and paragraphs of these instructions. Any requirement by any of the parties listed in article 5 for interpretation of any of these articles or related rules shall be documented in writing and any oral interpretation thereof shall be disregarded.

Article 11: Validity

The provisions of these general instructions for protection against radiation shall enter into effect after the elapse of three months of the date of issue.

Chapter II

The administrative requirements for protection against radiation and the safety of radioactive sources

Article 12: Basic commitment to protection against radiation

a- No practice or activity directly or indirectly related to a radioactive source or device that emits ionizing radiation may be applied, introduced, implemented, operated, suspended or otherwise terminated prior to securing a license to that effect from the Competent Agency.

b- All radioactive sources or devices that emit ionizing radiation may be designed, manufactured, built, assembled, dismantled, installed, received, delivered, possessed, imported, exported, purchased, sold, loaned, borrowed, used, operated, maintained, modified, discharged, handled, stored or otherwise disposed of only in accordance with the controls for protection against radiation and only after securing a license to that affect upon satisfaction of the requirement and conditions of the Competent Agency.

c- Raw nuclear materials shall be extracted, pulverized or grounded and nuclear substances shall be processed or re-processed only in accordance with the controls for protection against radiation and only after securing a license to that affect upon satisfaction of the requirements and conditions of the Competent Agency.

d- Transportation of any radioactive source using any means of transportation inside or outside the Kingdom shall be tolerated only in accordance with the rules of safe transfer of radioactive substances as may be issued by the Competent Agency and with the provisions of the international agreements that the Kingdom has ascribed to and after securing a license to that effect from the Competent Agency.

e- A person may engage in any work which involves ionizing radiation only after securing a license to that effect from the Competent Agency.

f- Any practice which involves exposure to radiation may proceed only in the presence of a radioactive protection officer or a qualified expert. Prior to the end of service of the radioactive protection officer or the qualified expert,

another protection officer or qualified expert licensed by the Competent Agency must be appointed to replace the former.

g- Any practice which involves exposure to radiation may proceed only under the direct supervision of the protection officer at the same location where these works are performed and while they are being carried out.

h- Salary hikes, payment of special allowances, working for fewer hours, or increasing the duration of leaves shall not be treated as substitutes for the precautions and procedures which would guarantee adequate standards of protection and safety. [?].

i- A person may engage in practices or activities which involve exposure to radiation only after having received adequate training on such activity and after acquiring knowledge of the methods and standards of protection against radiation and methods of safe operations.

j- Each worker shall be required to regard safety and protection as essential components that complement the occupational safety and health program and shall assume all designated responsibilities for protecting himself and the others.

Article 13: Licensing requirements

a- A facility, represented by its it or manager, which has plans to implement any of the practices set forth in the Basic Commitment (article 7 of the General Regulation for Protection against Radiation) and which involve utilization of a radioactive source shall file, prior to proceeding with the practice or acquisition of the radioactive source, an application to the Competent Agency for obtaining a license for the practice, source or radioactive sources.

b- Any person who intends to work with ionizing radiations shall file an application to the Competent Agency for a license to perform such work.

c- Any person or facility which has filed an application for a license to the Competent Agency shall proceed with such practice or activity only after securing a written license by the Competent Agency.

d- A license shall be issued for the facility or legal person covering certain and specific practices and radioactive sources or devices. The licensee shall not engage in any activities or practices other than those covered by the license nor shall the licensee use any radioactive sources that are different than or whose quantity or radioactivity are in excess of those covered by the license.

e- The license Applications shall be filed on the forms designated for the license applications prepared by the Competent Agency for issuance of a specific term license.
f- At the time of granting the license, the Competent Agency reserves the right to impose additional conditions. Such conditions shall be regarded as integral parts that supplement and complement the license issued by the Competent Agency.

Article 14: stages of licensing

For certain facilities and practices, such as nuclear facilities, X-ray machines, nuclear accelerators, radioactive waste management facilities and any other facilities designated by the Competent Agency, the Competent Agency shall issue the licenses in phases and as per specific practices for each phase. A practice which belongs to a later phase may not be implemented once a license has been secured for a previous phase. These phases shall be as follows:

a- The application for the facility or practice license shall be filed to the Competent Agency, enclosing the corroborative and supporting documents, such as the site plan, engineering and construction plans, the full and accurate technical specifications of the instruments, equipment and the radioactive sources that the facility intends to use. The Competent Agency will issue the license approving the site and commencement of constructions after satisfaction of the requirements of this phase.
b- Filing of the application for importation or fabrication of the radioactive sources in accordance with the procedures set forth by the Competent Agency and issuance of the related permit by the Competent Agency.
c- During the final stage of the construction activities, the facility proponent shall file an application for a license to install the instrument and equipment. The Competent Agency will issue a license to commence installation after satisfaction of the requirements and verification that the constructions are indeed consistent with the plans submitted. The Competent Agency reserves the right to inspect the construction works in progress to ensure compliance with the technical and engineering specifications of the facility.
d- During the final stages of equipment installation, the facility proponent shall file an application for a license to commence commissioning tests. The Competent Agency shall issue the required license after satisfaction of the requirements related to this phase and shall set forth the conditions to be followed when such tests are initiated.

e- Upon completion of the commissioning tests, the facility proponent shall file an application for a license for the routine operation of the facility. The Competent Agency shall issue the required license after satisfaction of the requirements related to this phase.

f- In the event of a requirement to stop or terminate the operation of the facility or to modify the practice or the radioactive sources, the facility proponent shall file an application for a license for such termination, suspension or modification. The Competent Agency shall issue the required license after satisfaction of the related requirements and shall set forth the additional requirements that the facility proponent shall be required to comply with at the time of operation suspension or termination or completion of the modification.

Article 15: Maximum duration for responding to the license application

The Competent Agency shall respond to the license application, perform the necessary inspection to ensure satisfaction of the requirements and issue its decision within thirty days as of the date of receipt of the complete application and required documents. In the event of any shortage in the required statement or documents, the period shall be calculated from the date of receipt of the last document or statement. Such period shall be sixty days for the accelerators and six months for the nuclear facilities. If the Competent Agency issues a decision rejecting the required license, it shall spell out the reasons for such rejection in writing.

Article 16: Renewal of the license

The licensee shall apply to the Competent Agency for renewal of the license of the licensed practice or sources as follows:

a- The application must be filed least three months ahead of the expiration date of the current license.

b- Such application for renewal must be filed at least three months prior to introducing any changes or modifications in the licensed practice or any changes in the methods of engaging in such practices or otherwise introducing any changes in the types, quantities or specifications of the radioactive sources or any modifications of the installation and its ancillary facilities.

Article 17: license to possess radioactive source(s)

a- After securing the approval of the practice or during the final stages of the construction process, the licensee shall submit an application to the Competent Agency for authorization to possess the radioactive source(s) using the forms approved by the Competent Agency.
b- The license to possess the sealed and non sealed radioactive sources shall be renewed annually by the licensee as long as the license remains valid.

Article 18: Termination of possession of radioactive sources

A person who has been issued a license to possess radioactive sources shall dispose of, transfer the possession of or otherwise loan such radioactive sources to another person only as per the written authorization of the Competent Agency and in accordance with the conditions mandated by the Competent Agency.

Article 19: Revocation or suspension of the license:

The Competent Agency reserves the right to cancel the license granted to any facility or person or otherwise suspended for a specific period of time in the following cases:

a- If the licensee does not comply with any of the conditions set forth in the basic commitment (article 12) of these instructions.
b- If the license has been granted based on presenting incorrect information or forged documents to the Competent Agency.
c- If the licensee commits violations or breaches which compromise the protection and safety requirements.
d- If the licensee is no longer qualified for any reason whatsoever to benefit from the license granted.

Article 20: Notification:

With respect to the licenses which are issued in one stage, the licensee shall notify the Competent Agency of the date of the commencement of the practice prior to commencement of implementation.

Article 21: Inspection:

a- The Competent Agency shall perform periodical or surprise inspection of all radioactive practices, sources and operators for verification of compliance with all instructions related to protection and safety.
b- The licensee shall enable the Competent Agency or its authorized representatives to have access for inspection and taking photographs of all radioactive practices, sources and all documents on the protection and safety. The facility shall also allow inspection of the buildings, practices and sources under its responsibility which may be directly or indirectly affected by the practice.
c- Any obstruction, stonewalling or delaying of the work of the Competent Agency's inspectors shall entail immediate revocation of the license, coupled with seizure and safe storage of all radioactive sources at the expense of the licensee, in addition to any other penalties as may be provided for in the Kingdom's Ionizing Radiation Protection Law and its Implementing Rules.
d- The Competent Agency shall be committed to preserving the confidentiality of the data, information and records it has access to or photocopied and shall use such data, information and records only for no purpose other than protection against radiation.

Technical demands for protection against radiation

Article 22: The facility's radiation protection program:

The licensee shall be required to draw up an integrated program for the protection against radiation in the facility which program shall be one of the licensing prerequisites. The program shall provide for the following:

a- Formulation of the facility's policy and procedures for protection against radiation and definition of the responsibilities and authorities of the parties involved.
b- Selection, appointment and training of the specialist experts, such as the radiation protection officers and radioactive source handlers and provision of the qualified expertise in the area of protection and safety.
c- Establishment of an effective system for monitoring workers' exposure to radiation.
d- Establishment of an effective system for monitoring public and the environment exposure to radiation.
e- Formulation of an integrated quality assurance program, embodying the establishment of quality control mechanisms and methods for review and

assessment of the efficacy of the protection and safety and protection systems and selection of tried and proven mechanisms for assuring the quality of radioactive exposure measurement.

f- Drawing up of a contingency plan for responding to radioactive mishaps in the facility.

Article 23: Technical supplies:

The licensee shall make available the technical supplies required to achieve the articles of the radiation protection program.

Article 24:

a- The records are official documents on the safety and protection against radiation. Such records shall be in the form of a damage proof ledger and its pages shall be arranged in order, numbered and stamped with the official seal in such a manner as to frustrate modifications, deletions or additions. The record data shall be entered on a timely basis by the radiation protection officer or the qualified expert and endorsed by the licensee at close intervals.

b- The principal parties, such as the licensee, the qualified expert, the radiation protection officer, the medical practitioner and the health expert, shall keep general records on their own respective responsibilities and the responsibilities borne by the other parties, in addition to all of the records set forth in these instructions as well as in chapter 13. The licensee may establish any extra records other than those provided for in these instructions.

c- The licensee shall retain all detailed records for a minimum period of fifteen years and the summary records for a minimum period of thirty years. Records on occupational or medical exposure shall be retained for at least thirty years or until the worker or the patient attains the age of seventy, which ever is greater of the two periods, except where the Competent Agency determines otherwise.

d- The Competent Agency reserves the right to have access to all protection and safety records as well as the right to photograph and have copies thereof. The worker shall also have access to his personal files, to the exclusion of other files [?], and have copies thereof when he leaves the work. The medical practitioner and the health specialist shall have access to the personnel records solely for the purpose of medical follow-up.

Article 25: Practice manuals and directories:

The licensee shall prepare, document and adhere to all practice methods that the facility is licensed to engage in. The licensee shall also draw up the instructions, directives and guidelines related to the protection against radiation in the facility as well as guidelines for the overall protection of the public, visitors and patients in normal and emergency operation scenarios. Such manuals shall be distributed to the workers whose work may have an impact on or otherwise by impacted by the protection issues.

Article 26: Selection and qualification of the workers:

a- Selection and qualification of the suitable work force commensurate with the volume of radioactive practices and sources shall be the responsibility of the facility's licensee, represented by its manager or president.
b- The licensee shall not employ qualified experts or radiation protection officers who have not obtained the appropriate personal permit of the Competent Agency. The Competent Agency shall issue a license for each expert qualified in specific field(s). The Competent Agency shall also issue a license to the radiation protection officer after verification of his credentials.
c- No person shall be allowed to engage in a practice which may entail exposure to radiation prior to verification of his medical fitness for such work and prior to receiving adequate training on the fundamentals of protection against radiation and rules of safe operation of radioactive equipment, sources and ancillary supplies. The Competent Agency shall issue a license for the worker after verification of his training.
d- In the absence of the licensed radiation protection officer for any reason whatsoever, continuation of the licensed practice shall be allowed only if a qualified substitute or a suitable qualified expert has been provided on a full time basis to discharge the duties of the protection officer.
e- The licensee shall be required to refresh the training of the radiation protection officers and the radiation or radiation source workers periodically as determined by the Competent Agency in order to upgrade their qualification on the aspects related to protection against radiation and safe handling of radioactive sources.

Article 27: Educating the workers on radioactive risks:

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Prior to engaging in any work, the licensee shall inform each worker who handles a radioactive source and each worker whose activity may have an impact on or otherwise be impacted by such source of the ionizing radiation hazards and the risks involved in the failure to obey the instructions and the precautions that the worker is required to take to avoid such hazards under normal and abnormal operations.

Chapter III
Basic and technical requirements for protection against radiation

Article 28: Basic principles:

The protection and safety system for any radioactive practice or source is based on three key principles, namely:

a- Justification of the practice
b- Modeling of protection
c- The limits that must not be exceeded

Article 29: The justification:

a- None of the practices provided for in the basic commitment shall be engaged in unless such practice yields a benefit to all persons exposed to radiation or the community as a whole which justifies the potential radioactive damage that may be associated with such practice.
b- At the time of justification of the practice, all possible immediate and subsequent damages must be taken into account. Such assessment must

provide for the expected radioactive damages of all direct and potential radioactive exposures and the other costs of the practice.

c- The practices whose implementation would result in hiking the volume of the radioactive substance (through addition or activation) in the commodities or products are considered among unjustified practices. Such practices would include the following:

1- The practices which involve fabrication, production, importation or sales of foodstuffs, drinks or other products intended for ingestion, inhalation or penetration of the skin or use by humans in general.
2- The practices which involve utilization of radioactive substances in the products or commodities, such as toys, ornaments, decorations and cosmetics.

Article 30: Modeling of protection:

A model of the protection procedures shall be made for each radioactive source used as part of any practice. This shall mean keeping the values of personal exposure doses, the number of exposed persons, and exposure potential at the lowest level achievable, while taking economic and social factors into consideration.

Article 31: The limits:

Enforcement of the normal exposure limits for occupational works and the public at large as provided for in chapter V and VII of these instructions. Such exposure limits shall not apply to medical exposures. The dose levels for medical exposures provided in chapter VI of these instructions shall be used for guidance.

Article 32: Compliance:

a- The licensee shall comply with the modeling procedures for the protection and safety of any source used in any practice by establishing restrictions on the doses and the hazards.
b- The restrictions to be imposed on the doses are as follows:
    1- The limits shall be derived from the instructions set forth in schedule 2 so that the equivalent doses may be kept within the allowable limits.
    2- The values established by the Competent Agency for any radioactive source must not be exceeded nor any other values

that may lead to exceeding the limits of the effective or equivalent doses.

3- With respect to the sources which may emit radioactive substances into the environment (including the radioactive waster management facilities) and to which persons far from the source site or future generations may be exposed to, restrictions must be imposed on the effective dose for any individual of the public (including persons far away from the site and future generations) for each year of operation so that the annual average of this dose for any critical group shall not exceed the value provided for in paragraph b.2 of this article, taking into consideration the cumulative emissions and potential exposures resulting from any other radioactive practice or source.

c- The values of discharges and emissions into the environment shall be restricted in accordance with the guidelines and limitations of the hazards set forth in paragraph b.3 of this article.

Management requirements

Article 33: The safety culture:

The safety culture shall be fortified through the following actions:

a- Formulation of policies and procedures that bestow on protection and safety issues absolute priority for inculcation in the minds and souls of all workers at all levels. The commitment to protection and safety must receive the same degree of attention allotted to production.

b- Speedy identification and treatment of the problems affecting safety and protection in a manner commensurate with their significance.

c- Facilitation of communications and flow of information between and among all levels.

d- Encouragement of benevolent rooting to protection and safety among the workers and taking remissness to task and accountability in a balance manner.

Article 34: The human factors:

a- The licensee shall take all precautions to minimize as much as possible human error contribution to accidents and to provide devices for detection and correction of such errors.

b- The license shall be required to ensure:
   1. Training of all the workers on whom protection and safety relies to the extent required to enable them to grasp their responsibilities and carry out their duties.
   2. Complying with sound principles when establishing operational steps to facilitate the operation and utilization of the equipment, minimize potential operating errors which may result in accidents and reduce misunderstanding of equipment dials and indicators under normal and abnormal operating conditions.

c- The licensee shall be required to take the necessary precautions and provide the appropriate protection and safety equipment and other requirements to satisfy the following:

   1. Minimize as much as practically possible the potential of human errors which may lead to unintended exposure of any person or that may contribute to accidents.
   2. Provide devices for detection and overriding of human errors.
   3. Facilitate intervention when the protection and safety systems fail.

Article 35: The qualified experts:

The licensee shall identify and retain the required licensed and qualified experts to provide consultation and assistance in the formulation of the facility's protection program and monitoring the execution of the instructions in the cases which require the presence of such expertise as may be dictated by the practice.

Technical requirements

Article 36: Safety of the sources:

The licensee shall secure the radioactive sources against theft and damage and shall prevent any unauthorized person from performing any of the practices listed under the basic obligation. The licensee shall also take periodic inventory of the radioactive sources, particularly the mobile ones, at appropriate intervals and refrain from transferring the possession of any radioactive source without the advance written approval of the Competent Agency.

Article 37: Defense in depth:

The defense in depth strategy shall be applied through a multilayer system of technical and operational procedures for the radioactive sources to allow for the correction of the failure of any of these levels by the following level and to compensate for potential human errors as well as equipment and instrument failure. The key safety components shall also be evaluated at the time of the design, commissioning and operation to prevent accidents, mitigate their consequences if they do occur and resuming control of the source.

Article 38: Good engineering practices:

The source for any practice shall be designed, its site selected, commissioned, operated, maintained, its wastes managed and disposed of on tried and proven engineering fundamentals and in accordance with approved criteria and standards. The licensee shall make allowance for adequate redundant safety margins to ensure reliable operation under normal circumstances and responsiveness to development capabilities in the technical standards.

Article 39: Quality assurance and calibration:

The licensee shall be required to apply a quality assurance system that would provide total faith in the satisfaction of all safety and protection demands protocols. Such program shall include the physical quantities of the sources inputs in the practice and periodical testing of the equipment and performance data. All instruments, sources and equipment in use shall be calibrated in accordance with the Competent Agency- approved time intervals.

Article 40: Assessment of safety:

a- Appropriate mechanisms and operational regulatory methodologies shall be established for the purpose of auditing and appraising the efficiencies of the safety and safety systems of the radioactive sources and practices. The appraisals related to the safety and safety shall be compatible with the nature of the source and the magnitude of hazards associated with it in all phases, coupled with the need to simulate of normal and potential exposure circumstances which may occur and if the source is subjected to any modification, development or maintenance, the safety system shall be reevaluated.

b- The licensee shall submit the safety assessment to the Competent Agency upon applying for a license, modification or renewal.

Article 41: Monitoring and protection of the environment:

a- The licensee shall engage in the practice in a way that would not lead to the creation of circumstances that are harmful to the environment or to pollution of the natural resources.
b- The quantities needed to ensure compliance with the requirements of these instructions shall be monitored and gauged and the licensee shall be required to provide the appropriate equipment for this purpose.

Chapter IV
The responsibilities

Article 42: General responsibilities of all parties

a- Identification of safety and prevention objectives in line wit the imperatives of these instructions.
b- Formulation and enforcement of safety and protection programs which are consistent with the volume of the licensed practices.
c- Identification of the procedures required for achievement of the safety and protection objectives and ensuring availability of the necessary resources.
d- Ongoing review of the procedures for verification that objectives are being met.
e- Identification of deficiencies and vulnerabilities in the protection and safety procedures and take appropriate remedial actions to avoid recurrence.
f- Boosting synergies between all parties concerned with protection and safety.
g- Keeping records on the responsibilities borne by each party.

TRANSLATION

Article 43: Responsibilities of the Competent Agency for Protection against Radiation:

a- Suggest laws and regulations relative to protection and safety.
b- Formulate the practice rules and manuals and the instructions related to protection and safety.
c- Evaluate the applications of the practices listed under the basic commitment.
d- Issue licenses for the radioactive practices and sources and formulation of related conditions and requirements.
e- Revoke or suspend the licenses granted in the event of the licensee's failure to comply with the Law, these instructions or related rules.
f- Issue personal licenses to all persons engaged in the radiation field.
g- Perform periodical or surprise inspections of radioactive practices and sources.
h- Identify, in concert with the concerned agencies, of the national dose limits for radioactive exposure and pollution with the various radioactive substances and concentrations of radionuclides in products.
i- Review and evaluate the safety and protection reports filed by the licensee and suggest remedial actions.
j- Approve the contents of curricula and qualifying courses.
k- Perform the environmental radiation surveillance.
l- Approval of the operational limits established by the licensee.
m- Approval of the contingency plan drawn up by the licensee to respond to radioactive and nuclear accidents.
n- Approve and monitor the facility's radioactive waste management programs.
o- Suggest the national radioactive and nuclear emergency plans and participation in their implementation.

Article 44: Responsibilities of the licensee (facility management)

a- Protect personnel, patients, the public at large and the environment from radioactive exposures which exceed the approved exposure limits.
b- Comply with the national protection and safety instructions.
c- Appoint one (or more) radiation protection officer to implement the technical and scientific aspects of the protection and safety and monitor compliance with all related regulations.
d- Employ one qualified protection and safety expert (or more) to provide consultation on the scientific and technological aspects, supervision and

direction of the radiation protection officer where required by the practice as well as the scientific aspect related to diagnosis and treatment. The licensee shall authorize the protection officer or the qualified expert to carry out specific duties and supervise specific aspects in the field of his specialty. However, the licensee shall remain responsible before the Competent Agency for compliance with all regulations on the protection and safety. The licensee shall also be required to communicate to the Competent Agency the names of its qualified experts and radiation protection officers and shall refrain from employing a qualified expert or a protection officer who does not have the pertinent personal license of the Competent Agency.

e- Formulate and identify the rules of a protection and safety policy in accordance with the standards set forth in these instructions.

f- Identify the objectives of safety and protection, allocate the related responsibilities and authorities within the facility, establish incentives and penalties and prioritize the procedures.

g- Provide the required trained human forces in suitable numbers and the appropriate academic credentials commensurate with the magnitude of the radioactive practices and sources.

h- Provide the appropriate protection and safety technical equipment and supplies in adequate quantities commensurate with the potential exposure to occupational radioactive exposure or exposure to the public and the environment.

i- Establish and apply written practice manuals (in-house rules) for the protection and safety of the workers, the public and the environment, taking guidance from the national practice guides.

j- Establish operational limits for the equipment and radioactive sources which must not exceed those approved by the Competent Agency and set limits for occupational exposure as well as exposure by the patients, the public at large and the environment in accordance with the dictates of these instructions.

k- Provide the services related to protection and safety, such as measurement of the personal exposure doses of the workers in accordance with the Competent Agency’s requirements and make available the medical and health services that are commensurate with the magnitude of the potential hazards.

l- Train the workers on the use of the practice or source equipment under normal or emergency conditions and periodically retrain and refresh the training on the protection and safety devices.

m- Keep records in accordance with the requirements of these instructions.

n- Establish appropriate quality assurance programs.

o- Provide the occupational and non occupational workers with adequate information on the radiation hazards which they may be exposed to under both normal and abnormal conditions.
p- Set up and faithfully implement programs for the evaluation of the facility's protection and safety and periodically inspect in a manner consistent with the magnitude of the potential hazards.
q- Draw up contingency plans for responding to accidents within the facility and have such plans approved by the Competent Agency.
r- Comply with the limits of radioactive emissions, identify their propagation routes, take the necessary measures to ensure that such limits are not exceeded, implement the environmental radiation surveillance and provide the required technical and human capabilities where such resources are needed.
s- Draw up a comprehensive plan for the management of radioactive waste management within the facility and have such plan approved by the Competent Agency.
t- Provide the Competent Agency and the designer (producer) with the experiences acquired on the operation and maintenance of the equipment and radioactive sources for the purpose of improving the protection and safety aspects.

Article 45: Responsibilities of the designer:

a- Design containment systems for the radioactive substances or sources based on scientific and technical parameters and standards which satisfy the quality and sound performance specifications.
b- Apply the defense in depth strategy wherever required.
c- Minimize generation and accumulation of radioactive wastes.
d- Minimize the prospects of the leakage of any radioactive substance from a sealed source under normal and emergency operation conditions.
e- Facilitate inspection and testing process of the modules which may have an impact on the protection and safety of the sources and practices.
f- Facilitate the friendly use of the source or equipment and minimize error potential during operation.

Article 46: Responsibilities of the supplier:

a- Ensure that the licensee has secured a permit to import, export or acquire the radioactive source(s).

b- Provide radioactive sources or equipment that have been designed and produced on solid technical and scientific parameters which satisfy the quality ratings.
c- Verify that the required equipment or source tests which confirm compliance with the required specifications have indeed been performed.
d- Make available all data and information related to the equipment. Such data and information must include all issues related to installation, utilization, maintenance and hazards.
e- Provide the licensee with any information on the required operation and maintenance experiences.
f- Ensure that all persons participating in the transfer or delivery of the equipment or source have received the related protection and safety information and that all protection imperatives are consistently enforced in all phases.

Article 47: Responsibilities of the qualified expert:

a- Supervise all of the licensee's issues related to equipment and source protection and safety in accordance with the national codes.
b- Directly oversee all protection and safety assessment s in accordance with the national codes.
c- Supervise all radioactive surveillance, gauging, personal exposure assessment and quality assurance processes.
d- Assume the full responsibilities of the radiation protection officer in his absence and supervise the latter's activities if he is present.

Article 48: Responsibilities of the radiation protection officer:

a- Draw up the overall framework of the protection and safety and related program in the facility and supervise implementation thereof within the facility.
b- Supervise observance of and adherence to the protection and safety rules, regulations and standards during the utilization of radioactive sources and the equipment which contains them.
c- Perform in due course of time the periodic testing and calibration of the gauging meters and sources as per the requirements of these instructions.
d- Submit to the licensee and the Competent Agency routine security and safety assessment reports.

e- Supervise and document data on all records as per the requirements of these instructions, have them endorsed by the manager of the facility and follow up on delivery to the Competent Agency.
f- Replace or supervise the replacement of the radioactive sources.
g- Follow up on the environment surveillance process and monitor personal exposure doses.
h- Make arrangements for protection and safety training programs for the handlers of radioactive sources and hold lectures and meetings related to protection and safety.
i- Report to the licensee and the Competent Agency any breaches of the safety and protection rules and regulations; maintain good rapport and ongoing communication channels with the licensee, the qualified expert and the Competent Agency.
j- Draw up and route guidelines to the workers and exchange opinion with them on the best methods for achieving the required standards of protection and safety.
k- Alert the professional workers who have approached or otherwise exceeded the allowable exposure limits, identify the causes and take all necessary actions, including medical follow-up and notification of the Competent Agency.

Article 49: Responsibilities of the worker:

a- Comply with the applicable occupational radiation protection rules and the work execution process designated for him by the licensee.
b- Cooperate with the licensee and the radiation protection officer to the extent required for responding to the requirements of these instructions.
c- Refrain from any action that my place him or those working with him in a position where the requirements of these standards may be violated.
d- Utilize all instruments and equipment in a sound and safe manner.
e- Provide the licensee with a history of previous radioactive exposure and personal medical information.

Chapter V
Occupational exposure

Article 51: Occupational exposure:

Occupational exposure is the exposure to ionizing radiation that the worker may suffer in or on account of his work as a result of situations approved by the Competent Agency [?]. Such exposure shall be under the control of the licensee.

Article 51: Limits of occupational exposure dose:

The licensee shall be required to refrain from exceeding the following limits of occupational exposure:

a- A medium effective dose of 20 milliseverts annually. This dose may be increased in one year to 50 milliseverts on the condition that the effective dose of an individual during any five successive years shall not exceed 100 milliseverts.
b- An equivalent dose for the eye lens of 150 milliseverts per year.
c- An equivalent dose for the extremities (arms and legs) or the skin of 500 milliseverts per year.
d- The exposure limit for a pregnant woman shall be 2 milliseverts for the duration of the pregnancy if the exposure is external or 1 millisevert if internal.

Article 52: The minimum age for occupational exposure and occupational exposure limits:

a- A person who is less than sixteen years old shall not be allowed to engage in any activity that may involve occupational exposure nor shall a person who is less than eighteen years old be allowed to work in a controlled area unless under direct supervision and for training purposes only.
b- Occupational exposure of trainees ranging between 16 and 18 years whose training calls for utilization of radioactive sources shall not exceed the following limits:

1- An effective dose of 6 millisevert per year.
2- An equivalent dose for the eye lens of 50 millisevert per year.
3- An equivalent dose for the extremities or the skin of 150 millisevert per year.

Article 53: Compensatory arrangement:

Special compensatory arrangements or preferential treatment in terms of salary, special insurance coverage, fewer working hours or length of vacation shall neither be granted nor used as substitutes for the appropriate precautions and procedures which do ensure adequate standards of protection and safety.

Article 54: Classification or workplaces:

The licensee shall be required to classify workplaces in terms of occupational exposure to controlled areas and supervised areas:

Article 55: Requirements related to controlled areas:

a- The area shall be surrounded by retaining walls or barrier devices where the source is being used on a continuous basis. In the areas where the source is used intermittently or where the source is relocated from one place to the next, the controlled area must be delineated and surrounded by appropriate barriers, coupled with the limitation of the duration of exposure periods.
b- The Competent Agency-approved warning signs and any other suitable instructions shall be conspicuously posted at the potential access points to and in suitable locations within the controlled areas.
c- Satisfaction of all occupational protection and safety procedures suitable for the controlled area.
d- Restriction of access to the area by means of administrative procedures such as access and work permits and installation of locks. The degree of rigorous restriction must be compatible with the nature of the potential hazards.
e- Provision of protective clothing and equipment, the appropriate restriction devices at all entrances to the area as well as provision of storage devices for the clothes and equipment.
f- Provision of the following requirements at all exits from the controlled areas which contain unsealed radioactive substances:

1- Skin and clothing pollution monitors.
2- Pollution monitors for any equipment, machine or instrument being relocated outside the area.
3- Washing and showering facilities.
4- Suitable storage for the contaminated protective clothing and equipment.
5- Suitable locker room for personal clothing.

Article 56: Requirements related to supervised areas:

a- Enclosing the area with a suitable barrier device.
b- The Competent Agency-approved warning signs shall be conspicuously posted at the potential access points to the area.
c- Periodical review of the conditions within the area to determine the extent of need for more rigorous protection and safety procedures or to modify the boundaries of the controlled area.

Article 57: Local rules and supervision:

The licensee shall be required to:

a- Establish in a written format the local rules, methods and steps required to ensure a protection level commensurate with the protection and safety standards for the workers and the public.
b- Incorporate in the local rules, methods and steps all values related to operational restrictions and the values of referenced and authorized standards, and the steps to be taken if these values are exceeded.
c- Circulate the local protection and safety rules and protection to all workers to whom such rules apply and the persons who may be affected by them.
d- Ensure that any work which involves exposure to radiation is done under proper supervision and that all suitable steps have been taken to ensure control over all protection and safety rules and procedures.

Article 58: Information and training:

The licensee shall be required to:

a- Provide female workers who are authorized to access controlled or supervised areas with information on the hazards to fetuses when a pregnant woman is exposed to radiation, the importance of having a pregnant woman inform the licensee or the work physician once she expects to be pregnant, the hazards of radioactive sources to nursing babies through polluted breast milk or contaminated milk from a mother with internal contamination. As a general rule, a pregnant woman shall not be allowed to work in a controlled area once a pregnancy is discovered.
b- Make available suitable information, instructions and training for all workers who may be affected by the activation of the contingency plan.
c- Keep and maintain records on personnel training in radiation.
d- Provide adequate information and instructions to visitors to ensure limitation of their exposure and the others who may be affected by the actions of those visitors.

Article 59: Personal protective equipment:

a- The licensee shall be required to:
    1- Provide the workers with the necessary and adequate personal protective equipment, such as protective clothing, breathing apparatus, aprons, gloves and human organ shields.
    2- Ensure that all workers have been provided with the proper instructions on the method of use of such equipment, including testing of the extent of suitability for each individual.

3- Ensure that the functions which require the use of personal protective equipment are assigned to workers who are capable of standing the extra effort based on authenticated medical reports.
4- Maintain all personal protective equipment in good condition and testing their usability at regular intervals.
5- Stock extra personal protective equipment suitable for use in radiation contingency cases.

b- The licensee shall be required to minimize the need for reliance on personal protective equipment during normal operation by providing the appropriate work circumstances and the proper engineering specifications.

Article 60: Individual monitoring and assessment of exposure:

a- The licensee shall be held liable for making arrangements for and performing the radiation personal monitoring of the workers, assessment of external and internal doses and keeping records on such doses.
b- The licensee shall make the necessary arrangements to ensure the quality of the measurements related to the workers' individual radiation exposure monitoring.
c- The individual radiation exposure monitoring shall be performed for the worker who works on a permanent or temporary basis in a controlled area using the methods approved by the Competent Agency.
d- The occupational exposure may be assessed for any worker who works on a temporary or regular basis in a supervised area or who occasionally accesses a controlled area by using the results of workplace radiation monitoring instead of individual monitoring.
e- The nature and frequency of radiation monitoring in workplaces shall be commensurate with the exposure values in those places as well as with the potential variations in the radiation levels.
f- The licensee shall identify the workers who are susceptible to internal contamination and shall provide suitable surveillance conducive to effective protection and correct assessment of the internal exposure doses.

Article 61: Monitoring of workplaces:

a- The licensee shall establish, implement and maintain the continuity of a workplace radiation monitoring program which must meet the following conditions:
1- Assessment of doses in controlled and supervised areas.
2- Assessment of radiation conditions in the work environment.

3- Review of the classification of the workplaces.

b- The nature of the monitoring program shall be based on the radiation conditions and the expected levels of contamination and fluctuations, on the proviso that the following factors be taken into account:
   1- Type of measurements such as the rates of the various radiation doses, surface contamination with radionuclides, potential fluctuations, and the concentration of radioactive radionuclides in the air.
   2- The methods of measurement used and the person in charge of performing them.
   3- Reference levels and actions to be taken if they are exceeded.
   4- The timing the measurements are taken and review of the monitoring results.

c- The licensee shall maintain records of the findings of workplace radiation monitoring.

Article 62: Health surveillance:

The licensee shall institute and have in place a workers' health surveillance program. Such program shall be based on the general principles and parameters of occupational health and whose functions shall provide for assessment of the workers' fitness for the intended functions either at the onset of employment or routinely while on the job.

Article 63: Personal dose records:

a- The licensee shall keep a personal dose record for each worker who is subject to the requirement of dose assessment in accordance with the dictates of these instructions and as shown in chapter XIII.

b- The licensee shall be required to:
   1- Allow the worker to have access in person to the data contained in his/her personal dose record.
   2- Allow the opportunity to the physician in charge of health surveillance as well as the Competent Agency to have access to the worker's dose record.
   3- Provide the facility to which a worker is transferred with a copy of the worker's personal dose record.
   4- Make the necessary arrangements for appropriate keeping either by the licensee or the Competent Agency of the worker's personal dose record when the worker terminates his/her activities which involve exposure to radiations or radioactive substances.

c- The personal dose records shall be preserved during the worker's working life and afterwards at least the worker attains the age of seventy, and for not less than thirty years after termination of the work involving occupational exposure, whichever occurs on a later date.

Chapter VI
Medical exposure

Article 64: Definition of medical exposure:

This shall mean medical exposure to ionizing radiation that the patient may suffer as part of the medical diagnostic or therapeutic process. The medical exposure of the persons who provide assistance and comfort to the patient on their own free will while being cognizant in advance of the hazards will be called for the purposes of these instructions voluntary exposure. Exposure of physicians or technicians shall not be deemed medical exposure, but rather occupational exposure.

Article 65: Responsibilities in medical exposure:

The licensee shall be held fully liable for the protection and safety of medical exposure and voluntary exposure in the practices which fall under the licensee's administrative domain and shall be required to ensure the following:

a- No patient shall be administered a diagnostic or therapeutic medical exposure unless the exposure is prescribed by an approved medical practitioner.
b- Radiation diagnostic or therapeutic functions shall be undertaken only under the supervision of an expert who is specialized in radio diagnosis physics, nuclear medicine physics or radio therapy physics according to the case where radiations or radioactive substances are used for diagnosis or treatment.
c- Calibration, dosimetry or any of the quality assurance activities shall be conducted only under the supervision of a qualified expert in radiotherapy physics in all cases where ionizing radiations are used for therapeutic purposes.

Article 66: Justifications of medical exposures:

a- All medical exposures should be subject to justification by weighing the diagnostic or therapeutic benefits they produce against the calculated radiation detriment they might cause, taking into account the benefits and risks of available alternative techniques that do not involve medical exposure to radiation.
b- In justifying each type of diagnostic examination by radiography, fluoroscopy or nuclear medicine, relevant guidelines will be taken into account, such as those established by the WHO in appendix 3.
c- Mass exposure for medical research purposes shall not be justifiable unless it is subject to the national codes and unless the ages of the individuals are over eighteen years.
d- There is no justification for radiological examination for theft detection purposes and should they nonetheless be conducted they shall not be considered medical exposure but shall rather be subject to the requirements related to mass exposure.

Article 67: Optimization in medical exposures:

Operational considerations:

a- the licensee shall make sure that all medical exposures for diagnostic purposes shall satisfy the following requirements:

1- Ensure that the exposure of patients be kept at the minimum necessary to achieve the required diagnostic objective.

2- Take into account relevant information from previous examinations in order to avoid unnecessary additional examinations;
3- The medical practitioner must be content with the acceptable results of the imagery quality to avoid repetition.
4- Where diagnostic radiology is involved, definitive and accurate selection of the area to be examined, the number and size of views per examination, type of image receptor, use of anti scatter grids in case of need, selection of optimal operating criteria (current, voltage, and the duration of tube operation), appropriate image storage techniques in dynamic imaging (number of images per second), adequate image processing factors (e.g. developer temperature and other factors). The net result of these options is to minimize the doses of the patient's exposure that would yield acceptable quality of the image and serve the examination purposes.
5- Pay special attention to the selection of the criteria listed in above paragraph 4 where pediatric examinations are involved.
6- Use portable and mobile radiological equipment only for examinations where it is impractical or not medically acceptable to transfer patients to a stationary radiological installation and only after proper attention has been given to the radiation protection measures required in for the use of such portable equipment.
7- Where nuclear medicine is involved, the medical practitioner, the technologist or other imaging staff should select the type of pharmaceuticals, the relevant radioactivity, method of image processing and methods of acceleration of the patient's biological evacuation processes so that the selection of the option sets would ensure minimum patient exposure to the radioactive substance which would produce an acceptable quality of the image.
8- Avoid radio therapy or use, unless necessary, of radionuclides which may expose the abdomen or pelvis of woman who is pregnant or likely to be pregnant unless there are strong clinical reasons for such examinations. any diagnostic examination of the abdomen or pelvis of women of reproductive capacity must be planned to deliver not more than the minimum dose to any embryo or fetus that might be present
9- Whenever feasible, shield radiosensitive organs such as the gonads, breast and thyroid gland as appropriate.

b- The licensee shall be required to ensure that the medical exposures for therapeutic purposes do meet the following requirements:

1- Reduce exposure of intact tissues during radio therapy to the possible minimum consistent with delivering the required dose to the planning target volume.
2- Avoid radio therapy or use, unless necessary, of radionuclides which may expose the abdomen or pelvis of woman who is pregnant or likely to be pregnant unless there are strong clinical reasons for such examinations. Any diagnostic examination of the abdomen or pelvis of women of reproductive capacity must be planned to deliver not more than the minimum dose to any embryo or fetus that might be present.
3- Whenever feasible, shield radiosensitive organs such as the gonads, breast and thyroid gland as appropriate.

Article 68: Restrictions and guidance levels:

a- The dose and intake limits shall not apply to medical exposures.
b- The guidance levels set forth in schedules 3.2 through 3.5 shall be used as guidance for medical practitioners. The guidance levels or the rate of the dose or volume of radioactivity to be administered to the patient and which are not provided for in these schedules shall be determined in consultation with the Competent Agency in such a way that the use of guidance levels would optimize the protection of the patient and prevent undue exposure.
c- The volume of the radiopharmaceuticals administered to the patient for diagnostic purposes shall be deemed within the limits of proper medical practices if they do not exceed the guidance limits set forth in schedule 3 for the most common nuclear medicine applications.
d- Excedence of the guidance levels may be acceptable only if based on a strong medical justification and only if the dose or the radioactivity administered to the patient and which do not exceed the guidance levels does not provide useful diagnostic information. In such cases, the medical practitioner who ordered the excedence of the reference guidance levels shall be summoned to appear before a professional ethical review committee to be formed by the Competent Agency for verification of the excedence causes and justifications.
e- The licensee shall constrain any dose to individuals incurred knowingly while voluntarily helping in the care, support or comfort of a patient who is undergoing medical diagnosis or treatment.
f- The effective dose of an adult helping in the care, support or comfort of a patient under medical diagnosis or treatment or visitors to a patient who has received therapeutic amounts of radionuclides or who is being treated with

brachytherapy sources, shall not exceed the reference levels specified in Schedule 4.

g- The dose restrictions shall be applicable to any person who is present in the building where the patient who has undergone treatment with sealed or unsealed radionuclides. Such patients shall not be allowed to mingle with the others before the activity of radioactive substances in the body falls below the values specified in Schedule 4.

Article 69: Training:

All individuals participating in the medical exposure practices, including physicians, physicists, engineers, technicians, nursing staff and the other participating individuals shall receive Competent Agency-approved training on the protection and safety aspects related to the functions of each, in addition to another training course on the safe operation of the equipment used in these practices. Such training shall be refreshed and updated at reasonable intervals on an as needed basis and the training shall be subject to the Competent Agency's approval.

Article 70: Considerations related to medical exposure practices:

a- The licensee shall be required to ensure that:
   1- The medical practitioners are committed to provide the patient with adequate protection and safety when medical exposure is prescribed or being administered.
   2- The medical workers and their aides are being provided and made available as needed. Such workers may either be health professionals or must have received adequate training for properly discharging the functions assigned to them when engaged in the therapeutic or diagnostic procedures prescribed by the medical practitioner.
   3- The requirements related to calibration, dosimetry and quality assurance are drawn up by or otherwise under the supervision of a qualified expert in radiotherapy physics when radiation is used for therapeutic purposes, including brachytherapy or external radiation.

b- The medical exposure quality assurance programs shall meet the following parameters.

1- The measurements related to the physical indicator values of the radiation generators and radiology equipment at the time of commissioning and thereafter periodically.
2- Verification of the proper physical and clinical factors used for therapeutic and diagnostic purposes.
3- Keeping of records on the related procedures and findings.
4- Verification of proper calibration and the operational conditions of the dosimetry and monitoring equipment.

Protection requirements for individual exposure

Article 71: Calibration:

A licensee who is authorized to engage in therapeutic or diagnostic practices using radiation or radionuclides shall observe the following requirements:

a- The calibration of radioactive sources used for medical exposure be traceable to a Standards dosimetry laboratory.
b- Calibration of radiotherapy equipment in terms of the quality of the radiation beam or energy or in terms of the absorbed dose or absorbed dose rate at a predefined distance.
c- Calibration of sealed sources used in brachytherapy in terms of the radioactivity of the medical preparation to be administered to the patient (in a specific milieu).
d- Calibration of the unsealed sources used in nuclear medicine procedures in terms of the radioactivity of the medical preparation to be administered to the patient.

Article 72: control of diagnostic exposure:

The licensee shall ensure that the patient's diagnostic medical exposures are kept at the minimum that would achieve reasonable results and the required diagnostic evidence if the exposures are in excess of the guidance level of doses set forth in schedule No.3.

Article 73: Discharge of the patient from hospital:

A patient who has been subjected to diagnostic procedures with radioactive substances shall be allowed to leave the hospital only after the radioactivity of the substances in his/her body drops to the levels set forth in schedule No.4.1.

Article 74: Optimization in nuclear medicine:

The licensee engaged in nuclear medicine shall be required to verify the following:

a- the physicians who prescribe or perform diagnostic applications with radionuclides:

   a. Ensure that the exposure of patients be kept at the minimum necessary to achieve the required diagnostic objective.
   b. Take into account relevant information from previous examinations in order to avoid unnecessary additional examinations.
   c. Observe the guidance levels relevant to medical exposure.

b- The technologists performing diagnostic radiology do seek to reduce the patient's exposure to the minimum consistent with the acceptable quality of the imagery.

c- Avoid utilization of radionuclides in the diagnostic and therapeutic procedures for women who are pregnant or expected to be pregnant in the absence of strong clinical reasons.

d- Instruct nursing mothers who are undergoing radioactive diagnostic or therapeutic procedures to suspend nursing their infants until the effect of the radioactive preparation drops below the effective dose limits for nursing infants.

Protection requirements applicable to therapeutic exposure

Article 75: Optimization in radiation therapy:

A licensee who is licensed to engage in the practice of radiation therapy shall ensure the following:

a- Maintain the intact tissue during radiotherapy at the acceptable minimum level that would ensure delivery of the required dose to the targeted organ and use protection shields to protect all intact organs and issues as much as possible.

b- Avoid therapeutic radioactive procedures which may expose the abdomen or pelvis of woman who is pregnant or likely to be pregnant unless there are strong clinical reasons.

Article 76: conditions applicable to pregnancy and radiotherapy:

Where a woman who is pregnant or likely to be pregnant is concerned, the licensee shall ensure that the following pretreatment precautions are applied:

a- Avoid the use of radionuclides for therapeutic purposes and procedures in the absence of compelling clinical reasons.
b- Devise a plan for each therapeutic procedure before proceeding with it so that the fetus may be exposed only to the minimum possible dose.
c- Inform the pregnant woman with the potential risks before initiating the treatment.

Article 77: Basic procedure in the event of medical exposure as a result of radiation accident:

The licensee shall immediately conduct an investigation of any radiation accident to assess the doses and their distribution deposited in the patient's body, clarify the necessary remedial actions to avoid recurrence of such accidents, carry out all remedial arrangements falling within the licensee's scope of responsibility and provide the Competent Agency with a written report indicating the causes of the accident and embodying information on the doses deposited and the remedial actions taken.

Chapter VII

Mass exposure

Article 78: Definition of mass exposure:

This shall mean any exposure suffered by any individual of the public to radioactive sources other than occupational exposure. Mass exposure shall cover all other exposures to controlled sources which can be minimized by intervention but not exposure of the public to regular levels of natural radiation background.

Article 79: Responsibilities:

a- The licensee shall be held fully responsible for protecting the public who may be exposed to radiation or radionuclides as a result of its licensed activities. Such responsibility shall cover all matters related to future generations or contamination of the environment.
b- The licensee shall specifically ensure the following:
    1- Draw up the policies and arrangements that would ensure compliance with the requirements and standards related to mass exposure of the public.
    2- Formulate the precautions, contingency plans and radioactive surveillance arrangements that are appropriate for the nature and magnitude of the radiation hazards in the event of an accident.
    3- Keep adequate records as set forth in these instructions.
c- The licensee shall be required to:
    1- Provide the visitors with adequate information and instructions to ensure restricting their exposure and that of the others who may be affected by the actions of these visitors.
    2- Provide escorts for the visitors when they enter any of the controlled or supervised areas. Such visitors shall be selected from among the persons who are familiar with the protection and safety rules and procedures in these areas.

Article 80: Limits of mass exposure dose:

a- The limit of the annual effective dose for the public shall be 1 millisevert/year. This dose may, however, exceed in any given year 1 millisevert on the condition that the effective dose during any five successive years shall not exceed 5 milliseverts.
b- The annual limit of the equivalent dose for the eye lens shall be 15 milliseverts /year.
c- The annual limit of the equivalent dose for the skin shall be 50 milliseverts/ year.
e- The annual limit of intake for the public represents one part of twenty parts of the annual limit of intake for occupational workers.

Article 81: Requirements related to protection of the environment and the public:

Any license to engage in a radioactive practice or source shall incorporate, over and above the instructions mentioned herein above, the following elements:

a- The radioactive impacts of the radioactive practice or source(s) on the environment.
b- Definition of the critical group of the public that are affected by the source or practice.
c- Review of the engineering and environmental factors.

Article 82: Discharge of radioactive substances and environmental surveillance:

a- Any discharge or disposal of radioactive substances into the environment shall be subject to the requirements defined by the Competent Agency and the requirements related to that license.
b- The licensee shall be required to select the optimal status for monitoring the discharge of radioactive substances into the environment based on the licensee's practice and on the sources used in that particular practice, together with the application of the restrictions on the effective dose defined by the Competent Agency which must be taken into considerations as follows:
    1- The need to provide for a large margin for the individual dose limits. Such margin should accommodate contribution by the other radioactive sources discharged into the environment, both globally and regionally, together with a reserve margin to accommodate future practices unknown at the present time as well as the changes in local conditions and human customs.
    2- Achievement of acceptable levels of discharges so that the discharge rates or quantities may not exceed the restrictions imposed in schedule No.5.
c- In the pre commissioning stage and for optimization purposes, the licensee shall be required to observe the following:
    1- Identify the pathways of significant exposures through which the radionuclides may reach humans.
    2- Identify the values of transmission factors, and if such values cannot possibly be identified, the licensee shall define with extreme caution the values to be used so that such exposures are closer to validity with no minimization of the assessment.
    3- Use the monetary value of unit collective dose required by the Competent Agency.
    4- Submit to the Competent Agency the radioactive waste discharge assessment preparatory to obtaining a license.

d- In the operation stage, the licensee shall be required to observe the following:
   1- Monitor the production, formation, gathering, collection, treatment, discharge, transportation and storage of the radioactive wastes and that such discharge is maintained at the lowest reasonable level and not in excess of the limits authorized by the Competent Agency.
   2- Monitor the discharge of radionuclides with an adequate degree of accuracy to ensure that the authorized limits have not been exceeded and to assess the dose resulting therefrom in critical human groups.
   3- Record and document the surveillance findings and the dose values resulting therefrom.
   4- Submit to the Competent Agency a report on the surveillance findings at regular intervals as approved by the Competent Agency.
   5- Immediately report to the Competent Agency any excedence of the authorized limits of exposure.
   6- Monitor any possible changes in the characteristics of the environment or behavior of the residents, particularly changes in the radioactive consequences of the discharge, and take such changes into consideration if necessary.

Article 83: Monitoring of exposure to natural radioactive sources:

a- All construction activities and the materials used therein shall be subject to monitoring so that the concentration of radioactive sources in them should not exceed the reference levels identified by the Competent Agency.

b- Suitable building technologies and adequate ventilation shall be used in the areas affected by high natural radioactivity and which the Competent Agency subjects to monitoring in terms of mass exposure to radon in accordance with the specific requirements identified by the Competent Agency.

c- The agencies concerned with control of consumer products shall ensure that the radioactivity levels in these products do not exceed the limits set by the Competent Agency.

Article 84: Monitoring of the environment:

The licensee shall be required to:

a- Set up and reinforce an adequate environmental monitoring program to verify the validity of the models in use on the condition that the proposed conditions for arriving at the discharge limits be realistic circumstances.
b- Provide the required devices and capabilities for local environment monitoring for any radioactive contamination that may result form discharge of unusually substantive quantities of radioactive substances or as a result of an accident.
c- Keep appropriate records on the monitoring results and the estimated dose values for critical groups.
d- Submit to the Competent Agency a summary report on the monitoring results at regular intervals as may be directed by the Competent Agency.
e- Immediately report to the Competent Agency any increase in the environmental contamination limits set by the Competent Agency, whether such increase is resulting from discharge by the licensed or any other facility.
f- Verify the validity of the previous assumptions for the assessment of the radioactive consequences of the radioactive substance discharge, especially during the initial years.

Article 85: Protecting consumer products against contamination:

If and when imported consumer products are concerned, the Competent Agency reserves the right to demand the importer to furnish a formal certificate endorsed by the watchdog Competent Agency in the country of origin, confirming that the amount of radioactive contamination in the pertinent product is below the allowable limits in the Kingdom of Saudi Arabia. The Competent Agency also reserves the right to perform the necessary radiological analyses to determine the levels of contamination in such products and to take the appropriate actions.

Chapter VIII
Safety of radioactive sources

Article 86: Responsibilities related to the safety of the sources

The licensee shall assume full responsibility for the safety of the radioactive sources it is licensed to use and shall be required to guarantee the safety of such sources as well as of the facility where such sources are located. The licensee shall apply all requirements relative to the safety and security of the sources, establish

the required parameters at which the various intervention procedures must be initiated and shall appoint, appropriately train and retrain at suitable intervals the necessary intervention teams.

Article 87: Location of the facility:

The licensee shall be required to:

a- Assess the safety of any site proposed for the establishment of a nuclear installation, a radioactive waste management facility, an irradiation facility or an outfit which uses radioactive source, taking into consideration the characteristics of the location which may have an impact on the safety of the sources, such as flash floods, earth tremors, earthquakes, other natural disasters, weather factors, and the abilities of the proposed site to counteract these factors.
b- Assess the viability of the protective procedures outside the location and the countermeasures related to the impacts of emissions in case of accidents.

Article 88: location of the source:

When selecting a location for any source, the licensee shall take the following into account:

a- The factors with potential impact on the safety of the sources.
b- The factors with potential impact on the workers' exposure, internally and externally, such as wall shielding, ventilation and remoteness from populated and occupied zones.

Article 89: Design requirements:

a- The protection and safety systems and components, especially systems and components of irradiation facilities, nuclear installation, and the components located in radioactive waste management and other facilities which use large sources shall be so designed as to respond to all of the requirements set forth in these instructions.
b- The design of irradiation facilities, nuclear installations and radioactive waster management facilities shall incorporate the safety characteristics that must satisfy the defense in depth strategy criteria with the ultimate objective of laying to rest the probability of potential exposures, taking the following into account:

1- Provision of shutdown devices for radiation emissions or control of radioactive releases from the source, coupled with the [proper] design of locks to minimize exposure or emissions if such devices fail.
2- Availability of alternatives and diversification of safety characteristics. Such alternative devices must be independent of each other and failure of any of them should not result in the failure of any other.

Article 90: Requirements related to safety assessment:

a- The licensee shall be required to assess the safety of the radioactive sources licensed for use and such assessment shall embody thoughtful audit of the following parameters:
   1- Nature, probabilities and extent of potential exposures.
   2- The operating technical limits and conditions for the source.
   3- Methods and devices through which the operation of the systems, equipment, various components or the safety and protection procedures can be overridden for a single or a collection of causes and identification of all possible consequences of the failure.
   4- The operating methods and devices related to safety which may compromise the protection system and analysis of the consequences of the faults in these methods and devices.
   5- The safety and protection criteria of the proposed changes to be introduced in any of the systems that are subject to this assessment.

b- Upon performing the probability assessment of the consequences that may result from a full fledged accident, the licensee shall take the following into account:
   1- The design and operation considerations intended to reduce the probabilities of bad consequences of the accident.
   2- Establish priorities for enhancement of safety parameters.
   3- Select the critical and important components of the equipment for high reliability.

c- The safety assessment shall be properly documented and reviewed by qualified experts. Additional reviews and audits shall be performed to ensure ongoing fulfillment of the operating requirements and technical conditions. Such audits shall be performed in the following cases:

1- If any essential changes are made in the source or the related operating or maintenance methods and steps.
2- If the operating experiment or accidents involving similar sources reveal that the current assessment is inaccurate or invalid.
3- Periodically, on the proviso that any changes in the protection and safety fundamentals or changes in the criteria and guidelines be taken into consideration.

Article 91: Maintenance, testing and inspection:

The licensee shall ensure performance of the following:

a- Carry out all types of maintenance, testing and servicing on an as needed basis to ensure that the source still fulfills the design safety and protection requirements for the duration of its use.
b- Carry out the maintenance and testing procedures in accordance with documented methods, amplified by the quality assurance requirements.

Article 92: Responsibility and accountability for sources:

The licensee shall be held fully responsible and accountable for the radioactive sources it is licensed to use. The licensee shall set up a source inventory system for maintaining records on all radioactive sources in accordance with these instructions.

Article 93: Monitoring of the sources:

a- The licensee shall be responsible for performing the radiation surveillance and verification of the values required for responding to the protection and safety requirements. To realize the objectives of the surveillance and respond to its requirements, the licensee shall:
    1- Provide and use suitable monitoring equipment.
    2- Properly and periodically maintain, test and calibrate the monitoring equipment using for reference recognized standardization factors.
b- The licensee shall carefully keep the records and findings of the surveillance, testing and calibration for the duration designated in these instructions.

Article 94: Investigation and follow up on accidents and mishaps:

a- The licensees shall conduct careful investigation and examination of any volume of radiation related to protection and safety, including the dose, radioactivity and other operational values which exceed the approved levels and shall in particular be required to follow up on the following:
   1- Any values detected beyond the normal operation conditions.
   2- Any equipment defect, error or abnormal event, indicating the reasons for excedence of the appropriate level or the operational restrictions, failure or error.
   3- Any other situations designated by the Competent Agency where investigation and follow up are required.

b- The investigation and follow up procedures shall be initiated as quickly as possible after the accident directly.

c- A written report shall be generated on the causes of the accident, coupled with verification of any radioactive exposures, definition of the value of the doses that humans may have been exposed to and proposing recommendations for prevention of recurrence of the same or similar accidents.

d- A summary report shall be submitted on any safety investigations or examinations to the Competent Agency on an expedited basis. Such report shall indicate the exposures which exceed the designated limits.

Chapter IX
Radioactive contamination

Article 95: Radioactive contamination:

a- radioactive contamination refers to the presence of a radioactive substance in or on the surface of another substance or in the human body or in or on

the surface of any place and where such substance is of a radioactive nature and its presence is not desirable or may cause damages.

b- In terms of the method of response, radioactive contamination is divided into:

1- Internal or external personal contamination.
2- Contamination of all kinds of equipment and instruments
3- Tropical contamination, such as the surfaces of counters, walls, floors and roads.
4- Contamination of substances, such as the soil, air, water. Plants…etc.

c- Surface radioactive contamination is divided into established and unestablished [?] contamination. The unestablished type is the contamination which can be removed from the surface during normal handling processes and which is transferred from surface to surface on contact. The established radioactive contamination is any contamination other than the unestablished contamination.

d- Volumetric radioactive contamination means the presence of a radioactive substance inside the volumetric unit of another substance. Examples include the derived air concentration (DAC).

Article 96: Limits of contamination:

a- Where beta, gamma and low toxicity alpha emissions are concerned, the limit of surface radioactive contamination shall be any concentration above 0.4 Becquerel/cm ^{3} (about 10^{-5} / cm^3).

b- For all other alpha emissions, the limit of surface radioactive contamination shall be any concentration above 0.04 Becquerel/cm ^{3} (about 10^{-5} / cm^3).

c- The unestablished surface contamination with highly toxic radioactive substances on the various surfaces and bodies shall not exceed the limits provided in schedule 6.1 of appendix No.6. As for the substances of the lower toxicity in the third and fourth degree groups, appendix No. 7, these limits may be increased to 10 folds the values set forth in schedule 6.1 of appendix No. 6. Also, the limits for established contamination may be increased by another ten folds.

d- The derived air concentration (DAC) for any individual radionuclide I at the workplace shall not exceed the value calculated in formula No.2.1 in appendix No.2.

e- In the presence of multiple radionuclides in the atmospheric air, the concentration of each radionuclide in the air C shall not exceed the value calculated in accordance with formula 2.2 in appendix No.2.
f- In the event of internal and external exposure, the concentration of any radionuclide in the air shall not exceed the value calculated in accordance with formula 2.3 in appendix No.2.

Article 97: Requirements related to radioactive contamination:

A licensee who is licensed to use unsealed radioactive substances shall be required to:

a- Provide the human expertise capable of detecting radioactive contamination and gauging of contaminated radionuclides contamination levels in all types of media.
b- Provide the necessary instruments and equipment required for detection and measurement of contamination in accordance with the requirements of these instructions.
c- Provide the necessary devices required for the protection of the workers, including gloves, breathing apparatus, and purpose clothing and shoes.
d- Provide the contamination monitoring devices at the locations where unsealed radioactive substances are handled in accordance with the license requirements.
e- Provide in the vicinity of the workplace the necessary locations and supplies for decontamination of persons and equipment and provide such areas with washing, cleaning and decontamination devices and materials.
f- Provide radioactive monitoring at the various inlets and outlets or the workplace where unsealed radioactive substances are handled.
g- Use appropriate ventilation systems at the locations where open radioactive substances are used and handled to prevent migration of the contaminated air to other locations.
h- Keep the required records for documenting all cases or accidents of contamination by licensed substances.

Article 98: Decontamination:

a- the licensee shall ensure the following:
    1- Prevent intake of radionuclides into the human body.
    2- Contain contamination and prevent spreading into larger areas.
    3- Minimize external exposure resulting from contamination.

b- A licensee who is authorized to use unsealed radioactive substances shall be required to draw up a detailed decontamination plan which responds to the following requirements:
   1- Method of control of the accesses leading to the contamination location and definition of the proportions and magnitude of the contamination.
   2- The instruments, materials and devices used in the decontamination.
   3- Sequential order of the steps of decontamination.
   4- Method of isolation of contaminated personnel, equipment and locations and method of collection of resultant wastes.
   5- Method of decontamination of persons, equipment and locations.
   6- Method of contamination measurement and termination of the contamination processes.

Chapter X
Transfer of radioactive sources

Article 99: Definition:

The term transfer as used in these instructions shall include all operations and actions related to the movement of any radioactive substance whose radioactivity is in excess of 70 kilobecquerels, be it inside or outside the device. This shall also cover the processes of the enclosure design, fabrication, maintenance, preparation, forwarding, handling, loading, storage in transit and acceptance of parcels at final destinations. The term shall cover normal and emergency conditions as well as local transportation processes within the city or intercity. Where international transfer is involved, the international transfer standards of the International Atomic Energy Agency shall apply besides the national radioactive substance transfer instructions, subject to advance approvals.

Article 100: Transportation license:

a- No agency or individual may engage in the transportation of radioactive substances unless licensed by the Competent Agency to transfer such substances. It should be noted that engaging in any of the processes set forth in the basic commitment other than transportation shall not mean a blanket license to transport radioactive substances and any license for transportation of specific kinds of radioactive quantities in specific quantities shall not be construed as a license to transport other kinds or larger quantities of the radioactive substances.

b- Prior to shipping any parcel containing a radioactive substance that requires the approval of the Competent Agency, the consigner shall ensure that all approvals required for such transfer have been secured from the competent agency in each country where the consignment is being transported within its boundaries and that the necessary clearance has been secured from the receiving country. Such licenses and authorizations shall be obtained prior to proceeding with the shipment.

Article 101: Insulation of radioactive substances in transit:

A radioactive substance shall be adequately insulated from the transportation workers, the public, hazardous materials and other substances which may be affected by it. For calculation of the insulation distances or the dose rates in populated areas on a regular basis in transit, the limit dose values set forth in article 102 shall be applied.

Article 102: Limits on transportation:

a- Where transportation workers are involved, the limit of the dose used for calculation of the insulation distance shall be 5 milliseverts per year.
b- For the public, the limit of the dose used for calculation of the insulation distance shall be 1 millisevert per year.
c- For sensitive films, the limit of the dose in transit shall not exceed 0.1 millisevert.

Article 103: Radioactive and nuclear accidents in transit:

The licensee shall provide, in strict compliance with the conditions set forth in these instructions, each vehicle used in the transportation of a radioactive substance with a contingency plan for responding to any accident in transit.

Article 104: Transportation responsibilities:

Besides the licensee, the consignor shall be responsible for the protection and safety aspects during the transfer process, for satisfaction of all requirements related to the delivery of the parcels and formulation of the appropriate emergency plan for the operation to be undertaken. The consignor must be cognizant of both the international and national rules and organizations for the transfer of radioactive substances, must provide the carrier with the contingency plan and instructions, be prepared to extend assistance in responding to emergencies if an accident occurs in transit, make available all relevant information and data on the consignment, be familiar on method of responding to the accident and dispatch a well-equipped crew to respond to the accident if needed.

Article 105: transportation documents:

The licensee shall see to it that the consignor has enclosed all documents and information required in the national instructions for safe transfer of radioactive substances as well as copies of a shipping documents and parcel design. All stickers, marks and warning signs shall be affixed in accordance with the national and international regulations on safe transfer of radioactive substances.

Article 106: Procedures related to transportation accidents:

The carrier shall be held responsible for acquainting itself with and rigorous enforcement of all regulations and rules relative to the safe transportation of radioactive substances it is handling and shall ensure the following:

a- Speedy recognition and awareness by the parties in charge of the transportation of the proportions of the accident and prompt action to respond thereto.
b- Availability of emergency instructions in the truck.
c- Education of the parties in charge of the transfer on the procedures to be taken in case of an accident.

Article 107: Inspection of parcels by Customs:

a- All customs processes, including inspection of the radioactive contents of parcels shall be carried out in locations equipped with adequate devices for exclusive monitoring of radioactive exposure and that such procedures be undertaken in the presence of persons qualified in the protection and safety issues. Any parcel that needs to be opened in response to Custom's instructions shall be restored to its original condition prior to delivery to the consignee.
b- Any radioactive substance consignment which has not been delivered to the consignee shall be kept in custody in a secure place and the incident shall be reported to the Competent Agency as soon as possible for directions on the actions to be taken with respect thereto.

Chapter XI
Storage of radioactive substances

Article 108: Requirements for storage of radioactive substances:

a- For protection and safety purposes, a radioactive substance or source which is not being used in its designated place shall be temporarily or permanently stored and isolated from the locations where workers are engaged or areas frequented by the public, pending disposal or reuse thereof.. Temporary, permanent and transit radioactive storage magazines in customs departments shall be subject to the national instructions on radiation protection and transportation rules.

b- Parcels containing radioactive substances shall be insulated during permanent, temporary and transit storage in customs departments from:
   1- Areas occupied by workers or frequented by the public.
   2- Other hazardous substances, chemicals, equipment under high pressure and photography films.

c- Suitable scanners shall be used to verify the presence of radioactive sources within their enclosures or shields during the processes of delivery, acceptance or inventory of the sources.

d- Radioactive storage clerks who have not received Competent Agency-recognized training shall not be employed in such posts.

e- Access to the magazine shall be allowed only for persons who have been trained on the radiation protection and handling issues and who may have such access to the magazines only in the presence of the radiation protection officer.

Article 109: Conditions related to the magazine:

The radioactive substance storage magazine shall be designed and its location selected to fulfill in every respect the safety and protection parameters, particularly the following:

a- Remoteness from the various threats, such as fires, contamination, floods, areas populated by workers or the public as well as the areas which may be impacted or have an impact on the ambient environment. The location must also meet the security requirements of the magazine.

b- Provision of more than one barrier in or around the magazine in satisfaction of the requirements of the defense in depth strategy.

c- Utilization of building materials, paints, floors and ceilings that are fire, water and acid proof and which provide for easy radioactive decontamination.
d- Provision of suitable fire sensing and fighting equipment in the vicinity.
e- Utilization of engineering dimensions and wall, ceiling and flooring thicknesses that would meet safety and protection parameters in the areas surrounding the magazine. Such areas shall be extended the same treatment accorded to areas frequented by the public and as long as they can be accessed or approached by the workers and the public.
f- The floors and inclinations shall be so designed and made as to prevent water leakage from the outside to the inside and to prevent transfer of radioactive contamination from the inside to the outside.
g- Provision of suitable ventilation systems, especially in the magazines where volatile radioactive materials are stored. Ventilation exhausts shall be located far from or at least two meters higher than the other buildings for proper dispersal of the substances and avoidance of impact on humans. It is advisable to use filters to filter the air before it is released into the environment.
h- The contents of the magazines shall be made of fire and corrosion resistant materials that are easy to decontaminate.

Article 110: Conditions on keeping radioactive sources in magazines:

a- The magazine shall be kept in an organized and orderly fashion to facilitate access to the required radioactive source or substance within the shortest possible period of time. Such magazine shall satisfy the safety and protection standards when populated, coupled with compliance with the limits of radiation exposure, taking all routes of access and exit in consideration.
b- Radioactive substances and sources shall be kept in the magazine within their own enclosures and shields. All information tags affixed on each source shall be clear and provide full information and data.
c- If a large number of radioactive sources or substances are stored in the same magazine from category “yellow II” to “yellow III”, the transportation index [?] for any group of radioactive sources or parcels (at the time of storage in transit) shall not exceed 50. If the transportation index exceeds this value, the source groups shall be segregated from each other and the separator distance between one group and the next neighboring group in any direction shall not be less than six meters.

d- A radioactive source whose transportation index is 50 or more shall be stored at least six meters away from any other source in any direction.

Article 111: Protection and warning devices during storage:

The licensee shall equip the magazine with the following:

a- Devices for measuring the dose rate and surface radioactive contamination for al radioactive sources stored in the magazine.
b- Devices for handling and loading the radioactive sources existing in the magazine.
c- All warning signs and signals alerting to the presence of radiations and radioactive substances. Such signs shall be so installed as to be visible and conspicuous to everybody outside the magazine.

Article 112: storage records:

Records shall be kept for the magazine contents of radioactive sources, showing the information related to the sources, their quantities, serial numbers, physical condition, and where stored within the magazine. The records shall also track the traffic of the radioactive source from and to the magazine and the name of the persons authorized to deliver and take delivery of these sources. The contents of the magazine shall be periodically inventoried and verified to check that the sources are inside their enclosures and shields using suitable radioactive scanners.

Chapter XII
Radioactive waste management

Article 113: Radioactive wastes:

Radioactive wastes are solid, liquid or gaseous substances or bodies which contain quantities of one specific or a number of radionuclides, including the following:

a- Unsealed radioactive substances residual after use in all fields and purposes.
b- Sealed radioactive substances whose use has been discontinued for any reason.
c- Bodies contaminated by radioactive substances, such as syringes, filtration paper, gloves, empty containers from which the radioactive substance has been used, radioactive decontamination residues, cleaning fluids and others.
d- Guinea pigs into whose bodies quantities of radioactive substances have been introduced, and the urine and excrement of persons who have been injected with radioactive substances or through oral intake.

Article 114: Responsibilities related to radioactive wastes:

a- Radioactive wastes shall be gathered, collected, treated, transported or disposed of only if the pertinent license has been secured from the Competent Agency, nor shall such substances be handled in a method or quantities that differ from the method or quantities approved by the Competent Agency.
b- The licensee shall assume all responsibilities related to the radioactive wastes generated by the licensed practices and by the radioactive sources in the licensee's possession. The licensee shall draw up and comply with a plan for the management of the radioactive wastes produced by its practices and the sources it is licensed to use, which plan must be approved by the Competent Agency.
c- The licensee shall employ a person who is adequately qualified technically to operate as radioactive waste management official. The facility's radiation protection officer may assume the role of the radioactive waste management official subject to the Competent Agency's approval.
d- The licensee shall be required to reinforce all of the rules and regulations related to the radioactive waste management issued by the Competent Agency.

e- The licensee shall draw up and comply with written rules and procedures for the collection, classification, treatment, transfer, storage and disposal of the radioactive wastes.
f- The licensee shall provide all measuring tools for gauging the concentrations of the various radionuclides in all wastes to be disposed of, as well as the human resources capable of performing such measurements with the required degree of accuracy to ensure that such disposal or discharges do not exceed the approved rates.

Article 115: Records and documents of the radioactive waste management:

The licensee shall keep records and documents on the waste management, providing for the following:

a- All radionuclides being handled by the licensee.
b- Used quantities and useable inventory.
c- Quantity of all kinds and forms of wastes in storage, indicating the date of the beginning and end of the storage period of the substances as wastes.
d- The wastes which have been disposed of, indicating the method and timing of disposal.
e- Results of radioactive measurements performed on the wastes prior to discharge or disposal thereof.

Article 116: Optimization of the radioactive waste management process:

The licensee shall reduce the quantity of generated radioactive wastes by its practices and operations to the minimum through proper and restricted utilization of the radioactive substances and in accordance with justified and proven methods and approaches. The licensee shall submit to the Competent Agency an annual report on the quantities and kinds of radioactive wastes which have been discharged, treated or disposed of.

Article 117: internal waste management system:

The licensee shall set up a system for the classification, collection, temporary storage, discharge, and disposal of the radioactive wastes or otherwise re-exporting such wastes to the source or delivery to the agency in charge of the radioactive waste management. The licensee shall provide the appropriate enclosures for the collection, transfer and temporary storage as well as all other

requirements for the insulation and shielding of these vessels for strict compliance with the various exposure limits.

Article 118: Classification of the radioactive wastes:

a- Radioactive wastes shall be classified based on a number of factors, such as the physical condition of the substances, half life and concentration of the radionuclides in addition to other sets of classifications such as amenability to flaring, compression, water solubility and other considerations.

b- Radioactive wastes shall be classified based on their physical conditions, solid, liquid and gaseous.

c- Radioactive wastes classification shall be based on the concentration of radionuclide contents into low, medium and high level radioactivity.

d- Radioactive wastes shall be classified on the basis of the half life of the radionuclides in short, medium and long half life.

e- Radioactive wastes shall be classified in terms of treatment into water soluble and insoluble, flarable or nonflarable, compressible or non compressible, in addition to other classification factors which will be addressed in detail in the instructions detailing the radioactive waste management.

Article 119: Solid wastes:

a- The different solid wastes shall be classified based on their radionuclides' half life, chemical properties and toxicity. Each group with similar properties shall be lumped together. In the classification and grouping process the following distinctions shall be observed:
   1- Flarable and nonflarable wastes.
   2- Compressible and non compressible wastes.
   3- Sealed radioactive sources and other kinds of wastes.

b- Each type of wastes shall be collected in its designated container vessel which shall be painted on the outside in yellow and appropriately marked with the radioactive symbol as well as all relevant data on the contents of the vessel. The vessels shall be stored in their designated areas pending disposal thereof using any of the methods suitable for the degree of hazardousness. The disposal may be in any of the following forms:
   1- Re-export to the producer.
   2- Delivery to the national agency concerned with the radioactive waste management.

3- Incineration, preservation of the incineration residues for delivery to the competent national agency or disposal thereof after attenuation of their radioactivity to the levels designated by the Competent Agency.
4- Disposal thereof in the public wastes after attenuation of their radioactivity to the levels designated by the Competent Agency.

Article 120: Liquid wastes:

a- The licensee's liquid wastes shall be classified on the bases of the radionuclide's half life and radioactivity. Chemically, the liquid wastes are classified into aqueous, organic, acidic, alkaline or neutralized. Acidic wastes shall be collected and separated from the other kinds of wastes. The collection vessels shall be impervious to the kind of their liquid contents. For this purpose, sealed cubitainers of polyethylene of suitable properties may be used. As for aquatic or equivalent wastes, vessels made of plastic or glass may be used. However, if glass vessels are used, they must be encased in an external shatter proof container.
b- When stored for lengthy periods of time for attenuation of the radioactivity, liquids may be stored in tanks which are impervious to the substance stored in them. Storage shall be sustained for a period of time adequate for the attenuation of the radioactivity as may be designated by the Competent Agency pending disposal thereof in any of the approved methods of disposal.
c- Only water soluble wastes may be disposed in the public sewage system on the proviso that the weekly discharge rate of the radioactivity shall not exceed the limits set forth in schedule No.5. The urine and excrement of patients who have received diagnostic or therapeutic radionuclides may likewise be discharged within the same rates.
d- It shall be prohibited to discharge water insoluble radioactive wastes into the public sewage system. Such wastes shall be filtered prior to discharge in the public system. Similarly acidic wastes shall be neutralized and the residues filtered prior to discharge. The sewage pipelines shall be flushed with adequate quantities of water and solvents after discharge.
e- It shall be prohibited to discharge water insoluble organic radioactive wastes into the public system. Approval of the competent local agency in charge of sanitary drainage shall be secured for discharge of liquids containing toxins or chemicals which are harmful to the system or the environment.

TRANSLATION

Article 121: Gaseous wastes:

Radioactive gases are released by the practices where such gases are used into atmospheric air and their concentrations may be so high as to constitute radiation hazards to the workers at the site and the public. Adequate care should be taken to avoid the emission of such gases into the environment by complying with the following guidelines:

a- Provide adequate ventilation in the rooms and locations where gaseous or volatile radioactive substances are in use and refrain from recycling any air from these locations into the other rooms in the building or other neighboring buildings.
b- Gases from the rooms or locations where gaseous substances are in use shall be released through chimneys that are at least two meters higher than the roof of any building in the vicinity.
c- The exhaust outlet of the stack shall be paced at a good distance from any window or entrance.
d- It is imperative to assess the exposures resulting from radioactive gaseous intakes in the critical group around the location of the stack and the annual effective dose for any person must not exceed the national limit for the public at large.

Article 122: **Documentation of radioactive waste data:**

All data and information related to the radioactive wastes shall be recorded during collection in the wastes record and the data sheets affixed on the vessel. Such information shall provide for the following:

1- Date of commencement of collection in the vessel and the date on which the vessel is full.
2- Name of the waste generator.
3- Components of the wastes.
4- Content of radionuclides.
5- Rate of dose on the external surface of the vessel.
6- Certification by the radiation protection officer that the external surface is free of radiation contamination.
7- The veracity of the information must be authenticated by the licensee.

Article 123: Transportation and storage of radioactive wastes:

a- The transfer of radioactive wastes shall be subject to the same criteria and requirements of the safe transportation of radioactive substances.
b- Radioactive wastes, whether awaiting attenuation of radioactivity or disposal thereof, shall be stored in accordance with the methods of storage of radioactive substances in magazines which satisfy the same requirements for the storage of radioactive substances.

Chapter XIII
Records

Article 124: Obligations related to records:

a- Each of the principal stakeholders, such as the licensee, the qualified expert, the protection officer, the medical practitioner and the occupational health professional, shall keep general records for their respective responsibilities. Also, the principal parties shall establish the records required for all radioactive sources and practices as may be required under these instructions.
b- Such records shall be regarded as official documents to be consulted on an as needed basis. The pages of the log shall be numbered so as to preclude alterations, additions and deletions. The record data shall be entered by the protection officer or the qualified expert on a timely basis and approved by the licensee at close intervals.
c- All detailed records shall be retained for a period of not less than ten years, while summary records shall be kept at least 30 years. Records on occupational and medical exposures shall be retained for not less than thirty years or else until the worker or patient attains the age of 75 (whichever occurs later), except where the Competent Agency determines otherwise.
d- The Competent Agency shall have the right to access and have copies of all of the records set forth in these instructions. Similarly, the worker shall have the right to access solely his own records or else have copies (or summary copies) thereof when he leaves the work, so shall the medical practitioner and the health professional have access to the workers' records for medical and health follow up purposes.

Article 125: Types of records:

The licensee shall be required to keep the following records:
a- Records on the practices.

b- Records on the radioactive equipment or sealed sources.
c- Records on unsealed sources.
d- Records on the workers' individual doses.
e- Records on the workers' medical fitness.
f- Records on medical exposures.
g- Records on personnel training.
h- Records on the radioactive scanning of the workplaces.
i- Records on the monitoring activities of the workplaces.
j- Records on the radioactive wastes.
k- Records on the equipment calibration and testing.
l- Records on the equipment and instrument repairs and maintenance.
m- Any other records as may be designated by the Competent Agency.

Article 126: Practice records:

a- The licensee shall set up a record which embodies all of the practices it is engaged in, indicating briefly the method of execution of these practices, the radioactive sources and the instruments used in their execution.
b- All parties concerned shall be required to operate in accordance with the methods and practices set forth in that register.

Article 127: Record on the equipment which emits radiation and sealed sources:

This record shall be dedicated to the documentation of all data, practices and movements of the equipment or the sealed sources. The record shall basically provide for the following:

a- Name, type, serial number and point of origin of the equipment or source and the maximum radioactivity value on the date of commissioning or maximum current and voltage.
b- The technical specification and external appearance of the equipment or source.
c- Method and location (s) of utilization and storage.
d- Date of delivery, commencement of operation and results of operation tests.
e- Name of the handlers and users of the equipment or source, and of the persons in charge of storage.
f- Statement on the custody of the equipment or source movement, method and means of relocation and the names of the persons in charge of each movement of the equipment.

g- Statement arranged chronologically on the failures occurring in the equipment, method of repairs, the names of the persons in charge of repairs.
h- Statement on the tests performed on the equipment or source, including leak tests, arranged chronologically according to the date of the test and the names of the persons performing the tests.
i- Statement on the equipment or source calibrations, arranged chronologically and the names of the persons who performed the calibration.
j- Statement showing the reasons for retirement or disposal of the equipment or source.

Article 128: Records of open (unsealed) radioactive sources:

This record shall be dedicated to documentation of all data related to the open radioactive substances as of the date of receipt to the date of disposal thereof. Such records shall provide the following information:

a- Name, source, physical and chemical condition and properties of the substance or source.
b- Total radioactivity and quantity (volume or mass) of the substance.
c- Date of delivery of the substance.
d- How and where the substance is used.
e- How and where the substance is stored.
f- Names of the persons in charge of handling, transfer, storage and use of the radioactive substance.
g- Definition of substance depletion arranged by the date of depletion and remaining quantity.
h- Clarification of any tests or calibrations perfro0med on the substance arranged chronologically.
i- Identification of the quantities transformed into radioactive wastes, arranged chronologically.
j- Any justifications for the disposal of the substance as radioactive wastes and method of disposal thereof.

Article 129: Record of worker's personal doses:

The licensee shall set up a record for documentation of the worker's personal doses. Each worker shall be assigned a section of this record, embodying all his/her internal and external radiation exposures arranged chronologically as follows:

a- Information on the nature of the work which causes radiation exposure.

b- Certified data on the measurement and assessment of the internal and external doses, the device used in the assessment, the agency and the name of the person performing the assessment.
c- The total of the effective dose that the worker has suffered in the previous facilities.
d- The annual periodic effective dose of the worker, including the committed effective, the total of the doses for five consecutive years and the total doses during the total duration of the work.
e- Any other doses that the worker may have been exposed to during any ordinary or extraordinary (emergency) events. Such doses shall be distinguished from the other doses.
f- The findings of the internal contamination measurement and assessment.

Article 130: Worker's physical fitness record:

The licensee shall keep records on the physical fitness of the workers who are subject to medical monitoring. Such records shall document the following:

a- Results of the general and special medical investigations at the beginning of employment in a job which involves exposure to radiation or radioactive substances.
b- Results of the routine investigations and analyses performed on the worker to verify medical fitness for the work.
c- Results of the medical follow up on any emergency exposures.

Article 131: Medical exposure record:

The licensee shall be required to keep records for all kinds of medical exposure which records shall be accessible exclusively to the concerned agencies, namely the patient, the medical practitioner, the qualified expert, the protection officer and the Competent Agency. The record shall provide for the name, age, nationality and method of treatment of the patient or aide [?] in addition to the following information:

a- For diagnostic radiology: all necessary data for the assessment of the dose of the patient or his attendant, including the number of exposures or investigations and the duration of each fluoroscopic examination.
b- For nuclear medicine: the name of the radioactive pharmaceuticals administered to the patient, the amount of radioactivity to the attendant in each pharmaceutical dose and the number and dates of these doses.

c- For therapeutic radiology: the method of treatment, description of the volume of the target planned for irradiation, the amount of dose in the center of the target, the maximum and minimum values of the dose deposited in the planned volume and the other organs and tissues, method of dose fragmentation [?] and total duration of treatment.

Article 132: Personnel training record:

This record shall be dedicated for documentation of all data and information related to the training of personnel on radioactive sources in the area of protection against radiation and on the safe handling of these sources. The record shall provide the following information:

a- The academic qualification and previous experience in the field of radioactive sources.
b- All training courses in the area of protection against radiation, the duration and date of each course in hours and the agency providing the training.
c- All training courses on the equipment which involves radiations or radioactive substances the date and duration of the course in hours and the agency providing the training.
d- The refresher and retraining courses, the date and duration of each course in hours and the agency providing the training whether on the equipment or the area of radiation protection.

Article 133: workplace radiation survey record:

This record shall be maintained to document the areas which contain radiation emitting equipment or sealed radioactive sources, such as the controlled and supervised areas and their environs. Such records shall provide for the following information:

a- Date of the radioactive survey and the name of the person who has performed it.
b- The device used in the survey.
c- Reference levels which must not be exceeded.
d- Compatibility of the new with the old data.
e- Compatibility of the survey data with the workers' personal exposure data.

TRANSLATION

Article 134: Workplace monitoring record:

The purpose of this record shall be the monitoring of controlled and supervised areas and their environs which contain open radioactive sources which may leak and spread in the workplaces and contaminate the workers, equipment, surfaces or air. The monitoring and recording rate shall depend on the quantity of existing radiation or which may leak or spread. The following data shall be provided in the record:

a- Type of monitoring (air monitoring for alpha and beta emissions), method of measurement and devices used in the measurement.
b- Results of the measurement and surface contamination value or concentration in the air.
c- Date of the monitoring and name of the person who has performed it.
d- Reference levels which must not be exceeded for surface or air contamination with radionuclides according to the type of nuclide.
e- Date of monitoring data analysis and the results of the review.

Article 135: Radioactive wastes record:

This record shall be dedicated to the documentation of all data and information related to the radioactive waste management and shall provide for the following information:

a- Method of disposal and names of the persons disposing of the wastes, the office in charge of the waste management and the qualified expert.
b- Name, chemical condition, quantity, and radioactivity of the liquid radioactive wastes disposed in the public sewers emitted at the time of disposal and date of discharge.
c- Date of storage of solid or liquid wastes, number of the vessels where stored, the total amount of radioactivity in the vessel at the time of storage.
d- Date of disposal of the solid and liquid wastes after storage and the amount of residual radioactivity.
e- Method of transportation of the radioactive wastes and the name of the removalist.

Article 136: equipment testing and calibration record:

This record shall be dedicated to the documentation of the calibration and testing of reach radioactive equipment or measuring device and shall provide for the following information:

a- Type, model, serial number and origin of the apparatus.
b- Date the calibration is performed arranged chronologically form the oldest to the most recent.
c- Name of the agency which performed the calibration and the name of the specialist who performed it.
d- Extent of consistency of the calibration parameters in comparison with previous calibrations.
e- Type of calibration (periodical or after the maintenance of the device or replacement of its batteries).
f- Any other observations worthy of note.

TRANSLATION

Chapter XIV
Radiation emergencies

Article 137: Response to radiation emergencies:

a- A licensee who is licensed to engage in a practice which involves radioactive sources shall set up a plan for radiation emergency which shall take into account all types of potential accidents and methods of responding to each one of them.
b- In the event of a radioactive or nuclear accident, the licensee shall respond thereto in a way conducive to containing the accident, preventing of its spread and minimizing its negative consequences.

Article 138: Definition of a radiation accident:

A radioactive accident is defined as an unintentional event or accident, including accidents or events resulting from error, defect or any fault in the operation of equipment or a radioactive source which gives rise to dire consequences that cannot be ignored from a protection and safety perspective and which may lead to potential radioactive exposures or unusual exposure conditions.

Article 139: Definition of the radioactive emergency plan:

This shall mean a set of successive procedures, actions and steps that must be carried out once a radiation accident occurs or as soon as it is discovered. The plan involves provision of the human and technical requirements needed for responding to the event and the practical training on implementation of all procedures and steps and the use of response equipment.

Article 140: Components of the radiation emergency plan:

a- The procedures and steps for responding to all kinds of potential radioactive sources accidents.

b- The human forces required to implement the steps for responding to the emergency situation.
c- The technical requirements and equipment needed for responding to the event.
d- The mechanism of coordination with the various parties participating in the response from inside and outside the facility.
e- Repeated training on the implementation of the plan.
f-

Article 141: Types of probable accidents:

Possible accidents related to the radioactive sources currently existing in the Kingdom include the following:

a- Loss or theft of radioactive sources or substances.
b- Accidents involving denudement of a radioactive source or substance (removal of the shield) or explosion accidents of a sealed source.
c- Accidents involving opening of the source, spill of the radioactive substance or contamination of the space, equipment or humans with the radioactive substance.

Article 142: Accident levels:

In terms of their geographical extension, accidents shall be divided into:

a- First level accidents:
These are accidence whose consequences do not go beyond the room, laboratory or building in which the accident occurs.

b- Second level accidents:
These are accidents whose consequences do not go beyond the location of the facility.

c- Third level accidents:
These are accidents whose consequences can extend outside the location of the facility.

d- Fourth level accidents:
These are accidents whose consequences may go beyond the boundaries of the state.

This classification does not mean that the hazards could be greater the higher the level of classification.

TRANSLATION

Article 143: Guidance intervention levels of protective actions:

a- Urgent preventive actions:
Schedule 9 illustrates the guidance values of the intervention levels for immediate preventive actions. The schedule clarifies the values related to sheltering, evacuation and iodine prophylaxis. The decision involving activation of any of these procedures must be immediate to ensure its effectiveness and must be based on the expectation of a release of radioactive substances more than on actual subsequent measurements to confirm the release.

b- Withdrawal of food supplies and drinking water:
The emergency plan shall specify the levels at which certain types of food supplies and drinking water must be withdrawn. Schedule No.9 specifies the guidance values of the intervention levels. Any decision to refrain from taking a specific action after excedence of these values must be justified.

c- Procedures related to agricultural and hydrological protective actions:
Protective actions should be considered following contamination of land or water and its sources after an accident. The levels at which preventive actions should be taken are lower than the values set forth in schedule No.9 on the withdrawal of food supplies and drinking water.

Article 144: Early detection of accidents:

The licensee shall be required to take the following actions to assist in the early detection of the accident:

a- Regularly review the operating methods and steps.
b- Draw up and periodically update training and retraining programs for the operators.
c- Draw up a system for reporting and review of equipment errors and failures.
d- Draw up a plan for the maintenance, its timings and the technologies used in it.
e- Ongoing monitoring and surveillance of the radioactive level for venue or personal contamination, especially contamination of the hands and feet.
f- Monitor and review radioactive substance inventory by performing periodic and regular stock taking, with more frequency for portable sources.

TRANSLATION

Article 145: Identification of the plan objectives:

For formulation of an emergency plan and definition of the accident response method, it is imperative to identify first the objectives of the plan. Schedule No.8.1 of appendix 8 demonstrates some models of objective identification.

Article 146: Emergency response plan:

a- To the exclusion of minor incidents, the emergency plans must be drafted in a written form with all response actions and procedures properly identified and spelled out therein. Wherever the plans call for participation by other agencies, such participating agencies must draw up their own portions of the plan and must obtain a copy of the portions assigned to them. These agencies may subsequently draw up detailed instructions for their personnel in a written form.

b- Where local emergency teams are concerned, the matter does not call for developing response steps and methods, rather such teams shall generally operate in accordance with their respective methods and steps, coupled, however, with the need to be informed at the time of notification of the guidelines and recommendations related to their specific mission. Therefore, the licensee and the Competent Agency must be prepared to provide the emergency team (Civil Defense and other concerned agencies) with the guidelines and recommendations related to the radiation accident response and such guidelines must have been incorporated in these agencies' operating methods for responding to radioactive source accidents.

c- Owing to the diversity of accidents and variety of their consequences, the plans drawn up by the Competent Agency for responding to emergencies must be of a generic nature based on the general principles of protection against radiation and on training. Therefore, implementation of such plans shall be entrusted to well qualified persons who are capable of speedy assessment of the situation and of making recommendations there and then.

d- The licensee must have in place a detailed plan for responding to potential accidents in the facility. The most salient part of the plan shall be the portion related to the identification of the proportions of the accidents, its nature and the initial executive steps required for control of the situation, minimization of radiation exposure and reporting.

e- At the time of development of the emergency plan, the responsibilities and duties of the parties during the response as set forth in schedules 10.1, 10.2 and 10.3 of appendix No.10 may be used for guidance.

f- Planning for emergencies and response thereto must comply with the basic principles for the protection of humans and the environment against radiation hazards and reduction of anticipated hazards to the levels that are practically acceptable. The basic principles of emergency response planning shall include the following:

1. Avoid the deterministic effect on humans by taking the actions that would create a maximum level for human exposure that is far below the threshold limits at which these impacts occur.
2. Maintain the hazards resulting from the stochastic effects of radiation below a specific level by taking the preventive measures which provide positive benefits for humans.
3. Establish ceilings on the stochastic radiation hazards that would reduce as much as practically possible the effective and the collective equivalent doses.

Article 147: Roles of the parties participating in the response:

a- For all first and second level accidents, the response responsibility lies primarily on the management of the facility (the licensee) where the accident has occurred. If the management of the facility is unable to respond, it shall be required to seek the Competent Agency's help.

b- With respect to transportation accidents, the responsibility lies with the facility licensed to use the radioactive source which shall be required to develop the necessary plan for responding to transportation accidents. The licensee shall also assume the responsibility for responding to the transportation accidents which occur during importation or exportation of the radioactive source and shall obtain from the consigner a copy of the safe source transfer instructions and the procedures for responding to anticipated transportation accidents for compliance therewith in the event of an accident during the importation and exportation processes. The licensee may delegate its responsibilities to the carrier if the latter has a license to transport radioactive substances issued by the Competent Agency.

c- For third and fourth level accidents, the responsibility for responding to the accident lies, besides the licensee, with the Competent Agency.

d- The first party responsible for the accident response must be so identified that this responsible party shall be in a position to assume the responsibility

and take the response decisions as soon as the accident is reported to it. Such responsible party may delegate the decisions, including the monetary resolutions on the cost of the response. Generally speaking, the financial considerations must have no impact on the speed of taking a response decision.

e- The Civil Defense and the other concerned agencies shall be tasked with the responsibility of protecting the public. Their response to the accident shall be the control of the access and approaches to the scene of the accident, fire fighting (if any), providing first medical aid, assisting in the search for the missing source and taking appropriate action to arrest the spread of contamination.

f- The Competent Agency shall be responsible for ensuring the protection of the workers and the public. It shall also see to it that the licensee has assessed the consequences which may extend outside the scope of the facility as part of the anticipated consequences of the accident.

g- Only well-trained persons and experts shall participate in the various monitoring and radiation measurement processes.

Article 148: Management during the emergency plan implementation:

a- To avoid chaos which may ensue after an accident and for effective response and minimization of human exposure and health damages and speedy recovery of control, there ought to be a series of orders and actions which are commensurate with the accident. Such series must be part of the emergency plan and must identify the permanent official who will be in charge of execution of the plan.

b- The licensee shall identify the chain of command of the officials in charge of responding to the accident. Since the progress of the accident is in many cases results from the actions of the onsite officials, such officials must be fully cognizant of the methods of response to the anticipated accidents.

c- The response official shall initiate the initial response steps in the first stages of the accident, such as caring for the victims, extinguishing fires and setting up barricades around the affected area.

d- Then, the response official shall report the accident to the officers of the facility and the other concerned agencies where required, such as ambulances, fire brigades and the police. Upon arrival of the pre assigned response teams at the scene, the onsite official shall brief them on the progress of the accident and the permanent official shall immediately begin to deploy the established plan and shall mange the accident response operations.

e- An emergency center commensurate with the magnitude of the accident shall be set up for management of the accident response operations and its consequences.

Article 149: Components of the radioactive emergency response team:

The size of the emergency team shall differ according to the level of the accident. For third and fourth level accidents, the team shall consist of:

a- Head of the response team and two deputies, who must all be qualified experts on the radiation protection issues, capable of assessing the situation and of taking quick and correct decisions and must have good knowledge of radiation measurement.
b- A radiation monitoring and measurement unit, comprising a number of specialists in all kinds of measurement and monitoring to be assigned to different work shifts.
c- A decontamination unit, comprising a number of experts in the decontamination of persons, equipment and the environment and in disposal of radioactive wastes.
d- A first medical aid unit
e- A media and communication unit.
f- A support service unit.
g- A fire fighting and control unit (from Civil Defense).

Article 150: Priorities of the response plan:

a- In the first minutes of the accident, the duties of the response shall be in the following order:
    1- Execution of the actions required to save life and assist the victims and wounded parties.
    2- Prevention of fires or extinguishing them if they already started.
    3- Identification of the potential hazards and the required response actions.
    4- Calling the protection officer if he is not already at the site.

    Saving life and containing fires shall come at the top of the priorities.

b- The interim officer available at the site at the time of the accident shall operate in accordance with the general series of orders which must be developed in advance and which may take various forms, such as:

- In the event of an accident, the following instructions shall apply:
  1. Call the facility manager.
  2. Contact the Competent Agency for Protection against Radiation.
  3. Contact Civil Defense, if necessary.
  4. Initiate measurement of the radiation level and assess exposure rates.
  5. Keep people away from the areas were the level of radiation is in excess of _____.
  6. Register the names of the people present at the site at the time of the accident.
  7. Register the names of the people in neighboring areas.
  8. Contain the spread of the radioactive substance or radiations in the area.

It may become apparent later on that there is no need for some of the actions taken, but it is advisable that such actions be, nevertheless, taken until the true image of the accident becomes clear.

Article 151: Accidents investigation and research methodology:

a- The investigation and research methodology in the first stage shall be as follows:

1- Identification of the victims, the wounded, the injured and the contaminated persons.
2- Determination if there is or there is no fire in the vicinity of the radioactive material.
3- Determination if there are or there are no flammable materials, liquids or gases in the vicinity of the accident scene.
4- Determination if there are or there are no toxic substances, explosives or other hazardous substances in the vicinity of the accident scene.
5- Identification of the anticipated radioactive hazards of the accident.
6- Documentation of the weather and meteorological conditions, such as the speed and direction of the wind.
7- Investigation of the extent of damage to the residents such as the impacts of the accident on the water tanks and foodstuff stores.

b- Two sets of the monitoring instruments shall be made available, one highly sensitive used of measuring weak levels of radiation and the other with lower sensitivity for measuring high levels of radiation. The apparatus must be of the kind whose detector is detachable from its own electronic component to allow for remote operation of the detector boom while the instrument operator and the electronic component remain outside the areas of high radiation or contamination levels.

Article 152: Reporting the accident:

a- Any radiation accident and its details shall be reported to the Competent Agency using the means of reporting designated by the Competent Agency.

b- The form provided in appendix 11 shall be used for reporting the accidents to the Competent Agency on the proviso that the report shall provide the following information:

1- Name, location and address of the facility where the accident has occurred.
2- Name, telephone number and address (if different from the above) of the reporter.
3- Time of the accident ant the time of discovery (if different).
4- Nature of the accident (loss, denudement of a source or contamination).
5- Name of the isotope or radionuclide involved in the accident.
6- Quantity of the source or substance radioactivity estimated in Becquerel or Curie. In the event of contamination, two values shall be reported, namely the total radioactivity of the source and the estimated radioactivity leaking from the source.
7- The chemical and physical data of the source, including the chemical and physical state of the leaking substance, its volume or mass, significant characteristics, and the general conditions prevailing in the site which may have an impact on the spread of the contamination.
8- Description of the equipment which housed the source at the time and during the accident, its type and serial number.
9- Results of the radiation or contamination measurements taken.
10- Statement on the victims who suffered radiation and non radiation injuries.
11- Determination of the extent of exposure by any of the public to the impacts of the accident.

12- Required help.

Reporting by telephone shall be followed by a written report to be forwarded to the Competent Agency which will immediately initiate the procedures upon receipt of the telephone report and verification of its veracity.

c- after the emergency situation, a written report shall be prepared and forwarded to the Competent Agency in accordance with the form provided in appendix 12, including the following information:

1- The valid and original [?] information.
2- The methods used in responding to the accident.
3- Assessment of exposure by the facility workers, those in charge of the source, the persons implementing the emergency plan and the public at large.
4- Causes of the accident and the remedial actions taken to avoid recurrence of the accident.

Article 153: Monitoring and assessment of the radiation status:

a- At the onset of the accident, a preliminary assessment of the magnitude of the radiation hazards shall be duly made using the appropriate instruments in order to discover any denudement of the source or contamination for evaluation of its proportions even on an estimated basis.
b- Once the official in charge of the response assumes his duties and he is acquainted with the status, a series of regular radiation monitoring shall be started using the monitoring devices appropriate for the accident and the radioactive source.
c- All personnel, response team and the public exposures as a result of the accident shall be duly assessed.
d- The radiation and contamination levels and extension shall be measured and maps depicting these levels shall be drawn.
e- Land and air contamination shall be measured in the areas surrounding the scene of the accident.
f- The emergency plan shall take into consideration and provide for seeking the assistance, if need be, of human expertise and technical capabilities from outside the facility, as well as from the Competent Agency, in the radiation monitoring and status assessment to the required degree of accuracy.

g- The measurement teams shall produce drawings and maps to project the radiation and contamination levels at the scene of the accident and its environs. The same teams will then proceed to perform ongoing monitoring and supporting to the accident response teams, providing advice on the methods of work and assessment of the personal dose of the persons in charge of the response and helping in the decontamination efforts.

h- All individuals who were present at the scene of the accident shall be monitored, so shall the equipment and things located in the scene before they can be removed off the site or reused.

Article 154: Control of the approaches and entrances:

a- The control process of the approaches and entrances shall depend on the nature and magnitude of the radiation accident. If a source is lost, there shall be no need for control of the accesses as long as it has been confirmed that the source is not at the site. In the event of denudement of the source, the accesses and approaches to the source shall be controlled to bar access to the locations where the dose exceeds the allowable limits. In the event of radiation contamination or even the possibility of a contamination, access shall be denied to a larger area which shall be designated off-limits.

b- Perhaps the best method of access and approach control shall be the use of barriers. If an accident occurs inside specific rooms or buildings with no extension beyond these rooms and buildings, the doors of the rooms and buildings may be used as natural barriers. It is mandatory then to put up the warning signs and signals at all doors, windows and approaches to bar access. Occasionally, there may be a need to shut down the ventilation system if its operation may cause the contamination to spread.

c- If denying access is required at greater distance, the various barriers and cordons used by the police and fire brigades may be utilized.

d- In the events involving loss of the radioactive source containment system or contamination accidents, the future weather conditions and wind direction shall be taken into account when barriers are deployed.

e- Access to or exits from the controlled areas shall be allowed only at the specific and designated points of passage. Such points shall be fitted out as radiation monitoring stations for the humans, equipment and materials and initial decontamination centers shall be set up in the vicinity of these points. In the event the controlled area is an open area, care should be taken to position the passage points in the opposite direction of the wind (in other words before the contaminated area in the opposite direction of the wind).

f- All persons entering the controlled areas shall be provided with personal protective equipment, such as the personal dosimetry equipment, protective clothing, breathing apparatus… etc.

g- Where the first level accidents are concerned, the licensee shall assume the responsibility of controlling the accesses and approaches while in second, third and fourth level accidents, both the licensee and the other concerned agencies shall assume this responsibility.

Article 155: Preventive measures for protection of workers in the off-limits area:

a- All workers in the off-limits area shall seek to complete the work in the shortest possible time.

b- Any person exiting an area contaminated by a radioactive material shall be wrapped in a blanket that does not permeate the radiation to avoid its spread outside the contaminated area. This practice shall be sustained pending full decontamination.

c- The injured and wounded parties shall be transported to the predefined hospitals and medical centers which shall be contacted prior to their arrival so that they may be ready to receive them.

d- All persons, other than the victims of the accident, who are present at the site during the accident shall be assembled in a near place and shall not be allowed to leave before confirming that they are free of any contamination. The assembly area shall be considered a waiting area attached to the off-limit area [?].

e- Areas containing sealed sources which are affected by the accident shall be considered among the off-limits areas.

f- It is advisable not to use water in extinguishing radioactive substance fires if the area is contaminated by the radioactive substance. If used, the water used in fighting the fires shall be retained to prevent spreading or reaching the public water sources.

g- Contaminated vehicles and equipment shall be allowed to exit the off-limits area only after decontamination.

h- It shall be prohibited to eat, drink or smoke in off-limits area or areas which are potentially contaminated.

i- The direction of the wind shall be taken into consideration when dealing with contaminated areas within the off-limits area to minimize the possibility of inhalation of radioactive particles in the air.

TRANSLATION

Article 156: Preventive measures for protection of individuals participating in the response:

a- Reduce to the minimum the duration of the time spent within the off-limits area.
b- Keep as far away as possible from areas containing radioactive sources.
c- Use shields between the sources and the populated areas.
d- Use breathing masks to minimize inhalation of radioactive substances.
e- Use protective clothing to prevent contamination of the skin, hands and feet, however, taking into account the fact that such clothing does not provide any protection against exposure to gamma rays or neutrons.
f- Use by all persons present in the off-limits area of personal dosimetry equipment.

Article 157: radiation exposure limits for persons participating in the response.

a- exposure of all persons participating in the response, including the police, Civil Defense, medical personnel, drivers, evacuation vehicle operators and others shall exceed the occupational workers' exposure limits only in the following cases:
    1- Actions intended to save lives or prevent serious injury.
    2- Actions intended to avert large collective doses.
    3- Actions intended to prevent development of catastrophic conditions

b- In all cases, an effort must be exerted to maintain the doses of intervening personnel below the values set forth in schedules 13.1.1 and 13.1.2 of appendix No.13, excluding the cases whose purpose is to save human life.
c- Workers performing specific tasks for the purpose of saving lives in the areas where radiation levels may reach or exceed the values set forth in schedules 13.1.1 and 13.1.2 of appendix 13 shall be volunteers of their own free will and shall do so only when the benefit to others clearly outweigh their own risk. Such workers must have been properly trained on the actions called for by the situation and that they be clearly informed in advance of the risks that they may be exposed to.
d- Once the emergency phase of an intervention has ended, all workers undertaking recovery operations, such as repairs to the buildings, waste disposal or decontamination of the site and surrounding area, shall be subject to the full and rigorous system of detailed requirements for occupational exposure.

e- All workers involved in saving lives or other emergency operations shall be provided with adequate protection and personal protection equipment and shall be administered natural iodine prophylaxis when needed.
f- All appropriate actions shall be taken to assess and record the doses received by workers involved in life saving and other emergency intervention actions. When the intervention has ended, the workers shall be informed of the doses received and the consequent health risk involved.

Article 158: Sheltering and evacuation:

a- If spread of the radioactive substance or increased rate of exposure as a result of an accident somewhere is imminent, an order shall be made for shielding and evacuating people form the threatened area.
b- Shielding shall be affected by closing the glass windows of the buildings, using breathing masks, refraining from going outside the buildings and keeping all widows closed pending elimination of the threat.
c- Evacuation shall proceed if the shielding procedures are found to be inadequate for protection of the people in the scenario of growing exposure rate and when the monitoring and measurement teams confirm the need for evacuation.

Article 159: Decontamination of humans:

1- Contaminated clothes shall be removed when exiting the contaminated site at the monitoring point to be set up for this purpose. Such clothes shall be reused only after they are decontaminated otherwise they shall be regarded as radioactive wastes.
2- The skin, hands and feet shall be decontaminated initially at the monitoring point to be followed subsequently by total decontamination and monitoring at one of the concerned centers.
3- Cases of internal contamination of persons shall be treated by applying the necessary medical procedures.

Article 160: Appliances and equipment required for the intervention:

a- The licensee shall be required to make available the basic tools that it may need to assess the radiation hazards associated with all phases of intervention. The licensee may seek the help of the Competent Agency in

providing some the appliances and equipment which are not available with the licensee owing to lack of ongoing need for them.

b- The type of the apparatus used in radiation monitoring shall depend on the type of the radioactive substance and the nature and type of the required measurement to be performed.

c- The licensee shall be required to regularly maintain the appliances and to duly perform all calibrations as scheduled to ensure the serviceability and preparedness of the equipment at all times. This shall be deemed part of the emergency planning.

d- The licensee shall provide the basic equipment and appliances on the basis of the inherent hazards incorporated in the emergency response plan as set forth in appendix No.14.

Article 161: The Competent Agency's radiation emergency response resources:

The Competent Agency shall provide the necessary resources and capabilities:

a- Monitoring teams to cover the work requirements around the clock by not more than 8 hours for each shift. Each team shall consist of a number of specialists in radiation measurement, monitoring and chemical analysis.

b- A mobile laboratory incorporating the instruments and equipment of the various spectrum measurements, namely:

1- Germanium spectrum for measurement of gamma ray spectrum, complete with all appurtenances, including the computer, related software and lead castle.
2- Sodium iodide spectrum, complete withal attachments.
3- Alpha and beta particles spectrum and counter.
4- Thermal and fast [?] neutron counter.
5- Necessary requirements for taking and preparing samples for radiation measurement.
6- A radiation chemical analysis laboratory.
7- Radiation scanners, probes, radiation surveyors, contamination monitors and personal dosimetry equipment.

Article 162: Data application during radiation emergency:

a- In the early stages of the accident, the information gathering process should provide the decision makers with data that would allow them to respond to the emergency case in a sound manner without any delay, while the data

gathered in subsequent stages should help those in charge in managing the accident and clarifying the status. The accuracy of the information gathered in the various stages is of critical importance in the assessment of the adequacy of the actions taken in response to the accident.

b- During the accident, the accident data flow shall serve the dual purpose of delivering the monitoring and follow up data and findings to the decision makers and delivery of the instructions of the decision makers to those in charge of monitoring and follow up. For this reason the communication and reporting method must be identified and established in advance since any error in reporting may lead to further complications.

c- The reporting unit system to be used in reporting shall be unified (millisevert, ram or other) since lack of advance determination of these units will lead to many errors which will further aggravate the situation.

d- Any report shall contain specific data. it is, therefore, essential that a reporting form be prepared in advance so that it will be ready for use in cases of emergency as shown in appendix No.11.

e- All information received form the monitoring teams as well as the instructions given shall be documented in a record, so shall all activities and decisions made, their timings, and the names of the reporters and the decision makers shall be recorded for assignment of accountability.

f- The method of calling the persons participating in the intervention shall be identified in advance, as well as one of the following media of communications: telephone, mobile, pager, email.

Article 163: The medical aspects of the emergency plan:

a- In the event of exposure to high doses of radiation or in the case of radiation contamination, centers specialized in the treatment of radiation exposure cases and decontamination shall be used.

b- The urgent task of the medical care for the persons exposed to radiation shall be identification of the type and severity of the radiation injury which can be classified as follows:

1- Persons exposed to radiation and persons who suffered other injuries or burns.
2- Persons who have not been exposed to radiation but suffered other injuries or burns.
3- Persons exposed to high doses of radiation and who show symptoms of exposure.

4- Persons who have received doses in excess of the exposure limits but below the threshold of deterministic effects.

c- Persons in categories 1, 2 and 3 in the above paragraph "b" shall be transported forthwith to specialized centers, whether they have been exposed to radiation or not, while the condition of the persons listed under subparagraph 4 of paragraph "b" shall be followed up medically [?].

Article 164: Termination of the emergency case:

The emergency case shall be terminated after verification of the following:

a- Regaining control of the source, restoring it to its shield or another shield that meets the safety and protection requirements.

b- Absence of any potential or unusual exposures and the end of any exposure threats.

c- Identification of all persons who may have been exposed to radiation and confirmation that the necessary action has been taken.

d- Completion of the decontamination process.

Appendices

Appendix No.1
Terms and definitions glossary

TRANSLATION

Appendix No.1

Terms and Definitions Glossary

This glossary lists the most important terms used in the radioactive sources safety and security regulations in the Kingdom of Saudi Arabia and sets definitions for the terms and the physical quantities used for the purpose of protection against ionizing radiation.

Countermeasure:
Any action intended to mitigate the impacts and consequences of an accident which involves radioactive emissions.

Irradiation device:
The term covers all nuclide accelerators, x-ray machines or sealed sources which may result in personal exposures which may in turn produce extremely harmful radioactive deterministic effects or sever contamination with radioactive substances.

Nuclear gauges:
The term includes all instruments designed and manufactured for detection and measurement of radiation or measurement and monitoring of the material thickness, density, filling level, interference, location, chemical composition, toxicity and Ph, in addition to calibration or reference sources.

TRANSLATION

Radiography devices:
The term covers all kinds of X-ray or neutron generating devices or devices which contain other radioactive sources used in radiography for the purposes of medical diagnosis, research or industrial photography.

Industrial gauges:
These are devices which contain radioactive substances or which emit radiations when energized. They are designed and manufactured for the purpose of detection of materials, measurement of their properties, monitoring of their thickness, density, humidity, status or chemical composition.

Health professional:
A person authorized by the competent national agency to engage in a profession related to health aspects, such as medicine, dentistry, pediatrics, nursing, physiology, occupational health… etc.

Decontamination:
Decontamination means removal of the radioactive pollutants for the purpose of minimizing the residual quantity of the radioactive substance in or on the surface of the object or persons or the environment.

Radiation:
The term radiation as provided for in these instructions means ionizing radiation.

Other parties:
The term covers the parties which perform specific activities related to the radioactive practice or source as authorized or assigned by the principal party. The other parties' term includes:

1- Supplier.
2- Worker.
3- Medical practitioner.
4- Health professional.
5- Radiation protection officer.
6- Qualified expert.

Clearance:
Clearance means exemption from the criterion requirements for the substances or issues which are subject to these standards.

Remedial actions:
The actions taken to minimize the doses which may be ingested in one of the intake positions.

Reference man:
This is an adult with a set of assumed anatomical and physiological characteristics as defined in the report of the International Committee for Protection against Radiation and used for the purpose of measuring and determining the human doses.

Containment:
Means containment of the substance to prevent its spread or emission at certain and calculated rate or the method used to achieve this containment.

Natural exposure:
This is the exposure resulting from naturally existing radiation sources in the environment.

Committed effective (equivalent) dose:
The committed effective dose is calculated up to a certain time after the intake of a radioactive substance as follows:

$$S(t) = \int_{to}^{to+\tau} \bar{S}(t)dt$$

Where t_0 is the intake time, $S(t)$ is the effective dose rate to time t. when t value is not identified, it must be deemed to be equal to 50 years for adults and 70 years for children.

The committed equivalent dose for an organ or tissue is calculated on the same basis after replacing the effective dose S(t) by the equivalent dose for the specific organ $\mathbf{S_T(t)}$

Collective effective dose (S):
This is a term which expresses the total radiation exposure in a group of humans. If the individual effective doses (for the individuals of the group) are close, the collective effective dose will be S which is the result of multiplying the average effective dose E by the number of the group individuals N, or in other words:

$$S = \bar{E}N$$

In the event of great variations in the individual doses, the group will be divided in subgroups for approximation of the individual effective dose of the individuals of a single subgroup, then the collective effective dose will be:

$$S = \sum_i \bar{E}_i N_i$$

Where $\bar{E}_i$ is the average of the individual effective dose in the subgroup i, N_i is the number of individuals in the same subgroup, all individual groups i will be added up.

When the collective effective dose is associated with a specific event of practice K, and the committed dose of that event or practice lasts for an indefinite period of time t, then the committed collective effective dose S_k will be the total collective effective dose resulting from the event or practice and will be defined as follows:

$$S_k = \int_0^\infty \dot{S}_k(t)dt$$

Where $S_k(t)$ is the collective effective dose rate at time t.

Collective equivalent dose (S_t):
This is an expression of the total radiation exposure of a specific organ or tissue T in a group of humans and is determined with the same method used for determination of the collective effective dose but by replacing the average effective dose $\bar{E}$ or the average effective doses $\bar{E}_i$ of the subgroups with the average equivalent dose of the organ or tissue $\bar{H}_t$ the average equivalent doses $\bar{H}_{ti}$ of the same organ or tissue in the subgroup in that order [?].

Collective dose:
This is the radioactive dose received by a group of humans. Its value is obtained as a result of multiplying the individual average dose by the number of exposed individuals in the group. The collective dose is divided into a collective equivalent dose S_T and a collective effective dose S and is measured in person/ severt.

Effective dose:
The effective dose E is the total of multiplying the equivalent doses of the human tissues and organs in the weighting factors of these tissues or organs, in other words:

TRANSLATION

$$E = \sum_{T} W_T . H_T$$

Where H_t is the equivalent dose of tissue or organ T and W_t is the weighting factor of the tissue or organs.

The gauging unit of the effective dose in the international standard system is joule/kg and is known as severt (Sv) or (rem) in the old system. The relationship between severt and rem is expressed as follows:

1 severt = 100 rem

Annual limit on intake (ALI):
This is the annual intake of a specific nuclide in the reference person through ingestion, inhalation or the skin whose limit may result in a committed effective dose equal to the limit of the annual effective dose.

Protection and safety:
Protection and safety as provided for herein will mean the standards designed to protect people from unnecessary exposures to ionizing radiation and to maintain the security of the radioactive sources, including the devices used for achieving this protection and safety, such as the equipment designed to maintain the exposures and consequently the hazards to the possible minimum as well as to prevent accidents and mitigating their consequences if they occur.

Defence in depth:
The term means the use of more than one preventive measure to attain a certain objective of protection and safety in the event of the failure of one of these preventive measures.

Regulatory Competent Agency:
This is the national Competent Agency tasked with the protection and safety issues in the concerned country.

Supervised area:
This is an area where the annual effective, equivalent or committed dose does not exceed one tenth of the limit of the annual occupational dose.

Controlled area:

TRANSLATION

This is the area where the workers may be occupationally exposed to doses that may reach or exceed three tenth of the limit of any of the equivalent, effective or committed doses set forth in the occupational exposure limits.

Radiation weighting factor (W_R):
This is a factor used for multiplication by the absorbed dose for calculation of the relative effectiveness of a certain type of radiation in producing impacts on health. The following table shows the values of the weighting factor of radiation by the type or energy of the external radiation falling on the human body or the radiation emitted by radionuclides existing within the body.

Type and energy of radiations	Radiation weighting factor
Gamma and X-ray radiations (all energies)	1
Electrons and mayons [?] (all energies)	1
Neutrons, energy less than 10 KVA	5
Neutrons, energy from 10 to 100 KVA	10
Neutrons, energy greater than 100 to 2000 KVA	20
Neutrons, energy greater than 2 up to 20 MVA	10
Neutrons, energy greater than 20 MVA	5
Protons, energy greater than 2 MVA	5
Alfa particles and heavy nuclear fusion products	20

If the use of probable neutron radiation factors is required, their value shall serve as a constant indicator and these factors can be calculated as follows:

$$W_R = 5 + 17e^{-(\mathrm{Ln}2E)^2/6}$$

Where E is the neutron energy in mega electron volt,

As for the types of radiations and energies not included in the above schedule, the probable radiation factors can be calculated as a specific factor with the linear energy transmission indicator L by using the following formula:

$$W_R = \bar{Q} = \frac{1}{D}\int Q(L)dL$$

Where D represents the absorbed
Q(L) represents the specific factor and is given by L indictor as follows:

Q(L) =1 at L ≤ 10
Q(L) = 0.32 L – 2.2 at 10 < L < 100
Q(L) = 0.32 L – 2.2 at 10 < L < 100

$Q(L) = 300/\sqrt{L}$ at $L \geq 100$

L is expressed in kilo electron volt per micrometer.

Tissue weighting factors (W_T):
An organ or tissue probable factor is a numerical factor which is multiplied by the value of the organ's or tissue's equivalent dose to determine its sensitivity to the occurrence of stochastic effects in it. The following schedule shows the probable factors for the tissues used for the purpose of protection from radiation:

Tissue or organ	Probable factor
Gonads	0.20
Red bone marrow	0.12
Colon	0.12
Lungs	0.12
Stomach	0.12
bladder	0.05
breast	0.05
Liver	0.05
Duodenal	0.05
Thyroid gland	0.05
Skin surface	0.01
Skin	0.01
Total of remaining organs	0.05

The remaining organs consist of the following: the adrenal gland, the brains, large and small intestines, the kidneys, spleen, pancreas and the thymus gland.

Consumer products:
The consumer products cover all items prepared for public use which emit ionizing radiations or contain traces of radioactive substances. Such products include static electricity neutralizers, ion-generating pipes, smoke detectors, ionized and ultraviolet light producers, radioactive flashing substances, high tension electron pipes, other appliances capable of generating relatively low flow of x-rays and any other products designated by the Competent Agency.

Intake:

This is the quantity of the radioactive substance which enters the body through inhalation, swallowing or through the skin and cuts. The same term is also used to describe the process of the substance entrance into the human body.

Deterministic effect:
The deterministic effect of radiations is the effect which will definitely take pace after exceeding the specific threshold (value) of the dose and its severity will increase with the increase in the dose.

Stochastic effects of radiation:
These effects which result from exposure to radiation and where the severity of the sickness is not correlated to the value of the dose but the probability of the disease is commensurate with the dose [?]. There is no minimum dose value limit at which these impacts take place.

Cost-benefit analysis (differential):
These are the steps taken in the radiation protection optimization for the purpose of determining the point to which the exposures have been reduced so that any additional exposure reduction is of low significance compared with the extra effort required to achieve such reduction.

Intervention:
Any action intended to mitigate or avoid exposure or possible exposure to sources which do not represent part of the practice or source control over which has been lost as a result of an accident.

License:
This is the document whereby the competent national regulatory Competent Agency authorizes the licensee to select a site or otherwise design, acquire, fabricate, produce, establish, possess, transport, import, export, receive, use, pre Competent Agency, transfer or dispose of any radioactive substances, radiation-emitting appliances, nuclear facility or radioactive waster management.

Radioactive discharge (effluent):
These are radioactive substances generated by a source which forms part of the practice and which are discharged in the form of gas, air particles, liquid or solid matter into the environment for the purpose of dilution and deployment in this environment.

Exposure:

TRANSLATION

The term exposure as used in these instructions means exposure to radiation or radioactive substances which results in irradiation of people or materials with ionizing radiation. The exposure may be external or resulting from materials outside the human body or otherwise internal resulting form sources existing within the human body. The exposure is classified as normal, potential, occupational, medical or public exposure. It may be transient, chronic or exposure in the intake condition [?].

Emergency exposure:
This is an exposure resulting from a sudden accident which calls for activating urgent preventive actions.

Public exposure:
This is the exposure suffered by the public from radiation sources. It includes all variations of exposure to controlled sources, excluding occupational and medical exposure and exposure to normal levels of natural radiation sources, but including exposures resulting from cases of intervention.

Medical exposure:
This is the exposure incurred by a patient as part of the medical diagnostic or therapeutic regimen, or otherwise incurred voluntarily by a person on his/her own free will after being acquainted with the hazards involved in helping or comforting the patient in the process of diagnosis and therapy, excluding occupational exposure.

Potential exposure:
This is unconfirmed exposure which may result form an accident with probability of natural incidence of a radioactive source for whose probability of occurrence a value can be set.

Temporary exposure:
This is an exposure which extends or may extend for a definite period of time.

Chronic exposure:
This is an exposure which lasts for a long period of time.

Occupational exposure:

This is the exposure that the worker in the field of radiation receives in the discharge of his duties.

Increased occupational exposure to natural sources:
This means the chronic (ongoing) occupational exposure to relatively high levels of radiation from natural radiation sources, such as the galactic radiations for the occupationally exposed persons during flights or earth radiations for certain mine workers.

Normal exposures:
These are radiations expected in normal operating circumstances, including exposures resulting from minor errors which are kept under control.

Safety analysis:
This is a review of the design and operation aspects which affect persons' protection and the safety of the sources, including minimization of hazards and analysis of all safety and protection components provided for in the design and operation of the sources.

Contamination:
This means the presence of a radioactive substance(s) in or on the surface of another material or man's body or in or on the surface of a place wherever the presence of the radioactive substance is undesirable or may result in damages.

Activation:
This means radiation activation induced by nuclear reactions.

Safety culture:
This is a package of trends and characteristics in persons and organizations which primarily consolidates and ensures that the safety and protection issues receive top priority and due attention commensurate with the significance of these issues.

Dose:
The term is used to express quantities such as the absorbed dose, the organ or tissue dose, the equivalent dose, the effective dose, the committed effective dose, and committed equivalent dose depending on the context. All these quantities

represent energies divided by the mass. The adjective or epithet which describes the dose is usually omitted when it is not required.

Organ dose:
This is the average dose in a certain tissue or organ of the human body and is defined by the formula:

$$D_T = \frac{1}{m_T} \int_{m_T} Ddm$$

Where m_T is the mass of the tissue or organ, D is the dose absorbed in a mass of the tissue whose amount is dm. the integration is taken for the whole tissue or organ.

Entrance surface dose:
This is the dose absorbed in the radiation field epicenter at the entrance surface through which radiations enter the body of a patient who is undergoing radiological diagnostic investigation, including the dispersed radiations which arrive at the same surface.

Average glandular dose:
This term is used in mammography and the dose is calculated as follows:

$$Dg = Dg_n X_a$$

Where Dg_N is the average absorbed dose as a result of exposure to air that is $2.58x10^{-4}$ kolom [?]/kg,

X_a is the exposure in the air needed to produce an image of suitable density. The value of Dg_N for the x-ray tubes made of molybdenum can be obtained from the following schedule:

Breast thickness (mm)	3.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0
Dg_N	2.02	.195	.175	.155	.140	.125	.115.	.105	.095

Multiple scan average dose:
This term is used in scan radiology (calculated tomography) as follows:

$$MSAD = \frac{1}{I} \int_{-n/2}^{+n/2} D(z)dz$$

Where n is the number of scans in the series,
I is the separator (distance) between scans,
$D_{(z)}$ is the dose in location z parallel to axle z. [?]

Equivalent dose:
The equivalent dose in an organ or tissue is the result of multiplying the absorbed dose in that organ or tissue by the probable radiation factor which caused it, or:

$$H_{T,R} = W_R D_{T,R}$$

Where $H_{T,R}$ is the average absorbed dose of radiation R in the tissue or organ T, W_R is the probable factor of the radiation R.

When the radiation field is a composite of radiations of different probable factors, the equivalent dose in the tissue or organ of all radiations will be calculated as follows:

$$\mathbf{H_T = \sum_R W_R . D_{T,R}}$$

The gauging unit of the effective dose in the international standard system is joule/kg and is known as severt (Sv) or (rem) in the old system. The relationship between severt and rem is expressed as follows:

1 severt = 100 rem

Ambient equivalent dose:
The ambient dose equivalent H*(10) at the point of interest in the actual radiation field is the dose equivalent which would be generated in the associated oriented and expanded radiation field at a depth of 10 mm (for highly penetrative radiations) on the radius opposite to the direction of incident radiation.

Absorbed dose:
The absorbed dose D is expressed as follows:

$$D = \frac{d\bar{E}}{dm}$$

Where $\frac{d\bar{E}}{}$ is the average energy value deposited by the ionizing radiation in a volume of the material and dm is the mass of this volume

TRANSLATION

According to the international standard system of units the absorbed dose is measured in joule per kg and the unit is named "Grey" (Gy). In the old system the "rad" was the unit used for measuring the absorbed dose and one Grey equals to one hundred rad.

Accident:
This is an unintentional accident, including operational errors or equipment failure or any other fault resulting in dire consequences which cannot be ignored from safety and protection perspective and may lead to potential exposure or unusual exposure conditions.

Limit:
This means the value of a quantity used in certain activities and under certain conditions which must not be exceeded.

Annual effective (equivalent) dose limit:
This is the value of the dose which must not be exceeded in the practices in a given year. The dose limits are established at levels which represent the maximum acceptable value for the normal operation of the practice.

Qualified expert:
This the person recognized by the competent national regulatory agency as a person who has the required knowledge and training to accurately gauge ionizing radiation, assess safety technologies , provide advise on protection against radiation and safety of the sources and to whom the licensee delegates these responsibilities.

Emergency plan:
This is a package of successive procedures and steps carried out as soon as an accident or incident occurs.

Nuclear fuel cycle:
These are all processes and operations participating in the production of nuclear energy. They include mine activities, pulverization, treatment and enrichment of uranium and thorium, manufacturing of nuclear fuel, operation of nuclear reactors, reprocessing of nuclear fuel, and management of nuclear wastes and disposal of radioactive wastes, as well as any research or developmental activities associated with the above activities.

TRANSLATION

Radon:
This is the two varieties of radioactive radon gas, namely radon 222 and radon 220.

Monitoring:
Monitoring is the measurement of exposure, dose, or contamination for reasons associated with the assessment of the values of exposure to radiations or radioactive substances in addition to interpretation of the findings.

Fault tree:
This is a diagram which shows parallel or successive faults and errors which may result in an accident or incident.

Event tree:
This is a diagram which shows the structure of events and its manifolds and their relationships represented by lines in the form of a tree based on the use of a logical model which represents the sequence of events which may occur.

Legal person:
The term means any individual, organization, commission, company, establishment, or consortium, or a private, public or administrative entity with Competent Agency to perform specific tasks under their own responsibility.

Licensee:
This is the legal person who has secured a license to engage in a practice or use of a radioactive source and who is granted specific rights relative to such practice or source and assumes all related obligations in connection with safety and protection.

Detriment:
The calculated and mathematical anticipation of damage (deterioration of health and other effects) resulting form exposure of individuals or population groups to radiation, taking into account all possible kinds of damages and the severity of each.

Principal party:
This is the party which has obtained a license for specific practices or sources, represented by the head or manager of the facility who shall assume all

responsibilities related to protection and safety of all practices and sources which involve radiation exposure under normal conditions or when an accident occurs.

Worker:
Any person who works regularly or temporary and who has rights and obligations with respect to the safety and protection issues.

Kerma:
The term Kerma (K) is:

$$K = \frac{dE_{tr}}{dm}$$

Where dE_{tr} is the total initial energy of the charged ionizing particles released by uncharged ionizing particles within a mass amount *dm*. Kerma is measure in joule/kg or Gy units.

Critical group:
This is a group of the public who are homogenously exposed to a specific source of radiation through a specific pathway or exposure. The group is usually comprised of individuals who receive the highest effective or equivalent dose form that specific source and pathway.

Risk:
This is the quantity which expresses the risks, detriments and their consequences associated with exposure. The risks are also associated with other quantities such as the potential occurrence of specific detriment or consequences and the characteristics of these consequences.

Secondary standard dosimetry laboratory (SSDL):
This is a reference laboratory dedicated by the competent regulatory Competent Agency for developing, maintaining and improving the primary and secondary criteria for gauging radiation doses.

Health surveillance:
This is the medical investigations intended to confirm the medical fitness of the workers at the beginning of their employment and while performing the duties assigned to them.

Unsealed source:

The term covers all radioactive sources which do not fulfill the definition of the sealed sources.

Sealed source:
This is a radioactive substance permanently enclosed within a sealed capsule with welding or a matter in solid form. The sealed capsule or the casing must be adequately sturdy to ensure prevention of leakage of the radioactive substance under normal operating conditions for which the source has been designed as well as under the scenarios of anticipated accidents.

Nuclear facility:
This is any laboratory or plant for manufacturing nuclear fuel, nuclear reactor (including critical and non critical clusters), research reactors, nuclear power plant, facility for storage of spent fuel, nuclear fuel enrichment facility or facility for re-processing of nuclear fuel.

Radioactive waste management facility
The term covers all facilities designed for the management of radioactive wastes (storage, treatment or disposal thereof).

Supplier:
this is the legal entity authorized by the user to perform the duties and responsibilities related to the importation of the radioactive source and its transportation within the Kingdom.

Qualified expert:
This is a person who has scientific degree and whose practical experience, full knowledge of the accurate measurement of ionizing radiation and experience in assessment of protection and safety issues and response to radiation emergencies are recognized by the competent national regulatory Competent Agency.

Radiation protection officer:
This a person who is scientifically qualified and specialized in the issues of radiation protection to a degree commensurate with the type and magnitude of the licensed practice, who is appointed by the licensee to monitor the enforcement of the protection and safety standards and who is subject to licensing by the competent national regulatory Competent Agency.

Exposure pathways:

These are the pathways through which the radioactive substances or radiation may reach humans.

Employer:
This is any legal entity with responsibilities and obligations to the worker who is employed in accordance with a mutual contractual relationship.

Guidance level:

This is the level of a specific quantity that must be reached and if exceeded specific suitable action must be taken.

Intervention level:
This is the value of the dose rate at which a protective action or a series of actions must be taken.

Recording level:
This is the dose, exposure or intake level determined by the competent national Competent Agency at or after which the values of the dose, exposure or intake received by the worker must be entered in his/her personal record once this level is exceeded.

Investigation level
This is the amount of a certain quantity, such as the equivalent dose rate, intake or the amount of radiation at which or once it is exceeded the situation must be investigated.

Action level:
This is the level of the dose rate or concentration of the activity at which remedial action must be set in motion.

Reference level:
This is the value of a quantity at which or when exceeded, a series of actions must be taken. The reference levels include the recording level, investigation level and intervention level.

Natural sources:
These are naturally existing radioactive sources which include galactic radiations which affect man especially during flights at high altitudes and earth radioactive sources in certain areas, in mines and other locations.

TRANSLATION

Source:
This includes any radioactive substance or material entity that may lead to radiation exposure through emission of ionizing radiation or release of radioactive substances. Such sources may be existing within or otherwise used in the practice. For instance, radon emitting sources are sources which exist in the environment. Also, the sterilization units with gamma ray irradiation and the X-ray units are sources in diagnostic radiology while a nuclear power plant is one of the practice sources associated with nuclear generation of electricity.

Authorized:
Authorized means obtaining a license form the competent national Competent Agency.

Approved:
The word approved as used in these instructions means recognition or approval by the competent national Competent Agency.

High energy radiotherapy equipment
This is an x-ray apparatus (or teletherapy machine containing a radioactive substance) which operates at generation voltage or energies in excess of 300 KV.

Low energy radiotherapy equipment:
This is an X-ray equipment or machine which operates at a voltage not exceeding 100 KV.

Reference air kerma rate:
This is the kerma rate in the air at a reference distance of one meter corrected for attenuation by air and dispersion. The quantity is expressed in microgrey/hour at one meter.

Dosimeter:
This is an instrument, equipment, machine or system which can be used for measurement or estimation of any quantity that may be associated with a certain dose.

Medical practitioner:
This is the professional health specialist authorized and licensed by the competent national Competent Agency to engage in the work and who has received training and the required practical experience for description of medical exposures.

TRANSLATION

Approved medical practitioner:
This is the medical practitioner responsible for the health surveillance of the workers and whose related capabilities and resources are recognized by the competent national Competent Agency.

Practice:
Practice as used in the context of these instructions means any human activity which may involve intake of sources, exposure pathways, exposure of a number of persons, or modification of the source's existing network of pathways in a way that would cause increased exposure or potential exposure of humans to radiation.

Radioactive waste management facility:
This is a special plant or installation dedicated to the handling, treatment, temporary storage or permanent disposal of radioactive wastes.

Irradiation installations:
These are installations which house large particle accelerators, x-ray machines or radioactive sources which may produce high radiation fields. Such facilities are fitted with shields and protective devices and are equipped with security devices and equipment such as locks and barriers which deny access to highly radioactive areas. The irradiation installations contain therapeutic facilities with external radiation beams as well as commercial sterilization and preservation facilities

Radiation generators:
These are machines for generation of ionizing radiation, such as s-rays, neutrons, electrons or other charged particles. Such generators can be used for scientific, industrial, medical and other applications.

Radioactivity:
The radioactivity of a certain quantity of radionuclide existing in a specific form of energy and at a specific point in time is:

$$A = dN / dt$$

Where dN is the projected quantity of the number of spontaneous nuclear transformations from the energy state within a time period of dt. The international standard radioactivity unit is measured in the inversion of seconds which is called Becquerel. A Becquerel means the decaying of a unit per second. The old unit for measuring radioactivity is curie and a single curie = 37000 million Becquerel.

Radioactive waste:

TRANSLATION

These are the radioactive substances generated by a source within a certain practice which are retained for the purpose of restricting the emission rates into the ambient vital environment irrespective of the physical state of these substances.

Intervention situation:
This is a situation which occurs when the intervention level is exceeded and includes the following:

a- Presence of naturally existing radioactive substances, including radon.
b- Presence of radioactive residues from previous incidents, such as contamination resulting from previous practices.
c- Accident or exposure situations leading to the activation of emergency plans and procedure, such as the accidents involving nuclear power plants and other facilities, accidents involving radioactive sources or satellites where nuclear substances are used or accidents involving air or land means of transportation of radioactive substances.

$$DAC_i = \frac{20 \times 10^{-3}}{h(g)_i \, x2500} Bq/m^3 \quad .....(2-1)$$

Appendix No.2
Equations for etymology of limits and derived values

Equation 2.1: equation for derivation of derived air concentration (DAC) of a single nuclide:

Where:
$H_{(g)}$ = the intake conversion factor of this nuclide via breathing into a committed effective dose in adults.

Equation 2.2 Equation for derivation of the derived concentration c_i in a nuclide mixed with other nuclides:

Appendix No.3
Radioactive exposures
Medical exposures reference levels
Schedule 3.1 Diagnostic radiation guidance levels for adults:

Radiology:

Investigation	Surface intake dose in milligrey	
	Anterior posterior cross section	10
Lumber vertebrae	Lateral section	30
	Lumbar sacro section	40
Imaging of the abdomen, urinary system and tissues	Anterior posterior cross section	10
Pelvis	Anterior posterior cross section	10
Hip joint	Anterior posterior cross section	10
Chest	Anterior posterior cross section	0.4

	Lateral section	1.5
Chest vertebrae	Anterior posterior cross section	7
	Lateral section	20
Teeth		7
	Anterior posterior cross section	5
Skull	Anterior posterior cross section	5
	Lateral section	3

* These are values in the air (primary beam) in the presence of backscatter and are applicable to combinations of conventional films and screens whose relative speed is 200. For fast combinations of films and screens (400-600) these values will be reduced by a factor ranging between 2 and 3.

Schedule 3.2 Calculated tomography (CT scan) guidance levels for adults:

Investigation	Multiple scan average dose * (milligrey)
head	50
Lumbar	35
abdomen	25

* This dose is measured in an equivalent water phantom measuring 15 cm long, 16 cm for the head and 30 cm for the vertebrae and abdomen.

TRANSLATION

Schedule 3.3 Mammography guidance levels for adults:

Average gland dose for each craniocaudal position.

1 milligrey (without grid)
3 milligrey (with grid)

* These measurements apply to a compressed 4.5 cm breast, consisting of 50% gland and 50% fatty tissues, using special systems, screens and films of the mammography units whose target and filters are made of molybdenum.

Schedule No.3.4 fluoroscopic investigation guidance levels for adults:

Operation method	Multiple scan average dose * (milligrey/minute)
standard	25
High level	100

* In the air (primary beam) with backscatter.

Schedule 3.5: Nuclear medicine investigation guidance levels for adults:

Investigation	**Radionuclide**	**Chemical state (a)**	**Maximum standard activity per test (megabecquerels)**
Bones Bone imaging	Technetium 99 m	Phosphonates and phosphorous compounds	600
Bone spectrum imaging	Technetium 99 m	Phosphonates and phosphorous compounds	800
Bone marrow imaging	Technetium 99 m	?????????????	400
Brain Brain imaging (static)	Technetium 99 m Technetium 99 m	Technetium tetroxide DTPA, gluconate, glucoheptonate	500 500
Brain spectrum imaging	Technetium 99 m Technetium 99 m Technetium 99 m	Technetium tetroxide DTPA, gluconates, glucoheptonate	800 800 500
Blood flow in the brain	Xenon 133	In sodium chloride solution	400

vasography	Technetium 99 m Indium 111	DTPA	500 40
Lachrymal gland	Technetium 99 m Technetium tetroxide	Technetium tetroxide ??????	4 4
Thyroid gland Thyroid scan	Technetium 99 m Iodine 123	Technetium tetroxide Negative iodine	300 20
Thyroid perfusion (after incision)	Iodine 131	Negative iodine	400
Thyroid and parathyroid scan	Thallium 201	Thallium chloride	80

Appendix No.4
Limits on medical exposure doses for persons who are not subject to diagnosis or therapy

Schedule 4.1: Guidance levels for discharging patients from hospitals

Radionuclides	Radioactivity in megabecquerels
Iodine 131	1100 *

* In certain countries 400 MBq level is used a model of good practice.

Schedule No.4.2: Reference values for patient helpers:

Adults: 5 millisevert during the treatment process.

Schedule NO.4.3: Reference values for visitors, including children:

Adults: 5 millisevert per incidence
Children: 1 millisevert per incidence

Appendix No.5
Rates and concentrations of discharges to the environment

Isotope		liquid		Gas
Name	Symbol	Max. concentration Becquerel/liter	Max. quantity (liter)	Max. concentration Becquerel/liter
Hydrogen 3	H-3	076100	13100	-
Beryllium 7	Be-7	048900	00204	2500
Carbon 14	C-14	002630	04230	-
Flour 18	F-18	024400	00041	1400
Sodium 22	Na-22	000428	02330	96
Sodium 24	Na-24	003180	00031	460
Silicon 41	Si-31	008560	00116	1680
Phosphor 32	P-32	000570	00175	36

TRANSLATION

Sulfur 35	S-35	010500	09500	89
Chlorine 36	Cl-36	001470	00680	17
Chlorine 38	Cl-38	011400	007.8	277
Potassium 40	K-40	000220	04545	59
Potassium 42	K-42	003185	00310	1040
Potassium 43	K-43	005470	00182	890
Calcium 45	Ca-45	001800	05550	44
Calcium 47	Ca-47	000855	01165	65
Scandium 46	Sc-46	000910	01095	18
Scandium 47	Sc-47	002490	00400	171
Scandium 48	Sc-48	000805	00124	113
Vanadium 48	V-48	000680	00147	52
Chrome 51	Cr-51	036000	00277	3900
Manganese 52	Mn-52	000760	00131	89
	Mn-52m			
Manganese 54	Mn-54	1920	520	78
Manganese 56	Mn-56	5260	19	1040
Iron 52	Fe-52	970	1020	208
Iron 55	Fe-55	4150	240	328
Iron 59	Fe-59	760	1314	33
Cobalt 56	Co-56	547	182	26
Cobalt 57	Co-57	6520	153	227
Cobalt 58	Co-58	1850	540	78
Cobalt 58m	Co-58m	57000	175	9610
Cobalt 60	Co-60	400	248	12
Cobalt 60m	Co-60m	805800	2.1	104100
Nickel 59	Ni-59	21700	4590	960
Nickel 63	Ni-63	9130	10950	260
Nickel 65	Ni-65	7610	131	1470
Copper 64	Cu-64	11415	87	1130
Zinc 65	Zn-65	350	2840	43
Zinc 69	Zn-69	44180	22	4460
Zinc 59m	Zn-69m	4150	240	378
Gallium 72	Ga-72	1245	80	235
Germanium 71	Ga-71	114150	875	11360
Arsenic 73	As-73	5260	1890	125
Arsenic 74	As-74	1053	945	59
Arsenic 76	As-76	855	116	168
Arsenic 77	As-77	3420	290	312
Selenium 75	Se-75	525	1895	83
Brome 82	Br-82	2530	395	198
Rubidium 82	Rb-82	485	204	134
Strontium 85	Sr-85	2445	408	152
Strontium 85m	Sr-85m	224500	44	29000
Strontium 87m	Sr-87m	45600	21	5950

Strontium 89	Sr-89	525	1890	15
Strontium 90	Sr-90	48	204	15
Strontium 91	Sr-91	2107	47	304
Strontium 92	Sr-92	3185	313	543
Yttrium 90	Y-90	507	197	83
Yttrium 91	Y-91	570	1750	14
Yttrium 91m	Y-91m	114100	8	11360
Yttrium 92	Y-92	2795	35	690
Yttrium 93	Y-93	1140	87	297
Zirconium 93	Zr-93	1245	8030	12
Zirconium 95	Zr-95	1440	690	26
Zirconium 97	Zr-97	650	153	135
Niobium 93m	Nb-93m	1140	875	69
Niobium 94	Nb-94	805	1240	5.2
Niobium 95	Niobium 95	2320	430	69
Niobium 97	Niobium 97	19850	50	2770
Niobium 98	Niobium 98	11410	8	2150
Molybdenum 90	Mo-90	3800	262	568
Molybdenum 93	Mo-93	425	233500	52
Molybdenum 99	Mo-99	2280	438	126
Molybdenum 101	Mo-101	33400	29	4800
Technetium 96	Tc-96	1245	802	183
Technetium 96m	Tc-96m	105300	94	16800
Technetium 97	Tc-97	20140	4670	30
Technetium 97m	Tc-97m	2490	4010	37
Technetium 99	Tc-99	2140	4670	30
Technetium 99m	Tc-99m	62250	160	6570
Ruthenium 97	Ru-97	9130	1090	125
Ruthenium 103	Ru-103	1870	530	52
Ruthenium 105	Ru-105	5260	189	735
Ruthenium 106	Ru-106	195	510	4
Rhodium 103m	Rh-103m	360500	277	50000
Rhodium 105	Rh-105	3700	2700	390
Palladium 103	Pd-103	7210	13860	320
Palladium 1091	Pd-109	2490	401	365
Silver 105	Ag-105	2610	343	168
Silver 110	Ag-110	485	2040	16
Silver 111	Ag-111	1050	945	78
Cadmium 109	Cd-109	685	1455	18
Cadmium 115	Cd-115	975	1020	127
Cadmium 115m	Cd-115m	415	2405	20
Indium 111	In-111	4720	210	543
Indium 113m	In-113m	4460	224	6250

Indium 114m	In-114m	330	2990	20
Indium 115m	In-115m	15930	62	2115
Tin 113	Sn-113	1850	5400	46
Tin 125	Sn-125	440	226	40
Antimony 122	Sb-122	805	12	125
Antimony 124	Sb-124	525	1995	19
Antimony 125	Sb-125	1245	800	26
Tellurium 123m	Te-123m	975	10210	30
Tellurium 125m	Te-125m	1570	6350	35
Tellurium 127	Te-127	8055	124	1040
Tellurium 127m	Te-127m	595	16780	16
Tellurium 129	Te-129	21700	45	3370
Tellurium 129m	Te-129m	455	2189	18
Tellurium 131	Te-131	3110	3	4800
Tellurium 131m	Te-131m	1245	800	137
Tellurium 132	Te-132	595	16780	69
Tellurium 133	Te-133	27000	5.2	6944
Tellurium 133m	Te-133m	9780	10	1602
Tellurium 134	Te-134	14500	68	1923
Iodine 123	I-123	1680	5920	6220
Iodine 125	I-125	91	10950	45
Iodine 126	I-126	47	21100	12
Iodine 129	I-129	12	8030	3
Iodine 130	I-130	685	1455	193
Iodine 131	I-131	62	16060	16
Iodine 132	I-132	4720	21	1320
Iodine 134	I-134	315	3135	83
Iodine 135	I-135	1245	8	2770
Cesium 129	Cs-129	22800	4	2970
Cesium 132	Cs-132	2740	36	543
Cesium 134	Cs-134	72	138	18
Cesium 134m	Cs-134m	68400	4.1	8920
Cesium 135	Cs-135	685	14590	181
Cesium 136	Cs-146	440	226	104
Cesium 137	Cs-137	105	94	27
Cesium 138	Cs-138	14890	65.0	5000
Barium 131	Ba-131	3040	328	568
Barium 133	Ba-133	910	-	83
Barium 133m	Ba-133m	2530	-	694
Barium 140	Ba-134	525	189	125
Lanthanum 140	La-140	680	145	113
Cerium 139	Ce-139	5260	189	65
Cerium 141	Ce-141	1925	5180	39
Cerium 143	Ce-143	1245	800	166
Cerium 144	Ce-144	260	379	0.3

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Praseodymium 142	Pr-142	1050	94	240
Praseodymium 143	Pr-143	1140	875	56
Neodymium 147	Nd-147	1245	800	59
Neodymium 149	Nd-149	10530	94	1480
Promethium 147	Pm-147	5265	1897	25
Promethium 149	Pm-149	1383	722	186
Samarium 151	Sm-151	13900	7150	31
Samarium 153	Sm-153	1850	540	198
Europium 152	Eu-152	975	1020	3
Europium 152m	Eu-152m	2740	360	568
Europium 154	Eu-154	685	1455	3.2
Europium 155	Eu-155	4280	2335	18
Gadolinium 153	Gd-153	5070	1970	59
Gadolinium 159	Gd-159	2735	365	446
Terbium 160	Tb-160	855	1165	17
Dysprosium 165	Dy-165	12450	80	2080
Dysprosium 166	Dy-166	855	1165	17
Holmium 166	Ho-166	975	102	192
Erbium 169	Er-169	3700	2700	125
Thulium 170	Tm-170	1050	945	17
Thulium 171	Tm-171	12450	8025	89
ytterbium	Yb-175	3110	3210	189
Lutetium	Lu-177	2580	3865	113
Hafnium 181	Hf-181	1245	800	25
Tantalum 182	Ta-182	910	10	16
Tungsten 181	W-181	18000	550	4620
Tungsten 185	W-185	3110	3210	1040
Tungsten 187	W-187	2170	455	657
Rhenium 186	Re-186	910	1090	113
Rhenium 188	Re-188	975	102	231
Osmium 185	Os-185	2685	372	96
Osmium 191	Os-191	2400	4160	73
Osmium 193	Os-193	1690	590	260
Iridium 190	Ir-190	1140	875	59
Iridium 192	Ir-192	975	10	24
Iridium 194	Ir-194	1050	94	240
Platinum 191	Pt-191	4025	245	1135
Platinum 193m	Pt-193m	3040	3280	1040
Platinum 197	Pt-197	3340	295	1470
Gold 198	Au-198	1365	730	160
Gold 199	Au-199	3110	320	176
Mercury 197	Hg-197	5955	1675	415
Mercury 197m	Hg-197m	2910	340	235
Mercury 203	Hg-203	720	135	195

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Thallium 200	Ti-200	6850	145	625
Thallium 201	Ti-201	14420	69	2840
Thallium 202	Ti-202	3040	325	655
Thallium 205	Ti-205	1050	9	290
Lead 210	Pb-210	6.1	6055	1.0
Lead 212	Pb-212	220	450	5.6
Bismuth 206	Bi-206	720	138	73
Bismuth 207	Bi-207	1050	948	22
Bismuth 210	Bi-210	1050	948	3.1
Bismuth 212	Bi-212	5265	18	0.4
Polonium 210	Po-210	1.1	8760	03.0
Astatine 211	At-211	124	80290	1.1
Radium 223	Ra-223	7.123	7295	15.0
Radium 224	Ra-224	20	4960	39.0
Radium 225	Ra-225	36	2770	20.0
Radium 226	Ra-226	1.4	2405	15.0
Radium 228	Ra-228	7.4	21170	089.0
Actinium 227	Ac-227	43.0	3185	00055.0
Actinium 228	Ac-228	3185	313	35.7
Thorium 227	Th-227	124	80	014.0
Thorium 228	Th-228	5.9	1020	0027.0
Thorium 229	Th-229	91.0	1090	00043.0
Thorium 230	Th-230	2.6	1605	0028.0
Thorium 231	Th-231	4025	2480	403
Thorium, natural	Th (nat)	1.1	875	00054.0
Thorium 234	Th-234	400	248	5.18
Protactinium 230	Pa-230	1485	670	2.0
Protactinium 231	Pa-231	9.1	518	00085.0
Protactinium 232	Pa-232	1900	5255	5.12
Uranium 230	U-230	50	1970	0085.0
Uranium 231	U-231	4890	2040	355
Uranium 232	U-232	4.5	182	019.0
Uranium 233	U-233	0.27	364	035.0
Uranium 234	U-234	5.27	360	035.0
Uranium 235	U-235	5.29	335	040.0
Uranium 236	U-236	5.29	335	039.0
Uranium 238	U-238	0.31	320	044.0
Neptunium 237	Np-237	12	80	0054.0
Neptunium 239	Np-239	171	5835	134
Neptunium 240	Np-240	16700	59	1470
Plutonium 236	Pu-236	5.15	628	0065.0
Plutonium 238	Pu-238	9.5	1678	0027.0
Plutonium 239	Pu-239	4.5	1824	0025.0
Plutonium 240	Pu-240	4.5	182	0025.0
Plutonium 241	Pu-241	290	343	13.0

Plutonium 243	Pu-243	16110	620	1505
Plutonium 244	Pu-244	7.5	1750	0026.0
Americium 241	Am-241	8.6	1460	00.30
Americium 242	Am-242	4565	218	3.7
Americium 243	Am-243	8.6	1455	0035.0
Corium 242	Cm-242	105	948	023.0
Corium 243	Cm-243	8.6	1455	0035.0
Corium 244	Cm-244	5.8	1165	0036.0
Corium 245	Cm-245	5.4	218	0021.0
Corium 246	Cm-246	7.4	211	0021.0
Corium 247	Cm-247	0.5	1970	0023.0
Corium 248	Cm-248	2.1	800	0005.0
Berkelium 249	Bk-249	1410	7.8	78.0
Californium 246	Cf-246	415	2405	27.0
Californium 248	Cf-248	48	204	014.0
Californium 249	Cf-249	5.3	255	0017.0
Californium 250	Cf-250	5.8	1165	0036.0
Californium 251	Cf-251	8.3	262	.0017
Californium 252	Cf-252	2.15	655	006.0
Californium 253	Cf-253	975	102	09.0
Californium 254	Cf-254	4.3	291	00.30
Einsteinium 253	Es-253	220	445	046.0
Einsteinium 254	Es-254	326	3065	26.0
Fermium 254	Fm-254	3110	3210	6.1
Fermium 255	Fm-255	545	1820	45.0

The concentrations are given for water soluble liquids.
The concentrations given for gases represent air suspended particles which are absorbed with medium speed in the lungs.

Appendix No.6
Limits of contamination

Schedule No.6.1. Limits of unstable [?] surface contamination of the various particles:

Type of surface	Maximum concentration (becquerel/cm^2)	
	High toxicity alpha irradiation	Low toxicity beta, gamma and alpha irradiation
Instruments and equipment	0.4	4.0
Skin and extremities	0.2	2.0
Laboratory coats and aprons	0.4	4.0
Personal clothing outside the lab	0.04	0.4

Appendix No.7
Groups of toxic radioactive isotopes

A. First Group: High Toxicity Radionuclides

Lead 210, Polonium 210, Radium 223, Radium 226, Radium 228, Actinium 227, Thorium 227, Thorium 228, Thorium 230, Protactinium 231, Uranium 230, Uranium 232, Uranium 233, Uranium 234, Neptunium 237, Plutonium 238, Plutonium 239, Plutonium 240, Plutonium 241, Plutonium 242, Americium 241, Americium 243, Corium 242, Corium 243, Corium 244, Corium 245, Corium 246, Californium 249, Californium 250, Californium 252.

B. Second Group: Medium High Toxicity Radionuclides

Sodium 22, Chlorine 36, Calcium 45, Scandium 46, Manganese 54, Cobalt 56, Cobalt 60, Strontium 89, Strontium 90, Yttrium 91, Zirconium 95, Ruthenium 106, Silver 110m, Cadmium 115m, Indium 114m, Antimony 124, Antimony 125, Tellurium 127m, Tellurium 129m, Iodine 124, Iodine 126, Iodine 131, Iodine 133, Cesium 134, Cesium 137, Barium 144, Cerium 144, Europium 152, Europium(?) 154, Terbium 160, Thulium 170, Hafnium 181, Tantalum 182, Iridium 192, Thallium 204, Bismuth 207, Bismuth 210, Astatine 211, Lead 212, Radium 224, Actinium 228, Protactinium 230, Thorium 234, Uranium 236, Berkelium 249.

C. Third Group: Medium Toxicity Radionuclides

Beryllium 7, Carbon 14, Fluorine 18, Sodium 24, Chlorine 28, Silicon 31, Phosphorus 32, Sulfur 35, Argon 41, Potassium 42, Potassium 43, Calcium 47, Scandium 47, Scandium 48, Vanadium 48, Chromium 51, Manganese 52, Manganese 56, Iron 52, Iron 55, Iron 59, Cobalt 57, Cobalt 58, Nickel 63, Nickel 65, Copper 64, Zinc 65, Zinc 69m, Gallium 72, Arsenic 73, Arsenic 74, Arsenic 76, Arsenic 77, Selenium 75, Bromine 82, Krypton 85m, Krypton 87, Rubidium 86, Strontium 85, Strontium 91, Yttrium 90, Yttrium 92, Yttrium 93, Zirconium 97, Niobium 93m, Niobium(?) 95, Molybdenum 99, Technetium 96, Technetium 97m, Technetium 97, Technetium 99, Ruthenium 103, Ruthenium 105, Rhodium 106, Palladium 103, Palladium 109, Silver 105, Silver 111, Cadmium 109, Cadmium 115, Indium 115, Tin 113, Tin 125, Antimony 122, Tellurium 125, Tellurium 127, Tellurium 129, Tellurium 131, Tellurium 132, Iodine 130, Iodine 132, Iodine 134, Iodine 135, Xenon 135, Cesium 131, Cesium 136, Barium 131, Lanthanum 140, Cerium 141, Cerium 143, Praseodymium 142, Praseodymium 143, Neodymium 147, Neodymium 149, Promethium 147, Promethium 149, Samarium 151, Samarium 153, Europium 152, Europium 155, Gadolinium 153, Gadolinium 159, Dysprosium 165, Dysprosium 166, Holmium 166, Erbium 169, Erbium 171, Thulium 171, Ytterbium 175, Lutetium 177, Tungsten 181, Tungsten 185, Tungsten 187, Rhenium 183, Rhenium 186, Rhenium 188, Osmium 185, Osmium 191, Osmium 193, Iridium 190, Iridium 194, Platinum 191, Platinum

197, Gold 196, Gold 198, Gold 199, Mercury 197, Mercury 197m, Mercury 203, Thallium 200, Thallium 201, Thallium 202, Lead 203, Bismuth 206, Bismuth 212, Radon 220, Radon 223, Thorium 231, Protactinium 233, Neptunium 239.

D. Fourth Group: Low Toxicity Radionuclides

Tritium 3, Oxygen 15, Argon 37, Cobalt 58, Nickel 59, Zinc 69, Germanium 71, Krypton 85, Strontium 85m, Rubidium 87, Yttrium 91, Zirconium 93, Niobium 97, Technetium 96m, Technetium 99m, Rhodium 103, Indium 113, Iodine 129, Xenon 131m, Xenon 133, Cesium 134m, Cesium 135, Samarium 147, Rhenium, Osmium, Platinum, Platinum, Thorium, Natural Thorium, Uranium, Uranium, Natural Uranium.

Appendix No.8
Identification of the objectives of the response to the various accidents

Schedule No.8.1: Models for identification of the objectives of the response to various accidents:

TRANSLATION

Serial #	Type of accident	Objectives
1	Loss or theft of a source	1- Identify of the location of the missing or stolen source. 2- Return the source to its shield. 3- Maintain the human exposure dose at the lowest level possible. 4- Assess the exposure values resulting from the accident. 5- Arrange for and apply medical first aid to the victims of the accident.
2	Exposure of the source	1- Return the source to its shield or any other suitable shield. 2- Maintain the human exposure dose at the lowest level possible. 3- Assess the exposure values resulting from the accident. 4- Arrange for and apply medical first aid to the victims of the accident.
3.	**Breakage of the container or loss of the protective device, contamination of the area, equipment or persons.**	1- Contain and prevent the spread of the contamination. 2- Decontaminate and clean up the area, equipment and persons. 3- Gather and dispose of the radioactive wastes and contaminated objects. 4- Maintain the human exposure dose at the lowest level possible. 5- Assess the exposure values resulting from the accident. 6- Arrange for and apply medical first aid to the victims of the accident.

Appendix No.9

Guidance levels for emergency protective intervention

TRANSLATION

Schedule 9.1: levels of anticipated doses for intervention under any circumstances

9.1.1: Severe exposures intervention levels:

Organ or tissue	Anticipated absorbed dose in two days (grey)
Total body	1
lungs	6
Skin	3
Thyroid gland	5
Eye lens	2
Gonads	3

When considering justifications which call for intervention for the purpose of taking immediate preventive action, it is imperative to take into account potential deterministic effects of doses which exceed about 0.1 grey (deposited in the body or organ) for the fetus.

9.1.2: Chronic exposure intervention levels:

Organ or tissue	The annual equivalent dose (severt/year)
Gonads	0.2
Eye lens	0.1
Bone marrow	0.4

9.2.1: Intervention levels for urgent protective procedures:

Protective action	Intervention level or standard
Isolation (such closing doors and windows)	The best practice of intervention levels to initiate isolation processes is 10 millisevert during a maximum period of two days. The licensee (or the local Competent Agency) may adopt lower levels for isolation and shorter periods to facilitate the following actions such as evacuation.
evacuation	The intervention level for temporary evacuation is 50 millisevert for a maximum period of one week. The local

	authorities may wish to set shorter periods and lower levels of exposure in order to expedite and facilitate the evacuation process. Also, higher levels may be used in the cases where evacuation is difficult as in the case of large population groups and lack of means of transportation.
Issue of iodine prophylaxis	The intervention level for handing out iodine tablets is 100 milligrey of the committed absorbed dose resulting form radioactive iodine in the thyroid.

9.2.2: Intervention levels for withdrawing foodstuffs from circulation:

The schedule shows the levels (in kilo Becquerel/kg) which mandate intervention and withdrawal of foodstuffs for practical reasons. The standards related to a separate set of radionuclides will apply independently of the total reactivity of the nuclides in every group:

radionuclides	Concentration (kilo becquerel)	
	General consumption foods	Dairy products, baby foods and drinking water
Cesium 134, 137 Strontium 89, Ruthenium 102	1	
Iodine 131		0.1
Strontium 90	0.1	
Americium 241, plutonium 238,239	0.01	0.001

Appendix No.10
Roles of the parties participating in the intervention in the event of radioactive accidents

Schedule 10.1: Method of responding to the loss or theft of a radioactive source or substance:

Description	Role of licensee	Role of local emergency teams	Role of competent agency
Responsibilities	1-Secure the radioactive source or substance. 2-Monitor the sources in stock. 3-Report the fact to the competent regulatory agency and the security Competent Agency. 4-Seek to locate the source or substance. 5-Provide technical assistance to local emergency teams and the competent agency. 6-Assess the doses and carry out radioactive survey or authorize another agency to do so.	- Provide assistance in locating the source.	1-Provide guidelines on developing a contingency plan. 2-Assign a 24 hour service to receive licensee's notifications. 3-Coordinate with the local authorities. 4-Verify that radioactive survey is performed in threatened areas. 5-ensure that radioactive doses are assessed accurately and audit the licensee's assessments.
Written steps and procedures	1- Document the source security method. 2- Monitor inventories. 3- Reporting		1-Establish the general methods and procedures for response and search for the sources. 2-Approve the emergency plan and the persons performing it.
Equipment	1-Standard radiation detection devices. 2- Dosimeters		1-Mobile radioactive survey devices. 2-Mobile radioactive gauges 3-Highly sensitive dosimeters
Training	Training on the response steps and procedures		1- Extensive experience in the radiation protection field. 2- Training on locating and search for missing sources.
Assessment of potential hazards	Yes	Obtain the hazards assessment from the licensee and the competent regulatory Competent Agency	Yes
Access control	Yes	Yes	
Intervention levels	Report the loss or theft of source		Identify the procedures and levels depending on the case and based on the assessment of the potential hazards.
Medical procedures	Very limited		Identify the best location for providing medical assistance and first aid.

Schedule 10.2: Response to an accident involves denudement of a source:

Description	Role of licensee	Role of local emergency teams	Role of competent agency

Responsibilities	1-Identify the method and procedures for containment of the source within the shield. 2-Secure the area and location. 3- Assess exposure doses. 4-Report the incident to the competent agency. 5-Restore the source inside its shield.	Assist in securing the area and the location.	1-Direct the guidelines related to the preparation of plans. 2- Assign a 24 hour service to receive licensee's notifications. 3- Assess the doses during and after the accident. 4- Provide technical assistance during the response.
Written steps and procedures	1- Draw up methods for restoring the source to its location inside the shield. 2- Reporting methods.		Provide the various equipment to meet all needs of radioactive surveys
Training	periodical training on the written emergency plans		Extensive experience in the area of radiation protection.
Assessment of potential hazards	Assess the hazards prior to responding to the accident.	Obtain the assessment results form the competent agency.	Review the hazards assessment.
Access control	Monitor the access in accordance with prepared and pre documented methods and procedures.	Cooperate in the access control as directed.	Coordinate between the local emergency teams and the licensee.
Intervention levels	Apply occupational and public exposure limits		Establish occupational and public exposure limits.
Medical procedures	Comply with the instructions of the competent regulatory Competent Agency.		Provide information on reference medical services.

Schedule 10.3: Method of responding to a radioactive contamination accident:

Description	Role of licensee	Role of local emergency teams	Role of competent agency
Responsibilities	1- Detect the occurrence of the contamination. 2- Delineate the contaminated area within the site. 3- Report the incident to the local emergency and the competent regulatory authorities. 4- Identify the contaminated persons in the site. 5- Prevent the spread of contamination within the site. 6- Decontaminate the workers. 7- Decontaminate inside the site. 8- Assess the workers' exposure doses. 9- Dispose of radioactive wastes. 10- Take corrective action to prevent recurrence of the accident.	1-Provide access control. 2-Assist in preventing the spread of the contamination outside the site. 3-Transport the contaminated persons and the injured to the hospitals. 4-Inform the public, if necessary.	1-Provide guidelines in drawing up the plans. 2-Identify contaminated areas outside the site. 3- Provide 24 hour service for receiving licensee's notifications. 4-Identify the persons contaminated outside the site. 5-Prevent the spread of contamination outside the site. 6-Decontaminate the public. 7-Decontaminate the area outside the site. 8-Assess the workers' and the public's exposure dose. 9-Assist in informing the media.

TRANSLATION

Written steps and procedures	1- Methods of decontamination. 2- Reporting methods. 3- Methods of access control. 4- Methods of prevention of contamination spread.	1- Method of response to the accident.	1-General methods and procedures of response to the accident. 2-Approve the licensee's methods of response and the individuals in charge of it.
Equipment	.1- Standard detection tools and devices. 2- Detectors for the radioactive substances in use.		1- Radioactive survey tools. 2-Detectors of the various radioactive substances. 3-Environmental samples analyzers.
Training	Periodical training on decontamination when dealing with tangible quantities of open radioactive substances		1-Ongoing training on decontamination. 2-Training on performing environmental measurements and environmental radiation surveillance.
Potential hazards assessment	Assessment of exposure doses at the site	Obtain the assessment results from the competent regulatory Competent Agency.	Assess the doses inside and outside the site.
Access control	Control accesses in accordance with the written plan.	Assist in access control.	1- Access control outside the site. 2- Request assistance for the local authorities.
Intervention levels	Apply the levels established by the competent regulatory Competent Agency.		Establish the limit levels of surface and other contaminations.
Medical procedures	Comply with the instructions of the competent regulatory Competent Agency.	Transport the injured and contaminated persons.	Provide information on the reference medical services.

Appendix No.11
Accident reporting form

Form No.19-Hh.A-21)

TRANSLATION

Radioactive accident reporting form

1- Name of the facility authorized to use the radioactive source:
Address:
P.O. Box: City: Postal code:
Telephone: Fax: Mobile:

2- Name of the facility manager:
Direct telephone: Mobile: Fax:

3- Number of the license authorizing the use of the sources:
Expiration date of the license:

4- Name of the facility's radiation protection officer:
License number of the protection officer:
Expiration date of the license:

5- Type of the licensed radioactive source:

Source	Radioactivity	Serial number	Type of ownership		
			Owned	Leased	loaned

6- Location where the accident occurred:
7- Date of the accident:
8- Time of the accident:

TRANSLATION

9- Time the accident was discovered:

10- Nature of the accident (indicate): exposure: contamination: swallowing: inhalation:

11- Type of radioactive source involved in the accident: radioactivity: serial number:

12- - Type of ownership of the source in use: owned: leased: loaned:

13- Persons exposed in the accident (indicate): Workers: employees: visitors: public:

14- number of persons exposed:

15- Persons present at the site during the accident (use separate sheet if necessary):

Serial No.	Name	Age	Has personal dosimeter	No.	Telephone	Identify nature of presence at the site

16- Persons present in the vicinity of the accident site (use separate sheets, if necessary:

TRANSLATION

Serial No.	Name	Age	Has personal dosimeter	No.	Telephone	Identify nature of presence at the site

17- Radiation dosimeter:
18- Radiation exposure level:

Exposure	Millisevert	Measure distance (m)
Actual		
anticipated		

19- Does the accident involve fire near the radioactive source:
20- Are there inflammable materials in the vicinity of the accident:
21- Are there other chemicals:
22- Type of potential radiation hazards as a result of the accident:
23- The weather conditions accompanying the accident:
24- Has the radioactive substance leaked?
If yes, amount of leak:

TRANSLATION

What is the device used in gauging the contamination:

25- Describe the procedures used by the facility to contain the accident:

26- Future anticipated (planned) procedures and actions:

27- Name of the person who performed the procedures:
Telephone: Mobile: Fax:

28- Name of the accident reporter:
Telephone: Mobile: Fax: pager:

29- Name of the person involved in the accident:
The parties to which the accident has been reported:

Agency	Name of receiver	Time and date of the report	Type of report			Nature of response
			Phone	Fax	message	

30- Recommendations:

31- Opinion of the competent agency:

32- The actions to be taken:

33- The competent agency person who investigated the accident:
Name: signature: date:

34- Head of the radiation protection division:
Name: signature: date:

35- Supervisor of the atomic energy research institute:
Name: signature: date:

Notes:

For further inquiries, please contact:
Head of the Radiation Protection Division, 'Abd ar-Rahman ibn Muhammad al-'Arfaj
Office telephone number 813635, fax 813658
Mobile 055444185, home telephone 81135 (emergency cases)
Email: alarfaj@KACST.edu.sa

Appendix No.12
Accident reporting form

TRANSLATION

Form No.19-Hh.A-21)

Radioactive accident reporting form

1- Name of the facility authorized to use the radioactive source:
Address:
P.O. Box: City: Postal code:
Telephone: Fax: Mobile:

2- Name of the facility manager:
Direct telephone: Mobile: Fax:

3- Number of the license authorizing the use of the sources:
Expiration date of the license:

4- Name of the facility's radiation protection officer:
License number of the protection officer:
Expiration date of the license:

5- Type of the licensed radioactive source involved in the accident:

Source	Radioactivity	Serial number	Type of ownership		
			Owned	Leased	loaned

6- Location where the accident occurred:
7- Date of the accident:
8- Time of the accident:
9- Time the accident was discovered:

TRANSLATION

10- Nature of the accident (indicate): exposure: contamination: swallowing: inhalation:

11- Type of radioactive source involved in the accident: radioactivity: serial number:

12- - Type of ownership of the source in use: owned: leased: loaned:

13- Persons exposed to radiation in the accident (indicate): Workers: employees: visitors: public:

Serial number	Workers	Employees	Patients	Visitors	public
1					
2					

14- Number of persons exposed:

15- Persons present at the site during the accident (use separate sheet if necessary):

Serial No.	Name	Age	Has personal dosimeter	No.	Telephone	Identify nature of presence at the site

16- Persons present in the vicinity of the accident site (use separate sheets, if necessary:

Serial No.	Name	Age	Has personal dosimeter	No.	Telephone	Identify nature of presence at the site

17- Radiation dosimeter:

18- Radiation exposure level:

Exposure	Millisevert	Measure distance (m)
Actual		
anticipated		

19- Does the accident involve fire near the radioactive source:

TRANSLATION

20- Are there inflammable materials in the vicinity of the accident:
21- Are there other chemicals:
22- Type of potential radiation hazards as a result of the accident:
23- The weather conditions accompanying the accident:
24- Has the radioactive substance leaked?
If yes, amount of leak:
What is the device used in gauging the contamination:
25- Describe the procedures used by the facility to contain the accident:
26- Future anticipated (planned) procedures and actions:
27- Name of the person who performed the procedures:
Telephone: Mobile: Fax:
28- Name of the accident reporter:
Telephone: Mobile: Fax: pager:
29- Name of the person involved in the accident (operation accident, etc):
The parties to which the accident has been reported:

Agency	Name of receiver	Time and date of the report	Type of report			Nature of response
			Phone	Fax	message	

30- Recommendations:
31- Opinion of the competent agency:
32- The actions taken to respond to the accident:
33- The competent agency person who investigated the accident:
Name: signature: date:
34- Head of the radiation protection division:
Name: signature: date:
35- Supervisor of the atomic energy research institute:
Name: signature: date:

Note:
For further inquiries, please contact:
Head of the Radiation Protection Division, 'Abd ar-Rahman ibn Muhammad al-'Arfaj
Office telephone number 813635, fax 813658

TRANSLATION

Mobile 055444185, home telephone 81135 (emergency cases)
Email: alarfaj@KACST.edu.sa

TRANSLATION

Appendix No.13

Basic equipment and instruments required for responding to emergencies

a- Radiation scanners, including:
- Radiation scanners for Gamma rays and Beta particles equipped with Geiger Muller counters in ranges from zero to 1 millisevert distributed in graduates.
- Radiation scanners for Gamma and Beta in ranges from zero up to 50 millisevert distributed in gradates.
- Radiation scanners for Gama, Beta and X-rays in ranges from zero up to 10 millisevert distributed in gradates.
- Dosimeters equipped with audible warning for Gamma and Beta rays in ranges from micro severt to 1 millisevert and others from 1 micro severt up to 100 millisevert.
- Alpha and beta contamination monitors, with large sensitive surface with standard calibration [?] in ranges from zero up to 3000 pulses per second distributed in several graduates.
- Dosimeters for thermal and fast neutrons.

b- Personal protective equipment, including:
- Electronic devices for measuring thermoflash personal dose (or alternative device).
- Plastic protective clothing, such as gloves, boots, aprons and head covers.
- Breathing masks and apparatus fitted with filters to prevent intake of radioactive substances.
- First aid kits.
- Handling booms from a distance of 0.5, 1 and 1.5 meters.

c- Support equipment, including:
- 1000 watt diesel generator.
- Two connection cables, at least 25 meters long with connection plugs.
- Lighting tools, lamps and floodlights.
- Plastic or steel containers and vessels for radioactive wastes.
- Radiation and radiation waste warning signs and labels.
- Tool box and ropes.
- Barriers.
- A collection of polyethylene and plastic bags and containers in various sizes.
- Means of communication and a camera.

- Any other equipment or instruments required for responding to the accident.

d- **The documentation package, including the emergency plan, response tools, work methods and procedures, equipment records and related manuals.**